

# SUPPLY CHAIN STRATEGIES

DEMAND DRIVEN AND CUSTOMER FOCUSED

THIRD EDITION

Tony Hines



# Supply Chain Strategies

*Supply Chain Strategies* demonstrates how organizations must take strategic decisions in order to manage their supply chains to sustain competitiveness in the global economy. Whereas many textbooks on supply chain management focus on purchasing and operations, this new edition of Tony Hines' text focuses upon the direction-setting and efficient resource-allocation that organizations need to provide in order to satisfy their customers. Overcoming tensions between political, economic, technological, ethical and environmental considerations is shown to be vital to develop effective strategies for managing the supply chain.

The third edition of Tony Hines' successful textbook integrates thoroughly updated international cases to demonstrate how strategic thinking and SCM play out in the real world, and contains a host of useful pedagogy to reinforce learning, including learning outcomes for each chapter, discussion questions and a handy glossary. New to this edition are chapters discussing supply chain risk, procurement strategies and supply chain futures.

This book is ideal for courses on supply chain management – especially those that require a strategic element.

**Tony Hines** is CEO of Consuming Future, a London-based consultancy which supports and promotes ethical and sustainable business practices. Previously, he was Professor of Marketing at Manchester Metropolitan University.

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# **Supply Chain Strategies**

Demand Driven and Customer Focused

Third Edition

**Tony Hines**



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## Preface to the third edition

Supply chains have become more prominent in everyday talk about business. TV and press coverage about supply chains is everywhere today. Newspapers devote much more space within the business pages and sometimes the front pages, which was not the case when I wrote my first edition of this book; supply chains hardly got a mention. The general public is far more aware of the important part that supply chains play in their daily existence. Shortages evidenced by empty supermarket shelves were commonplace during the pandemic across many categories from food to toilet rolls. Businesses too, realize that supply chains are the difference between achieving their goals and missing performance targets. Supply chains determine profitability and they build or damage reputations. Supply chain strategies are an important bridge between the producer and the customer. Supply chain strategies play a much bigger role in the marketing strategies firms employ than they receive credit for. Supply chain strategies are an important marketing tool. Supply chain strategies determine operational practices.

If you want to understand business you have to know about supply chain strategies. These are the strategies that drive sourcing and procurement decisions; decisions about how, when, where and what goods and services to produce; configuring transport and logistics; decisions about which companies and organizations to partner with; decisions about technologies to employ; criteria determining locational choices for everything from production and warehouse facilities through to manufacturing, wholesale and retail operations; decisions about which markets to enter or remain in, knowing when to develop, diversify and divest. These are all supply chain strategies to bring goods and services to customers. Time, cost, value, distance, responsiveness, risk and resilience are all part of the equation. Volatility, velocity, variety and variabilities in quality can be sources of disruption. Technology can also be a disruptor but it can also present solutions for instance creating visibility across the supply chain. Disruptions are ever present and from time to time we are reminded of how destructive they can be whether it is because of shortages of raw materials or labour, strike action, production delays, volcano eruptions, ash clouds, tsunamis, sunken or grounded ships such as the *Ever Given* in Suez, wars or pandemics such as Covid-19. Supply chain strategies have to be developed in environments that are volatile, uncertain, complex and ambiguous.

Supply chains create cost and drive value. Supply chain strategies require investment in people and technologies to support them if they are to achieve the objectives set. Supply chains today are central to the success of any organization, as such they are very much a boardroom concern as well as an operational necessity. It is important to understand that the value chain is a cost chain until the customer pays for goods and services. The customer, client or service user has to be at the centre of everything an organization does. In this sense supply chain strategies are demand driven and customer focused.

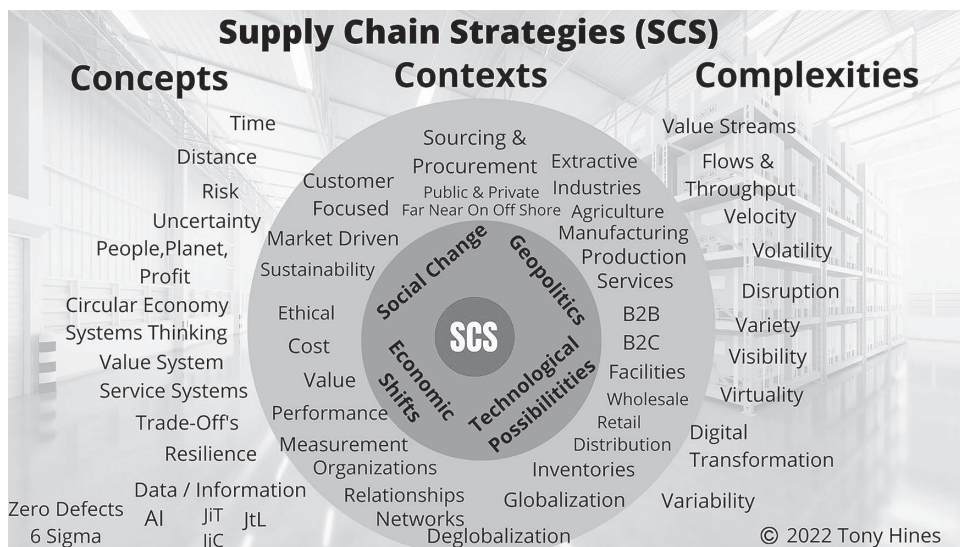


Figure 0.1 Supply chain strategies – concepts, contexts and complexities

Each chapter in this book deals with a central topic impacting supply chain organization and management that has been selected to illustrate and explain issues that need to be evaluated to determine supply chain strategic choices; choices that all organizations make. There are pros and cons to every decision. Those making the choices need to understand the system and how it is connected and interconnected. They need data about the environments in which supply chains are situated to identify threats and opportunities. They need to possess and build capabilities that reduce system and organizational weaknesses and create strengths to compete. There is a need to know about strategy, operations, people, finance and marketing and how they fit into the supply chain system shaping choices and strategic options. It is necessary to understand how geopolitics is changing the nature of the wider environment within which organizations and supply chains operate; how social change shapes consumption and production; how economic factors shape the global economy; how shifts in technology change possibilities.

Figure 0.1 provides a framework to think about supply chain strategy development. At the core is the environment within which supply chains exist influenced by social change, geopolitics, economic shifts and technological possibilities. Around the core are the different contexts for the development of supply chain strategies. An illustrative non-definitive list of concepts that inform supply chain decisions is shown to the left while supply chain complexities are shown to the right in the figure. These ideas are developed further throughout the book.



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# 1 Environmental context for supply chain strategies

## Introduction

Taking a strategic approach to managing supply chains involves direction setting, establishing a programme for change and allocating resources effectively whilst simultaneously utilizing resources efficiently. To achieve these strategic objectives organizations must focus their supply chain activities to satisfy customer demand. Managers need to think differently about what they do and the purpose of the organization and organizational networks in satisfying demand through effective (strategic) and efficient (operational) supply chain structures, relationships and strategies. Operational thinking is pervasive in most organizations. Indeed, this should come as no surprise since most managers are promoted to positions demanding strategic thinking and strategic skill from positions demanding different, important operational thinking and skill sets. In such circumstances, the tendency is often to retain operational thinking without recognizing the shift required in their new roles to think strategically. The ability to think strategically and translate that thinking into operational activities likely to work in practice is an important competence for strategic development to be successful. Those managers who can successfully make the transition from operational to strategic thinkers are a very powerful force for their organization. The shift in focus from operational to strategic is illustrated in Table 1.1.

This opening chapter situates supply chain strategies in the context of the external environment, recognizing global patterns of demand exist in a symbiotic relationship with local markets that are paradoxically part of this globalizing or deglobalizing pattern of development.

Table 1.1 Moving supply chains from operations to strategic focus

<i>From operational focus</i>	<i>To strategic focus</i>
Immediate time frames	Medium – long-term time horizons
Concrete	Conceptual
Action/activities/doing	Think, reflect, learn and act
Reactive problem solving – “fire fighting”	Proactive – identify future opportunities
Routine – “day to day”	Future development – change programme
Production/service processes	View total supply chain from customer perspective
Product push	Demand pull
Viewing supply as a production problem	View supply as a market problem – to satisfy customers
Resource utilization – efficiency focus	Resource development (including competence), planning and acquisition – effectiveness focus
Operational efficiency	Strategic effectiveness
“Hands-on” approach	“Hands-off” approach
“Feet on the ground”	“Helicopter view” or “view from the bridge”

## 2 *Environmental context for supply chain strategies*

Differences and similarities in supply chain strategies are identified and developed for different types of organization throughout the book. The customer focus and its unique place informing supply chain strategies receives greater attention locating arguments for the approach in the contemporary and historical business literature recognizing the inter-disciplinary nature of the field.

“We’ve learned that world-class performance is dedicated to serving the customer” (Schonberger, 1990, p. 1). He recognized that building a chain of customers was more important conceptually than limiting thinking to any one function. The idea of turning attention towards customers transforms supply push perspectives into demand-led strategy. Supply chain strategies must not be viewed as a function or a functional activity but rather an organizational and trans-organizational responsibility to satisfy customer demand.

Disciplinary boundaries and debates about what the subject content of study should be continuously change (Bartels, 1951). In the earliest days, distribution was viewed as central to marketing (Bartels, 1976). Peter Drucker once referred to distribution as the economy’s “dark continent” indicating that it was not well understood by many in business (Drucker, 1962). Fifty years on a McKinsey Report called for better economic statistics and trade measures to develop a better quantitative understanding of global value chains (Roxburgh et al., 2012). The difficulty with studying distribution is that by nature it is interdisciplinary. This means that it is difficult to study agency without studying structure since distribution is embedded in wider systems of market relations. It is as a consequence difficult to recommend that a particular strategy if carried out would achieve enhanced performance without considering the interconnections and relationships that exist across organizational boundaries and in wider networks that comprise structure and determine the degree of agency. At a practical level, for example, how much agency does a small firm supplying a single large firm that is its major customer really have? In this principal, agent relationship the principal is able to determine the structure and nature of the relationship because of its relative power. The smaller firm has some agency it can choose to supply or not. The strength of its capacity to bargain will depend on the wider networks particularly if there are other suppliers who can take their place without disruption to the larger firm. Put differently, economists would refer to market types of competition: monopoly (single supplier with power), monopsony (single buyer with power), oligopoly (few suppliers who may collude) and perfect competition (many buyers and sellers, open access to information). Each type characterizes a set of relations that exist. The case has been made well not to lose sight of demand when considering supply strategies. This supports the view that supply chain strategies require a market-demand driven customer focused approach.

Supply chains exist within a broader environment, linking interconnected firms across different geographical locations. They are determined by factors such as space, place, time, cost, profit and value. Supply chains are both physical and digital in form and are contained inside other systems that form the supply chain ecosystem.

Organizations operate in an external environment that presents opportunities and threats. Understanding customers and service users is essential to frame appropriate strategies for survival and profitability. Customers are arbiters of value and have the potential to create or destroy it through market interactions. Marketing activity creates awareness, selling creates income and profit and contributes to ROI. Customer demand must be satisfied through supply chains that fulfil orders and provide service. Supply chain strategies are demand-driven and customer-focused. Figure 1.1 illustrates customer focused supply chain strategies in their environment.

Supply chains are central to the ways in which customers and suppliers interact and trade globally. Supply chain processes from extraction, procurement, manufacture, transport,

Supply chains exist in an external environment shaped by political, economic, social, technological, legal regulatory influences inside a physical world system.

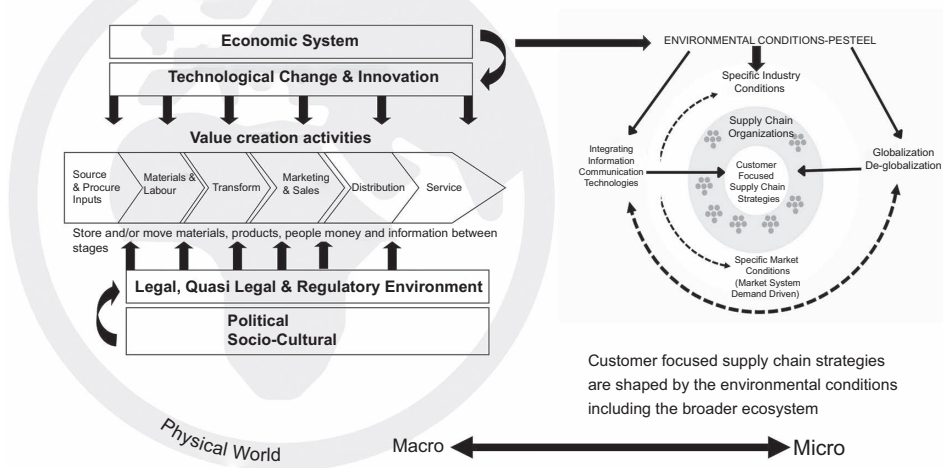


Figure 1.1 The environment for supply chain strategies

distribution and consumption cycles all require choices about how we organize them. These choices configure resources, patterns of trade, supply networks, processes and systems, all of which have different cost structures with different impact on the planet, people, profit as well as the long-term viability of all life and ultimately existence. Research indicates that supply chains are responsible for the majority of the damaging environmental impact produced by greenhouse gases. There are significant business benefits in having a supply chain that minimizes environmental impact.

In this chapter, we begin by examining the geopolitical system within which supply chains exist. We introduce a number of variables that influence supply chain structures. This starting point enables us to visualize and conceptualize supply chains as part of a broader system which sets the environmental context for supply chain strategies. Let us begin by asking the question – why should we study supply chains?

- *Why study supply chains?*

Supply chains are a unit of analysis, a means of abstraction to understand complex systems, structures, relations and behaviours existing inside, between and across organizations. They are physical interconnections between organizations moving goods and services from their origins of production to their point of consumption and exchanging money/value, information, and service in the process. Supply chains have existed as long as people have engaged in trade and begin at a point of origin and end with consumption after passing through several links in the chain. Although ending with consumption is not necessarily the final step because in the circular economy we recycle, re-use and repurpose waste products.

Production, consumption and distribution of goods and services were located in the economics discipline since inception (Smith, 1910 [1776]). Service exchange and value has been widely discussed it began with an analysis of capital in industrial society (Marx, 1976 [1865]). Marx provides a detailed analysis of different types of value: value in use and value in exchange.

#### 4 *Environmental context for supply chain strategies*

Value in use focuses on production and value in exchange examines the process of value created in markets or through other means of exchange.

In addition to being economic systems, supply chains are social systems constructed by people which impact natural systems. The nature and structure of supply chains require careful analysis of how, why and what people determine is appropriate when they design supply chain networks or when supply chain networks emerge from working practices. Underpinning disciplines of sociology and psychology have something to offer to help us understand supply chain structures, interactions and relationships.

- *Supply chain strategy a definition*

**Definition:** The supply chain encompasses all activities associated with the flow and transformation of goods (products and services) from an initial design stage through the early raw materials stage, production stages and on to the end user before entering an end of life cycle. Additionally, associated information and cash flows form part of supply chain activities. Supply chains are service systems delivering value to consumers and customers; and contributing value to suppliers, producers and distributors. It is worth pointing out that value is only created when revenues exceed costs. Strategies discussed assume this purpose to create value in the supply chain.

Supply chain strategies are necessary to manage the co-ordination and integration of these activities through improved supply chain relationships, to achieve competitive or co-operative advantage. Integrating the supply chain requires organizations to synchronize not only its own activities but also the activities of external organizations that either supply or receive outputs from the organization. In grocery retail supply chains, they use the term from seed to store, in textile and apparel supply chains the term from concept to consumer and in heavy industry and manufacturing industry from mother earth to mother earth illustrating the full cycle from extraction, conversion, through to customers, consumption and recycling. This is illustrated in Figure 1.2.

Competition and co-operation are uneasy partners within all economic systems. Political attitudes of regional, national and international communities determine how co-operation and competition is regulated. Laws enforce the regulatory frameworks and trade agreements made between organizations in different nation states. Different organizations in the same country, region or internationally enter contractual obligations centred on the supply and demand for goods and services. These contractual obligations bring with them responsibilities to uphold agreements without recourse to legal remedy and yet legal remedy must be available when one or other of the parties to it do not honour agreements. Laws govern economic behaviour and attitudes within nation states and internationally. However, legal compliance should be a last resort. Most business arrangements on a day-to-day basis rely on agreement and co-operation between the parties within the relationship. Competition and co-operation are discussed in this text in the context of different supply chain strategies, structures and relationships. Competitive forces are at work in private and public service organizations and consequently differently configured supply chain strategies are required within the same organization and across organizational boundaries.

## Supply Chains

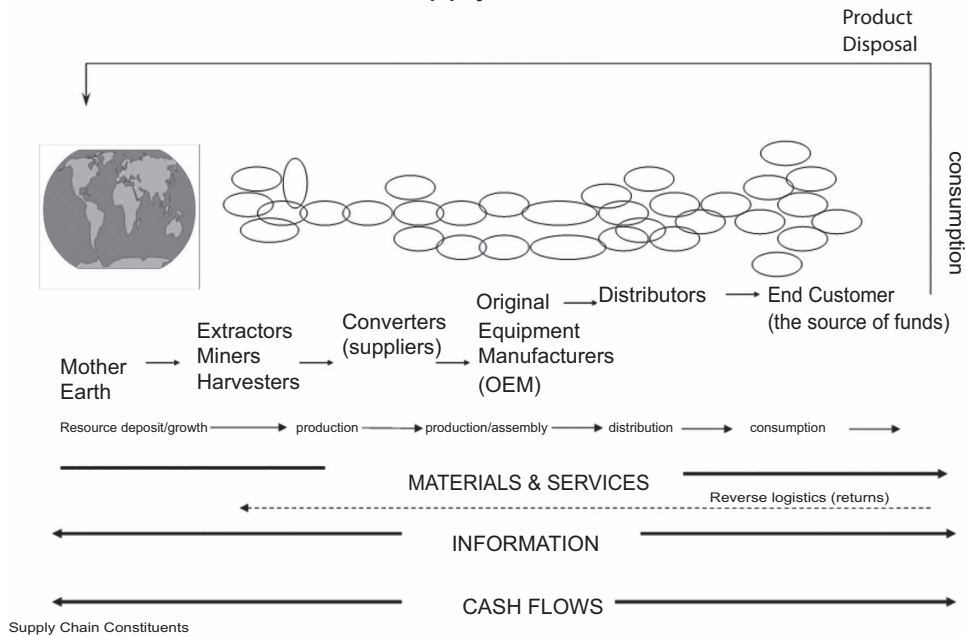


Figure 1.2 Supply chain constituents

Context is important in making supply chain strategy decisions. There is no such thing as either a universal supply chain strategy, or an industry wide supply chain, but there are rather, different types of supply chain structures, strategies and relationships all of which must aim to satisfy the final customer.

### Geopolitics

Geopolitics is an ever present force at play. Geopolitics shapes and creates the environment within which supply chains exist. While geographies may appear unchanged, political landscapes are ever changing. Governments in different locations around the world structure relations with other nations. So, for example, who they trade with, the terms of trade and the tariffs applied. Political considerations play a large part in shaping global trade. Institutions such as the World Trade Organization (WTO) regulate arrangements between trading nations (Hines, 2022b).

There is an increasing reliance on scarce resources which are non-renewable. Whether it is fossil fuels (e.g., coal, oil and gas) needed for energy or rare earth metals (e.g., cobalt, palladium, lithium) necessary for wind turbines, electric vehicles, smart phones, computers and many other products. It is claimed that we dug more materials out of the earth in one year 2017 than all the materials extracted prior to 1950 (Conway, 2023). My question is how long can this continue?

Excessive demand puts pressure on extractive industries, processing and manufacturing supply chains. For example, electric and hybrid vehicle require twice as many rare earth metals in the production of a single vehicle compared to combustion engine vehicles (Pitron, 2022). The problem is that extracting rare metals is a highly polluting activity.



## 6 *Environmental context for supply chain strategies*

When steam engines powered by coal moved aside for diesel and petrol driven engines, it required change at scale. The scale will be much greater switching from oil and gas to electric powered by renewable energies. The triggers are sustainability and climate change. The impact that CO<sub>2</sub> emissions and other pollutants are having on the planet along with depletion of critical resources threaten its very existence. The prevailing assumption is that by switching to clean energy this will reduce the impact on climate from pollution caused by fossil fuel emissions. There is much evidence to support the claim (LePage, 2011; Stern, 2007; UNEP, 2022). One of the challenges is going to be not to increase damage caused by mining and processing many rare earth materials to make the transition. Yet another challenge is to ensure that all nation states co-operate to spread the burden of change. The likely economic, social and political impact of this change is great.

- *Supply Chain Resilience*

Geopolitics and supply chain resilience are inexorably tied together. United States President Joe Biden thought it so important to protect the military industrial complex and secure supply chains that he signed an order do so. President Biden took several steps to improve supply chain resilience. “He signed an executive order directing an all-of-government approach to assessing vulnerabilities in and strengthening the resilience of the United States’ critical supply chains” (The White House, 2022). He also announced new steps to combat the supply chain crisis at the G20 summit in Rome. He said he will increase funding for two initiatives to promote international supply chain resilience among U.S. partners and allies. “The initiatives will improve and simplify customs and clearance procedures, reducing delays and encouraging sustainable and efficient supply chains” (Forbes, 2021). In addition, he convened a global forum on supply chain resilience that brought together key government officials and private sector stakeholders from across key U.S. “allies and partners to address short-term supply chain discontinuities” (The White House).

Supply chain resilience has received a great deal of interest in the past few years. You might be partially right in thinking that interest grew during the Covid-19 pandemic due to the disruptions it caused but many had considered resilience an important capability and strategic option prior to that (Barroso et al., 2011; Carvalho et al., 2012; Ponomarov & Holcomb, 2009). Increasing flexibility, creating redundancy, building collaborative supply chain relationships and improving agility are key strategies (Tukamuhabwa et al., 2015).

A simulation study examined how resilient a three-echelon automotive supply chain is under conditions of increasing complexity, vulnerability and disturbances (Carvalho et al., 2012). Simulation studies are particularly useful to model the impact of different scenarios. One such study examined risk and resilience in liquified natural gas (LNG) transportation systems to mitigate risk and examine costs of disruption (Berle et al., 2013). According to another study communicative and cooperative relationships had a positive impact on resilience (Wieland & Wallenburg, 2013). Complexity has increased with global sourcing alongside turbulent and uncertain markets which increased risk. Building resilient supply chains has become a priority to mitigate risk (Christopher & Peck, 2004). Case studies are a valuable way of examining resilience of energy supplies. Such studies can help understand security and risk (Urciuoli, 2014). Results from this study showed “that today, oil and gas supply chains have in place a good combination of disruption strategies, including portfolio diversification, flexible contracts, transport capacity planning and safety stocks.” Security threats identified by the companies included hijacking of vessels (sea piracy), terrorism and wars. The research concluded “that the European Union has built a comprehensive portfolio of strategies to deal with scarcity of oil and gas resources.”

Nevertheless, the invasion of Ukraine in 2022 demonstrated this to be false when Russia cut off supplies from Nord Stream 1.

### **Europe's energy security**

Conflict between Russia and Ukraine is both political and economic. It has severely impacted energy supplies to the European Union (EU) and beyond. Until the demise of the Soviet Union in 1991, Ukraine (the borderlands as it was known during medieval history) was part of the Soviet Union. When it became an independent state on the break-up of the Soviet Union it inherited a nuclear arsenal which it subsequently agreed to return to Russia in exchange for energy – gas. Gazprom the state-owned energy company supplied 35 per cent of Europe's gas supply through a pipeline running through Ukraine from Russia, Ukraine often delayed payments to Russia and Russia accused Ukraine of siphoning of gas bound for Europe without paying (Yergin, 2021). State owned Gazprom then decided to build a second Nord Stream pipeline under the Baltic missing out Ukraine and emerging in Germany to supply European gas. Delivering gas directly to the European Union bypassing Ukraine meant that vital revenues would be cut to Ukraine. It placed Russia in a powerful position as Europe's major energy supplier. The European Commission said that energy products supplied from Russia accounted for 60 per cent of total energy products supplied in 2017. Liquefied Natural Gas (LNG) makes up just over one third of the energy supplied to the EU. During 2021, it was said to be closer to 45 per cent and some estimates put it over 50 per cent. In addition, Russia supplied about 25 per cent of the EU's crude oil. Russia's wish to capitalize on its fossil fuel endowment and Europe's thirst for low-cost secure energy supplies created the perfect storm that would later unfold. After Russia invaded Ukraine in February 2020 gas supplies were lowered by Gazprom as support for Ukraine increased in Europe and the West. Baltic States clamoured to join NATO and Ukraine had already flirted with the idea of becoming part of the EU and a member of NATO. There were accusations that Russia had weaponized energy supplies to Europe. Supplies were steadily lowered, and prices increased causing the energy crisis that many European countries experienced. The European Union (EU), the United Kingdom and the United States placed economic sanctions on Russia in retaliation for the invasion of Ukraine and the threats to energy security. The commanding heights of western economies were under threat in the struggle between markets and states (Yergin & Stanislaw, 1998).

The Nord Stream 2 pipeline designed to bypass Ukraine cost \$11 billion to build it was filled with gas and ready to go when in February 2022 Russia invaded Ukraine and Germany refused certification needed to make it operational. On the 22 September 2022, Nord Stream 2 was blown up with the finger of suspicion pointed by Russia at Ukraine.

### **Globalization**

The term “globalization” was coined to represent the ways in which markets have converged throughout the world and the ways in which production poles have shifted geographically to satisfy global consumers. It is an emerging pattern observed from extant economic data examined over time for the many production, distribution and consumption arrangements. It is a continuing long-term trend with new and emerging patterns of economic behaviour clustered under the theme of globalization, to make sense of the phenomena.

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Other writers have defined it in different ways which include Beynon and Dunkerley's (2000, p. 3) claim that globalization "is a defining feature of human society at the start of the twenty-first century." Mattelart (2000, p. 97), states that globalization "has a hegemonic role in organizing and decoding meaning of the world" (Seabright, 2004). Schirato and Webb define it as power relationships, practices and technologies that characterize and shape the contemporary world (Schirato & Webb, 2003, p. 1). For others defining global capitalism is rooted in "property rights" and "market exchange" (Centeno & Cohen, 2010). The convergence trends identified in markets, products, consumer behaviour and society encapsulate key features of the concept of globalization as used within the context of this text.

Globalization has led to aggregation of market demand, integration of consumer choice synchronized in supply chains, with increased activity of global network interactions and highlighting the interdependencies involved. We may purchase shirts in local stores close to where we live or from virtual stores anywhere in the world made from cotton grown and milled in India, buttons sourced from Republic of Korea, thread from China, fabric cut and sewn in Bangladesh and packaged, shipped and delivered to retail stores in the United States and Europe. These processes although geographically dispersed become seamlessly integrated in a supply chain structured to meet and satisfy customer demand. We buy our shirts from companies of strangers on whom we depend (Seabright, 2004).

It is important to recognize that convergence is one part of the equation, and that divergence and anti-global forces represent the other part. Approaching 20 per cent of the world population lives in poverty. This is defined by the World Bank as people living on less than one dollar per day. Supporters of globalization are "believers" they stress the benefits, they are optimistic and they see it as the culmination of revolutionary structural change. Sceptics view globalization as evolutionary change, continuing the trend of colonial expansion that was at its height between 1870 and 1914. They are more pessimistic than the protagonists.

International trade is not new. We have engaged in international trade since humankind has been able to walk even before the development of nation states. The "Silk Road" from east to west is an early example of a supply route transporting products from where they were made in China through to the markets of Europe where they were sold. Although the term supply chain strategy had not yet been coined those ancient traders following their trade routes to market were engaged in market led supply chain strategies. Of course, today global trade is regulated in ways it was not in the past. Today, regulations are considerably more onerous for many goods crossing borders in different parts of the world.

Table 1.2 shows the top 23 importing and exporting countries by value with the year-on-year change.

- *Commercial revolution – the rise of national and international organizations*

The modern world with its international trade has a long history back to the Silk Road a well-trodden "trade route" developed around 202 BC during the Chinese Han dynasty. The route stretched from China to Europe taking in India, Persia, Arabia and North Africa. However, international trade began to take its modern form with the foundation of the East India Trading Company in 1600. Many consider the company to be the forerunner of the modern multinational corporation and it was certainly the architect that shaped the pattern of international trade for 250 years and beyond (Robbins, 2006).

In the nineteenth century both in the United States and Europe industrial development took place on an unprecedented scale. The first industrial nation was Britain (Mathias, 1969). The history books record how the first industrial revolution witnessed human migration from the

*Table 1.2* Leading exporters and importers in world merchandise trade (excluding intra-EU trade), 2021 (billion dollars and percentage)

<i>Rank</i>	<i>Exporters</i>	<i>Value</i>	<i>Share</i>	<i>Annual percentage change</i>	<i>Rank</i>	<i>Importers</i>	<i>Value</i>	<i>Share</i>	<i>Annual percentage change</i>
1	China	3364	18.4	30	1	United States of America	2935	15.8	22
2	Extra-EU exports	2578	14.1	17	2	China	2689	14.4	30
3	United States of America	1754	9.6	23	3	Extra-EU imports	2500	13.4	27
4	Japan	756	4.1	18	4	Japan	769	4.1	21
5	Hong Kong, China	670	3.7	22	5	Hong Kong, China	712	3.8	25
	Domestic exports	20	0.1	-43		Retained imports (1)	160	0.9	20
	Re-exports	650	3.6	27					
6	Korea, Republic of	644	3.5	26	6	United Kingdom	694	3.7	9
7	Canada	508	2.8	30	7	Korea, Republic of	615	3.3	32
8	Mexico	495	2.7	19	8	India	573	3.1	54
9	Russian Federation	494	2.7	48	9	Mexico	522	2.8	33
10	United Kingdom	468	2.6	17	10	Canada	504	2.7	20
11	Singapore	457	2.5	26	11	Singapore	406	2.2	23
	Domestic exports	208	1.1	31		Retained imports (1)	157	0.8	25
	Re-exports	250	1.4	22					
12	Chinese Taipei	448	2.4	29	12	Chinese Taipei	382	2.1	33
13	United Arab Emirates	425	2.3	27	13	United Arab Emirates	348	1.9	41
14	India	395	2.2	43	14	Viet Nam	332	1.8	26
15	Switzerland	380	2.1	19	15	Switzerland	324	1.7	11
16	Australia	345	1.9	37	16	Russian Federation (2)	304	1.6	27
17	Viet Nam	336	1.8	19	17	Türkiye	271	1.5	24
18	Malaysia	299	1.6	28	18	Thailand	267	1.4	29
19	Brazil	281	1.5	34	19	Australia	261	1.4	23
20	Saudi Arabia, Kingdom of	276	1.5	59	20	Malaysia	238	1.3	25
21	Thailand	272	1.5	17	21	Brazil	235	1.3	41
22	Indonesia	230	1.3	41	22	Indonesia	196	1.1	38
23	Türkiye	225	1.2	33	23	Saudi Arabia, Kingdom of	153	0.8	11

*Source:* WTO – World Trade Statistical Review 2022

*Notes:*

1. Secretariat estimates.
2. Imports are valued f.o.b.

countryside to newly developed towns and cities built around newly developed industries conducted in factories. Thus, domestic production moved out of the homes and into factories where products could be manufactured in volume to achieve economies of scale in production. As this

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new economic order began to take shape the businesses that developed became larger, employed larger numbers of people and eventually became national rather than merely local businesses. These businesses transformed the ways in which people lived their lives, earned their livelihoods and consumed goods. As markets developed so too did transport and communication systems to ensure that the product from these factories could be sold, earn profits for the owners and wages for the workers. This economic cycle also created consumers who would spend their earnings. These businesses have created new centres of population (towns and cities), transport links between production centres and their markets developed nationally with roads, canals and later railways to ensure that goods could easily be transported to their market. In every respect these were market-led developments driven by demand.

Later many national organizations expanded their sphere of reference to engage in international trade. Similarly, as international trade develops so too does the infrastructure to oil the wheels of commerce. Sea links, rail links, road links and air links have developed to support the growth of international trade. Ideas of what constitutes an industry, a market and competition constantly change because of these shifts in boundaries. Today in many markets boundaries appear to be less important whilst in others they are especially important and present real barriers to trade. Recent innovations in information and communication technologies (ICT) have enabled many organizations to shift their spheres of operation yet again. This time they are not necessarily physical infra-structural developments like roads and railways but rather they are electronic links. These links are partly physical, fibre optic cables, satellite communication systems transmitting information between different parties and partly waves and signals in the “ether.” The digital economy dealing in intangibles such as information and financial exchange is contributing to economic growth and development of trade alongside the physical economy moving tangible goods to markets. All these goods and services need supply chain strategies.

It is not simply bilateral trade, that is, trade between two nation states that happens when there is international trade but rather multilateral trade in many cases, such as, trade between groups of countries. This trading pattern developed throughout the twentieth century. As it did trading blocs emerged. These were groups of countries that decided to trade freely or relatively freely with each other by reducing barriers to trade such as tariffs and duties. The European Union is one such trading bloc as are the NAFTA countries of North America’s Free Trade Agreement (Canada, United States and Mexico) and ASEAN is a political and economic union of ten member states in Southeast Asia. There are others.

- *Regional trading blocs*

In the twentieth century the most important preferential trading agreement was the British Commonwealth preference system. The United Kingdom, Canada, Australia, New Zealand, India and other former British colonies had preferential trading arrangements covering all classes of goods and services. The United Kingdom ended this arrangement when it entered the European Economic Community (EEC). The decision to do so, taken in 1972, became more important in the 1990s and beyond as the European Union began to achieve greater integration of trading policies and practices across the union. Most UK exports and imports are conducted in intraregional trade within the European Union.

The United Kingdom left the European Union after a referendum in 2016 put forward by the ruling Conservative Party. The majority voted by a small margin (3.78 per cent) to

leave. The turnout was 72.21 per cent and the vote 51.89 per cent for leaving and 48.11 per cent for remaining. The United Kingdom subsequently left the European Union even though most of its trade was with EU members. The fall out from leaving the European Union is still there for all to see. The disruptions caused to trade and the friction introduced into supply chains has had a significant cost for many businesses. There are many complex arrangements inside the agreement to leave the European Union. One example was the Northern Ireland Protocol which was finally agreed after much discussion in 2023. There remain unresolved issues. All of this has added friction, cost and caused disruption to many supply chains. Labour shortages, shortage of farm labour to pick crops, HGV driver shortages, port disruptions, increased border check costs, export licenses and many other factors increased frictions. Some of the worst disruptions were experienced in January 2021 with port disruptions: queues and closures. Exports through UK ports was down by around 68 per cent in January 2021 (Road Haulage Association, 2021). In the first quarter of 2021 – 63 per cent of firms said they had experienced delays of up to three days (Chartered Institute of Procurement and Supply, 2021).

- *World View*

World views determine how we think about supply chains and for the past 30 years the prevailing view has been that supply chains are global in nature. In the 1990s, then editor of the *Harvard Business Review*, Joan Magretta, said that supply chains needed to be “fast, global and entrepreneurial” reflecting current thinking at that time (Magretta, 1998). Previously, Kurt Lewin said that strategies get frozen in time until something changes the way we think about them at which point we unfreeze our thinking develop a new paradigm of how things work and refreeze until the next time something stimulates us to change our view of the world (Lewin, 1947). I think you would agree that the world appears to change faster in the digital age. However, we might consider a caveat from Plato who talked about universal truth existing beyond the realm of appearance – the world that most of us inhabit on a daily basis (Plato, 1941). People are social animals and the need to connect, relate and trade is necessary for survival and growth. There will continue to be interest in trading globally now that patterns of world trade have developed and been established, some over centuries not merely decades. The nature of that trade will remain even if the geography shifts. Global shifts are a continuous phenomenon (Dicken, 1998). Time, money and need will determine the nature of global supply and demand (Hines, 2014). The forces of economics prevail and shape world trade. If this universal characteristic is prevalent so too will global supply chains remain. The paradigm may shift as Thomas Kuhn acknowledged (Kuhn, 1962) but the essence remains as Plato noted.

### **Deglobalization**

It is likely that we will experience some rebalancing of supply chains as the world recovers from the disruptions caused by the Covid-19 pandemic and Russia’s invasion of Ukraine. China supply chains are already being redistributed across Asia to minimize country risk and reliance. These are part of a continuous process of change rather than necessarily a break with the past. Hence, change that is evolutionary rather than revolutionary.



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Nevertheless, there is a trend emerging that some supply chains that were severely disrupted during recent years are ripe for review in terms of how they are configured and where they reside. Some nation states and some businesses keen to reduce risk and build resilience are apt to promote and act to deglobalize supply chains. This may not be as easy as it appears on the surface. There are country specific assets that will always require long rather than short supply chains depending on buyer-supplier locations. Far shoring may well not be as popular as it has been in the past 30 years to reduce cost. It is more likely that we see a mix of offshore, nearshore and onshore rebalancing supply chains to reduce risks.

As onshore production became comparatively more expensive many organizations decided to lower cost by offshoring. Moving production to where costs were lower. Often labour cost was the determinant. So, if you could move production to elsewhere in the globe even if it meant far shoring it would still be lower cost given the trade-off between transport and labour cost. This extended supply chains and made them more complex carrying higher risk and, in many cases, vulnerable to global uncertainties. As vulnerabilities increased there has been increasing interest in near shoring as opposed to far shoring as a strategy to reduce risk. And for some onshoring or reshoring supply chains that migrated to far shores in previous times.

This is a developing pattern emerging that is sometimes referred to as a trend to deglobalize supply chains.

### **Volatility**

System dynamics was the focus of Jay Forrester's research examining industrial dynamics. It is from his work we observe what has become known to generations of supply chain professionals as the "bullwhip." An effect that observes the impact of demand amplification as the demand signal is passed upstream to replenish goods. Oscillations in the supply chain caused by the bullwhip effect cause disruptions to the flow of goods through the supply chain system (Forrester, 1961).

Volatility is a disruptor. Global supply chains work on the assumption that each link in the chain can meet demand. For example, a retailer procuring agricultural products from Spain will expect the supplier to deliver within predetermined timescales. If the retailer is based in the United Kingdom, goods may come by ship, rail and road within days of being harvested. Any delay would increase the risk of the goods deteriorating in transit. So, when you have disruptions adding friction (delays) to supply chain processes such as those evidenced in post Brexit trading arrangements these will add cost, bureaucracy and delays which means that risks increase.

- *Time and Distance*

Greater distances add time to supply chains. If there are any delays to agreed lead times and delivery times, it will impact the supply chain. Volatility often occurs when demand is higher than expected or supply is less than expected. If exports of oil or liquefied natural gas (LNG) by ship are disrupted by war or one significant source of supply is removed from the market (e.g., Russia) prices will rise. It might also encourage other suppliers operating in an oligopolistic market to hold up deliveries to earn more profit. Volatility changes the balance in supply chains (Hines, 2022c).

- *Volatility, Uncertainty, Complexity and Ambiguity (VUCA)*

VUCA is an acronym which highlights four challenges for those managing organizations in relation to environmental conditions it can be traced back to leadership theories of Warren Bennis and Burt Nanus. It is a term used in the United States Army which draws attention to volatility, uncertainty, complexity and ambiguity. It highlights four things to understand to make decisions as a strategic leader and was applied to military education during the cold war period. The term is now widely used in contemporary supply chain management. The term highlights sources of systemic, behavioural and organizational failures that result from not understanding VUCA in specific situations.

- Volatility = the dynamics of the system, causes and the speed at which things change.
- Uncertainty = Understanding the unpredictable nature of events and possible surprises.
- Complexity = Understanding of the chain and interactions of cause and effect of interconnected activities.
- Ambiguity = Mixed messages and meanings of events occurring in real-time.

Managing situations in a complex, dynamic world requires awareness, vision and strategies to cope with VUCA. Volatility requires vision and clarity. Uncertainty requires foresight and insights from data to make the unpredictable more predictable, complexity requires managers to remove noise from the signals to gain clarity. Ambiguity requires both agility to respond quickly when change occurs and clarity to focus on cause and effect avoiding misreading the situation.

### Uncertainty

*Uncertainty is when the probability distribution or likelihood of occurrence is unknown.*

*Risk is when the probability distribution is known but the actual value is not known.*

The most used type of probability to assess everyday occurrence is *conditional probability* (also known as Bayes Theorem) and it may be explained as follows:

The **conditional probability** that event  $A$  occurs, given that event  $B$  has occurred, is calculated as follows:

$$P(A|B) = P(A \cap B) / P(B)$$

where:

$P(A \cap B)$  = the probability that event  $A$  and event  $B$  both occur.

$P(B)$  = the probability that event  $B$  occurs.

Let's say that in the past month, 100 container ships arrived at the Port of Felixstowe from China. Of these, 70 arrived on time and 30 were delayed. You can use this data to calculate the probability of a container ship arriving on time given that it is coming from China.

Using Bayes' Theorem, we can write:

$$P(A|B) = P(B|A) * P(A)/P(B)$$

where:

$P(B|A)$  is the probability of a container ship coming from China given that it has arrived on time. This value is not given in our example, so we will assume it to be 0.8 (i.e., 80% of container ships arriving on time are coming from China).

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**P(A)** is the overall probability of a container ship arriving on time. In our example, this value is 0.7 (i.e., 70 out of 100 container ships arrived on time).

**P(B)** is the overall probability of a container ship coming from China. In our example, this value is 1 (i.e., all 100 container ships came from China).

Substituting these values into Bayes' Theorem, we get:

$$P(A|B) = 0.8 * 0.7/1 = 0.56$$

Therefore, based on our data, the probability of a container ship arriving on time given that it is coming from China is approximately **56%**.

Another example might be:

Problems that occur in the “real world” exist with uncertainty as a feature. For example, when we have a business, we do not know with certainty what our annual income will be. We attempt to forecast income, but it is not necessarily going to turn out as planned because of uncertainty. Forecasts rely on past data to predict the future. We base our forecasts on assumptions. It is the assumptions we make that cause differences between an actual result and a forecast.

Uncertainty arises when information about something is unknown. Uncertainty is damaging to supply chains. It generates unknown risk that cannot be assessed with accuracy. When businesses calculate risk, they can do so because they are able to consider a range of possibilities and convert them to probabilities, that is, probable outcomes. This is because they know the nature of the risk and can assess probable outcomes. A simple example might be commitment to promotional activity. Annual sales of a certain product have been consistent at around \$100,000. If a business spends \$10,000 on a promotion, they may forecast different scenarios as follows:

1. No additional sales generated ( $100,000 \times 0.0 = \$0$ ).
2. Increase sales by 20 per cent ( $100,000 \times 0.2 = \$20,000$ ).
3. Increase sales by 50 per cent ( $100,000 \times 0.5 = \$50,000$ ).
4. Increase sales by 100 per cent ( $100,000 \times 1.0 = \$100,000$ ).

They then decide to assess likely occurrence and attach probabilities to each scenario (1, 2, 3, 4) as follows:

1. 0.1 (10 per cent).
2. 0.3 (30 per cent).
3. 0.4 (40 per cent).
4. 0.2 (20 per cent).

Now it is possible to assess the risk of the investment in the promotion by using the expected values and their probabilities of occurrence. We use the probabilities as weightings in the calculation to predict revenue. Note this is an estimate based on what manager's think is most likely. There are four possible results.

*Expected Value Calculations (EV) of promotion*

	<i>Expected outcome</i>	<i>Income</i>	<i>Probability</i>	<i>EV</i>
1.	No increase in sales	\$0	0.1	\$0
2.	20 per cent increase in sales	\$20,000	0.3	\$6,000
3.	50 per cent increase in sales	\$50,000	0.4	\$20,000
4.	100 per cent increase in sales	\$100,000	0.2	\$20,000
			1	\$46,000

The Expected Value calculation determines that the promotion will generate an additional \$46,000 and cost \$10,000 earning additional profit \$36,000.

Using the data in the above example but assuming different (or revised/posterior) probabilities such that each expected value has an equal chance would change the weightings to a chance of one in four or a quarter (0.25) and that would result in an EV \$42,500. This would earn \$32,500 after promotion cost. Assumptions we make will always change the forecast.

Let us now have a look at energy supply. In the example a survey in a particular neighbourhood reveals there are two major supply companies for both gas and electric. The categorical data from the survey is displayed in the matrix. Computing the probabilities displayed in the second example shows that 46 per cent have gas as their principal energy source and 54 per cent use electric as their principal source of energy with 54 per cent using Supplier (1) and 46 per cent using Supplier (2).

<i>Energy Supply</i>			
	<i>Gas</i>	<i>Electric</i>	
S(1)	250	500	750
S(2)	400	250	650
	650	750	1400

<i>Energy Supply</i>			
	<i>Gas</i>	<i>Electric</i>	
S1	0.178571	0.357143	0.535714
S2	0.285714	0.178571	0.464286
	0.464286	0.535714	1

**Complexity**

Complexity in simplest form suggests a degree of difficulty. When we talk about supply chain complexities, we can think of supply chain arrangements that are intricate in nature. For example, how we source – globally, locally, far shore, near shore, offshore, on shore arrangements. The descriptions we attach to sourcing alone begin to give a flavour of how sourcing is talked about by supply chain strategists. Sourcing and procurement decisions have implications for cost, profit and volumes. The distances involved, the shipping arrangements, the time each type of operation takes and so on. Complexities caused by distance, time, interconnectedness and interdependencies that impact efficiencies and effectiveness within and across supply chains. There are different types of complexity categorized as network, process, product,

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range, customer, supplier, data, information and organization. It is critical that organizations can identify complexities and take steps to minimize risks and any potential damage they can do to operations, strategies and goals that the organization has set.

Complexity has also been identified and categorized into four types: structural, technical, temporal and directional (Remington & Pollack, 2008). Each type has specific characteristics as follows:

- Structural – is to do with managing interconnectedness.
- Technical – challenges in design and delivery mechanisms.
- Temporal – uncertain environments.
- Directional – ambiguities in goal and objectives.

### **Ambiguity**

Ambiguity arises from mixed messages received. There was an old Second World War joke about this which explains the concept well. During the heat of battle a message passed along the trenches from an officer said, “send reinforcements we are going to advance” as the message was relayed by troops down the line when it got to the final destination it was delivered as “send three and fourpence we are going to advance.” Hence, ambiguity in the messaging. Similarly in supply chains ambiguity from demand signals can cause a misreading of the situation as noise is added to the message in the system. This causes a bullwhip effect discussed earlier in this chapter.

To reduce the impact of ambiguity, agility is necessary, which means supply chains need to be flexible, adaptable and responsive to changing situations. Agile strategies and embedded agile and responsive practices allow the system to adapt to changes caused by ambiguities in the external environment. You may not be able to predict the future due to uncertainty, but you can act fast when disruption occurs if you are agile and able to respond quickly.

### **Risk**

Doing business with countries around the globe carries a particular risk. Dun and Bradstreet assess and rank country risk indicators and produce tables that indicate the levels of risk across seven categories with seven being highest risk and one lowest. Table 1.3 illustrates a comparative cross-border risk assessment. The list from top to bottom also has some element of ranking within the categories DB1–DB7. In making the assessment of political risk, commercial risk, macroeconomic risk and external risk are categories of assessment. Each is explained briefly:

- *Political risk*

Is the internal and external security situation, policy, competency, fostering and enabling of the business environment.

- *Commercial risk*

The sanctity of contract, judicial competence, regulatory transparency and degree of systemic corruption that affect commercial transactions are assessed.

- *Macroeconomic risk*

*Table 1.3* Country risk – Dun and Bradstreet traffic light system with country risk ratings from DB1 to DB7

DB1	Lowest risk	Lowest degree of uncertainty associated with expected returns, such as export payments and foreign debt servicing.
DB2	Lowest risk	Lowest degree of uncertainty associated with expected returns. However, country-wide factors may result in higher volatility of returns at a future date.
DB3	Slight risk	Enough uncertainty over expected returns to warrant close monitoring of country risk. Customers should actively manage their risk exposures.
DB4	Moderate risk	Significant uncertainty over expected returns. Risk-averse customers are advised to protect against potential losses.
DB5	High-risk	Considerable uncertainty associated with expected returns. Businesses are advised to limit their exposure and/or select high-return transactions only.
DB6	Very high-risk	Expected returns subject to large degree of volatility. A very high expected return is required to compensate for the additional risk or the cost of hedging such risk.
DB7	Highest risk	Returns are almost impossible to predict with any accuracy. Business infrastructure has, in effect, broken down.

*Note:* Traffic light refers to DB1 and DB2 green, DB3 and DB4 amber and DB5, DB6 and DB7 red.

*Source:* Dun and Bradstreet

Risks include inflation, balance of payments, money supply growth and indicators that determine a country's ability to deliver sustainable growth.

- *External risk*

The current account balance, capital flows, foreign exchange reserves, size of external debt and all such factors determine the country's ability to attract foreign exchange and investment.

Dun and Bradstreet have a rating system that uses a traffic light system of assessment. The lowest risk countries are rated DB1 and DB2 (green on the DB traffic light system), amber country risks DB3 and DB4 with the higher risk countries DB5 to DB7 shown in red.

When the global pandemic took hold in 2020 it closed production capacity in many parts of the world. Most noticeably China was unable to continue supplying many of the manufactured products in demand by consumers and business customers in different parts of the world. There was severe pressure on global supply chains. Consequently, many businesses began to move some production to other parts of the globe where production units remained open. For example, Apple iPhone components and finished products switched to other Asian suppliers in Vietnam and India. In 2022 as economies began to slowly re-open businesses also began to search for new sources of supply for many products that were hitherto supplied from China. Reassessment of risks in supply moved up most agendas. Talk of resilience encouraged many organizations to balance risk and cost differently. For some it became an opportunity to reshore some production as well as to offshore nearer to markets served to reduce the threats of disruption.

Different types of supply chain carry with them different types of risk. In the discussion that follows I will briefly outline some of these risk profiles examining extractive industries, agriculture, manufacturing, services, wholesale and retail. This is intended to give readers a grasp of key differences that need to be contextualized when creating supply chain strategies.

### **Extractive industries**

The extractive industries are those such as mining, drilling and pumping earth's minerals to the surface from land or sea. Coal, oil, gas, gold, iron, copper, lithium and rare earth minerals (Pitron, 2022). Quarrying also falls into this category, for example, extracting rock minerals for building and other activities. Dredging and fracking also fall into this category. Supply chains in these industries are capital intensive, often dangerous, high-risk and with high rewards. It is often because there are high rewards that people are prepared to take greater risk and these industries often impact local communities where they are located. Mineral resources have always been fought over and have often been colocated with corruption and crime (Grann, 2017). Where there is money to be made there is often illegal activity. In the Democratic Republic of the Congo (DRC) it is claimed that 98 per cent of net profits from illegal mineral extraction go to transnational organized crime groups (De Jong & Stewart, 2019). Fossil fuel extraction has become contestable with many environmental groups protesting against the removal of non-replenishable resources. Sustainability and climate change have become a focus for such groups (e.g., Friends of the Earth, Greenpeace, Occupy, Extinction Rebellion, Just Stop Oil). Research and planning are the hallmarks of successful operations. These are also supply chains that come under a great deal of scrutiny and are highly regulated by states. Many of the discussions about geopolitics are associated with these industries.

It is worth saying that the technological shifts we are witnessing with automobile manufacture as the industry transitions towards electric vehicles (EV) is based on having efficient extractive industry supply chains to deliver rare earth metals. As is energy too, as it transitions from fossil fuel dependency and nuclear power to more sustainable renewable energy sources to lower pollution and protect the planet there is a dark side. Cobalt, gold, palladium, lithium and production of other rare earth metals must increase significantly. China dominates these rare earth metal markets all of which are essential to EV's, wind turbines, solar power, computers, tablets, communication infrastructure, smartphones and tablets (Hines, 2022a).

### **Agriculture**

Agriculture is the practice and science of how humans have cultivated land for productive use to grow crops, feed livestock for human consumption, harvest those crops and cull animals for food. These supply chains are both cyclical and seasonal. Seasons determine when and how crops are grown and climate determines what is grown, produced and harvested. Humans have been able to reduce the impact of cycles and seasonality through international trade. They have also been able to mitigate risk from crop failures, droughts and flooding to maintain supplies from overseas sources when domestic sources are insufficient, inadequate, diseased, fall short or are affected by natural disasters. Such supply chains require careful planning to source, procure and distribute products to markets for sale when required.

There are many different supply chains that are geographically dispersed around the world. From cotton crops in India and elsewhere grown for textiles and clothing manufacture to sheep farming in Australia, New Zealand, North and South America, Wales and elsewhere from which to produce food and wool for textiles and clothing. Plants cultivated for medicines. Grapes grown and harvested for wine and juices, apples, oranges, pears as well as other fruits grown and harvested for food. Bananas and berries, wheat and other grains, potatoes and other vegetables for food and many more crops too. Each of the products has very different risks and different supply chain structures. Maintaining biodiversity and soil quality is essential. We rely on agriculture to sustain human life.



Global market for agriculture in 2023 is in the region of \$13 trillion. In the United Kingdom, the industry contributes under one per cent to GDP (gross domestic product) (Gov.uk, 2021). Gross value added £11.2 billion (0.5 per cent GDP).

## **Manufacturing**

Manufacturing industry transforms raw materials into finished goods. Manufacturing processes have inputs that include raw materials, sub-assemblies, components and work-in-process and they have outputs which may also be work-in-process that are transferred to other units as their inputs to manufacturing. When manufacture is complete, we have finished goods. This is usually the final product for sale. Logistics and transporting goods to the next destination is the step to move goods to a designated distribution centre for further movement later or to ship directly to customers.

Global manufacturing production in 2023 is in the region of \$44.5 trillion. In stark contrast the UK manufacturing sector is about 9.2 per cent of GDP, compared to the United States where it is 12 per cent and China where it is 27.5 per cent.

## **Services**

Services make up the highest contribution to GDP in the developed economies. It is estimated to be around 79 per cent of GDP in the United Kingdom and a similar proportion in the United States. In the global economy overall services are two-thirds of GDP. In China, the service industries are about 52.8 per cent of GDP. Service industries represent much lower proportions of GDP in lesser developed economies.

Service industries include banking and financial services, insurance, legal, accountancy, education and many sectors where the output is less tangible. Some of the world's largest businesses are service businesses. For example, in the tech sector we have Alphabet, Meta, Amazon, Microsoft, X (formally Twitter), TikTok and more all providing services and ranking highly on the lists of the top businesses in the global economy.

## **Wholesale**

Wholesale is a step in the supply chain between producers and customers when it is necessary to break bulk. A vertically integrated chain might consist of a manufacturer, wholesalers, retailers, customers and consumers. Wholesalers form an important function to distribute goods from manufacturers to retail businesses who in turn sell goods to customers who may or may not be the ultimate consumers. For example, a customer might purchase the goods on behalf of a family unit who consume the goods.

When retailing comprised many small and medium sized firms it played a much more important role in supply chains. Today many large retailers have cut out wholesalers to deal directly with suppliers. These large retail businesses can perform the wholesale function without the need to have an intermediary wholesaler. Examples include Walmart, Home Depot, Tesco, Sainsbury, Asda and many more large retailers in the United States and United Kingdom. Cutting out this stage allows large retailers to negotiate directly with suppliers, earn larger discounts and higher profits.

## **Retail**

The retailer sits between suppliers and consumers. Retailers are customers of suppliers, and they purchase products for resale in their stores. Consumers purchase goods from the retail stores. In recent years, the retail landscape has changed considerably. The only contact point historically



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would have been a physical store on a high street or in the shopping mall. Most business-to-consumer transactions were conducted in the retail stores. As the Internet developed in the last decades of the twentieth century it offered further channels for consumer goods. Online retailing grew significantly in the first decades of the twenty-first century. In 2022 online retailing globally accounted for 25 per cent of sales by value according to Statista. Around \$20 trillion is attributed to retail stores in physical spaces and \$6 trillion online.

There are many retail channels to customers, but the two most important today are physical stores and online routes to the customer. In the past we had stores, direct marketing through mailshots and catalogues. TV retailing through home shopping channels and automated retailing vending machines. Today retailers operate omnichannel which means they have many ways to reach their customers and for their customers to purchase goods from them. To be a successful omnichannel customer retailers need data about how customers make contact and purchase goods. As an example, many customers and potential customers will browse retail offers on a website before making a purchase to get as much information about products, services, prices, availability and delivery details. They may not buy on the website and might decide to visit a store where they have checked availability and price to save wasted journeys.

One trend in retail is the shift from physical to digital shopping. Online retail sales have grown significantly in recent years, especially during the pandemic, as consumers sought convenience, variety and safety. Online retail has also offered opportunities for retailers to engage with consumers directly through personalized recommendations, social media and retail media networks. Retail media networks are platforms that allow retailers to sell advertising space to their vendors or third-party advertizers on their websites or apps. One example is Walmart which works with vendors on retail media networks through Walmart Connect and made more than two billion dollars in 2021 revenue (Kohan, 2022).

However, physical retail is by no means dead. Many consumers still value the experience of visiting a store, touching and trying products and interacting with staff and other shoppers. Therefore, retail developments need to innovate and differentiate themselves by offering more than just products. They need to provide a great customer experience with service to create destinations that appeal to consumers' lifestyles, preferences and emotions.

### **Consumption**

Consumption happens as the final product or service is used by the business or person that procured it. Services are consumed at the point of service whereas goods are consumed over their useful life. It is essential to understand the concept of what the term useful life means in this context. As an example, we buy food and will consume it reasonably fast whereas we purchase other items such as machinery or computer equipment which may be used over a number of years. When a physical product purchased comes to the end of its useful life it is disposed of and at this point it will become waste unless it can be re-used or repurposed.

### **Circular economy**

Supply chains play a vital role in the circular economy. We need to examine change and how it can be harnessed to improve the way we do things to reduce waste and pollution that damages the planet, the people, animals and the ecosystem. The degenerative take, make use and lose approach of the industrial age is being replaced by the regenerative design of dynamic systems to renew, reuse, repurpose and recycle resources. Thus, ensuring sufficient resources remain for future generations to live on the planet. There is much we can do to manage these assets better.

Kate Raworth's excellent book *Doughnut Economics* sets out a clear path to achieving a circular economy (Raworth, 2017). It demonstrates why the take, make, use and lose approach of the industrial age is no longer relevant if we want to preserve the planet for future generations. We need to think differently about how we set about the task to achieve the objective. It is argued that economic thinking that appeared relevant for the industrial age is now simply wrong-headed. We must redefine the purpose and the goals we need to achieve to lower the impact of pollution, resource depletion and degradation of soil and water from those industrial activities. We appreciate industry is important, but we need to think differently about how we do it. Energy, water and food are the fundamentals for human existence, as well as plant and animal life which are central to the food chain. The social foundation of Raworth's Doughnut lays down the expectations for people to live fulfilled lives. Beyond this there is a safe and just space for humanity and beyond that there is an ecological ceiling which if we exceed it will have a detrimental impact on the planet, resources, people, animals and plant life.

The circular economy sets out to understand an interconnected world which is a complex dynamic system. Systems thinking helps us understand those interconnections. It might be argued that nothing is random. There is always cause and effect in a system, but we do not always see the connections. They are not immediately visible. Once we have better tools to see those patterns – to make them visible we begin to understand the fractals, the patterns and we can begin to define the problem more clearly. Today we have been able to identify the problems more clearly and now it is time to set about solutions to resolve them by developing tools to achieve the circular economy. This is summarized in my adaptation of the doughnut showing a resource reset necessary at the centre in Figure 1.3. Supply chain strategies are central to making the circular economy a reality.

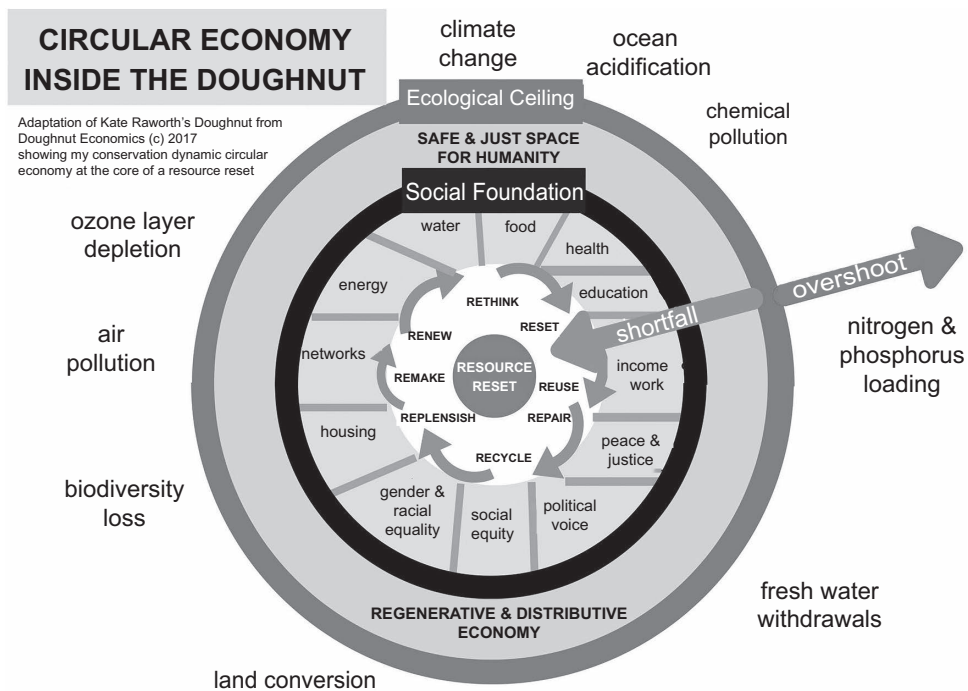


Figure 1.3 Circular economy doughnut

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**Recycling and waste**

There is now much more attention paid to the end of life of products with an emphasis on recycling. Concern for the planet and people as well as profit has led to this change. It is a global concern. As more businesses design more products made with sustainability at the centre and search for ways to reduce the negative impacts there is a growing emphasis on product designs to be sustainable. Climate change is undoubtedly one of the main drivers. With many products containing rare earth metals when it comes to electronics the industry has to focus on how it can reduce E-waste. This not only removes the harmful effects of toxic materials, but it also ensures that through recycling and repurposing these materials get re-used rather than consigned to landfill as first choice. Figure 1.4 illustrates my conception of a circular supply chain which incorporates sustainable thinking at the centre.

**Sustainability**

Sustainability may be defined as meeting the needs of the present without compromising the needs of the future.

World Commission on Environment and Development, 987)

Sustainability demands equity between generations. Three pillars of sustainability are environment, social and economics. The United Nations has set out 17 sustainability goals which cover these pillars in detail. You can find out more about these at <https://sdgs.un.org/goals>. A summary of the goals is shown in Figure 1.5.

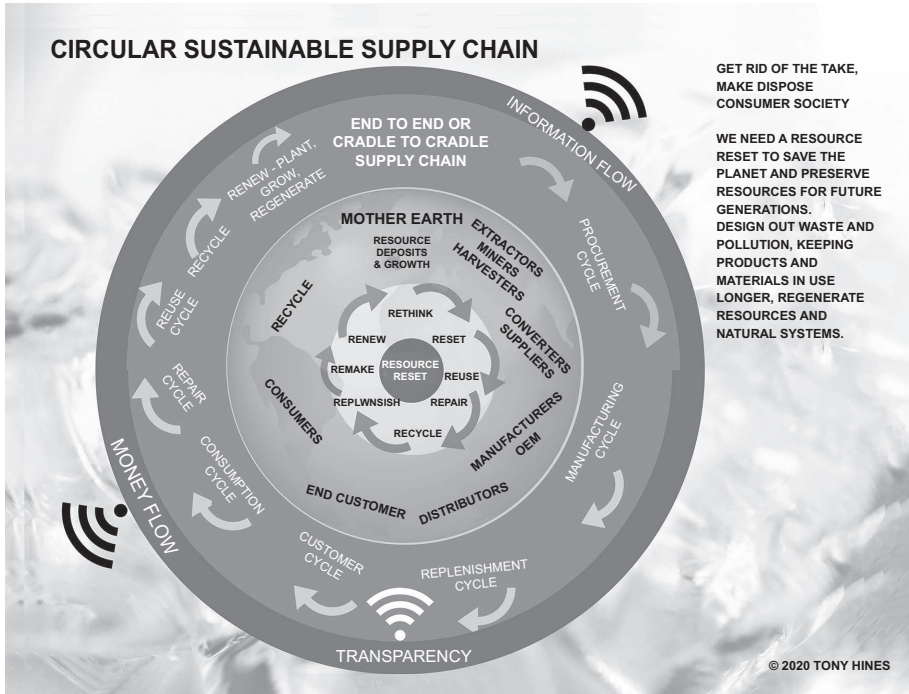


Figure 1.4 Sustainable circular supply chain



Figure 1.5 Sustainable development goals

The problem, in a nutshell, is human activity and its impact on the planet. There are frequent temperatures rises more than 40 degrees causing wildfires in Australia, Greece, California and Turkey. There is a growing inability of the earth to reflect the sun's rays to reduce ground and sea level temperatures. Deforestation and the imbalances that brings to capturing carbon emissions and excessive waste with chemical, plastic and other waste entering the seas and landfills. Biodiversity is reducing; animals are impacted badly by human activity destroying their natural habitat. Ocean and river fish stocks will be depleted. Fresh water free from contamination is a problem in many parts of the world. Soil quality for growing crops is under threat as is the amount of arable land to grow food that is free from harmful fertilizers. Climate change is a source of major disruption.

Sustainability is a major concern for all. The concept of sustainable development has been debated since publication of the Brundtland Report (1987) and the Rio Declaration (1992) following on from the Earth Summit in the same city in 1989. The Brundtland Report noted that "critical global environmental problems were primarily the result of the enormous poverty of the South and the non-sustainable patterns of consumption and production in the North" thus, making the distinction between the developed and developing world. It called for a strategy that united development and the environment which is now described by the common term sustainable development (World Commission on Environment and Development, 1987). The Rio Declaration noted the major concerns of the impact of production patterns with increasing amounts of toxic waste, the search for renewable energy to lessen the impact on climate change, the corresponding emphasis that needs to be placed on sustainable public transport systems by all governments and awareness of a growing scarcity of water. The Kyoto Protocol was established in December 1998 but there were notable exceptions particularly the United States and recently Canada renounced the protocol in 2011. In general term this Protocol establishes

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agreements between member states of the United Nations to reduce greenhouse gasses (carbon dioxide, methane, nitrous oxide, sulphur hexafluoride) as well as two gasses produced by these greenhouse gasses which are (hydrofluorocarbons and perfluorocarbons). The largest emissions come from industrialized countries of the United States, European Union, Russia, China, Japan and India. There is a complex system of trading in carbon credits that has been introduced to allow countries to purchase or sell agreed allowances for greenhouse gas emissions. Effectively a tax if you produce more than allowed or a rebate if less.

The Stern Report (2007) made a compelling case for the impact of climate change and the need to take immediate steps to prevent irreversible damage to the natural world and the ecosystem which we are part of and inhabit. The consequences of industrialization are that the number of dams to prevent flooding of fertile land reclaimed for food production amongst other things has been estimated approaching 30,000 by 2000. There were none in 1750 of any scale. Water usage has increased from around 1000 km<sup>3</sup> per year in 1900 to nearly six times that quantity by 2000; fertilizer consumption has increased from a zero base to 300 million tonnes in the same time period. There are now over 700 million motor vehicles where there were virtually none at the start of the twentieth century and CO<sub>2</sub> emissions have risen by 22 per cent between 1980 and 2000. Furthermore, since 2000 they have tripled over the average from 1990 to 1999. The developed economies with just 20 per cent of the world's population have contributed 75 per cent of the cumulative carbon dioxide emissions. The industrialization under construction in China and India will significantly worsen this position (Speth, 2008).

Quality of life requires both natural and social systems to be sustainable. In recent times a focus on carbon emissions and how we can influence them has taxed the minds of policy makers into realizing that serious climate change will be irreversible. Governments and policy initiatives have realized that growth at any cost is a price too high to pay. Some have questioned if sustainable capitalism is possible (O'Connor, 1994). The flawed assumption is that by increasing growth everyone benefits but this has not proven to be the case (Shutt, 2010). The reason for this is that the distribution of benefits has accrued to a small number of people and organizations. Governments and trading blocs alike focus all their attention on increasing growth measured as gross domestic product (GDP). A number of Nobel Prize winning economists have referred to this phenomenon as pursuing the wrong goal (Stiglitz, 2012).

Organizations have become very conscious of the part they play in contributing to these carbon emissions. Many are very keen to establish their green credentials by measuring how much they have reduced their emissions by acting. These are published in their annual reports and on the website. Organizations are taking social responsibility as an important issue but exactly how much of this is genuine is questionable and, in some cases, they may simply be responding to limit negative publicity. Nevertheless, there are organizations that have made genuine efforts.

Supply chain strategies are an obvious place to examine how an organization may reduce its carbon footprint. For example, retail organizations can influence the distances that goods travel and the means of transport. Both these decisions will determine carbon emissions. If food that could be provided locally is purchased from countries that have to ship goods thousands of miles and sometimes by air to keep it fresh, then this has an obvious impact. Lowering the "food miles" travelled has become an issue for policy makers and environmentalists alike. Packaging materials, production processes and recycling policies can all play a part in reducing carbon emissions. California strawberries sold in the United Kingdom have CO<sub>2</sub> emission of five litres per kilogram. If you buy orange juice and oranges, it can take two glasses of petrol to get one glass of juice to your breakfast table.

If you are still in any doubt why action is needed to become more sustainable check out the facts summarized in Figure 1.6.



# IN JUST 70 YEARS 1950-2020

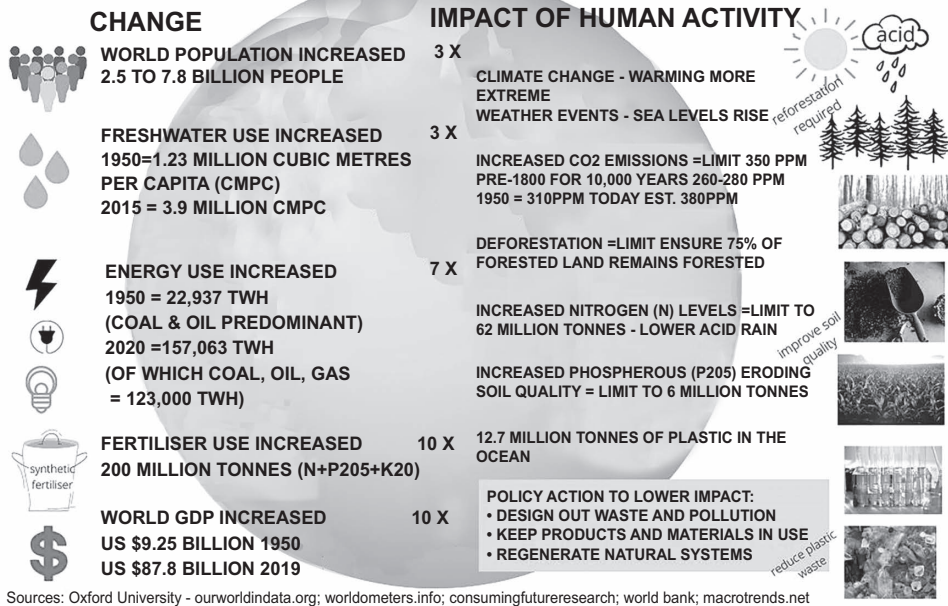


Figure 1.6 Seventy years of change 1950—2020

## Environmental, social and governance (ESG)

Data are required on ESG. Each of the three elements are necessary in an ESG compliance statement. Investors have increasingly requested ESG reports before investing in organizations. Customers, consumers and suppliers too have become more concerned about ESG.

- Environmental: Climate change, greenhouse gas emissions, biodiversity loss, deforestation/ reforestation, pollution mitigation, energy efficiency and water management.
- Social: Employee safety, health, working conditions, diversity, equity, inclusion, conflicts and humanitarian crises. All are necessary to assess risk with results to enhance or destroy reputation, customer satisfaction and employee engagement.
- Governance: Corporate governance, compliance and risk data are required to complete the governance aspect of reports. These include preventing bribery and corruption. Diversity of board of directors demonstrating non-bias in selection and recruitment, executive compensation, cybersecurity as well as privacy practices and management structure.

## Supply chains and ESG

All three elements of ESG are central to supply chain management. Supply chains have a significant role to play in reducing the impact of environmental factors. There are different estimates of exactly how much pollution is caused by supply chains. The different measures come from what data is included in the measures. According to McKinsey and Co. two thirds of a company’s ESG impact derives from suppliers and their supply chains (Cherel-Bonnemaison

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et al., 2021). They go on to say “consumers, are increasingly choosing brands with strong ESG credentials, even if the prices are higher.” Embedded emissions, that is, those that companies import via their supply chain account for 80—90 per cent of greenhouse gas emissions. It is likely higher if you go beyond tier one suppliers.

Embedded emissions come from purchased goods and services, employee travel and commuting, and the use and end-of-life treatment of sold products. Of these emissions, two-thirds are usually from the upstream supply chain. Tier-n suppliers are also more difficult to monitor, increasing the risk that poor environmental or labor practices go unnoticed.

(Cherel-Bonnemaison et al., 2021)

If you decide to do your own research on this topic, be sure to be precise about what data sources you use, what exactly you are measuring and what you decide to include in your measurement. ESG must go beyond a public relations (PR) exercise if it is to be useful, as well as necessary.

### **Supply chain people**

Supply chain people are responsible for coordinating every aspect of the supply chain, including planning, sourcing, procurement, manufacturing, delivery and disposal. They ensure that operations run smoothly in everything from planning to sourcing raw materials, manufacturing, delivery and returns. Supply chain management are responsible for strategic direction and goal setting for supply chains they manage. They work closely with other functions such as sales, marketing, human resources, IT, production and finance and as part of cross functional teams when working on organization projects. In enlightened organizations chief supply chain officers have a place at the top table and become part of the strategy team setting business goals for the whole organization.

S&OP stands for sales and operations planning. Balancing supply with demand is a key responsibility and this is often the function performed by S&OP. The purpose of S&OP is to anticipate and respond to changing conditions that affect the performance of your business across the extended supply chain (including marketing, customers, manufacturers, logistics and suppliers). Sharing data across teams reduces risk, improves effectiveness of supply chains and optimizes performance. It reduces waste provides, lowers inventory, reduces financial risk and delivers better customer service. It does this by creating effective teams, not only within the organization supply chain but with the extended supply chain working with partners in the total supply chain. In this respect, it is an essential function when supply chain environments are volatile.

Supply chains have many different roles and opportunities that require talented people to manage the complex, dynamic supply chain system in a modern economy. These roles range from sourcing, procurement, production and operations through to logistics, transport, distribution, warehousing and retailing. Data analysts are needed to provide information to manage supply chains. Digital transformation in the supply chain has placed a greater emphasis on people with technical skills to manage the technology. As in society people working in the supply chain have multiple skills and there are opportunities for different people with different skills and abilities to contribute to these roles.

### **Supply chain places**

Every organization has a supply chain. Some organizations supplying services may have digital supply chains only, whereas most organizations will have physical supply chains when goods are moved around. Supply chain places can be anywhere from extraction sites, farms,

production units, data warehouses accessible through cloud technologies, physical warehouse and distribution centres, ports through to logistic hubs, transport and retail stores.

The location of each supply chain place has a significant effect on everything from time and distances travelled, profitability, product cost, sustainability and environmental impact. Therefore, supply chain managers need to consider several factors such as demand, capacity, lead time, transportation cost, taxes, tariffs and regulations when deciding where to locate their supply chain places. Some supply chain places may be closer to the sources of raw materials or suppliers, while others may be closer to the markets or customers. Some supply chain places may be centralized or regionalized, while others may be diversified or globalized. Some supply chain places may be owned or operated by the same company (e.g., vertically integrated), while others may be outsourced or contracted to third parties.

### **Supply chain technologies**

When the first edition of this book was written technology solutions in supply chains were only just beginning to realize possibilities of leveraging the internet. In the past 20 years things have moved forward at break-neck speed. Today supply chains are using cloud technologies to improve visibility and reduce uncertainties. Cloud technologies have become a game changer along with artificial intelligence (AI). Cloud technology is transforming supply chain and logistics management by providing optimization, innovation, collaboration, visibility and resilience.

This said we still see firms with legacy systems and many still use Excel spreadsheets to manage complex operations. However, in discussions with many tech professionals they tell me that this is unsustainable.

- *Cloud technology*

Cloud technology is a way of using computing resources and data storage over the internet, instead of on local devices or servers. Cloud technology has changed the way supply chains operate in several ways, such as:

- **Integration:** Making access to data available everywhere by storing and accessing through cloud technologies which allows organizations to operate their supply chain and get information any time, any place, anywhere.
- **Responsive and scalable:** This helps them respond quickly to changing market demands and customer expectations. Cloud technology also helps companies scale up or down their computing power and storage capacity without having to buy or maintain expensive hardware.
- **Facilitates collaboration with supply chain partners:** Cloud technology provides access to cutting-edge technologies and capabilities that can help companies improve their supply chain performance and efficiency. For example, cloud technology can help companies use emerging technologies such as artificial intelligence, machine learning, blockchain and internet of things to optimize their supply chain processes and outcomes. Cloud technology also facilitates collaboration among different supply chain partners by allowing them to share data and insights in real-time.
- **Cloud technology helps companies gain more visibility into their supply chain operations and performance by providing real-time data and analytics.** This helps them make faster and more informed decisions, anticipate and predict market changes and risks and design and deliver personalized products and services<sup>2</sup>. Cloud technology also helps companies improve their supply chain resilience by enabling them to recover quickly from disruptions and adapt to changing conditions.



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Big solution companies with enterprise resource planning (ERP) systems are feeling the pinch from digital disruptors entering the market offering supply chain technology solutions that do not come with any of the baggage from previous generations and patch up system solution providers. The technical solution market is competitive and not solely dominated by the large providers as it once was. The industry change mirrors what happened in the computing industry as mainframes gave way to networked systems. The cost is falling too.

*Artificial intelligence (AI)*

Artificial intelligence (AI) is any non-human form of intelligence. AI has the capability to process enormous quantities of data relatively fast. AI interprets data to act. It does so using operating mathematical rules known as algorithms. Computer programming software are essentially algorithms. AI is used in robots, telecommunications (e.g., smart phones, tablets and computers), driverless vehicles, drones, all forms of transportation, production machinery, warehousing and packaging, sound systems, televisions and many other types of everyday equipment around us. Anything with a microchip is probably using some form of AI. Electric vehicles as an example contain over 3,000 microchips that operate the battery system, the drive system, locks and simple things like heating, wipers and audio-visual equipment in the vehicle. Anywhere you have sensors you have AI. (See Figure 1.7.)

There are two types of AI which are referred to as generative AI such as ChatGPT which uses large language models (LLM) to gather data and interpret information and there is non-generative AI. Generative AI can generate text, images and other media. Non-generative AI is a simpler form making decisions on a limited set of data applied in the algorithm to act. For example, a home heating system triggered by a thermostat will switch on or off according to the

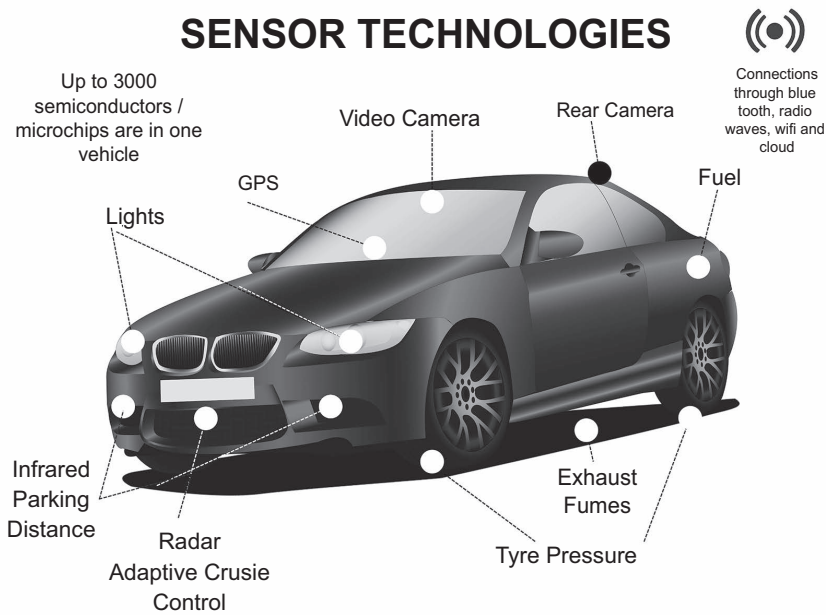


Figure 1.7 Sensors and microchips in cars

data received about temperature and the level it is set at. This uses a simple microchip preprogrammed to perform the task. Generative AI learns from experience much like a human would do to improve performance. This is often called machine learning.

Artificial intelligence (AI) and machine learning are changing the nature of work and how it is done. The biggest change is the substitution of machines replacing human labour. This is happening everywhere. Just as during the period often referred to as the industrial revolution changed the way people did work, the type of work and the place of work moving from field to domestic industry to factories, today it is happening once again. This time it is not a move from an agrarian society to an industrial society. It is rather, a switch where routine repetitive tasks can easily be done by machines. This releases labour to do other things. More complex tasks can be undertaken by humans that is more rewarding. The change has the potential to improve the world of work. However, you must be sure that freed up labour from the AI revolution can be applied elsewhere. The transition may not be as smooth as those advocating the AI revolution profess.

During the first industrial revolution there was resistance to the transition from those workers whose jobs were under threat. For example, in the textile industry in the United Kingdom the introduction of the power loom invented by Edmund Cartwright increased production capacity and reduced demand for labour. Output increased tenfold and more with the introduction of power loom technology. Originally, water power was used later replaced by steam power, and in turn by oil and electricity. Workers revolted by breaking up the machines that they saw stealing their jobs away. In 1812 textile workers taking action were known as Luddites named so after a Leicestershire weaver Ned Ludd who was a leader of the resistance to this introduction of technology. If you look up this term in the dictionary today, it will say something like a person who is opposed to technology and new working practices. AI will no doubt spawn its own resistance as it becomes clear that the promised benefits are not evenly distributed across the population and in particular the workers displaced unable to find new work will be in the vanguard of resistance to changes.

In 1834, the seeds of unionized labour were sown when six agricultural workers from Tolpuddle in Dorset were transported to Australia after forming a secret resistance to the introduction of the Combination Act 1799 forbidding workers to meet in groups. This group became known as the Tolpuddle Martyrs, and they were transported to a penal colony in Australia. Think pandemic lockdown and you get the idea. Nevertheless, as the industrial revolution took hold so too did the development of the trade union movement. Industry 4.0 is another moment in time that is redefining the way we work. The adjustment at times appears painful as old industries cease to exist and new ones replace them. The human-technology interface has never been more central to development than it is today. Supply chains are a good observatory of how this change is happening.

Supply chain strategies have become the concern of the “C” suite and technology will ensure they stay at the centre of organizational decisions. Figure 1.8 illustrates how and why this will be so.

## **Summary**

In this introduction, the environment in which supply chain strategies are enacted has introduced the key factors that interact with it (political, economic, social, technological, ethical, ecological and legal – PESTEEL). The social system provides the setting for political, economic, technological and social change. Different forces at play shape the nature of geopolitics which in turn shapes the global economy and its structure. Volatility, complexity, ambiguity and uncertainty give rise to risk and the different forms it takes in relation to supply chains. Different types of economic activity also impact sustainability of the planet, causing climate change and determine the future of organization when it comes to resources, people and profit. This is why the circular

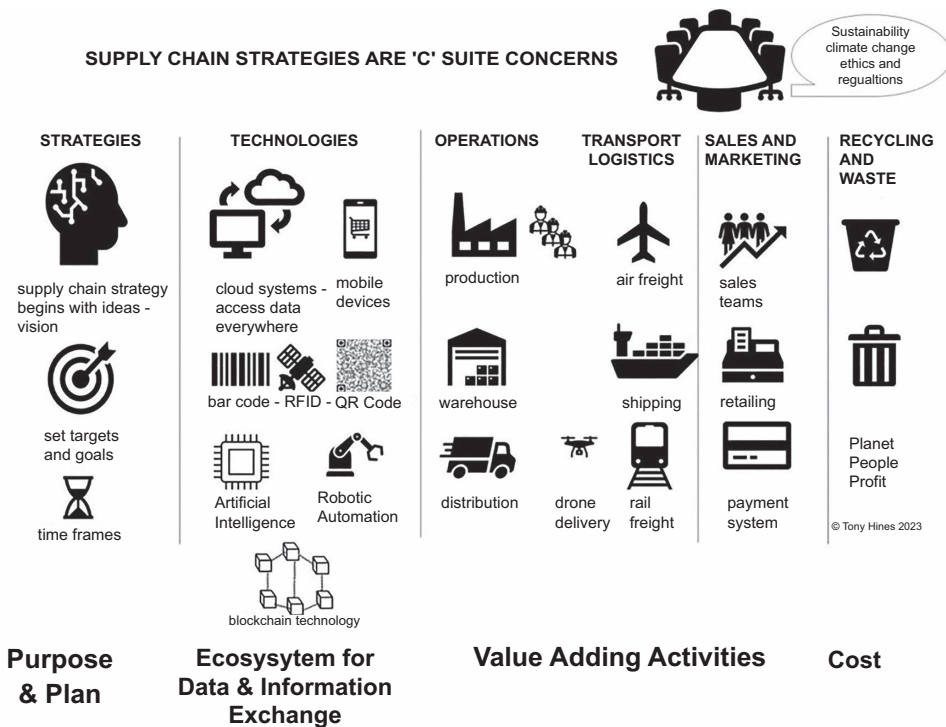


Figure 1.8 Supply chain strategies – people and technology

economy is necessary to improve all our futures. Supply chains need to embrace the challenges ahead. The rest of this book will examine and explore these ideas further in the context of supply chain strategies that are demand driven and customer focused.

**Discussion questions**

1. Why is geopolitics a force shaping supply chain structures and strategies?
2. Are global supply chains sustainable? Explain why.
3. Discuss what impacts deglobalization might have on supply chains and the choices businesses make.
4. Explain each of the following terms (volatility, uncertainty, complexity, ambiguity) and make a case for better understanding of the causes that disrupt supply chains.
5. Define and explain supply chain risk and discuss the reason it is different from uncertainty.
6. Discuss the concept of interconnectedness in relation to supply chain management and explain why integration is important.
7. Supply chains move downstream to the final customer define and discuss what is mean by this statement and explain stages in the process of supply chain management.
8. Describe what is meant by the term “circular economy” and discuss how it might improve ways of managing supply chains for people and planet.
9. People talk about supply chain systems but what exactly is a supply chain system?
10. How do you think supply chains are and will be impacted by technological change?

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## 2 Supply chain risk – 7Vs

### Types of risk

Two main types of risk exist in supply chains which are endogenous and exogenous. The first type comes from within the system and the latter comes from outside the system, that is, the external environment.

**Endogenous risk:** When the internal machinations of the system, the interconnections and actions of supply chain actors inside the system are the cause of risk. There are numerous examples which revolve around systems complexity things such as failures in demand planning, production operations, transportation, sourcing and procurement arrangements could all be the source of endogenous risk.

**Exogeneous Risk:** When external factors outside the control of the organization impact on it. Examples include terrorist activity, wars, natural disasters and political instability. Geopolitical tensions that cause supply chain disruptions would fall into this category. It is another form of volatility.

The “C” Suite has become more interested in supply chain strategies and risk management in recent times. The many supply chain disruptions since the Covid-19 pandemic have forced many executives in the boardrooms of major corporations to think about and plan strategies to mitigate supply chain risk. Future proofing supply chains has become the mantra of many advocating resilient supply chains. It is not only limited to the boardrooms of major corporations, but the interest is shared by many medium-sized and smaller businesses and those in government and the public sector. The supply system with all its interconnections (sourcing, procurement, operations, logistics, transport and distribution) carry risk and all have potential to contribute value. According to Gartner, 89 per cent of organizations have experienced a supply chain risk event in the past five years (Gartner, 2023).

### *Defining risk*

Risk and uncertainty are two sides of the same coin. Risk can be assessed, and steps can be taken to reduce risk, whereas uncertainty cannot be measured and nor can it necessarily be predicted. When assessing risk, we assign probabilities to outcomes. With uncertainty, outcomes are unknown and they cannot, therefore, be predicted. Risk assessment, avoidance, management and mitigation are common within supply chains and accounted for when strategies are planned. We often make assumptions about risk to predict possible and probable outcomes. For example, whether to outsource, offshore, nearshore, or onshore suppliers. Given these scenarios, we calculate risk and



### 34 *Supply chain risk – 7Vs*

predict outcomes from pursuing each strategy. In so doing, we might make assumptions about political, economic social technological, ethical and legal factors affecting the decision (PESTEL). We often do so in terms of predicting financial loss or gain from pursuing particular strategies.

#### *Examples of common risks in supply chains*

There are many supply chain risks; here are some of the most common:

- **Inventory risk:** This could be inventory not arriving in time for a sales period or for scheduled production (volatility risk).
- **Stockpiling:** This is a further inventory risk by holding too much stock. Overstocking increases cost of carrying *stock keeping units* (SKUs) along with risk of damage or deterioration while in storage or through obsolescence when you hold SKUs too long. This risk emerges from holding too much inventory maybe to become more resilient and meet customer demand as it arises (volume risk).
- **Quality risk:** This occurs when inventory arriving fails quality inspection. This can disrupt production, selling or onward supply to customers. For example, you may decide to switch suppliers and subsequently find that their quality standards are more variable than expected (variability risk).
- **Labour shortages:** During the Covid pandemic many organizations experienced shortages due to illness, plant closure due to government directives and this meant that goods could not be produced. In the United Kingdom, after Brexit, many EU workers returned to their home countries, which left serious gaps in the UK labour force. One example was the shortage of HGV drivers (volatility risk).
- **Pricing risk:** When there is a sudden shift that is unforeseen in the price of raw materials and other goods inbound, it causes changes to the cost structure and this could make outputs unprofitable if sold at existing prices. It is another type of volatility risk. There have been many examples of this type of risk and disruptions caused during and post pandemic and from the impact of Russia invading Ukraine which pushed up the price of many goods including gas, oil, electricity, grain, metals amongst other things.
- **Unpredictable demand:** When there are sudden shifts in demand changing normal patterns such as supermarkets facing excessive demand for toilet rolls during the Covid-19 pandemic. This creates a “bullwhip effect” which was discussed in Chapter 1.
- **Seasonal risks:** These could be weather related disruptions from floods or fires that were not expected or, if they were expected, the level of disruption was uncertain. This type of risk might also occur if there is a change in expected weather patterns due to climate change, which affects crop production.
- **Black swan risk:** These are unusual, unpredicted and sometimes unprecedented events that cause disruption. The Evergreen ship stuck in the Suez Canal blocking traffic entering the canal is such an example. The ship delayed many ships during a ten-day period of disruption adding time to journeys and causing backlogs at other ports as the flow of traffic meant that there were more ships to unload in shorter periods of time as they arrived at the ports together once the canal reopened.
- **Data security risks:** May arise from having incomplete or inaccurate data. This could be caused by not investing in appropriate technologies such as updating software and hardware options that are fit for purpose. Or it might simply be that you are not collecting or accessing accurate data from your supply chain partners. There may also be risks from cyberattack and ransomware demands that cause breaches of data security.

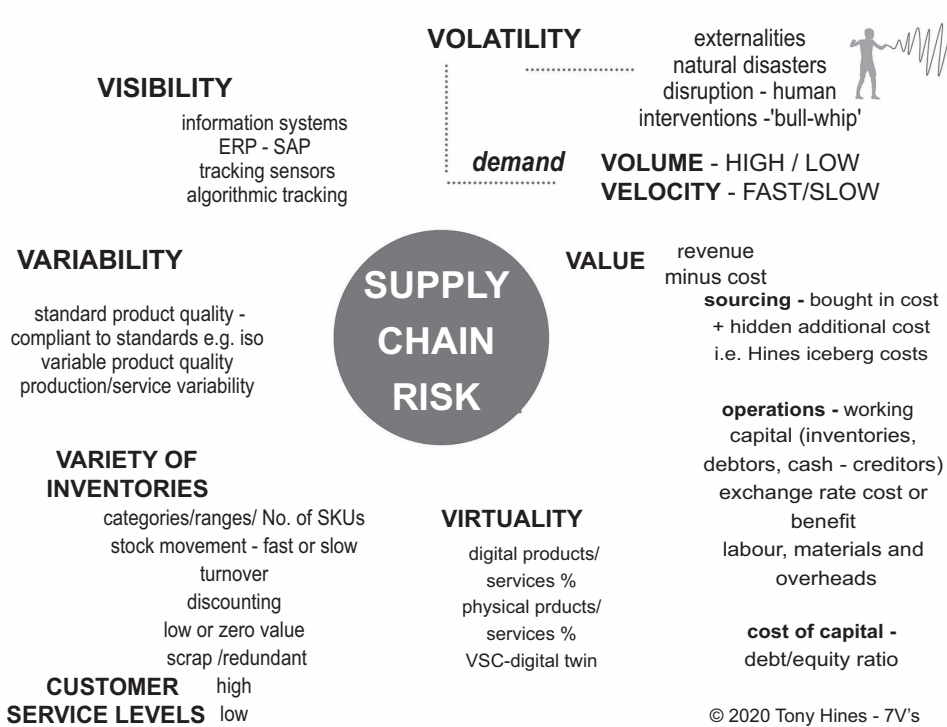


Figure 2.1 Hines 7V risk and value creation model

You will see from the examples that it is possible to categorize these risks into specific types. Now I want to refine the analysis in the next sections to show how these risks align to the 7V framework developed in this chapter. There are risks from volatility in supply and demand, volume changes, velocity at different supply chain nodes, variable quality, variety – holding too many varieties of goods or not enough to satisfy customers, visibility – not knowing where goods are in the supply chain and virtuality – risks associated with digital supply chains. These 7Vs determine value by identifying risk factors that impact value. Figure 2.1 illustrates the 7V framework, risk and value are determined by how well these factors are managed in the supply chain. The customer is at the centre of everything we do in supply chain strategies. We need to know what customers value to manage supply chains effectively.

The major business challenges for organizations developing supply chain strategies include developing capabilities to manage value by assessing risk. Risk can be framed in terms of factors that change that risk: *volume*, *volatility*, *velocity*, *variety*, *variability*, *visibility* and *virtuality*. To do so, organizations need to look at the ways in which they interact with customers at every level and view these challenges from a customer perspective.

### 7V Model identifies risk or value in supply chains

$$R \text{ or } V = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7)$$

$X_1$  = Volatility

$X_2$  = Volume



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$X_3$  = Velocity

$X_4$  = Variety

$X_5$  = Variability

$X_6$  = Visibility

$X_7$  = Virtuality

where  $X_1, X_2, X_3, X_4, X_5, X_6,$  and  $X_7$  are the seven variables representing the values of the seven factors, and  $w_1, w_2, w_3, w_4, w_5, w_6,$  and  $w_7$  are the weights assigned to each factor. The weights represent the relative importance of each factor in determining the overall value or risk. The sum of the weights should be equal to 1, that is,  $w_1 + w_2 + w_3 + w_4 + w_5 + w_6 + w_7 = 1$ .

This functional equation specifies the relationship between the overall value or risk and the seven factors in implicit form. You can evaluate the function for different values of the factors to calculate the overall value or risk.

Supposing after analysis the obtained value for each variable was as follows and we assigned probabilities to each risk factor as indicated we arrive at an expected value (EV) for the risk as indicated:

<i>Factor</i>	<i>\$ Value</i>	<i>Weight</i>	<i>Expected Value</i>
X1 = Volatility	\$100,000	0.3	\$30,000
X2 = Volume	\$50,000	0.2	\$10,000
X3 = Velocity	\$20,000	0.1	\$2,000
X4 = Variety	\$30,000	0.1	\$3,000
X5 = Variability	\$10,000	0.1	\$1,000
X6 = Visibility	\$60,000	0.1	\$6,000
X7 = Virtuality	\$10,000	0.1	\$1,000
		<b>1</b>	<b>\$53,000</b>

### China dependency

Waking up to reality – the world’s dependency on China continues despite disruptions due to Covid-19. China dominates manufacturing in electronic goods and in processing metals that are needed to produce batteries for electric vehicles (EVs) such as cobalt and lithium. China is regarded as a middle- and upper-income country according to the World Bank. China is responsible for over 30 per cent of all goods manufactured. China has 133 companies in the world top 500. China has a population of 1.4 billion and has transitioned rapidly from an agrarian society to industrial economy. It is now the number one economy overtaking the United States in terms of global market share. China has talented scientists that continue to improve and innovate technologies to support industry and the energy ecosystem.

China has committed to reach net zero targets by 2060. China plans to increase its use of fossil fuel consumption up to 2030 and rapidly reduce that with clean energy up

to 2060. China's entry to world markets in recent times began in 1978 as it opened up its closed economy. It continued to transition with entry to the World Trade Organization (WTO) in 2001. During the past 20 years it has set about building its resource base particularly in metals from the Central Africa Copper Belt – cobalt is a valuable resource emanating from the DRC.

China has been engaged in a trade war with the United States during the past couple of years. This because it has access to US markets but continues to deny access to US companies. It also has ambitions to dominate the Southeast Asian region and continues to claim territories, particularly Taiwan.

### **Value in relation to customers**

Customers expect value and suppliers need to anticipate and identify what customers value in order to supply a bundle of goods and services that equate with value to exchange money for products. Value in exchange, use and over time is important to the customer. This is the value challenge. Customers nowadays are seldom prepared to purchase quantities suppliers would like to supply, at a time determined by the supplier, in standard form, with non-standard performance a highly probable outcome. This perhaps best describes a hitherto mass-production era. Today's customer is more demanding in every sense. Meeting the demands of customers as and when required is the challenge for supplier organizations. Ensuring that capacity can be increased when demand is high and lowered when demand is low without incurring excessive or unnecessary cost is the volume and volatility challenge. Velocity is recognition that speed of response in supply chains has become an important competitive advantage in many commercial contexts. Variety is a recognition that customer requirements vary, and suppliers need to be capable of customizing products and services as a consequence. Variety is also what drives customers by introducing new products and services; by being able to anticipate customer demand. Variety presents challenges to suppliers in terms of inventory cost and risk. Variability is the challenge of management control in ensuring that goods and services satisfy quality criteria and deliver the required standard for customer satisfaction. Visibility is a core capability for managing the total supply chain from source to consumer. Visibility and transparency ensure that parties within the total supply chain know what the current pipeline looks like.

Information and communication technology has allowed organizations to view frequently status reports on sourcing, procurement, production, logistics and customer demand ensuring that there are no blockages, unnecessary inventories or unplanned cost build up. Integration of systems, policies and procedures across organizational boundaries between organizations working together within a supply chain to satisfy the customer has been the catalyst for visibility whilst technology provided the means. "Virtuality" has allowed organizations to replace inventory with information through the creation of digital supply chains supported by ICT. Organizations need to focus their attention on customers by creating capabilities that deliver market-driven supply chain strategies.

Supply chain strategies must be responsive to customer requirements and in that sense, organizations need to develop sustainable strategies, offering service to the customer, with speedy responses, suited to the customer, at a standard quality supported by systems, structures and relationships that deliver customer satisfaction.

### **Volatility**

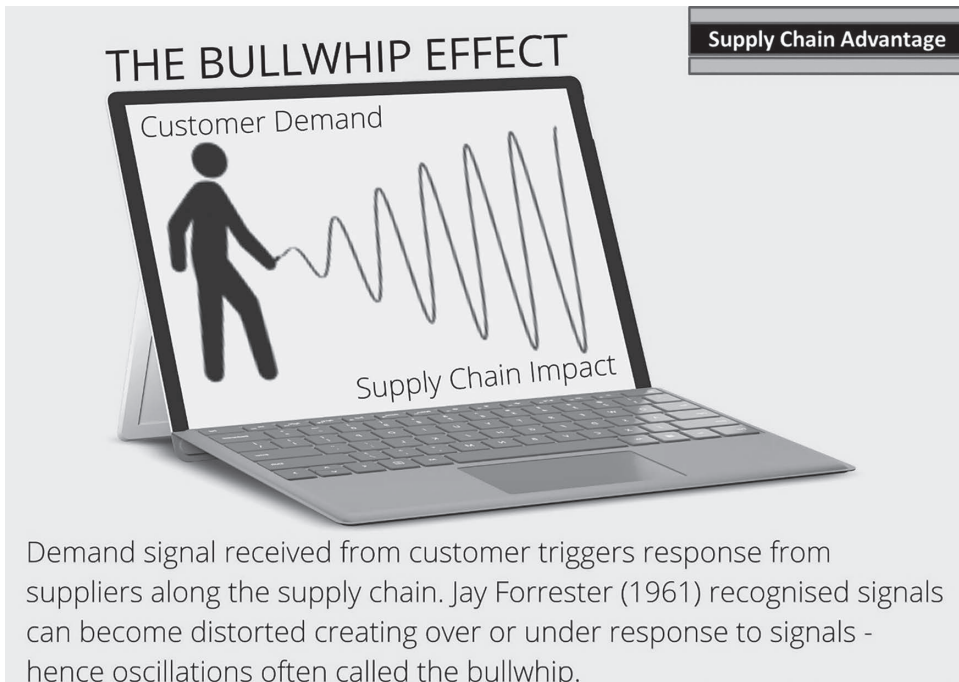
Volatility is caused by external factors and internal system factors. Exogeneous factors that cause volatility and disruptions to supply chain systems comprise natural occurrences such as weather disruptions, volcanic activity such as volcanic ash clouds disrupting airfreight, Tsunamis disrupting shipping, floods and fires. In addition, human activities including wars, strikes, protests, bureaucracy, customs checks, labour shortages, power outages, cyberattacks and system failures also cause disruption and make supply chains volatile. Sudden increases in demand may also add to volatility in a supply chain by causing a bullwhip effect. Mitigating the impact of volatile supply chains reduces risk and reduces the loss of value that may occur within the supply chain because of untethered volatility.

Volatility suggests instability and unpredictability. Chain reactions occur when chemicals added to existing chemicals cause further reactions that spread throughout the system. Volatility in a supply chain works similarly. A series of events happen each caused by the previous event. Supply chains are said to be volatile when there is uncertainty in a part of the network that causes reactions elsewhere in the system. Supply chains are dynamic systems and a change in one node in the network can impact the whole system. For example, if one supplier represented by a single node in the supply network drops out this will cause changes elsewhere in the system.

Another way to think about volatility is to consider system volatility caused by external factors (PESTEL). Within the broad context of political, economic, social, technological, ethical and legal factors. For example, we may think of changes in government of particular countries where supply chains are located or pass through. Economic shifts in exchange rates or changes to resource endowments of particular nation states may cause disruptions to supply chains. One such example might be fire or flood damage to crops. Further examples of volatility might be depletion of finite resources such as oil, coal or gas lowering supply and pushing prices up. In addition, social unrest, protest, shifts in technologies used and the ethical or legal factors that change relationships and disrupt the status quo are further examples of volatility that disrupt supply chains. It is not just supply-side changes that cause volatility there may be demand side changes that disrupt supply chains. For example, demand volatility caused by changing market conditions. This type of volatility affects volume. Volatility is also caused by disruptive technologies and innovation.

Global supply chains are prevalent in many, if not, most industries. Many benefits accrue from having global supply networks which include reducing risk of reliance on local supply, getting better prices for the same quality of supply, an ability to ensure demand is met from the global network with the ability to move capacity and production. The downside might be longer lead times or delivery times. Problems may arise when distance delays deliveries through unexpected disruption. In an uncertain world this has become a greater problem. Take the examples of gas supply from Russia to the European Union and you get the picture. Global supply chains as a means of mitigating risk and meeting demand have become the dominant paradigm for supply chains, just-in-time (JiT) systems that operate in many industries come under pressure when disruption occurs. The system relies on stability and certainty to satisfy demand. It fails when there is uncertainty and disruption.

Jay Forrester's work on systems dynamics carved out a pathway to understand the nature of vulnerabilities in the supply system (Forrester, 1961). Many supply chain operatives have learned the impact of the "bullwhip" (see Figure 2.2) causing oscillations in a supply system as demand is amplified upstream. So, awareness was present, and the practice has been sharpened through experience but for many the stark realities of a pandemic impacted supply chain taught them invaluable lessons in how to cope with dynamics.



Demand signal received from customer triggers response from suppliers along the supply chain. Jay Forrester (1961) recognised signals can become distorted creating over or under response to signals - hence oscillations often called the bullwhip.

Figure 2.2 Bullwhip effect

Volatility is a challenge for all supply chains. Uncertainty can make supply chains vulnerable to volatility. There are times when volatility is predictable. In the latter form, risk can be identified, assessed, managed and the impact and effects can be mitigated by having strategies to cope with volatility. First, you must identify vulnerabilities in your supply chains to assess risk. What makes your supply chain vulnerable and what might the possible outcomes be if this event occurs? We usually answer the question by computing the risk in terms of financial loss by assigning probabilities to the possible outcome. Once we know the size and scale of the problem, we can develop strategies to mitigate risk from the vulnerability identified. Resilience, agility and flexibility are three such strategic responses to volatility in the supply system. Resilience requires organizations to develop systems to become responsive to disruptive challenges by ensuring they have coping strategies in place for the worst-case outcomes in any given situation. Agility is the ability to be fast of foot to respond quickly to challenges presented by supply disruption as well as rapid changes in customer and consumer behaviours. Flexibility is the capability to change resource commitments fast in response to external requirements including market conditions and customer behaviour.

The global financial crisis in 2008 created conditions that impacted many global supply chains. An interesting research study tracking the impact of the crisis on global supply chains by Christopher and Holweg (2017), shows that although conditions calmed down volatility remained at higher levels than previous. These researchers argue that concepts of recovery and resilience can minimize cost and mitigate risk by developing strategies to reduce exposure to volatility. An earlier study by the same researchers suggested that many of the approaches to managing supply chains were developed during times that were much less turbulent (Christopher & Holweg, 2011). Volatility is a challenge and it is a risk. Agility and flexibility will reduce the impact.

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The Covid-19 pandemic simply highlighted the vulnerabilities of supply chains for many suppliers and buyers. It was a shock to the supply chain system. In normal times disruptions occur but not necessarily at the speed or scale as those experienced during the pandemic. Many supply chains were disrupted as vulnerabilities were exposed. This created many challenges for suppliers and buyers. According to McKinsey (2023), 77 per cent of US consumers changed their buying habits during the pandemic. Consumers once loyal to brands switched rapidly to competitor products as shelf availability of their favourite products declined. A similar picture emerged across Europe, Asia and the rest of the world as the pandemic supply shortages happened. Global supply chains are so interconnected that a change in one part of the system is soon felt elsewhere. For example, as China closed its factories and ports as a consequence of the pandemic shelf availability of many previously abundant supplies declined throughout the world.

The dynamics of supply chains changed during the pandemic and agility is a requirement to compete in a fast-moving consumer goods environment (FMCG). Business-to-business (B2B) markets have changed too and they now face many of the challenges that were once restricted to consumer markets. Once again, in such circumstances developing agile strategies to cope with change is critical. Agile supply chains are of course more resilient and much more likely to cope with shocks to the system. If you design your supply chain to spread the risk of single country sourcing by having multiple country sources of supply, then that is one way to embed resilience into the supply chain system.

Figure 2.3 shows typical risk profiles by looking at risk and impact of the risk. It is a simplification of reality as are all diagrams of this nature, but it illustrates how high-risk for moderate inflation has relatively low-impact on supply chain disruptions whereas the closure of the Suez Canal has high-impact even though the event was only a low-risk at the time it happened. High-risk events are those that have been estimated by the organization to be highly probable. In the first quadrant top left, you see high-risk events but they are deemed low in impact to disrupt supply chains. Beneath the first quadrant, low-risk and low-impact events are shown. These are not too bothersome. Some events are high-risk and will likely have a high-impact disrupting supply

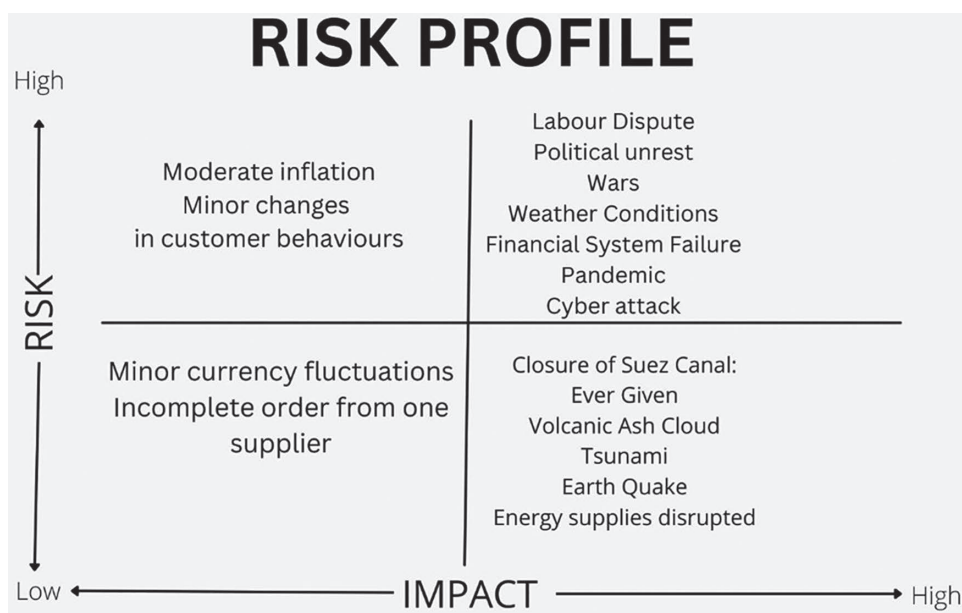


Figure 2.3 Risk profile



chains. In the final quadrant we have low-risk, meaning the likelihood of the event happening is comparatively low but if they do happen, they are probably going to cause serious disruption.

### *Volatility in the real world*

#### **Disruption in the Suez Canal: The *Ever Given* case**

Twelve per cent of global trade in goods passes through the Suez Canal. Thirty per cent of all container vessel trade passes through the canal, which is valued at \$1 trillion for one year.

Britain built the Suez Canal over a ten-year period from 1859 to 1869. The canal is 119 miles long (or 190 km) carrying shipping traffic between Asia and Europe. A little less than the distance from Birmingham to London, United Kingdom. The canal carries 12 per cent of global trade each year. Around \$4 billion value of goods passes through the canal daily from east to west. Twenty per cent of UK imports travel this route from Asia bringing electronic goods, TVs, medicines, furniture, homewares, toys, white goods including washing machines, dishwashers, fridges, clothing, aircraft parts, precious metals, shoes, carpets, computers, cameras, microchips, phones, musical instruments, car parts and vehicles from Japan and South Korea. In 2019 close to \$200 billion travelled via container ships through Suez with such goods.

#### **M.V. *Ever Given***

*Ever Given* is a Golden-class container vessel 400 metres in length and 60 metres wide capable of transporting over 20,000 × 20 ft. containers on board – see Figure 2.4. The average value of goods in a 20 ft. container is said to be around \$50,000 based on insurance data. When full, a ship of this size would carry up to one billion dollars in cargo.



Figure 2.4 *Ever Given* container ship

Photograph by Torn Kees, *Ever Given* in Port of Rotterdam March 2020, CC2.0 (<https://creativecommons.org/licenses/by/2.0/>)

The *Ever Given* was launched in 2018 and is owned by Shoeni Kisen Kaisha (Japan). Back in February 2019, the *Ever Given* was involved in a collision with a 25-metre ferry ship which was badly damaged in Hamburg, Germany. Shortly after the accident, the river Elbe was closed to shipping due to high winds. It is currently chartered by a Taiwanese company Evergreen Marine, registered in Panama, and managed by a German company Bernhard Schulte Ship Management (BSM).

*Ever Given* is one of the longest container ships in service with a gross weight of 220,000 tonnes and a dead weight around 200,000 tonnes, powered by a low-speed two-stroke diesel engine. The fully laden draft (or draught UK) of the ship is under 15 metres. It had an all-Indian crew numbering 25. Crew size is usually determined by gross weight and port of registration.

Intermodal traffic has seen containerships with just 100 standard 20 ft. boxes in the 1960s grow to the giants we see today with over 20,000 TEU (20 ft. equivalent units) while crew sizes have shrunk. In the past 20 years alone, ships have increased in size while crew sizes have shrunk by up to 50 per cent, which has raised concerns about safety of vessels. In addition to the crew there were two Egyptian pilots helping guide the ship through the canal from the Suez Canal Company when it ran aground on Tuesday, 23 March 2021, in heavy 40-knot winds and a sandstorm. Damage to the rudder during this storm as the ship grounded may have added to the difficulties of steering the ship as it lodged in sand.

Over six days in March 2021 a real-world drama unfolded as the MV *Ever Given* was stranded in a narrow section of the Suez Canal just six kilometers in from the southern entrance. The ship was enroute from Tanjung Pelepas, Malaysia, to Rotterdam (Netherlands). The disruption to supply chains in Europe with goods coming from Asia was estimated at around \$10 billion for each day the canal remained closed. The incident demonstrates the reliance placed on the Suez Canal and indeed other waterways that link continents. The gigantic container ships that sail continuously around the globe bringing essential as well as non-essential goods to businesses and consumers are a vital link between producers, suppliers and customers.

*Ever Given* initially held up a further 320 ships or more lined up to the crossing point where the ship was lodged with their cargo delayed. The canal is very narrow at this point and the ship was positioned across the two banks so that no other traffic could pass. Cargo was stuck waiting to sail through Suez, the shortest route from Asia to Europe. Many ships that had not yet entered the canal decided to sail around the Cape of Good Hope adding up to two weeks (ten days both ways) to journey times and 3,000 nautical miles longer each way than travelling through Suez with the additional fuel costs involved.

Marine salvage teams worked tirelessly to free the ship to refloat it but with some difficulty. Eight tugs tried to dislodge the ship on Thursday 25 March, but without success. The next attempt tried removing 30,000 cubic metres of sand and mud from underneath the grounded ship. On Sunday 28 March, with 14 tugs and dredging taking place a small amount of water was said to be moving under the ship. Consideration was being given to removing some or all of the containers to lighten the load, but this is no easy task and there was no handling equipment nearby to achieve that. There was talk of sending a crane from Alexandria. On Monday the 29th, the ship was finally freed from its lodged position across the narrow stretch, and it was moved to the great lake area of the Suez

Canal where it remained awaiting damage inspection. On Tuesday 30 March, ships stuck in the canal began to get underway to their own destinations after a long delay. The repercussions from the disruptive event lasted for months with the knock-on effect of delays for goods stacking up at Asian ports for future deliveries and a shortage of containers given they will be delayed on their return journeys. Freight costs may well increase adding to prices paid by customers. Ships that were delayed also had long waits to discharge cargo and were queuing to enter destination ports. Port backlogs caused congestion and container dwell times increased as a consequence along with increased cost and possible box shortages with containers stranded in the wrong place awaiting return to other ports for reloading.

### **Disruption, risk and uncertainty**

An event such as this has not previously disrupted the flow of traffic through the Suez Canal since it was opened in 1869. Such an unlikely event is difficult to predict or plan for in advance. This type of disruption with zero probability but massive impact is impossible to avoid. When it happens, it has consequences for many ships with intersecting supply chains caught in the traffic jam. One thing is certain in supply chains, which is at some point disruption will happen. The more that these larger vessels are routed through relatively congested and narrow shipping lanes, of course, will most likely increase the probability of disruption. It is an example of uncertainty threatening to disrupt supply chains.

### **Conclusion**

There will be lessons to learn from this unprecedented incident in the Suez Canal although it will take time to establish all the reasons why the ship ran aground in the way it did. The big question is what could have been done differently. No doubt, the Suez Canal Company will be working with the owners to find out what happened and what can be done to avoid repeat incidents in future. The chairman of the Suez Canal Company indicated on Saturday 27 March, that technical difficulties or human error may have been responsible for the accident.

Since the incident occurred, the Suez Canal Company has started a \$10 billion project to widen the canal and has purchased two large dredgers to resolve such an incident faster. In December 2021, *Ever Given* sailed from China to Rotterdam with an even heavier load than was on board the day of the accident in March that year.

You can listen to my story about six days that closed the canal and disrupted global supply chains on the *Chain Reaction Podcast* on your favourite podcast platform or by following this link: [www.buzzsprout.com/1666120/episodes/8248199](http://www.buzzsprout.com/1666120/episodes/8248199).

### ***Resilient supply chains coping with disruption***

All supply chains must learn how to cope with volatility and disruption. During the Covid-19 pandemic, supply chain professionals learned what it means to have resilient supply chains more than ever. There were shortages of personal protective equipment (PPE) for front line workers in health and emergency services. Supply chains were stretched already because of the



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pandemic closing retail stores, leisure facilities, entertainment venues, restaurants and factories. Transportation was increasingly becoming difficult due to Covid too with shortages of heavy goods vehicle (HGV) drivers and shipping crews. The factory closures lowered manufacturing capacity around the globe as the number of Covid-19 infections increased and workers had to self-isolate so as not to spread infections further. Demand exceeded supply in nearly every category of PPE and for specialist equipment needed to fight infections and save lives such as ventilators for this deadliest of respiratory viruses.

Global supply chains have faced many disruptions threatening their functionality. During the last decade alone, these disruptions have included natural disasters related to volcanic eruption and ash clouds; tsunamis destroying vital communities and infrastructure; forest fires due to climate change and crop failures. Human activity has also impacted supply chains in the form of increasing industrialization and the impact on the planet. For example, deforestation in the Amazon rainforest and elsewhere with the growth of intensive farming, meat production, palm oil and other products to meet the growing global demand. River and sea pollution with much plastic waste deposits and chemicals destroying the natural ecosystems. Then there are many large container ships discharging their boxes or sinking on their journeys to bring goods to destination ports along with oil and chemical discharges such as the nitric acid and oil from the *Xpress Pearl* off the coast of Sri Lanka destroying the sea life and beach communities. We also had the *Ever Given* ship blocking Suez previously discussed. In addition, we have witnessed piracy with ships being held up for ransom payments off the coast of Africa. As bridges, roads, railways, airports and vital infrastructures are destroyed, either by natural disasters or wars, this too adds to pressures on global supply chains. The need for supply chain professionals to employ strategies to minimize the impact of disruption is paramount. Resilience to bounce back from any disaster is a necessary requirement for the smooth operation of supply chains.

#### **Volume**

As volume changes occur, it requires supply chains to adapt and respond to meet the challenges presented by this variation. As demand for a product increases, suppliers need to produce more. To do this they need capacity to ramp up production. Otherwise, they risk losing the order. Capacity is a determinant of production. Agility to respond is key. Flexibility to change production arrangements is necessary to meet the challenges of shifts in demand. Rapid response in doing so demonstrates agility.

Of course, volumes go down as well as up and if volumes reduce and become permanent it may be necessary to close production and distribution and storage facilities, reduce the workforce and close down transport departments. Managing volume is necessary to be efficient by lowering cost both in total and at the SKU level. The lower that costs are means that there is opportunity to increase profitability. This must not be done at the expense of becoming less effective in serving customers. It only makes sense to reduce cost if service levels can be maintained. Changing service levels is a strategic as well as an operational decision. It may be the case that if you over serve beyond a customer's expectations you will simply increase cost. Alternatively, it may be the case that by setting and maintaining a high service level you are always first choice as a supplier, and you may even get more business or valuable word-of-mouth endorsements and recommendations that do.

Cost, volume and profit are three sides of an argument when it comes to supply chain management. It is important to lower cost when you have opportunities to do that. However, it must not be done at the risk or expense of losing customers and future trade. Volumes alone can lower cost by spreading total cost across more units of production. Increased volumes can also result

in purchasing discounts for increased order quantities of raw materials, work-in-progress and components used in production and any finished goods. Maintaining adequate supply is a volume problem. Risk emerges when volumes fall or rise rapidly. Even small changes in volume happening at speed change the dynamics of the cost, volume, profit relationships. Supposing I have a factory working flat out at full capacity if a new customer comes in with a small order if I were to accept it, I may have to purchase new machinery, rent an additional factory unit and hire additional labour to supply the order. This would not make economic sense in the short-term.

### **How volume is an issue for electric vehicle producers**

Electric vehicles (EVs) have as many as 3000 microchips to manage everything from drive and transmission, fuel systems including battery power and operation, lights, heating and ventilation systems and the radio and music system in the car. As demand for EVs has increased, automobile manufacturers transform from making cars powered by fossil fuel to EV technology this demands new parts for vehicles, different production tools and techniques and even methods of manufacture generally. Everything from layout to bill of materials for EVs is different. Shortages of rare earth metals used in EV manufacture threaten to disrupt future production plans. Even with careful management of processes, there is currently insufficient capacity to meet the planned growth in demand. EV manufacturing is tricky, and brands are racing to tie up deals to develop and share battery production facilities. Unit production costs are likely to remain higher than combustion engine vehicles as the volumes are comparatively lower. Shortages of skilled labour, microchips, cobalt, lithium and other rare earth metals mainly processed in China all add to the complexity of manufacturing. In addition, distances are greater in terms of geographies and transport costs to excavate, process and ship parts to where they are needed. As a result, the United States has passed a bill to ensure that EV battery capacity is developed at quantities needed to maintain resilient EV supply chains. One of the main problems of transitioning is that timeframes are relatively short. Research and development for combustion engine model changes have become faster but often require five to ten years to make the necessary adjustments to tooling, equipment and procurement that ensures the success of new models. With climate change targets and the phasing out of combustion vehicles this is challenging. As one senior executive in the automobile industry said to me, *too much to do in too short a timeframe*. During the pandemic chip shortages held up production, closed facilities and changed behaviours with manufacturers increasing chip orders and holding higher inventories for future production making the whole shortage issue worse. An example of the bullwhip effect in practice.

### **Velocity**

Velocity is speed. In supply chains and business, time is important. The faster you can produce goods and services lowers cost. Take a humble shipping container the faster you can return it to where it is required after use lowers dwell time and dwell time costs money. Each time a shipping container is left idle there is a charge for the dwell time. That is the time it remains idle at the destination port. Consider factory throughput as another example the faster you can push raw materials through a process to complete manufactured products means that costs of process time are reduced. It may also mean you can supply finished goods faster and consequently

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invoice and receive payment sooner. Velocity of throughput means lower supply chain cost and a faster cash flow cycle by achieving faster sales.

Throughput is a key concept in supply chain management. Throughput is a measure of the flow rate through the factory or service system – inputs, process and outputs. Velocity increases as the flow rate is raised and lowers when it is reduced. Fast flow is better because it reduces cost and minimizes risk.

Inventory is a major cost for manufacturing firms and retailers. Managing inventory is essential to optimize supply chain performance by minimizing cost and maximizing value. Inventory comes into the firm, it is temporarily stored before processing, it then is processed and changes form. After processing, it is temporarily stored before moving in to the next stage which might be further processing or as a sale to a customer. So, you see inventory is a flow process. The more you can speed up the flow the easier it will be to archive faster throughput to reap the benefits.

Cycle time compression in the supply chain can release resources and improve profitability. Identifying the cycles in your supply chain is the first step to improve performance. The second step is to measure the time it takes to complete each cycle. These simple steps have potential to bring benefits to the business, the network and to customers. Having data about each of the cycles moving from upstream to downstream enables firms to lower costs, improve throughput times and lower risk. Managing volatility, volumes and velocity to achieve value. It improves cash flows, profitability and return on investment and enables better asset utilization. Lowering cycle times improves supply chain flexibility and means that you can be more agile when it comes to implementing strategies for supply chain advantage (Hines, 2022).

***Application of Little’s Law***

In my discussions with Frederico Crespo CEO of Valiot, he told me about his work with Heineken. He is a graduate of MIT and he grew up working in his grandfather’s paint manufacturing plant in Mexico. He says this background set him up for his future work. He talked about his work with Heineken and how he was able to improve their supply chain performance in Mexico. He examined their system processes identifying 16 areas for improvement and focused on one that was most fruitful on which to focus scarce resources for maximum effect. He discussed Little’s Law (Little, 1961), and how it helped his throughput analysis to compress cycle times.

Little’s Law and how it helps throughput analysis to compress cycle times is demonstrated the following three examples:

$$L = \lambda \times W$$

where:

L is the average number of items in a queuing system

$\lambda$  is the number of items arriving per unit of time

W is the average waiting time each item spends in a queuing system

In essence this queuing theory application can be applied to supply chain throughput to improve inventory flows through the supply chain system.

### Example 1

Supposing 100 units arrive each hour and remain in storage for 30 minutes before entering production. How much inventory is held in the store on average?

Answer:

$$L = 100 \text{ units/1 hour} \times 0.5 = 50 \text{ units}$$

n.b. If throughput time could be reduced to 15 minutes (1/4 hour) the average stock holding could be reduced to 25 units ( $100/1 \times 0.25 = 25$ ).

### Example 2

If a hospital department has 50 patients in a day and it can process just ten every hour what is the average waiting time?

$$\begin{aligned} W &= L/\lambda \\ &= 50/10 \\ &\quad \text{Average Waiting Time} \\ &= 5 \text{ hours} \end{aligned}$$

There are just two ways this average waiting time could be reduced which are:

1. Lowering the number of patients arriving at the department, OR
2. Processing patients faster, that is, increasing throughput time.

### Example 3

Supposing we hold finished goods for three days before sending them to customers. If daily demand is 20 units and the average production lead time is five days, we are able to calculate average inventory as follows:

$$\begin{aligned} L &= \lambda \times W \\ &= 20 \text{ units per day} \times (3 \text{ days} + 5 \text{ days}) = 160 \text{ units} \end{aligned}$$

Suggested further reading: Little and Graves (2008).

## Variability

Variability is about achieving consistent quality when it comes to all aspects of supply chain management. There are three main types of variability to consider in supply chains that give rise to risk that threatens value and reputation. These are:

1. Product quality.
2. Service quality.
3. Process quality.

**Product quality** must be consistent to ensure customers return to purchase goods. Quality standards form an important element of product performance. There are British, European and International quality standards that are set externally. There are also quality standards set

within organizations that may exceed the minimum standards set by these external bodies. The kitemarks and certifications awarded by external bodies provide recognition of achieving the standards set by them indicating consistency giving confidence to supply chain partners and customers. The result is trust. Examples of these quality standards are BS 5750, ISO 9000, 9001, 9002. There is also Six Sigma which is a measure indicating products have zero defects.

**Service quality** is an important indicator of how organizations provide a consistent level of service that customers can rely on. It is a measure of how well the organization is meeting the expectations of its customers. Customer focused organizations must measure service quality. Customers expect and trust the measures to make choices and decisions about who to buy from. There are five dimensions of service quality in Table 2.1 which are: Tangibility, reliability, responsiveness, assurance and empathy (Zeithaml et al., 1996).

Analytical tools such as SERVQUAL and RATER are used by many organizations. Survey instruments are used to gather data about the service quality dimensions. Measurement tools often indicate satisfaction with the organization and the quality of service. Surveys must be short, structured for ease of completion, avoid unnecessary questions, have clarity, be concise and measure what is important to the customer.

Other analytical measures applied might include customer effort scores (CES). A survey analyzing how easy it is to business with your organization. These are the type of surveys conducted after recent contact such as a phone call or use of website, that is, *Will you answer some brief questions about your experience with us after your call today?* A short survey is then conducted, if you agree. These surveys often use a seven-point rating scale from strongly disagree (one) through to strongly agree (seven). Total scores from all surveys are divided by the total number of customers using the service to calculate an average score. This provides an indication of how easy it is to do business. A score of five and above is considered to show that it is relatively easy to do business. Below four and some further indications are necessary to see how service quality can be improved to provide a better customer experience.

Net promoter score (NPS) is another way to find out what customers think about doing business with you. It measures customer perception by asking a simple question such as: How likely are you to recommend (company X, brand A, or product Z) to a friend or colleague? Score it using a Likert Scale one to ten. Once all the survey results are in for a particular time period, an average NPS is calculated.

**Process quality** is a measure of how processes are fit for purpose or not. For example, if we consider a simple order to pay process then sometimes you know as a customer that things can go very smoothly, or they can be clunky and difficult. Digital transformations undertaken by many online organizations have made processes better in most cases. However, occasionally if or when something does not go as planned how easy is it to resolve the issue. Organizations use other

Table 2.1 Dimensions of service quality

<i>Dimension</i>	<i>Definition</i>
Tangibility	Physical evidence: The appearance of physical buildings, equipment, people and communication documents.
Reliability	The ability to do what you say you will on time.
Responsiveness	The capability, ability and willingness to act and provide prompt service.
Assurance	By conveying a professional attitude building trust with customers. Certifications and accreditations may be part of this.
Empathy	Attention to detail demonstrating a caring attitude towards customers and their individual requirements.

technologies such as online chat services or they have inbuilt correction mechanisms to put it right if it is a simple error. Others offer phone contact services to resolve queries or email. Nevertheless, sometimes the customer experience is not as good as it should be and you have difficulty in finding ways to make contact with the right person in the organization to correct an error.

Variability has a dual meaning in supply chain strategies. Firstly, it is the difference between planned outcomes and actual performance. Secondly, it refers to quality. So, variability is a measure of quantity variance and quality standards. In the second state, variability is the challenge of management control in ensuring that goods and services satisfy quality criteria and deliver the required standard for customer satisfaction. Variance from a standard must be corrected. If not, it presents a risk to quality, which in turn could damage reputation and value.

From a strategic point of view within this 7V framework, the main concern is the variability in quality against a standard set within the control of the organization and with its supply chain partners. Standards include those externally set by external authorities, those agreed with supplied partners and those expected by customers. In that context the focus on quality of product, service quality and process quality to understand supply chain performance is critical.

A further concern about variability arises from the performance of external supply chain partners upstream. Variability in the sense of uneven flow across the total supply chain is another concern as this presents risk and potential loss of value within the system, which can cause collateral damage to supply chain partners. Performance objectives and outcomes can be measured to provide key performance measures against the criteria set. Variance often indicate areas of improvement.

Performance can be variable at every level in a supply chain as goods move from upstream to downstream customers. This type of variability needs improvements on operations to meet performance criteria. In turn, the smooth flow of goods and service without friction and variability is necessary to achieve strategic objectives.

### *A measure of variance*

In the simplest of terms, if you plan to deliver goods in three days and it takes four, you have a variance of one day and it is negative because it is longer than planned. If, however you delivered in two days you have a positive variance of one day. Positive variances often imply that you have beaten a performance target whereas negative variances mean you have failed to reach the target measure.

Although measures of variance can be indicators of variability, they are not of themselves variability measures. For example, if we have variances against performance criteria it does not necessarily indicate variability is at play across the system. Variable performance would need to be consistent to be identified. If deliveries were always late and the number of days varied that would suggest variable performance. If the variance was consistent, it might indicate a different problem, for example, a hold up at a transfer point or at a port.

While a variance is a measure of difference at a point in time, that is a static measure of performance against a target or standard, variability occurs in the flow of the service system and is dynamic in nature.

### **Variety**

A category is a class of things with shared characteristics. In this case, the thing is inventories that share characteristics. Within categories we have different SKUs which when offered to customers who shop the category provide variety. Retailers talk about stocking a range and



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this often refers to a variety of goods in a particular category. When inventories are managed in any business it is essential that they are kept as low as possible to keep cost down and to lower risk of deterioration or obsolescence. Inventories are normally managed by category. In manufacturing, plant types of inventories are usually limited to their balance sheet descriptors: raw materials, work-in-progress and finished goods. Beyond this, a category is a particular type of inventory, for example, groceries, hardware and the like. Next time you visit a supermarket if you are unsure what this term means take a look down the aisle you are in and you will likely see similar goods side by side on the shelves, for example, all toothpastes, all shampoo, fresh fruits and vegetables, confectionary, bread and cakes. These are categories and for ease of placement in stores, inventories are managed by category. Supermarkets offer variety within the category. That is all the different brands that comprise the category. This is known as variety. Supermarkets will often limit the variety of SKU within each category. This is a practical step to lower inventory holding. Obviously, supermarkets have to offer choice, but they also want to limit that choice so as not to hold too much stock. Managing variety is the way they achieve this. Often, they will only accept a new line into a category when they take one out, they will no longer supply.

If you visit any warehouse, they will probably store goods by categories that align to their customer (internal or external). For example, retail warehouses will store inventories by the call off categories used by the stores they serve. Direct to consumer goods will be stored by categories that the customer has ordered usually aligned to website categories. Take a look at Amazon categories next time you search for goods to buy and you will get the picture.

In summary, minimizing variety reduces cost and risk. Increasing variety will increase cost and risk. The costs are those we associate with inventory holding. The more variety means that average stock holdings increase. It means committing more working capital to buy stock. The reverse is true if we reduce variety. Average stock holding cost falls and because the value has lowered and the variety, too, means that the risk has also lowered from holding too much inventory.

### **Visibility**

Supply chain visibility is the ability to track the movements of goods (e.g., products or components) and services (e.g., digital products) throughout the total supply chain, from suppliers to manufacturers and on to customers. The scope of supply chain visibility depends on the product and the complexity of the supply chain. It is enabled by technology that provides real-time data about logistics and other aspects of the supply chain. The goal of supply chain visibility is to improve and strengthen the supply chain by making data readily available to all partners in the supply chain, including customers. It is the way that everyone who needs to know is kept informed about progress. Visibility reduces errors, delays and disruptions that may otherwise occur. It improves customer service. It increases supply chain efficiency and as a result lowers total cost of supply. It is a means of improving supply chain relationships too by involving all partners in the communication and information loops.

Examining the evidence, we see that one of the major issues talked about regularly is how to create visibility with suppliers beyond tier one suppliers. For example, a clothing retailer may have placed contracts with a supplier overseas and they want to have information about progress on their order. Whilst it might be easy to connect with this supplier (their tier one supplier) it may not be so easy to have visibility to tier two, three and beyond. Put differently, the tier one supplier's supplier. In the past, supply chains became opaque further upstream. For example, if we consider the retailer again dealing with their garment supplier based overseas what is often unclear or less visible is where components that make up the finished garment such as trims

(e.g., zips, buttons, Velcro fasteners) come from. Many retailers for this reason have supplier compliance manuals that identify approved supplier lists from whom the garment supplier must purchase these items. This is a crude attempt to control visibility in supply chains as well as a means of lowering cost for the retailer.

Technology has created platforms that enable this more opaque part of a supply chain beyond tier one to become visible. Typically, these platforms employ cloud-based technologies to access data from anywhere in the world about production and transport logistics at any point in time on their journey from point of origin through to the final customer in the chain. It is possible to create total end-to-end supply chain visibility. Partners in the supply chain are able to locate the goods in any part of their supply chain by employing cloud-based technologies and platforms.

Visibility means that supply chains are no longer opaque, and we can know with a degree of certainty what there is and where it is located in the supply chain. As already indicated, digital technologies have improved this aspect of the supply chain in recent times. Many will recall times when it was difficult to track and trace goods moving through supply chains. Indeed, it was sometimes difficult to find things in a single warehouse prior to the use of bar codes, radio frequency identity tags (RFID) and QR codes.

#### ***Difference between visibility and transparency explained***

A distinction is often made between supply chain visibility, which is the ability to know where everything is at a point in time within the system and transparency, which focuses attention on who you will share the information with. This latter meaning is important when it comes to which organizations have been granted access to the data. My preference is for open visibility it benefits all in the long run. There are many stakeholders in supply chain systems that need to be considered. Some stakeholders will have legal and ethical claims to data held by organizations and this trend will continue to rise in importance. So, it is necessary to devote some mind space to it now to future proof your supply chains. We already see retail consumers wanting information about where their food comes from, how it is produced, stored and distributed, in addition to the contents of the pack.

#### ***How innovations in technology made supply chains visible: reducing risk***

Visibility in the supply chain is the key to keeping track of all the movements that take place in the supply chain. Digital technologies have made it possible to reveal the location and the movement of all goods from the point of order through to the customer. In other words, it enables visibility. Keeping track of the end-to-end supply chain is now possible when we think back 20 years or more ago, it was very difficult to keep track of goods in the supply chain. When you placed an order, you hoped that order arrived in the specified period from the organization you made the purchase from, and quite often you did not have any data or information about the location of those goods until they arrived. If they did not arrive, you knew that that company had missed its deadline delivery date and you had to set about the task of chasing up the order. Sometimes you might ring up a few days in advance, or a day or two in advance and just check that things were on track. But even the people giving you assurances at that point would not necessarily know where those goods were physically held.

The digital age changed everything. The first big innovation, of course, was the humble bar code. Now the bar code was great technology to identify a specific item. It had details to do that on the bar code. The bar code could be read by machines, machine readers, and the information contained in the bar code could be revealed, but more than that, the bar code enabled tracking and allowed traceability. So, you could track that bar code from the place of origin through to the



customer. Or at least maybe a retail store, so the bar code was an innovation that marked a step change in the supply chain. Then came the radio frequency identity tags (RFID). Another means of tracking goods from point of origin through to the customer. So, every movement could be tracked and then, of course, we have sensors. Sensors today pinpoint the geographic location of any item and there are more sensors in the world today than ever. There are millions of them. It has always been important to know where a ship is on the ocean. You wanted to know how far away they were from port, when they were going to arrive at a port, how long they stayed at a port, when they left the port and so on. Most of that had been done through radio technologies and it was sufficient to broadly know where those ships were at any point in time. Today, with all the tracking technologies we have we can precisely determine a ship's location using satellite technologies. Geographical positioning systems (GPS) pinpoint any ship's location. We can tell exactly where the ship is on the ocean, how far away it is from destination port and when it is going to arrive so we can see exactly where that ship is at any point in time. So, we know where the cargo is and if we know where the cargo is, we can tell how long it is going to take to be delivered. And we know how long those ships remain in port and when they stop and leave. We can track trucks the same way. And we can track rail travel, and we can track every movement. So once the goods or even the raw materials enter a production line and they move through a production system, we can trace each activity through the system. And this gives what we call visibility. Customers want information. When you place an order, you want to have some indication of when that order will be delivered and the lead times involved. And so, tracking technologies have helped the supply chain immensely to establish visibility. OK, in a nutshell, what can supply chain visibility do for you or your organization? Well, it has an immediate effect on the bottom line. The data that you get hold of so that you know where your goods are at any point in time means that you make this whole supply chain visible. You can reduce inventories in that supply chain without holding additional buffer stock just in case an order is late, so that lowers your cost. It can increase the speed to market because you are connected, and you can see those connections and you know where the products are. So, you can get the goods to the shelves faster. It means you are likely to get less disruption in the supply chain if you know where everything is, and you know that you have things on track. You can manage the risk. Data are key to the whole issue of supply chain visibility. It means that you can develop strategies that are more effective for your organization as well as integrated so that everything moves smoothly from the point of origin through to the customer. In the end-to-end supply chain. This makes your customers happier. You have your "control tower" with the data, you have your dashboard indicators, and everything is visible.

Supply chain collaboration has been shown to be a key influence in achieving supply chain visibility, enhancing stakeholder trust, improving both environmental and financial performance according to Baah et al. (2022). Collaboration also improves risk management according to Shuting et al. (2023).

## **Virtuality**

Virtuality is about digital systems employed to manage supply chains. In other words, to create value through digital networks. Virtuality also means you can replace physical goods and physical movements in the chain with information.

Simulacrum essentially describes a copy of an original. Philosophers have been fascinated by this concept for centuries in many different settings. When we speak of virtuality, we are essentially referring to a digital system that replicates the physical reality. In supply chains, we can create a virtual copy that mimics the physical reality. An exact copy in digital form. It is a digital twin.

This can be especially useful to visualize where blockages might occur or how we can release resources to improve performance of the total supply chain. It may also indicate where cost builds up and how we may improve throughput and add value to the supply chain. It is also helpful when thinking about customers and what they value about the service they receive from the supply chain system. Where can we as supply chain strategists design value improvements within the system we build and develop? It can help us identify potential opportunities and to limit potential threats.

A virtual supply chain (VSC) is a risk management assessor and optimizer simultaneously that combined with artificial intelligence and machine learning can make decisions that mitigate risk and add value. In every supply chain system there are many nodes, many touch points and thousands if not millions of decisions happening in double quick time. Human intervention is not always necessary if you can replace it with AI and release the human to deal with the more important decisions as they arise. It can reduce the impact of being overwhelmed by data.

The road to virtual supply chains is a path that has been developing for some time. It is discussed when we here key phrases such as digital transformation. Supply chains have been moving closer to this reality at each step in a transition process from paperwork to spreadsheet on to key performance indicators (KPIs) and on again to dashboards and control towers. What if we now make the leap from this still mostly physical conception of supply chains supported and managed more by humans operating computer systems to one where the virtual supply chain became mostly self-managing leaving only the very highest level of decision making requiring human intelligence. This would, in effect, be a Pareto approach to managing decisions where 80 per cent are managed by the virtual supply chain and 20 per cent by humans.

There are many parts of a supply chain system that are automated already but one of the problems for many organizations has been that all parts of the system may not use the same platforms or joined up enabled technologies because past legacy IT investments are not yet fully depreciated. It is often easier for those organizations behind the curve to make the leap to the new system investment needed to transform to the next level. Undergoing digital transformation needs careful planning. It is both a technical and a social change for people working in supply chains. People may need to develop or possess different skills than those needed right now to move to the future VSC.

So, you do not have to see the physical goods or go and measure them or count them, weigh them, you can make them visible in the virtual system. So, the information replaces the physical identification. If you were to physically inspect goods, the two should, of course, tally. They should be the same. You should know what is there at any point, and here it leads me on to the. Virtuality is not just a platform to create visibility, but it might be a platform for delivery too in some circumstances. And you can think of all sorts of examples, for example. Amazon selling books will have many books listed in the catalogue, and they will have some hard to find and not very often bought books in that list which they can afford to have on. And the customer might see it and decide that it is a book that they want or they might be searching for that particular book and they order it, but they will not necessarily have that book in a warehouse. They will create that book from digital forms that they have of the book. To deliver to a customer and they might print. One copy of the book, in other words, print on demand service. One copy of the book to deliver to the customer. So, the customer is satisfied the customer gets value. The supplier creates the value. By managing the service carefully and cleverly. To allow the customer to order that one copy. And it moves a physical copy of that book on to the customer. Alternatively, it might move just a simple digital copy of the book. Through to the customer, so it can be read on Amazon's Kindle or another visual device. And so, virtuality is important in its own right as not simply a system or a platform to create value but also to deliver service.

### **Digital transformation in practice: the case of Kraft Heinz**

Kraft Heinz announced in a press release it was migrating most of its global datacentre assets to the Microsoft Azure Platform and its enterprise resource planning (ERP) software to SAP on Azure.

Through this transformation, Kraft Heinz expects to reimagine its day-to-day operations, create a more collaborative supply chain and enhance consumer experiences by using real-time predictive analytics to improve inventory transparency and anticipate consumer and channel demand. Collaboration with Microsoft is critical to our transformation strategy, providing us with the machine learning and advanced analytics to drive innovation and efficiencies across the supply chain so we can get products into the market faster, better serve our customers and, ultimately, deliver on the sustained and growing consumer demand.

Furthermore, Kraft Heinz will create “**digital twins**” for its 34 owned manufacturing facilities in North America to help test and perfect solutions and processes before applying them on the plant floor. For example, the technology, fuelled by Azure Digital Twins, will help predict outcomes that identify optimal product capacity and reduce mechanical interruptions by proactively addressing issues before they occur, with the goal of ensuring the products that reach retail shelves and consumer hands are the highest possible quality (Microsoft, 2022).

### **Value**

Revenue minus cost is the value retained in the supply chain. For example, 100 units of material is bought in at five dollars per unit. Total cost is \$500. Supposing after processing there is one dollar additional cost per unit that would make the total cost \$600. If I were able to sell the output at an invoiced price of \$1,200 that would mean the value contribution is \$600. There may be some additional overhead cost to be added later for administrative processing/billing and that would reduce the gross margin to give a net margin.

When it comes to managing, end-to-end supply chains there are a number of process cycles to manage as goods and services transfer from upstream to downstream. Each process cycle is an opportunity to reduce risk and add value to the total supply chain. Even at the end of useful life waste management, recycling and reuse options provide opportunities to mitigate risk, minimize cost and add value. Performance objectives in any supply chain focus on the customer and each performance objective will have cost, speed, quality, flexibility, reliability, value, service and sustainability that supply chain performance measures use. Agility and resilience are embedded in these objectives. The process cycles might be adjusted to take account of the specific industry context as of course will objectives and performance measurement. Figure 2.5 gives an indication of what is required.

### **Conclusions**

We began our discussion about risk by identifying two main types of risk: endogenous and exogenous. The first type coming from within the supply chain system and the second coming from external forces. Risk is predictable and quantifiable. Uncertainty is something that is not predictable. Risk can be managed because to some extent it is predicted, whereas uncertainty

is not predictable. It is important to understand this difference because the strategies that we decide to employ will be different to tackle risk and uncertainty. We can mitigate risk and we will be able to put numbers on the risk. Uncertainty is not predictable, and it is not possible to quantify in the same way as risk.

When it comes to things that carry risk that are quantifiable, we can apply the 7V framework to identify the type of risk and to calculate the probability of it occurring. We can also go beyond the calculation of occurrence to place monetary values on risk. In a similar way that actuaries do when they calculate insurance risk. When it comes to formulating strategies to deal with risk and simultaneously create value or retain value in the supply chain Table 2.2 provides some ideas.

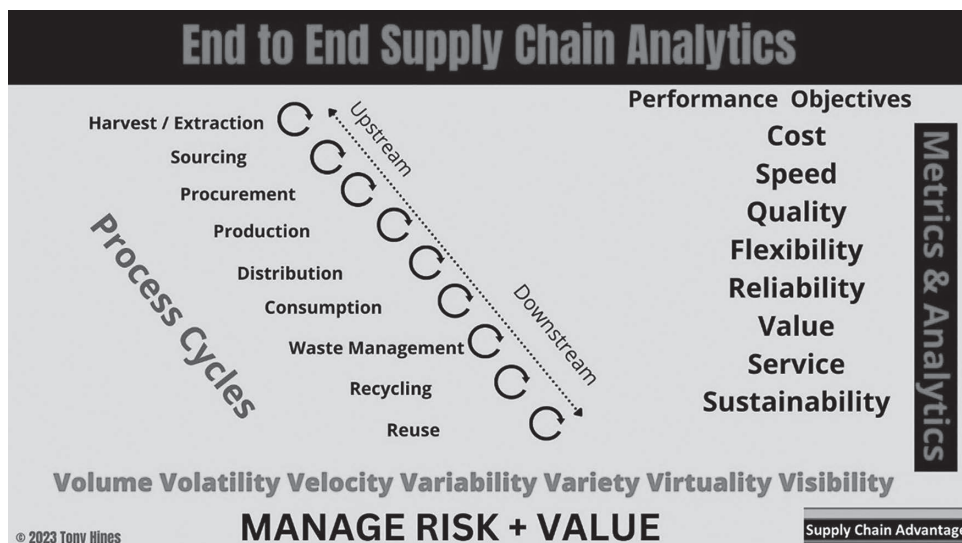


Figure 2.5 End-to-end supply chain analytics

Table 2.2 Risk and strategies to mitigate risk

Risk element using Hines 7V framework	Examples of strategies to mitigate risk
Volatility	<p><i>Exogenous risk:</i> Identify external factors and their potential to disrupt supply chains. Decide on the likelihood of occurrence – assign probabilities and estimate monetary impact.</p> <p><i>Endogenous risk:</i> Work to improve supply chain information system along with communication and sharing data with stakeholders. Employ digital transformations to automate and manage impact of risk.</p>
Volume	<p>Strategies to manage volume change rely on early warning of the shifts. Working in close partnership with other supply chain stakeholders should ensure that you identify volume changes along with their impact on capacity, sales and production planning (S&amp;OP) is a primary requirement. Agility, responsiveness and flexibility will form key elements of supply chain strategies to deal with volume shifts.</p>

(Continued)

Table 2.2 (Continued)

*Risk element using Hines 7V framework*    *Examples of strategies to mitigate risk*

Velocity	Flow and speed are key to avoiding risk in any supply chain. Identify potential blockages and take action to avoid them. Use throughput calculations to assess impact and risk. Smooth flow is key to managing throughput time. Avoid wastage.
Variability	Standardization of products, services and processes ensures that consistency and quality standards are maintained. Strategies to minimize variability include implementing and adhering to international quality standards, implementing best practices and regular inspection of quality, for example, quality control. Ensuring input quality, process quality and output quality reduces variation. Process control systems maintain quality. Developing and maintaining standards of service that achieve consistency. Additional operational controls such as Six Sigma, zero defects. Employing qualified workers and implementing training programmes to reduce variability. Sourcing quality suppliers to reduce input variation. Continuous improvement programmes to reduce variability of production, process and service. Improve collaboration with supply chain partners to reduce variability where it occurs.
Variety	Reducing inventory levels may be achieved by managing variety. Range reduction, category management and optimization strategies all reduce inventory variety. Limiting unplanned expansion of product categories and SKUs held. Other strategies to achieve this include throughput management, supplier rationalization and reduction programmes. Lean and agile strategies to remove bloated inventories alongside an active programme to reduce inventory variety. Variety reduction must be balanced against customer service and quality. Optimizing order quantities reduces cost and may help reduce variety, for example, economic order quantities (EOQ). Improving accuracy of forecasts to maintain throughput ensures that you do not introduce inventory variety to fill a gap if disruption occurs. Outsourcing strategies may reduce variety. The use of 3PL services may reduce variety and levels of inventory held. Vendor managed inventory (VMI) may also ensure that variety is limited and bring other benefits to manage inventory.
Visibility	Strategies include digital transformation employing the best technologies is a means of improving visibility throughout the supply chain. What began with the humble bar code and RFID tagging has transformed into sensors using IoT, Industry 4.0 and cloud-based systems to create more visibility.
Virtuality	Strategies that complement or replace existing physical systems, for example, virtual supply chains (VSC). These systems use digital technologies and cloud-based systems to optimize supply chain performance.

**Discussion questions**

1. Explain risk and give examples of supply chain risks.
2. Give a definition of both risk and uncertainty.
3. How does understanding risk improve value in the supply chain?
4. Explain the notion of value in relation to supply chain management.
5. Define volatility and describe the two main types of risk in relation to volatility.
6. Give three examples of volatility in supply chains.
7. Why is it important to manage volume carefully within supply chains?

8. Define velocity and say why it is important to managing supply chains.
9. Explain the term variability and discuss why it is necessary to avoid it when managing supply chains.
10. Many organizations attempt to reduce inventory by reducing inventory variety, what are the pros and cons of this strategy?
11. Explain circumstances on which it might not be possible to reduce variety.
12. How is visibility achieved in supply chains?
13. Discuss how technology can be used to improve value by managing any or all of the 7Vs.
14. Define virtuality and explain how this concept is used to create value in the supply chain.

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### 3 Strategic concepts and the customer-focused market-driven supply chain

John Maynard Keynes was an influential twentieth century economist who recognized that practicing managers did not always connect their practices to the ideas of philosophers and economists that originated and shaped them. Keynes put it thus:

The ideas of economists and political philosophers, both when they are right and when they are wrong, are more powerful than is commonly understood. Indeed, the world is ruled by little else. Practical men, who believe themselves to be quite exempt from any intellectual influence, are usually the slaves of some defunct economist.

Keynes (1936)

The same could be said of strategists and strategic practices enacted by managers in organizations and in formulating supply chain strategies.

This chapter examines a number of important strategy concepts. These strategy concepts are discussed in relation to how they inform supply chain strategies that are customer focused and market driven. These ideas are developed in further detail in the rest of the book also. The chapter begins by examining traditional approaches to planning and strategic management. Definitions of strategy are offered and different levels of strategy are explored. Strategic thinking and learning are discussed within the context of developing competence and capabilities before establishing the importance of setting strategic objectives. In turn setting strategic objectives requires resources be applied to implement chosen strategies and appropriate performance measures developed to evaluate strategic performance. Finally, the importance of customer focused supply chain strategies and the concept of strategic fit are discussed within this broad framework of strategy development.

#### Strategy

Supply chain strategies are pivotal to the success of most contemporary business organizations and they may be equally important for not-for-profit organizations too. Organizational decisions relating to the design and structure of supply chains determine supply chain strategies and are an important recurring theme throughout this text. It is important to recognize that supply chain strategies exist whether or not they are planned. In other words, all organizations de facto have a strategy. An organization making an operational decision to procure materials may not be conscious of determining a supply chain strategy, but a decision taken *ex-ante* may have long-term consequences, both for the purchaser and supplier. For example, *ex-post* it may have determined the lead times, costs and quality involved in production or service provision over a long time period. Essentially, what appeared to be an operational decision has become a strategic



decision, albeit an unconscious one in the example. The chance meeting in the early years of the twentieth century between Mr Marks and Mr Dewhirst set in motion one of the longest lasting supply chain relationships in history for both Dewhirst the clothing manufacturer and Marks and Spencer the retailer. What was essentially a “one-off” meeting for Marks to acquire shirts for his new penny bazaar in Leeds led to a strategic supply decision. This is not to say that all strategic decisions are serendipitous, many are planned. This book can only really help with the latter type of strategic decision. If you require help with the other type of unforeseen event then you might consider a clairvoyant.

### **Strategic planning or strategic management?**

Strategic planning is an activity that all organizations undertake. How they set about this task may differ as has been acknowledged by many commentators (Andrews, 1971; Chandler, 1962; Clegg et al., 2011; de Wit & Meyer, 2010, p. 5; Mintzberg & Lampel, 1999; Mintzberg et al., 1998; Porter, 1980). Strategic planning conceptually involves knowledge of where the organization fits into its macro and micro environment to establish the position of the organization and setting objectives for where the organization would like to be at some future time period usually three to five years from now and creating a plan that will deliver organizational objectives. Marketing, operations and resources (assets, people and money) are critical to achieving any strategy. A firm must attract customers, it must deliver products and services and to do so will need to have resources in place and utilize them effectively. Market-driven strategies must add value for the customer (Day, 1990). The organizational supply chain is a bridge between customers and operations that deliver and fulfil the customer promise. Planning is important but implementing and managing the plan is equally important.

Strategists must ensure that organizational resources are used efficiently and it is necessary to measure achievement against intention. Measuring performance against the plan and acting accordingly are also part of the strategy process (Kaplan & Norton, 1996). Measurement continues to be important taking a resource based view (RBV) as organizations need to build competence when gaps occur (Prahalad & Hamel, 1990, 1994; Prahalad & Ramaswamy, 2004). It is essential for organizations to be adaptable to changing conditions in their environment developing “dynamic capabilities” that enable them to achieve their objectives and “integrate, build and reconfigure internal and external resources” embedding them in their “social, structural and cultural context” (Teece et al., 1997, p. 516). An example of developing a dynamic capability would be for an organization to work with other stakeholders or partners in the supply chain to leverage overall supply chain performance (Agarwal & Selen, 2009). Therefore, strategic planning and strategic management are both required if managers want to move the organization to their desired destination, metaphorically speaking.

### **Defining strategy**

Strategy comes from the Greek word *strategos* meaning “general” but in its modern usage in the strategic literature it has been used in different ways. Strategy in contemporary general usage refers to a plan of how to get to a chosen position. In economic terms, it is the means (how) to achieve the ends (objectives). Historically, writers have referred to strategies discussing means and ends (Andrews, 1965; Chandler, 1962). This means and ends approach is referred to as a broad definition of strategy (Hofer & Schendel, 1978). The narrower definition focuses purely on the means to achieving the end result.

***Descriptive and prescriptive approaches to strategy***

Historically, the strategy literature tends to fall into two distinct categories – descriptive and prescriptive. Descriptive approaches report observations of organizational strategy and they may attempt to explain. Prescriptive approaches make normative statements of what strategy ought to be whereas in essence descriptive approaches focus on what has been. The latter are positive statements about experience. Practising managers and consultants often adopt the prescriptive approach in a planning context. Academics and practising managers may describe actual strategy observing patterns from the past behaviours of the firm.

Mintzberg (1987) offers a number of definitions using 5Ps:

- Plan = looking forward is the traditional definition of strategy (prescriptive).
- Pattern = looking back at consistency of behaviours over time (descriptive).
- Position = looks in at products and markets.
- Perspective = looks out, fundamental way of doing things, a theory of the business.
- Ploy = manoeuvre (to attack, to defend).

Strategy as planning and positioning is the traditional definition of strategy. The earliest strategy texts devote their full attention to this. Rational planning and analysis was the dominant approach to examining organizational strategies in the 1950s onwards. This is mainly grounded in economic approaches to strategy. It remained the main focus throughout the 1960s and 1970s. If you were to ask most practising managers what strategy is, they would probably reply it is a plan, offering the prescriptive definition. However, if you were to ask them to explain their organizational strategy, they may respond by describing past events and patterns of behaviour, or processes they are engaged in offering a descriptive definition. It is important to recognize that realized strategies are not always deliberate and intended strategies are not always realized. When a strategy is realized, but is not intended, it is referred to as an emergent strategy. For example, an organization may pursue a series of opportunistic strategies that can be recognized as forming a particular pattern of activities converging over time. Real strategies are neither purely planned nor are they purely emergent. Realized strategies are a combination of both deliberate and emergent strategy. Figure 3.1 illustrates realized strategy as a combination of planned and emergent strategies. It shows that some planned strategies fail and are never realized.

There are many views of the strategy process in the extant literature demonstrating the differences in approach see Table 3.1. These differences highlight the emphasis that each writer places on what they consider to be the central thrust of strategy. Examples are: rationality, organic and bureaucratic approaches (Allison, 1971); entrepreneurial, adaptation or planning (Mintzberg, 1973) later added emergent, ideological and umbrella (Mintzberg & Waters, 1985); leadership which is referred to as commander, change, culture, collaborative or crecive (Bourgeois & Brodwin, 1984); linear, adaptive and interpretive (Chaffee, 1985); systematic, ad hoc, reactive and organic (Ansoff, 1987); plan, position, ploy, perspective and pattern (Ansoff, 1987); deductive, compressive and inductive (Nonaka, 1988); dynamic not static (Pettigrew, 1992).

Strategies are sometimes viewed as directional, focusing effort, giving definition and meaning or establishing a consistent planned approach to business organization. Each of these different perspectives has associated advantages and disadvantages as illustrated in Table 3.2.

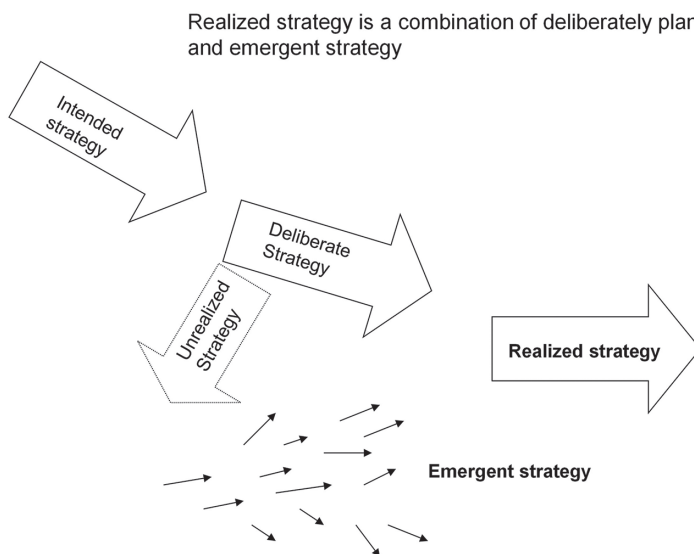


Figure 3.1 Planned, emergent and realized strategy

Table 3.1 Strategy process models in extant literature

Author	Year	Strategy process models
Allison	1971	Rational, organic, bureaucratic
Mintzberg	1973	Entrepreneurial, planning, adaptive
Bourgeois and Brodwin	1984	Commander, change, cultural, collaborative, crevice
Grandori	1984	Optimizing, satisficing, incremental, cybernetic, random
Mintzberg and Waters	1985	Entrepreneurial, planned, emergent, ideological, umbrella
Chaffee	1985	Linear, adaptive, interpretive
Ansoff	1987	Systematic, ad hoc, reactive, organic
Mintzberg	1987	Plan, position, ploy, perspective, pattern
Nonaka	1988	Deductive, compressive, inductive
Pettigrew	1992	Dynamic (not static, agents construct strategy, tensions – actions versus structures, emergent)

Table 3.2 Advantages and disadvantages of different approaches to strategy

Strategy as	Advantage	Disadvantage
Direction	Plan a course through the environment	Setting a pre-determined course without knowledge of the environment in advance is perilous
Focus of effort	Promotes co-ordination of effort	Groupthink results
Defining the organization	Provides meaning	Meaning becomes too simplistic and rich complexity is lost
Providing consistency	Reduces ambiguity provides a theory of business	Distorts reality

Source: Adapted from Mintzberg et al. (1998)

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*So, what exactly is strategy?*

There are a number of common areas of agreement about what strategy is and they are listed:

- Strategy concerns both the organization and its environment.
- Strategy in its broad definition is about both means and ends.
- Strategy in its narrow definition is focused on means to achieve the end.
- Strategy is complex.
- Strategy affects the overall welfare of the organization.
- Strategy is both content and process.
- Strategies are not purely deliberate.
- Strategies exist on different levels.
- Strategy involves different thought processes (conceptual and analytical).
- Strategy making is a process that can be planned but may also emerge.

Hart (1991, p. 121) states that high performance firms have to balance conflicting approaches to strategy simultaneously:

- Planned and incremental.
- Directive and participative.
- Controlled and empowered.
- Visionary and detailed.

According to Mintzberg et al. (1998) design, planning and positioning has dominated the strategic literature and the bias has been reflected in practice. This is stated, in part, as justification for examining a number of different non-rational and non-prescriptive approaches within the text *Strategy Safari*.

In this text, descriptive and prescriptive approaches will be adopted as appropriate to the context and the realized consequences of strategy evaluation, choice, implementation and control are viewed as the result of management decisions, which may have been planned and/or emergent. Strategic evaluation and choice are associated with risk and uncertainty. This was recognized by Loasby (1976, p. 5) who put it thus: "If choice is real, the future cannot be certain; if the future is certain, there can be no choice."

One flawed assumption of many strategic planning processes is that a priori decisions capture all critical information relevant to the decision in advance of the implementation time-period. Information is always partial. It is just a matter of degree. Assumptions are just that. Strategies are human management decisions made on partial information in advance of the actual time-period, with assumptions about conditions, interactions, attitudes, behaviours, actions and reactions in the environments the firm operates in. Managers interpret information and make assumptions based on their knowledge, experiences, advice and learning from their own mistakes and the mistakes of others. Strategic planning relies on forecasting future environmental conditions ahead of the time period in which the plan will be implemented. Strategic management is the process of managing the organization's strategic position in the time period the plan is implemented.

It could be argued that developing supply chain strategies is a planning process and implementing and controlling supply chain strategies is a management process. Whichever stance taken, one thing is certain both are needed to consciously strategically manage an organization.

## **Levels of strategy**

It is important to recognize that strategy may be formulated at different levels of the organizational structure. Corporate level strategy is determined for the whole corporation. Take a firm that has several different divisions, it may develop strategies for the whole organization and each of the different divisions may be strategic business units (SBUs) each with their own strategy. In such instances, the SBU strategies must be congruent and fit with the overall corporate objectives and corporate strategy.

### ***Corporate strategy***

Corporate strategy is concerned with questions such as: what type of businesses should the organization be in? Which markets should the firm pursue? What purchasing and supply chain strategies should be implemented throughout the corporation? What infrastructure needs to be developed to support the whole of the organization achieve its goals? Decisions about diversification and primary structures for the organization together with the contributions that the organization's portfolio of businesses should make to the whole are all corporate level strategy issues.

### ***Business strategy***

Business level strategy focuses attention on what the SBUs need to do to achieve their business level objectives within the corporate whole. Questions such as: how can the SBU compete in a particular market? What products and services should be offered? Where to locate SBU's? How can the SBU finance its operations in line with overall corporate policies? What supply chain structures are needed to achieve the SBUs strategic objectives?

### ***Operational strategy***

Operational strategies tend to focus on products and markets and how best to achieve business objectives set by at corporate level and SBU level. Managing capacity, where to locate facilities, managing technologies, people and value may all form part of operational strategy. Operations strategy sets broad policies and develops plans for effective use of organizational resources that best support the firm's long-term competitive strategy. Operational strategies need to be integrated with corporate strategy. Decisions may relate to the design of facilities, processes and the infrastructure required to support processes. Many supply chain strategies fall into this category although they could also be at business or corporate level too.

### ***Competitive strategies***

Supply chain strategies are most definitely competitive strategies. In competitive markets, customers drive markets and markets drive organizational behaviour. Customers make purchasing decisions for a variety of reasons such as cost or service attributes relating to a purchase. Firms need to position themselves to meet the customer's demands. As a consequence, a number of key operational competitive dimensions determine the competitive position in the market place. These may include:

- Cost – keeping the cost of products or services low allows the firm to offer the customer better value for money through competitive pricing. Focus on this attribute will be particularly

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important when the firm is in competition with low-price competitors. Low-cost alone may not be sufficient to attract and keep customers and the firm may need to compete on other dimensions too. Furthermore, being the lowest cost provider may not be sustainable over time. It is important to acknowledge that there is always only one lowest cost operator in the marketplace, any marketplace. Competing with that lowest cost supplier may or may not be feasible given the firm's size and capabilities. Product markets that compete on price alone are effectively commodity markets where the customer cannot distinguish between the products available from competing firms. Competition is often fierce and profit realization relies on high volumes being achieved.

- Quality and reliability – there are two aspects of quality: first, product/service quality and secondly, process quality. Continuously improving quality and reliability of the products and services offered may be important in the market being served. The organizational objective must be to specify product/service quality at the appropriate level acceptable to the particular market. Over specification may add cost but not necessarily value from the customer's perspective. The second aspect of process quality is particularly important for all firms competing in the market because no customer wants products with defects. Process quality determines the reliability of the product/service and its reliability. Error free products are the result of “zero defect” processes. Techniques and tools such as statistical process control, sigma six are part of this total quality management to deliver reliability. Quality kite marks such as ISO9000 series are badges that signify that the organization has appropriate quality processes to a particular standard in place.
- Speed of delivery – the speed at which a product/service can be delivered may determine a competitive advantage in some markets. For example, security or emergency services that offered a response on site within ten minutes of the alarm being raised would be preferable to a service offering a response within one hour. In retailing, Inditex the Spanish retailing group behind the Zara fashion brand have built their success and reputation on being able to get merchandise from design concept to retail store within three weeks.
- Delivery reliability – delivering on time or ahead of time may help the organization to establish delivery reliability, which may be critical to secure repeat business. Failure to deliver on time may result in loss of existing contracts and exclusion from future contract negotiations, bidding or tendering.
- Flexibility – is the ability of a firm to change processes or products. For example, the firm may need to develop and/or introduce new products quickly for its customers. Innovation, design, access to and capabilities in managing new technologies and changing processes may all be part of being strategically flexible.
- Responsiveness – is the ability to cope with changes in demand. For example, retail stores may offer promotions to customers that stimulate higher than normal demand for a product or range and suppliers will need to be able to respond to this change. Capacity planning and being able to adjust upwards and downwards to changes in demand patterns as and when required is a capability required for longevity of an organization (Nohria & Eccles, 1991).

In addition the organization's reputation, its brand, service and technical abilities will affect the organization's capability to compete effectively.

Strategies to co-operate through strategic partnerships and alliances are also necessary and may form part of an organizations competitive strategy. The word *co-opetition* was coined to describe this type of strategy (Brandenburger & Nalebuff, 1996).

These different levels of strategy overlap and strategic decisions may or may not be exclusive to a particular level. Strategic decisions will be taken at corporate, business or



operational depending upon how the organization is structured and how its managers interact with each other.

***Strategy or strategies?***

It is also important to understand that organizations may not simply pursue a single strategy but that multiple objectives may require multiple strategies. These multiple strategies may need to be pursued simultaneously in parallel with each other. It is critical that managers do not attempt to implement conflicting strategies. These are strategies that work against each other to the detriment of the organizational unit pursuing the strategies. In this context, the focus of the effort should be co-ordinated if the strategies are to be coherent and congruent with each other.

For example, an SBU may decide to pursue a global sourcing strategy and simultaneously pursue strategies to dominate a particular local market. These two strategies are not necessarily in conflict. However, if the corporate strategy had set an objective of where possible the organization should source locally to serve local markets, then the SBU strategy may conflict with corporate level strategy. It is important for managers to reconcile such conflict to minimize the effects of conflicting strategies. The consequences may be real or perceived. By this statement, it is clear that real effects are tangible such as difficulties in implementing global sourcing when resources including the firm’s infrastructure make it difficult to pursue and the effect may result in disruption to product flows and increasing cost. Perceived consequences may be intangible (feelings, attitudes and behaviours of customers towards the organization as a consequence of the particular strategy) such as customers making choices to avoid the organization’s merchandise as a consequence of its global sourcing policy. The real effects may not materialize immediately. For example, an organization may not be aware that consumers have collectively decided to avoid its products especially if it is a new market. There will be no past history to compare current performance against. It may lead the organization to conclude wrongly that other reasons were the cause of the problem. Perceptions may ultimately lead to real consequences such as a fall in revenue, increased operating cost or insufficient profit.

**Strategic thinking, systems and learning**

Schön (1971) created the notion of business firms as learning systems evolving in relation to their changing environment. Rapid inventive transformations of the firm happened as innovation occurred. Classical firms were built around products. Clothing is an example. Clothing manufacturers required people who understood design, fabric properties, dye processes, cutting and sewing operations. Professional managers competent in sourcing, purchasing, production, logistics, marketing and finance complete the firm. The firm is an intermediate link that interacts with its suppliers and the ultimate consumer. Since the 1940s, there have been many turning points with transitional themes as summarized in Table 3.3.

*Table 3.3* Examples of transitional shifts

<i>From</i>	<i>To</i>
Static product line	Product innovation
Single product line	Product diversity
Product based	Process based
Firms as bounded systems	Firms with blurred boundaries within the supply chain

*Source:* Adapted from Schön (1971)



In the 1950s, firms began to think of innovation as commonplace and an integral part of the firm whereas, previously, entrepreneurs established firms around their inventions. Research and growth were seen as important elements of the firm's system. Consumers used technologies developed in the Second World War in peacetime to deliver new products in demand. Simultaneously firms developed improvements to technological and marketing systems to deliver their new products to customers. There was a general broadening of the industrial base and by the 1960s, clothing became fashion, shoes became footwear. Different technologies were employed to develop new products from new materials. Traditional industries were invaded by science-based industries throughout the latter part of the twentieth century. Textiles, shoes, paper, graphics have been transformed through invasion by chemical, petrochemical, electronics and information communication technologies. Well-defined products with well-defined technologies were no longer the norm.

**Strategic thinking science or art?**

The notion that strategic thinking is scientific in approach comes from the planning school approaches to strategy. However, in common with most epistemological development this is only part of the story. Strategy is also a creative process and as such maybe strategy formulation is more of an art than a science. Figure 3.2 illustrates these two different approaches and demonstrates that strategic thinking is conducted systematically and creatively. Strategic thinking is both science and art. One side of the brain deals with the rational approaches to formulating strategy and the other side deals with creative and serendipitous approaches to strategy. Learning comes from a variety of sources including experience, reading, observing,

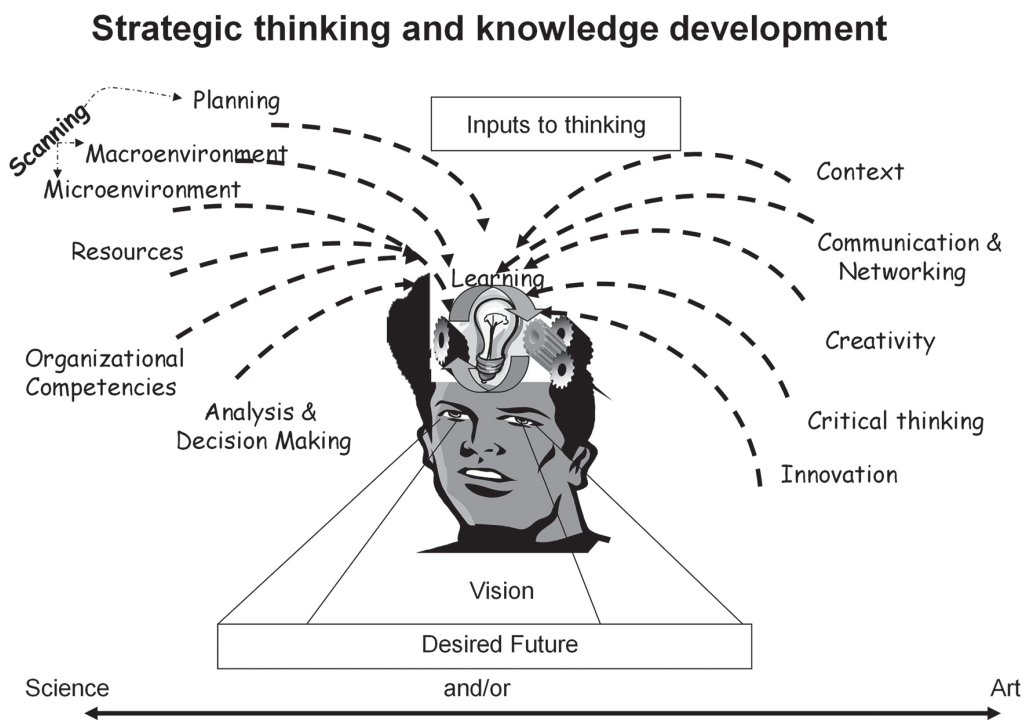


Figure 3.2 Strategic thinking and knowledge development

doing and thinking. The problem with many practicing managers charged with strategic responsibility in many organizations is that they spend too much of their time doing, observing and experiencing and too little of their time thinking and reflecting upon experiences, observations and practices.

**Static or dynamic environments**

Figure 3.3 depicts a simple four-box model abstracting four different types of environment in which organizations may sit. These environments are polar opposites and you may argue that the world is not so simple. Nevertheless, it gives a framework from which to identify some basic factors influencing firm behaviour and to further analyze conditions and consequences. In the figure, environments are classified as stable or dynamic. Stable environments may be complex or simple. Simple stable environments are predictable. Demand for a product or service in this type of environment would be relatively constant with little variation. Another dimension to stable environments is they are those that can be classified as more complex meaning they are more difficult to handle but there is still little change over time that allows the organization to predict demand with some accuracy. For example, a seasonal business may have complexities in terms of products offered but peak periods and trough periods will occur with regularity. Stable environments are easier to manage. Dynamic environments pose the challenge for managers. Dynamic environments may also be classified as dynamic or simple. Simple environments are fast moving but they are reasonably easy to predict. For example, many grocery retailers would operate in a fast moving environment but the demand for certain staple foods, soap powder and detergents may be reasonably well predicted. However, by contrast fashion retailing is both complex and dynamic. Complex because customer demand is fickle and fashions change between the time the retailer orders and supplies goods to the customer. The risks are greater in the latter type of business. Of course, we have assumed that businesses operate distinctly in

**Types of strategic environment**

	Stable	Dynamic
Complex	Difficult to handle but little change over time	Very uncertain, constant change high-risk
Simple	Predictable	Fast moving but reasonably predictable

*Figure 3.3* Types of strategic environment

one of the four types of environment for means of illustration. In reality, a single business may have product ranges or services that span all four types making the supply chain challenges a complex conundrum.

Traditionally the areas that the supply chain spans cut across different disciplinary areas of academic study (marketing, operations, human resource management, finance, economics). However, there is a clear case for adopting a Gestalt approach to the study of these areas within supply chains. Managing organizational supply chains is key to the success of most contemporary complex organizations. Organizations need to be both efficient and effective in how they manage and fulfil their customer requirements. Efficiency requires the organization to make best use of resources (doing things right) and effectively is about doing the right things. Organizations need policies, procedures and systems to deliver effectively. These three factors need to be sufficiently flexible to respond to the customer if they are to be effective.

The strategic planning process is illustrated in Figure 3.4. It shows that organizations must scan their environment before setting strategic objectives and developing a plan.

Environmental scanning entails an examination of the macro and micro environments in which the organization operates. The macro environmental scan examines political factors, economic factors, social changes occurring, cultural shifts, changes in technology that are impacting on businesses and market structures, ecological influences, ethical dimensions of conducting business and legal considerations. Developing a good knowledge and understanding of these macro conditions and their consequences is essential.

In addition to understanding the macro-environment, managers need to understand their immediate environment. Firstly, it is important to know the rules of the industry the firm operates in and business models that lead to success in the industry. Knowledge of the organization's position within the industry is required in order to identify particular strengths or weaknesses. Strengths can be developed and harnessed to pursue the particular strategy the firm decides. Weaknesses may be minimized and developing or buying in new competences needed to move the business in its desired direction may close gaps.

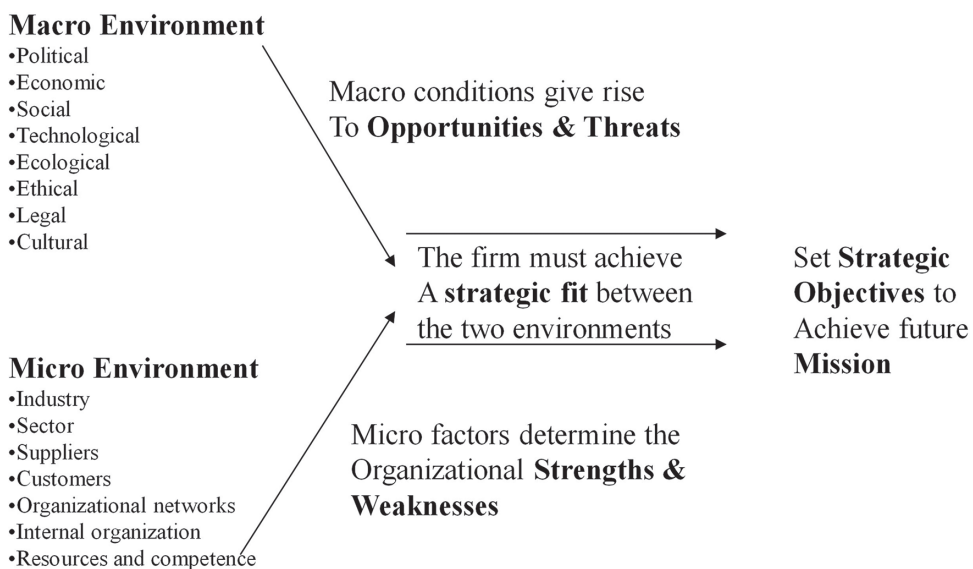


Figure 3.4 Developing strategic objectives from the environmental audit

One useful conceptual model to understand the strategic nature of industry competitiveness was developed by Porter (1980). The model shown in Figure 3.5 depicts five forces that are present in the organization's immediate industrial or sectoral environment.

The forces identified recognize the power balance between suppliers and buyers in a particular industry. If there are many suppliers and few buyers, the power resides with buyers. Conversely, if there are many buyers and few suppliers the power resides with suppliers. In many respects, this simplifies the buyer-seller relationship in one dimension and it will become clearer later in the text that buyer-supplier relationships are more complex than this simple model suggests. Nevertheless, understanding the nature of power in the relationship is important. The vertical line depicts the effect of new entrants to an industry and how that can change the nature

## Five forces analysis

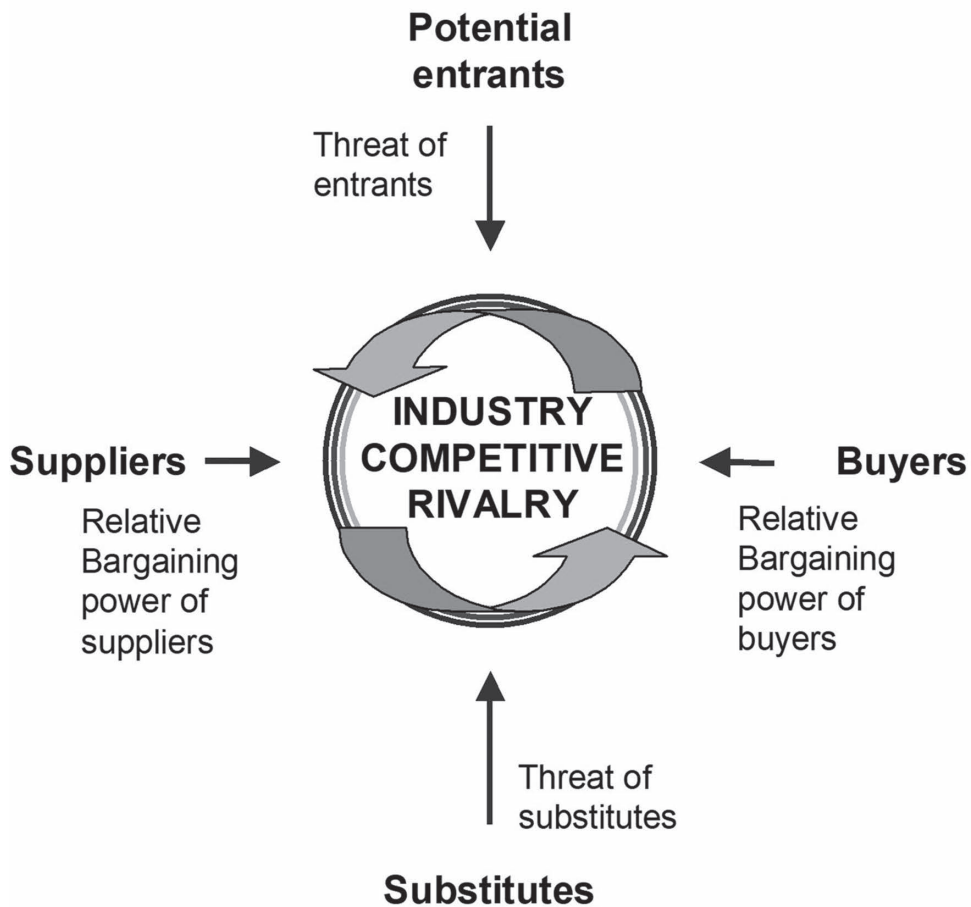


Figure 3.5 Five forces shaping the organizational environment

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of competitive rivalry. For example, in retailing the entry to the UK market by Walmart was achieved through takeover of an existing retailer Asda. The new entrant happened to be the largest retail business in the world with long established suppliers and market strategies based on low-price and volume. The new entrant was able to capture market share immediately through takeover and influenced the way in which other retail competitors behaved towards it. Tesco the largest retailer in the United Kingdom responded by cutting prices on many lines. The retail sector has also seen consolidations through merger and takeover in a scramble for existing players in the market to become ever larger to compete effectively. New entrants always have an impact when Zara entered to the UK high street it revolutionized the way in which many of the long established fashion retailers operated their businesses, particularly their supply chains focusing on fast fashion. Organizations that offer substitute products or services will also change the nature of competitive rivalry in an industry. For example, the development of the Internet and electronic mail has had an impact on how the postal and telecommunication industries operate. How competitors in the industry respond to each other as a consequence of these forces is itself a further factor influencing competitive rivalry.

In applying the five forces model, it is important to define the industry or sector that is the focus for the analysis. This may be more difficult than it first appears. There are of course standard industrial classification codes (SICs) that one could use. However, these have their limitations since the competition may exist outside the traditional classification. Take, for example, a designer womenswear retail store. You may decide to define the competitive rivalry by market or product. In examining the competitive rivalry, do you compare all womenswear retailers since they may offer competitive products some of which will be designerwear, some may be haute couture and others may be mass-market retailers? Do you include or exclude department stores? Whatever your decision in drawing such comparisons it will impact upon the subsequent analysis. It is also important to recognize different applications in terms of business-to-business (B2B) markets and business-to-consumer markets (B2C). Figure 3.6 provides an illustration for B2C using designerwear retailers as the focus of competitive rivalry and gives examples of the influences on that market. Alongside this is an illustration of the model applied to B2B markets using clothing manufacturers as the focus of analysis.

Another useful conceptual model examining the environmental influences related to supply chains was developed by Saunders (1997, p. 55). This is illustrated in Figure 3.7 it shows how the firm and its competitors are influenced primarily by conditions prevailing in supply markets

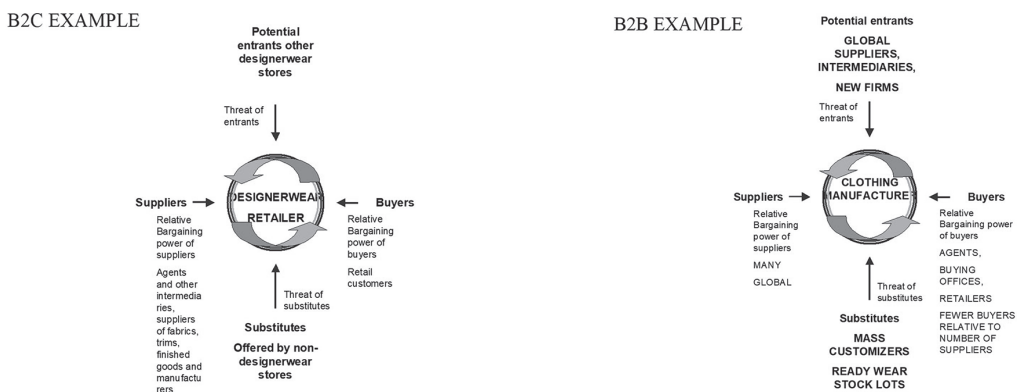


Figure 3.6 Examples of five forces in B2C and B2B

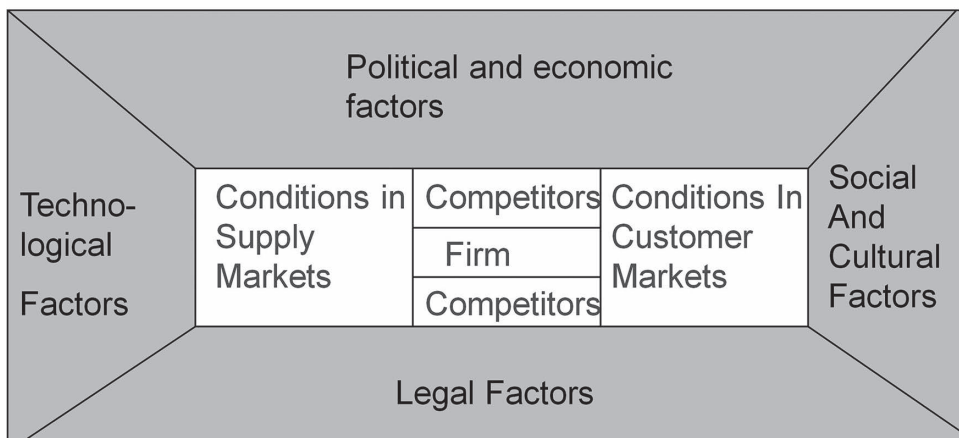
and customer markets. In this respect, it is similar to the five forces model horizontal line considering the relative bargaining power of suppliers and buyers. However, it is different in recognising other conditions that may influence the firm and its competitors apart from relative bargaining power. The model then shows how wider influences in the macro-environment are influencing market conditions and the behaviour of the firm and its competitors. In this respect, the model integrates the macro and micro environmental factors influencing the organization.

Most of these conceptual models appear to assume that the influences are unidirectional impacting upon the organization. The reality is that firms interact with their environment and as a consequence, they too influence to a greater or lesser extent the environmental conditions. For example, large organizations may well apply greater pressure on government to implement particular policies, pass particular laws, maintain monetary and economic policy and so on. Smaller firms may act collectively to achieve greater influence over their environment.

Conditions in the organization's macro environment may lead to the identification of particular opportunities or particular threats facing the firm. An organization will only be able to maximize opportunities and minimize threats if it is able to exploit the opportunities or repel the threats identified. Their ability to do so will depend upon their capabilities. Organizational capability is dependent upon resources the firm is able to deploy and how effectively and efficiently those resources can be applied.

Until recently structuralists maintained a dominant view in strategy and in the development of strategic knowledge explaining superior performance through structural features such as barriers to entry, substitute products, industry structures and the nature of competition (Porter, 1980, 1985; Ansoff, 1987). A different view was held by Selznick (1957) and Penrose (1959), who were early movers towards a resourced based view of strategy. Contemporary views have

## Environmental factors



Source: adapted from Saunders' (1997:55)

Figure 3.7 Environmental analysis for supply chains

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suggested that skills and capabilities are more significant in determining strategic success rather than a myopic focus upon the external competitive environment (Barney, 1991; Prahalad & Hamel, 1990; Wernerfelt, 1984). Boundary decisions are affected by the way firms identify their capabilities (Barney, 1999). Capabilities allow strategic flexibility (Combe & Greenley, 2004) and benchmarking capabilities has become important in strategic positioning (Vorhies & Morgan, 2005). Collis and Montgomery (1995) suggested that focus on both the competitive environment and the organizational capabilities were necessary in examining the organization’s performance in its competitive environments. In essence, the range of views expressed simply acknowledge the different emphases. The “outside in” approach is essentially structuralist and focuses attention on the environmental impact upon the organization’s strategy. Whereas the “inside out” approach recognizes that firms need to be capable of taking advantage of the opportunities identified outside. To create successful supply chain strategies the firm needs to be able to understand both aspects. In effect, this is strategy as perspective.

**Competence and capability**

Christopher (1996, p. 71) commented that one of the most profound changes is the recognition that even the largest business organizations has only relatively few competencies in which they can be said to have a real distinction. This recognition has resulted in a focus upon core business and a trend to outsourcing everything else. The growth of outsourcing has placed increasing emphasis on managing relations between partners in the organizational network. Although the language of “core competence” is recent, the concept of specialization on which it is based can be traced back to Adam Smith in 1776 and the theory of comparative advantage expounded by David Ricardo in the economics literature in the nineteenth century (Smith, 1910 [1776]).<sup>1</sup> Furthermore, a number of different commentators have used different terms such as *firm resources*, *organizational capabilities* and *core competencies* interchangeably see Table 3.4 for a summary of usage of terms.

**Definitions of core competence**

Definitions of core competence are somewhat tautological. Resources are called strengths and a firm’s strengths are regarded as strategic resources (Nanda, 1996, p. 100). Selznick

Table 3.2 Resource based views of strategy

<i>Terminology</i>	<i>Author reference (date)</i>
Distinctive competence	Andrews (1971)
	Hofer and Schendel (1978)
	Selznick (1957)
Strategic firm resources	Barney (1986a)
	Barney (1986b)
Invisible assets	Itami and Roehl (1987)
Strategic firm-specific assets	Dierdickx and Cool (1989)
Core competencies	Dosi et al. (1991)
	Prahalad and Hamel (1990)
Corporate culture	Cremer (1989)
Corporate capabilities	Nohria and Eccles (1991)
Organizational capabilities	Baldwin and Clarke (1991)
Dynamic capabilities	Teece et al. (1997)



(1957) was first to introduce the concept of a distinctive competence but he never defined it. Andrews (1971, p. 46) later stated that a distinctive competence was something a firm did well. In similar vein Hofer and Schendel (1978, p. 25) refer to resources that will achieve the firm's goals or objectives. Dosi et al. (1991) take the definition a step further by stating they are differentiated skills, complementary assets, organizational routines and capabilities that achieve a firm's competitive capacities in a particular business. This latter definition appears to move towards a position of acknowledging contextual influences. Prahalad and Hamel's (1990) definition was more narrowly focused towards human resources. Later Prahalad and Hamel (1994) widen the scope of their definition referring to bundles of skills. Barney (1986a, 1986b) uses the term "strategic firm resources" to mean the same as a "distinctive competence" or a "core competence."

The resource-based view of strategy is important for supply chains examining capabilities to compete on efficiencies and effectiveness. Operant resources (people) are able to re-engineer the ways in which they organize resources to achieve these twin aims of efficiency and effectiveness. Detailed explanations about re-engineering (Grint, 1994; Hammer & Champy, 1993), service logic (Homburg et al., 2002; Lusch & Vargo, 2006; Lusch et al., 2007, 2009; Wright et al., 2012) and supply chains (Maglio et al., 2009) are contained in the extant literature.

Whatever their chosen terminology is, the focus for most of these authorities is the same. They are adopting a similar stance examining the key strengths the firm has or is capable of building to achieve its strategic goals. They may all be classified as taking a resource-based view of the organization. Organizations either develop competences internally or they buy-in the competences they require. Mergers or acquisitions often have a primary aim of purchasing particular markets (e.g., a means of achieving a market entry strategy such as Walmart's purchase of Asda UK to get immediate market-share), purchasing particular technologies (e.g., Glaxo's acquisition of Smith-Kline Beecham to acquire biotechnologies), and purchasing "know-how" or knowledge through acquisition. Collaborative arrangements may achieve similar ends without the responsibilities and risks of ownership.

Prahalad and Hamel (1994, p. 219) define a core competence as follows:

A core competence is a bundle of skills and technologies that enables a company to provide a particular benefit to customers.

Examples given of a core competence by Prahalad and Hamel (1994, p. 219) include *pocketability* at Sony, *on time delivery* at Federal Express, *logistics* at Walmart leading to choice, availability and value for customers. To this list, one could add *supply chain management* per se as a core competence. It is not simply an aspect of managing the supply chain such as on time delivery that is a core competence in many contemporary organizations but if one considers an organization like Amazon.com the ways in which it sources and procures product, stores and moves product from the various suppliers and onto the customer by bundling different skills and e-business technologies to deliver products faster and at lower cost than many of its competitors is a good example of supply chain management per se as a core competence for that organization.

Core Competencies are skills or capabilities that make an organization unique. The key question is what share of the future markets will these competencies enable the organization to capture. The identification of core competence gaps can help an organization recognize (a) where it wants to be; (b) which competencies it should build; and (c) how they should be built. This recognition will lead to the strategies that the organization will pursue. Core competencies represent intellectual capital. Questions arise such as what is core and what is

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non-core, how long does it take to build the competencies and how many such competencies are necessary to compete effectively. In answer to the first part, a core competence is a source of competitive advantage. In Porter's terms, there are only two sources of competitive advantage: cost and differentiation (Porter, 1985). Pursuing this line of argument, it would appear that a core competence must either give a cost advantage or differentiate the organization from its competitors. Restructuring the organization and downsizing may be one way to achieve competitive advantage by becoming smaller and lowering costs. Re-engineering processes and continuous improvement are another route to competitive advantage by being better, that is, more efficient and hence lower cost. Or re-inventing industries and regenerating strategies to alter the rules of engagement are another source of competitive advantage to become different. Prahalad and Hamel (1990) make clear that competitive advantage itself is not a core competence and that a core competence is a critical success factor (CSF) but that not all CSFs are core competencies. It can take five to ten years to build core competencies and it is unlikely that any organization will have more than 15 core competencies and the range will usually be between five and 15 (Prahalad & Hamel, 1994, p. 224). Finally, for a competence to be core it must satisfy three criteria:

1. It must make a disproportionate contribution to customer perceived value.
2. It must be competitively unique, that is, not unique to the firm as such but must in some way differentiate the firm's offering in a unique way.
3. It must be extendible meaning that the competence may be applied to new product areas or to new market developments and not just to existing product groups or existing markets. Core competencies will, therefore, enhance customer value or reduce cost.

Prahalad and Hamel (1994, p. 224) discuss the idea of non-core and core in relation to competence in detail. They argue that it doesn't matter whether or not the term used is competence or capability and recognize that firms competing on their capabilities is not a novel or new idea in itself. It is further suggested that simply to list all the competencies a firm has is not very useful in terms of assisting managers since equal attention cannot be given to all these items. Focus needs to be upon competencies that are at the centre of what the firm does rather than at the periphery. In other words, it is *core* to what they do. For any competence to be regarded as a core competence it must pass three tests:

1. ***Customer value***

The competence must contribute to customer perceived value disproportionately and deliver fundamental customer benefits.

2. ***Competitor differentiation***

In order to be regarded as a core competence the capability must be competitively unique. Thus, a competence that resides in all firms in an industry is not unique and cannot therefore be regarded as core unless the individual firm has a competence level that is substantially superior. It is notable that Prahalad and Hamel (1994, p. 227) continue their argument about core and non-core by referring to underdeveloped competencies ubiquitous within an industry.

3. ***Extendibility***

Core competencies are the gateways to tomorrow's markets according to Prahalad and Hamel (1994, p. 227). Managers must abstract away from a particular product configuration in which the competence is embedded and imagine how it can be applied to new product arenas.

### Learning and organizational capability

According to Prahalad and Hamel (1994) core capabilities and competencies differentiate a company from its competitors leading to a competitive advantage. Organizational learning has been defined as the capability of an organization to adapt to its environment (Hedberg, 1981). Garvin (1993) identified organizational learning as a capability required by all firms.

The model in Figure 3.8 is a conceptualization involving three learning loops that develop a firm's capabilities and core capabilities in relation to managing supply chains beginning with resources, routine operations, work practices and taking account of external environmental conditions and mission. Resources at the firm's disposal determine supply chain structure. Mission and management actions can affect resources and determine supply chain strategy. Relationships link both supply chain strategy and structure and connect the firm with its internal and external operating environment.

The first loop creates routine practices using resources. The second loop combines work practices and organizational routines determined by management action and interaction. Relationships are an important focus for learning in the context of the supply chain in this second loop. The third gives meaning to capabilities in the context of the competitive environment and mission. Management intervention aims to provide direction to learning processes (Argyris, 1991). Core capabilities are components of organizational context, radical learning means learning how to do radically new things (bottom loop), that are important in radically new ways implying activity in the top loop, (Argyris & Schon, 1978).

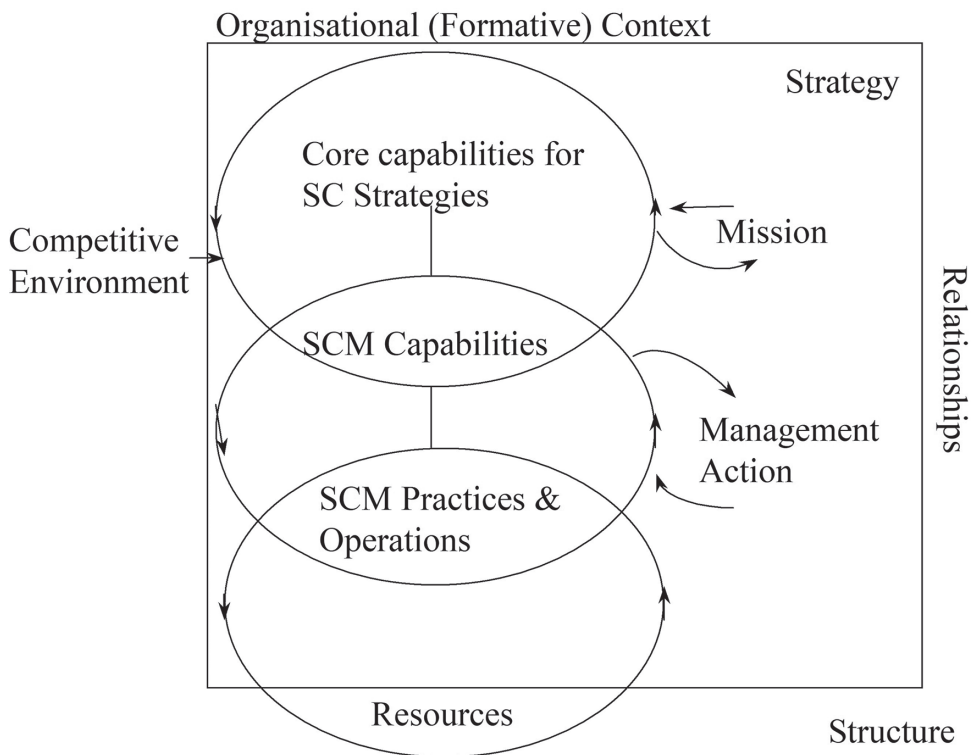


Figure 3.8 Learning to develop supply chain capabilities

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Individual competence and organizational capability may be improved through learning. Organizations are able to build strengths and minimize weaknesses through learning. Learning how to learn and how to manage learning inside the organization is critical to improving strategic performance (Argyris, 1996).

***Example of learning loops in action***

An organization may decide to assign workers to their daily tasks or routines, allocate materials to a production line and decide on the number of lines and which equipment to use for the day's activities. These are everyday occurrences in a factory setting; they are routines and located in the first loop at the bottom. Management intervention may occur in the second learning loop to make adjustments to the size of the workforce, the number of machines, to train the workforce or to change processes to improve capabilities and performance. Work experience (learning curve effect) and individual/team learning may improve individual and team performance in the second loop. The third learning loop is market facing and market driven. The third loop also contains learning from daily routines in the first loop, an evaluation of capabilities in the second loop and the influences upon organizational context from the marketplace and from the corporate mission. The final loop leads to strategic management interventions. The nature of the competitive environment and market conditions balanced with organizational capabilities that exist may influence the organization to decide to move production from one location to another, to invest in new plant or divest of existing plant to achieve its corporate or SBU strategic objectives.

**Developing strategic objectives**

In developing strategic plans after scanning the macro and micro environments, the managers will need to identify opportunities and threats to determine possible future directions. These opportunities and threats need to balance against the organization's current and potential competences and capability to implement a particular strategic plan. Managers will want to set objectives or planned outcomes that should be a consequence of pursuing a particular strategic direction. Objectives need to be measurable so that managers can assess progress towards their goals. It may be trite to state that objectives need to be "SMART" but SMART they should be:

*Specific* (the stated objective should be as precise as it can be)

*Measurable* (need to be able to identify and measure actual achievements against the plan)

*Achievable* (given resources at the firm's disposal)

*Relevant* (does this objective fit the firm's purpose/mission)

*Timed* (specific dates by which progress can be measured)

For example, the statement of a particular objective to satisfy the criteria might read:

To achieve a five per cent increase in share of the UK mobile phone market measured in retail values rather than volumes by 1 January 2030.

There is often an assumption that setting objectives is a scientific process. Systematic it may be, scientific it is not. Setting objective is a subjective process involving human judgement and as such involves all the human frailties that exist in individuals and in collective decision-making processes. Evaluations may be made subject to specific *a priori* criteria laid down by

a management team to give a feeling of objectivity to the final decisions taken. Nevertheless, ultimately it requires judgement to set objectives, human judgement. The appropriateness of the strategic objectives set by the management team are a manifestation of their knowledge, experience and understanding, hence their managerial competence.

**Committing resources to a plan and “opportunity cost”**

Once the managers responsible collectively develop specific strategic objectives for the organization they will need to evaluate a number of strategic options and make choices to commit resources to the plan. In economic terms, the resources are referred to as factors of production: land, labour, capital and entrepreneurial effort. There is an opportunity cost of applying resources to a particular plan. The opportunity cost being the alternative plans that could have been implemented using the same resources.

Once strategic objectives have been agreed and strategic choices evaluated, the detailed plan is formulated. Strategic plans have operational implications. For example, if the strategic objective is to lower cost of bought-in materials by a specific and measurable percentage over a five-year time-frame, managers may choose to source products from countries where the quality of product is similar to an existing supplied item, but the cost of producing the items is lower because of the economic conditions prevailing in the country of supply. Making this choice may impact upon the firm’s operations. For example, the firm may need to plan more carefully to take account of longer delivery times or longer production lead times than those achieved by local suppliers. The firm may also need to forecast the impact of exchange rate fluctuations upon prices agreed with suppliers, which may be in a foreign currency. Furthermore, changes in economic conditions in the country of manufacture such as inflation, unemployment and interest rates will inevitably impact upon the supplier’s cost base either favourably or unfavourably. Political stability in the source country where the supplier operates may introduce further dimensions of risk and uncertainty, which impact upon operations.

Figure 3.9 illustrates the strategic management processes. Once the plan has been formulated, it is implemented and their needs to be some management control. The latter are interventions by managers to keep the plan on course to achieve the strategic objectives.

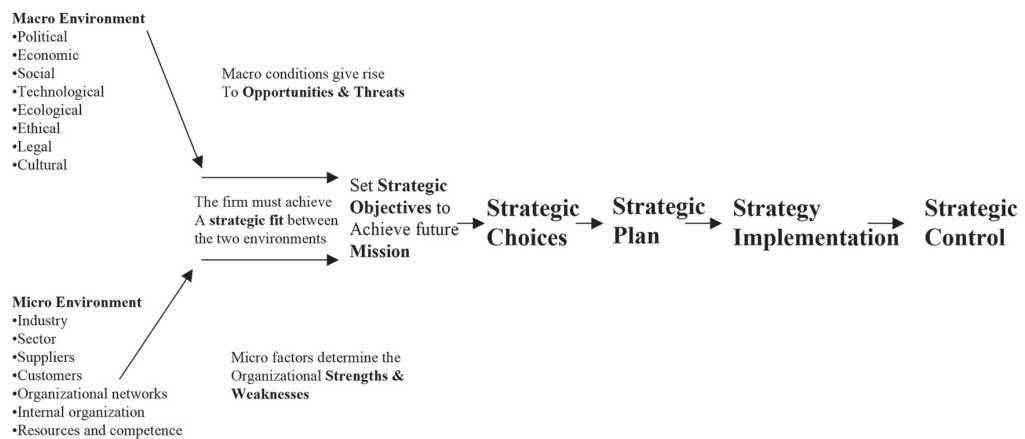


Figure 3.9 Developing strategic options-choices, plans, implementation and control

Figure 3.10 illustrates the strategic planning processes with feedback loops that demonstrate how control is affected. Control is achieved by measuring the planned outcomes against the actual performance during a particular planning period. Strategic plans covering say a five-year period may be divided into operational time periods, for example, a financial year. Performance indicators may be set for each operational time period that give an indication of how the organization is performing against its strategic objectives.

Finally, Figure 3.11 demonstrates that strategic control may not simply make adjustments to the plan alone. Strategic control may be exercised by re-examining the effectiveness of implementation. It may require a re-think of the strategic choices that the management of the organization have made or it may require the organization to re-visit the strategic objectives that were

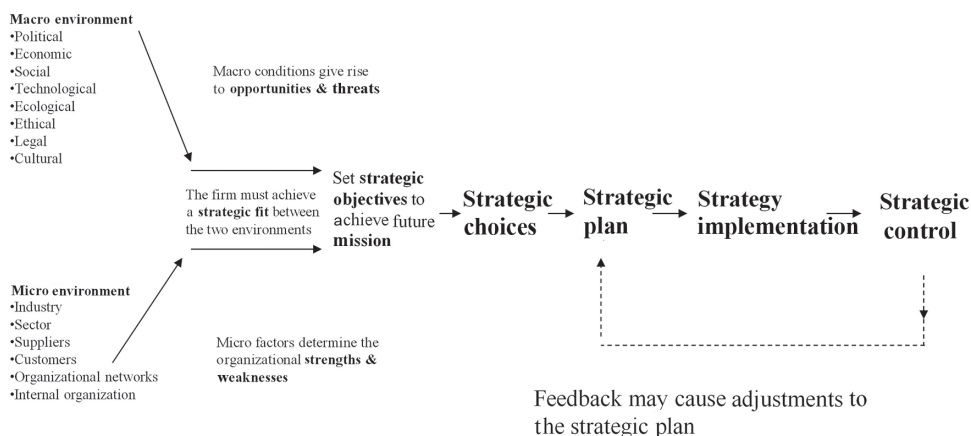


Figure 3.10 Illustration of feedback loops to update plans as necessary

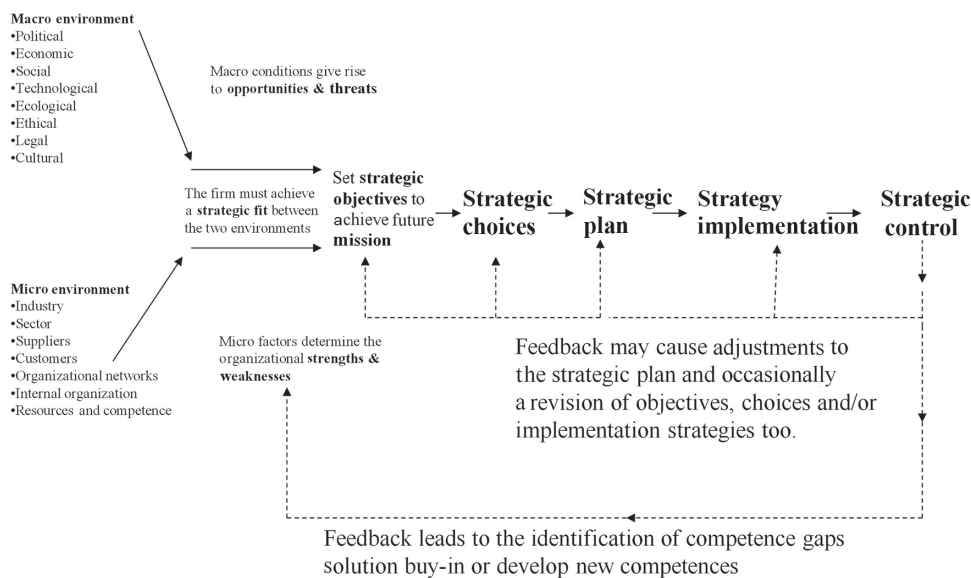


Figure 3.11 Illustration of the iterative nature of strategy planning processes

originally set. Changes may need to be made to any or all of these matters. In the process of exercising strategic control, it may also become clear that the organizational competences to implement a particular chosen strategy are insufficient. Gaps identified in this way may be filled through competence development or acquisition.

It was mentioned earlier in the chapter that Porter (1980, 1985) recognized two sources of competitive advantage that could lead to organizations adopting one of three generic strategies which are lowest cost, differentiation or focus. A focused strategy may also employ cost or differentiation as its main strategy. Table 3.3 illustrates the three strategic options and the likely supply chain focuses required by the customer and how the strategy might be communicated.

Figure 3.12 illustrates that high returns on investment may be achieved through either a differentiation strategy or through means of a low-cost strategy. Low-cost strategies rely on high-volumes and low-unit profitability which combined, achieve higher than normal returns on investment. A differentiated strategy returns higher than normal returns on lower volumes. Porter (1980) stated that firms that tried to pursue a mixed strategy of low-cost and differentiation get “stuck in the middle.”

*Table 3.3* Cost, differentiation and focus applied to supply chain strategies

<i>Strategic option</i>	<i>Customer values</i>	<i>Communicated to the customer through</i>
Cost leader	Low prices above all else	Price and price promotions
Reduce cost base – through efficiency and productivity measures		
• Lean purchasing	Efficiency	
• Lean production	Efficiency	
• Learning curve effect	Efficiency	
• Experience	Productivity improvements	
• Economies of scale	Productivity improvements	
• Specialist knowledge, skills, systems, technologies that lower cost	Productivity improvements	
Differentiation	Reputation	
Branding and brand values and levels of service		
• Quality of product and/or service	Quality over price	
• Reliability	Reliability over price	
• Flexibility (e.g., agile production)	Ability to switch later in the purchase cycle more important than price alone – postponement	
• Responsiveness – speed in response, processes, deliveries	Time above price	
• Dependability	Depend on fulfilment	
• Value for money (not just cost)	Value above pure price	
Focus	Specific needs being satisfied	Service attention
• Niche – a small but easily identifiable target market	Specialization	
• Customer requirements	Customization	
• Local, regional, national, international markets	Coverage	



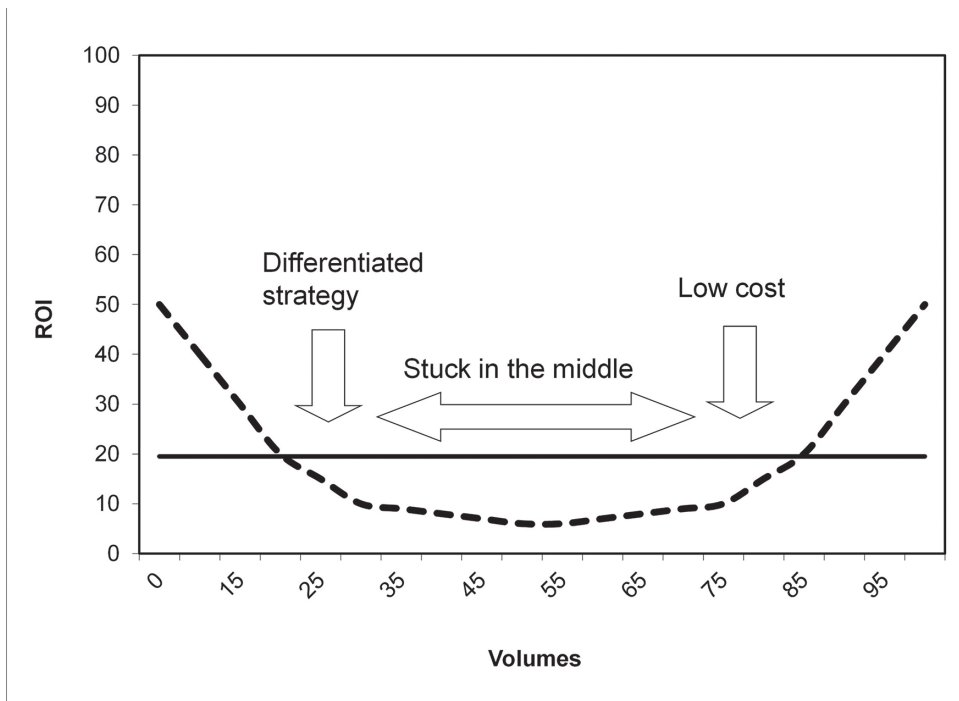


Figure 3.12 The links between return on investment, differentiation and cost

### Supply chain strategies and strategic fit

Supply chain strategies are conducted under the umbrella of the corporate strategy of the organization. Competitive strategies are market focused. Strategic fit has to be achieved between the supply chain strategies and the competitive strategies adopted by the organization. To achieve the strategic fit the organization has to:

1. *Understand the customer* by being customer focused and recognising the key requirements in each target segment they serve.
2. *Understand the nature and structure of their own supply chains* and how they respond under changing conditions in the market and the micro and macro-environment.

Market variables determine six key attributes of any supply chain structure and they are:

- *Volume* – quantities demanded by the customer.
- *Time* – the customer is willing to wait for fulfilment of the order.
- *Variety* – determines the number of suppliers.
- *Service level* required – high, medium or low product availability.
- *Price* – how sensitive the product is to price changes.
- *Rate of change, innovation and new product development* – customers buying fashion expect new products whereas customers buying standard apparel that is functional do not.

The purpose of identifying customer segments is to identify similarities between groups of customers in order that their needs can be satisfied efficiently. Customers in different segments

may have similar needs to other segments but most times the differences will be greater than the similarities observed. Where similarities are observed, the supply chain structures and strategies may be similar and economies may be achieved by sharing costs across the target segments. Where differences are identified, there is less room to develop standard services across the target groups and the costs of supply chains may be higher as a consequence. However, it is not simply about cost (but cost is important) it is about responsive supply chains. These are supply chains that are able to meet the challenges placed upon them by high-velocity changes in demand.

Chopra and Meindl (2001, p. 29) draw a distinction between demand uncertainty created by the customer in the market and implied demand uncertainty. The latter is the demand uncertainty implied by the supply chain itself and how it is structured to deal with attributes valued by the customer. For example, customers need a larger range to select from implies that there will be a greater variance in demand. Similarly, if delivery lead times reduce this implies that demand uncertainty increases because there is less time to react to a change in delivery times experienced. If variety is reduced this implies a decrease in uncertainty as demand for products become more aggregated and hence more certain. Retailers often say that increases in customer service levels are a one-way street meaning they cannot reduce them, there is no turning back. As customer service levels increase and products are more readily available, there is an implied risk owing to surges in demand. Retailers often exacerbate the condition by offering promotions in store across product categories. Stores offering short lead times and high variety have a higher level of implied demand uncertainty than do those with longer lead times and low variety. The paradox appears to be the better you become at attempting to meet customer demand the higher the risk through the uncertainty of implied demand. A further example is the textile apparel supply chain. Downstream at the apparel manufacturer, high variety and fast responsive supply chains carry greater implied demand uncertainty than do the textile fabric mills where customers place orders months in advance of the time it is required for apparel manufacture. Forecasting is easier when demand is more certain (Figure 3.13).

One explanation of why profitability can be low even when margins are high in the retail textile supply chain

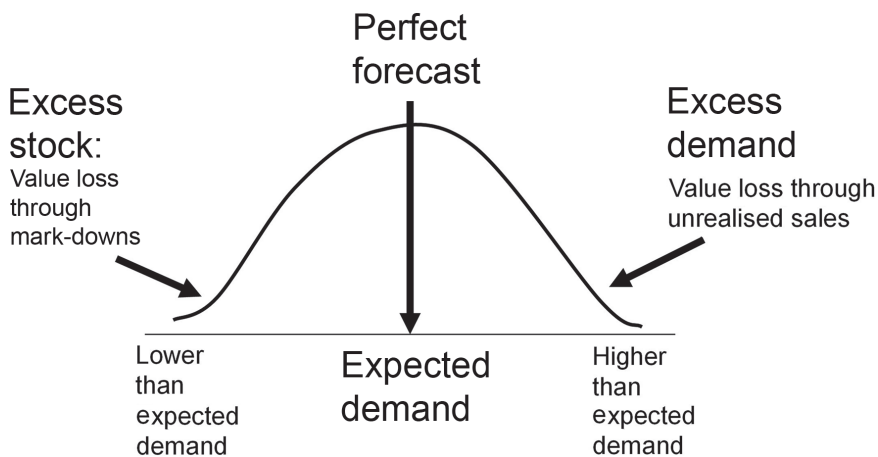


Figure 3.13 One explanation of why profitability can be low

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The environment is far more stable. Markdowns are high for products with high-implied demand uncertainty (e.g., fashion items).

Fashionable clothing has the following attributes: high variety, small volumes, fast lead times in production and delivery and changes offering new design and innovations are done quickly rendering old fashion obsolete. As a consequence, there is high-implied demand uncertainty. If retailers were able to make a perfect forecast or better still not rely on forecast at all but act upon actual demand information a situation whereby there was either excess inventory or excess demand that could not be fulfilled would never arise. Inventory would be scheduled to arrive in time to meet customer demand. Synchronization of these processes would be achieved more effectively thus increasing profitability. In practice, what happens in many retail supply chains is that commitments are made well in advance of the selling season and volumes and other critical decision variables such as colour, size, styles and categories are based on forecast demand. Value can be lost in season if forecasts are inaccurate and inevitably, they are, sometimes by very large percentages. Risks at the retail end of the supply chain are very high which is why fashion margins are set relatively high to cover the risks involved. If stocks do not move as expected hard decisions are taken quickly to mark-down aggressively to move inventories through the retail supply chain. Inevitably, this lowers overall profitability but it does attempt to avoid the risk of being stuck with inventories incurring holding costs.

If demand is greater than expected, sales can be lost by not having sufficient product to sell. This may be equally as disturbing for retailers who have invested heavily in promoting merchandise and sales. In effect, they will have spent money generating demand that they cannot fill but a competitor might. In effect, they have subsidized the competition. Retailers would like to act on real demand and this means they need to have responsive suppliers. A responsive supplier in this context means one that is able to make and deliver quickly to meet demand. This allows a retailer to postpone production until they are sure of demand thus avoiding risk whilst simultaneously not losing customers by not being able to meet excess demand. Wastage is eliminated in the supply chain, stock-holding risks (mark-downs, obsolescence) are removed and customer demand is met efficiently.

Fisher (1997) identified that implied demand uncertainty is correlated to other characteristics of demand as shown in Figure 3.14.

The spectrum of arrangements might include low-implied demand uncertainty for functional items through to high-implied demand uncertainty owing to fashion. Goods and service

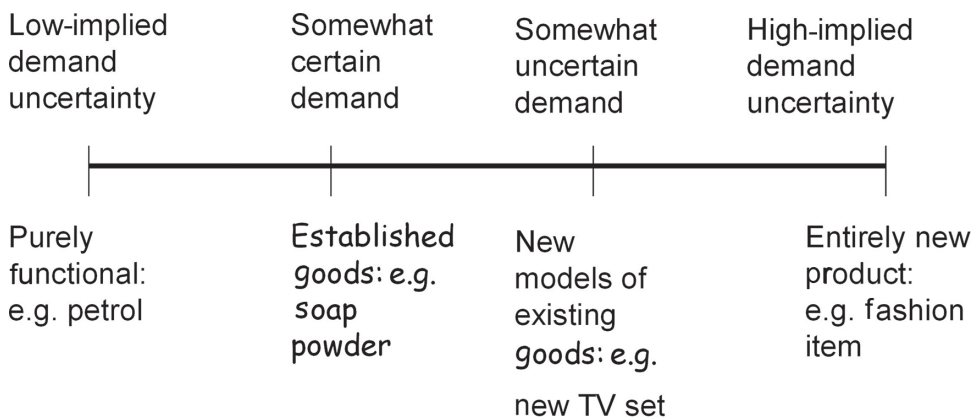


Figure 3.14 Dimensions of demand uncertainty and product types represented

with high-implined uncertainty are often new with little direct competition and as a result, the profit margins are higher than those with lower implied risk. Forecasting is more accurate when demand patterns are more certain. Increasing implied demand uncertainty creates difficulties in matching supply and demand. A stockout or overstock situation is likely as in the case of fashion able clothing. Overstocks lead to mark-downs or lost income through under-stocking, for example, retail promotions.

Understanding the customer is only the first step to designing strategic fit. Meeting demand is the next step. The question is how responsive is the supply chain to the customer's demand? Supply chains have many different characteristics but all supply chains have two important attributes cost and service. In this respect, we can equate service with responsiveness rather than a narrower definition of service level availability. Supply chain responsiveness is a measure of ability to:

- Respond to volume changes in demand.
- Compress lead times (QR).
- Deal with variety of products.
- Build and deliver innovative new products quickly (QR).
- Achieve a high service level.

Supply chains displaying more of these characteristics are said to be more responsive. However, there is a trade-off between responsiveness and cost. For example, capacity may need to increase to deal with larger volumes and more variety and hence this will incur higher cost. Every strategic decision to improve responsiveness will increase cost. Figure 3.15 illustrates that high-levels of responsiveness are dependent upon increasing cost. The responsiveness cost frontier represents a spectrum of strategic choice. Supply chain efficiency is therefore measured as a cost of producing and delivering goods and service to the customer. Increases in cost lower efficiency but they will increase responsiveness. A supply chain can be highly efficient or highly responsive it cannot be both in this model. For each increase in responsiveness, there is a decrease in efficiency.

Putting responsive and efficient supply chains as a trade-off recognizes that different levels of responsiveness have associated cost implications. A highly efficient organization may be less responsive. Take the case of a textile mill it has time to plan production to ensure that volumes achieve economies of scale and the customers have been accustomed to waiting so speed of response has been less important for large volume operators. At the other end of the spectrum

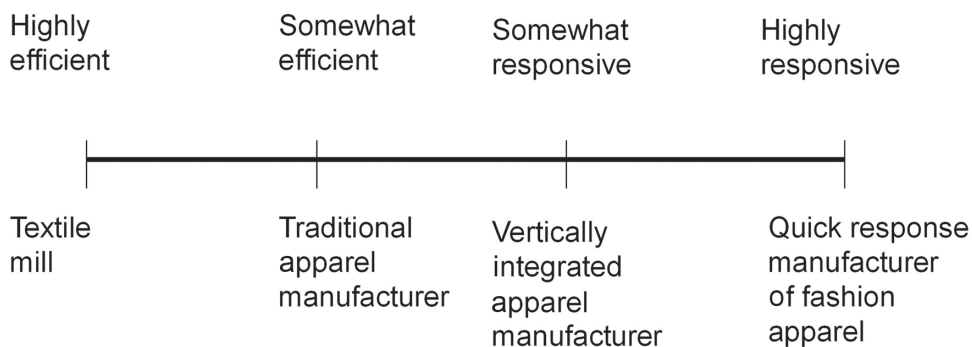


Figure 3.15 Efficient and responsive supply chains

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the quick response apparel manufacturer employed to get replenishment items into fashion retail stores in two or three weeks is under a time pressure and efficiency in terms of cost and economies of scale is less important to the retail customer than ensuring that they do not miss the selling period. Figure 3.16 illustrates the concept of strategic fit further for an organization focused upon efficiency. It illustrates how each of the functional strategies fit with the organizations overall competitive strategy. Having the right supply chain strategy must be strongly associated with the organizations competitive strategy. The supply chain strategy cannot be planned or implemented independently of the corporate strategy.

Understanding what the customer needs and designing supply chain strategies that can meet their needs is what customer focused supply chains are all about. Figure 3.17 illustrates the trade-off involved.

In the two examples, both achieve a strategic fit in terms of their competitive strategy. The large textile mill competitive strategy is to have large volume orders to gain economies of scale to minimize operational costs and offer customers best prices. Because the mill can be reasonably certain regarding the implied demand it is more focused on achieving efficiencies which is valued by its customers rather than responsiveness which would cost more and which the customers may value less than the price paid. In the case of the quick response, fashion manufacturer speed of response is highly valued by the retail customer so that they do not miss the season sales. Price is less important and therefore supply efficiency is not as important as ensuring timely supply. There will be a strategic fit between the corporate and supply chain strategies in this case because the organizational competitive advantage is built around speed of response and so too is the supply chain strategy. Fisher (1997) identified a comparison of different strategies based on whether the organizational primary aim was to be efficient or responsive. Table 3.4 summarizes the different approaches discussed.



Figure 3.16 Strategy fit: how supply chain strategies fit with competitive organization strategies

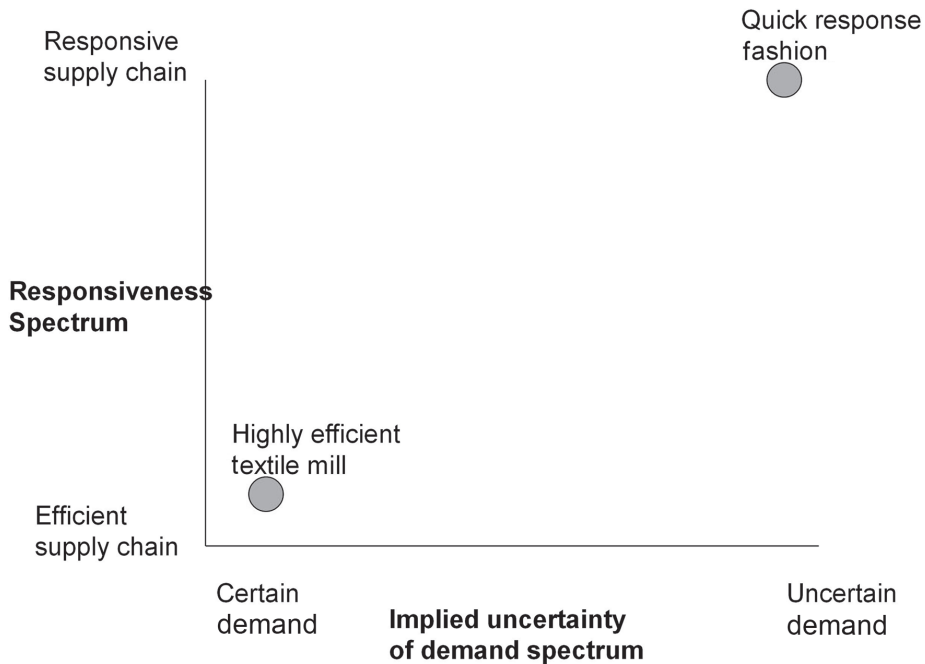


Figure 3.17 Uncertain demand and responsiveness of supply chain

Table 3.4 Characteristics of efficient and responsive supply chain strategies

	<i>Efficient supply chain</i>	<i>Responsive supply chain</i>
Primary goal	Supply at lowest cost	Quick response (QR) time and flexibility synchronicity (effective in meeting customer demand)
Product design strategy	Maximize performance at lowest cost	Create modularity to share materials, components, parts to allow postponement and product differentiation
Pricing strategy	Lower margins, higher volume, price is the prime customer driver	Higher margins as price relatively less important to the customer
Manufacturing strategy	Lower cost through high plant utilization	Maintain capacity to meet unexpected demand
Inventory strategy	Minimize inventories to lower cost	Maintain buffer inventories to meet unexpected demand
Lead time	Reduce but not at the expense of cost increases	Uncompromisingly lower lead times even if it means incurring higher costs
Supplier strategy	Select suppliers on the basis of cost and quality	Speed, flexibility, quality and dependability are the most valued characteristics of a supplier
Transport strategy	Choose lowest cost mode of transport	Choose fastest means of delivery depending on need regardless of cost
Service strategy	Standardized-fixed	Adaptive – flexible
Value strategy	Cost based – necessary emphasis to reduce cost	Price based – emphasis on responsiveness may require price adjustments

Source: Adapted from Fisher (1997) with service and value strategy added by author

***Synchronizing the supply chain to meet customer demand***

The value proposition put to the customer should be congruent with the needs identified in the market segment. It is important to recognize that within organizations there may be scope to have different supply chain strategies focused upon different groups of customers. In other words, there may not be a single supply chain strategy for the whole organization. Rather there may be a number of different supply chain strategies that fit strategically with the corporate strategy and the different competitive strategies being pursued in different market segments.

There are two clear elements to any market offer and they are:

- Visible elements – choice presented to the customer (the store, the catalogue, the website, the sales people and the merchandise) and delivery
- Invisible element – the back office, the factory, the supply chain

Production of goods and services is largely hidden from the customer in most situations unless, for example, the chef cooks a meal at your table and presents the food in front of your eyes you would never know what goes on behind the scenes in most restaurants. You only see the finished article, food delivered to your table. The panic to get the right vegetables, fish and other ingredients to prepare the food, the stand in chef owing to illness, the earlier fire in the kitchen, the fact that two staff are off tonight, the fact that the cooker is playing up you are blind to. The ambience is calm and relaxing in the restaurant itself and this is the only part you see. Synchronizing production and supply chain activities with customer choice is the key to successful fulfilment. Meeting the customer's need becomes the focus for restaurant staff in the example. The fact that there are labour shortages and supply chain issues is something they need to sort out to deliver the menu they have offered, is an example of a highly responsive supply chain.

Understanding strategic concepts and competitive dynamics so that we can design and implement better strategies is essential. In order to mitigate supply chain risk we can examine fragility, vulnerability and rigidity (FVR) in specific supply chains (Martins & Silva, 2021). If you want to see the maths behind how to do it take a look at the *Encyclopaedia of Earthquake Engineering* (Porter, 2021).

It is often stated that it is supply chains that compete. Intuitively this appears so but do we have the metrics to understand the total supply chain? Recent research suggests not. There is a need for more research on such an important topic especially as many supply chains are more complex (Smith et al., 2022). Understanding competitive dynamics so that we can design and implement better strategies is essential. If we want to understand performance and risk better it is suggested that we need to examine agility and resilience together rather than in isolation (Gligor et al., 2019). The ability to build organizational capabilities to be flexible is essential too, if supply chains are planning for resilience to deal with uncertainties (Huo et al., 2018). Demand driven supply chain strategies became a necessity during the Covid 19 pandemic (Ishak et al., 2023). Adaptive strategies will become the norm when disruptions strike. More than ever supply chain strategies need to be market (demand) driven and customer focused in an age of uncertainty.

**Summary**

It has been noted that strategy is both content and process. Many of the frameworks are, in effect, process models of how to form and formulate strategy. These processes allow the content of strategy to develop. For example, the strategic planning framework begins with environmental



scanning and analysis that determine opportunities and threats and organizational strengths and weaknesses. From this analysis content for vision, mission, purpose and strategic objectives are set and determine strategic choices having evaluated a range of options, means to the desired ends. Visions are translated into a detailed plan, process and content, which is implemented (process) and then controlled (process).

These strategic processes are similar at different levels of strategy. It is content and context of strategy that is different at different levels of strategy. In the supply chain system context, for supply chain strategies to develop, the development process may be intentional, deliberate and planned. The realized supply chain strategies may be the result of planning and/or a consequence of unintended, non-deliberate, emergent influences. Past strategies may be described identifying both the planned and emergent strategies realized by an organization. Future strategies are planned and offer prescriptions to achieve a desired future objective. Management interventions occur as a consequence of recognition that an emergent strategy is desirable or not desirable. Management effort might be increased to shape the desired emergent strategy or to dampen and curtail an undesirable emergent strategy. Management interventions also shape the strategic plans, the intended strategies chosen to deliver the strategic objectives.

This chapter began by discussing approaches to strategy as a descriptive or prescriptive. Differences between strategic planning and strategic management were noted from the literature. Strategic concepts were also linked to discussions of supply chain strategies. A number of different definitions and statements of what strategy is according to various commentators over time were offered. It was recognized that in reality realized strategies might be planned or emergent and that some planned strategies are never realized. A number of important strategic conceptual frameworks and planning models were also introduced. The next chapter will focus upon the emergence of supply chain management and the need for supply chain strategies. These strategies must be customer focused and market driven. The final part of the chapter explained the need to develop supply chain strategies that fit with the organization's competitive strategy.

### **Discussion questions**

1. Define the term "strategy."
2. Discuss the difference between strategic planning and strategic management.
3. Explain what you understand to be the differences between descriptive and prescriptive strategies.
4. Identify different levels of strategy and give examples of each type of strategy.
5. "Strategic thinking is required to develop strategy." Do you agree?
6. "Competence and capabilities are important for an organization to develop appropriate supply chain strategies." Discuss.
7. Explain why organizational learning is important to achieve strategic objectives.
8. Explain why it is important to develop supply chain strategies that take account of "strategic fit."
9. "Committing resources to supply chain strategies has an opportunity cost." Discuss.
10. "Synchronizing supply chain activities is an important part of any supply chain strategy." Discuss.

## Note

- 1 Adam Smith published *The Wealth of Nations* in 1776 and within the work described in great detail the benefits of specialization in relation to the production of pins. The essence of the argument was that through specialising in a particular skill each worker could become more productive in that aspect of work. As a consequence of specialising in a particular skill or few skills, each worker's contribution to the total production process becomes more effective and a firm is able to produce more in a given time. David Ricardo referred to comparative advantage and although this concept was discussed at the macroeconomic level comparing countries it has great similarity with the arguments presented at the micro economic level when drawing comparisons between firms. A comparative advantage is said to arise when a particular country is able to concentrate its efforts or resources on those activities in which the country has a comparative advantage. A core competence is a skill that a firm has that distinguishes it from competitors. By focusing upon its core competencies, a firm can achieve a competitive advantage. Therefore, historically economists were concerned with specialization to achieve a comparative advantage at a macroeconomic level whereas today managerial economists have focused upon core competencies to achieve a competitive advantage at the firm level.

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## 4 The emergence of supply chain management and supply chain strategy as a critical success factor for organizations

### Introduction

The purpose of this chapter is to discuss the emergence of supply chain management, the underlying concepts and the development of supply chain strategies as an important influence upon successful organization strategies and operations. The chapter begins with a discussion of historical developments generally and in organizational management that have created the necessary conditions for the emergence of supply chains as an important focus for managers. It then moves on to address contemporary issues that occupy the mind space of practising managers. Empirical examples demonstrate the importance of the supply chain phenomena in creating successful strategies, structures and relationships that enhance organizational value. Finally, future directions are considered before outlining a new research agenda for this developing and important aspect of business management.

Supply chain management was a phrase first coined in the early 1980s to describe the range of activities co-ordinated by an organization to procure and manage supplies (Oliver & Weber, 1982). Initially the term referred to an internal focus bounded by a single organization and how they sourced and procured supplies, managed their internal inventory and moved goods on to their customers, (Harland, 1995; Macbeth & Ferguson, 1990). The original focus was later extended to examine not simply the internal management of the chain. It was recognized that this was inadequate and that the reality in managing supplies meant that supply chains extended beyond the purchasing organization and into their suppliers and their supplier's supplier (Christopher, 1992). It is recognized that there may be tiers of suppliers. Additionally, it is recognized that the organization may have a customer who has other customers where their supplies are incorporated into other products or bundled in a particular way to provide a different product.

You may ask yourself the question why is managing a supply chain seen as important. Firstly, customers have so much choice nowadays from an enormous field of competitors that delays in supply mean delays for the customers who probably are not willing to wait when they can obtain the same or similar substitute product elsewhere. Secondly, perhaps when you realize that the average retailer's balance sheet has inventories worth over 50 per cent of the total value of assets it brings the issue into focus. Thirdly, the average manufacturing company spends over 50 per cent of every sale on raw material, components and maintenance repair operations (MRO) purchases then it becomes crystal clear why managing the supply chain is so significant. In this context managing the supply chain is a critical success factor (CSF) for most organizations (Leidecker & Bruno, 1984). This is an important question for supply chain strategists: which are the few factors that require careful management and are critical to the organization (Barney, 1999; de Wit & Meyer, 1998)? Supply chains span organizational boundaries and therefore it is



appropriate to address the question to identify the critical factors within a supply chain system (Cox, 1997; Malik et al., 2011).

### **Historical developments**

Organizations historically structured themselves into functions: purchasing, production, distribution, marketing and accounting. These functions managed discrete parts of the organization. In a business environment where organizations were in competition with one and other it was important to control the internal organization in order to compete. As business networks have developed and become more complex the boundaries of organizations have become less discrete and somewhat blurred (Barney, 1999). Some commentators have gone so far as to suggest that this blurring of boundaries may mean that it is not organizations that are in competition any more but rather supply chains (Christopher, 1996). Functional structures have become historical straightjackets rather than practical. As a consequence “functional silos” restrict intra-organizational and inter-organizational development necessary to compete in the modern business environment (Slack et al., 2001).

### ***Metaphorical descriptors – pipelines, chains and networks***

It is interesting to examine both developments in the management literature and in practice. Much of the concern with supply chains developed from the purchasing and operations management literature throughout the 1980s and 1990s which have their roots in earlier organizational and management literatures relating to marketing, purchasing supply and economics disciplines. Metaphors have always been adopted to describe these organizational structures. In practice journals in the apparel sector throughout the 1970s and 1980s the term “pipeline” was used to discuss the flows of raw materials through manufacturing processes and onto the final customer (Hunter, 1990; Hunter et al., 1993). The term “supply chain” first appeared in a US Outlook article (Oliver & Webber, 1982). In the 1990s “supply networks” became fashionable (M.G. Christopher, 1996). However, it doesn’t help students or researchers in this area that commentators develop new terms frequently even though they are essentially referring to the concept of managing supply chains. For example, “commodity chains” have been used to describe global production networks (Gereffi, 1994). The next two sub-sections provide a discussion of the focus of analysis and the major themes that have emerged from the literature.

### ***Levels of analysis***

Early work referencing supply chain structures focused on internal operations from the point of entry into the firm until it exited to the customer (Macbeth & Ferguson, 1990). Indeed, Oliver and Webber (1982) were referring to the integration of internal business functions and the flow of materials and information coming into and going out of the business when they originally coined the phrase. This particular definition equates closely to the traditional materials management perspective (Houlihan, 1984; Stevens, 1989; Jones & Riley, 1985). As Harland (1995) recognized the term supply chain management has had different meanings for different writers. Many early studies and some later studies (Burt, 1984; Campbell, 1985; Hakansson et al., 1976; Heide & Miner, 1992; Lamming, 1993) have focused upon the dyadic aspect between a supplier (manufacturer or distributor) and buyer (retailer or distributor). In supply chain terms, these are only two links of the chain.

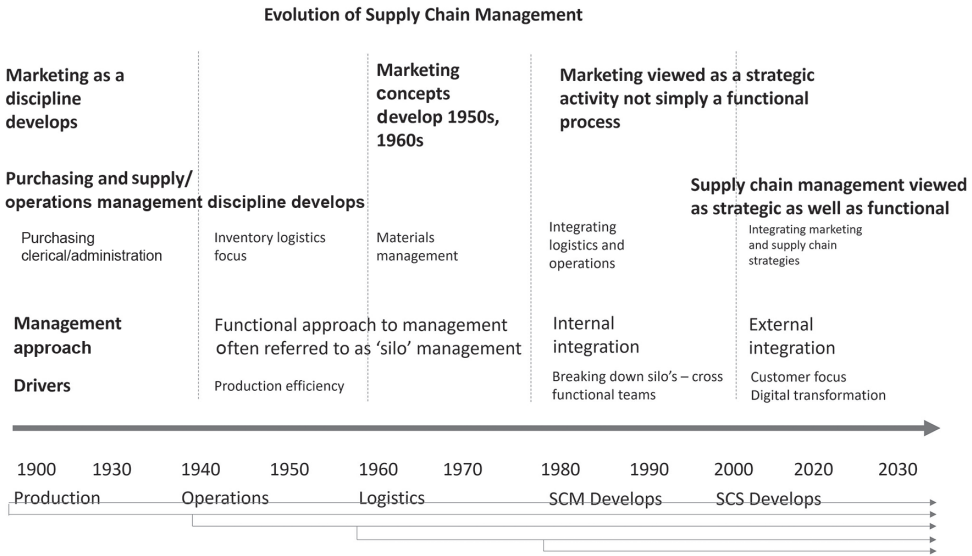


Figure 4.1 Evolution of supply chain management

**Themes in the literature**

A number of themes may be observed from a study of the eclectic literature referring to supply chains. Figure 4.1 illustrates the developments that have taken place in what we have come to regard as supply chain management literature. Themes emerged as the focus and emphasis within the literature changed to reflect the practical concerns of managers at the time. The diagram illustrates the separate development of the different literature bases underpinning and discussing what we now regard as supply chain management concepts. The literature develops from tactical and operational concerns to address the strategic issues. Contemporary literature has synthesized different ideas from the underpinning disciplines into first supply chain management and later supply chain strategy. This section discusses some of those important themes.

*Transaction costs*

Themes emerge from the literature often reflecting the contextual concerns of the time. For example, *transaction costs* were of prime concern from 1937 with active research conducted in the 1940s and 1950s and the main discipline through which the studies were conducted was economics (Coase, 1937; Heckert & Miner, 1940). There have been a few later studies on this theme such as Williamson (1979), Ellram (1994) and Hobbs (1996). A main focus of transaction cost analysis has been concerned with 'power'. Power is important in the transaction process since it determines the negotiation which is often based on price alone. Within this theme, power is seen as important within the exchange process between two or more parties. In retail buyer-supplier transactions power has moved from suppliers in the 1940s, 1950s to the retailers in the 1960s, 1970s, 1980s, 1990s, 2000s with increasing concentration of retail buying in the hands of a few large retail organizations in most sectors including food and fashion.



*Manufacturing supply chains and efforts to lower inventory costs*

Since the First World War and more particularly after the Second World War *manufacturing management* and *industrial management* provided the context and the focus for research examining aspects of what we now recognize as supply chain management. For example, Forrester (1961) examined the “bullwhip” effect of managing inventories and recognized that the further up the supply chain from the end customer one examines inventories it will be subject to amplified swings of over and under supply as a consequence of errors in the demand forecast. Research into the dynamics of supply chains and modelling the effect of changes to teach managers about the consequences has been a major theme since Forrester first examined the “bullwhip” effect in the 1960s when systems thinking became popularized in management. The temporal dimension is important since simultaneously throughout the 1960s and 1970s interest was growing as computer power developed in mathematical programming applying optimization-modelling techniques to supply chain inventories. Since then many studies have concentrated on simulation and pipeline modelling (Fisher et al., 1994; Fransoo & Wouters, 2000; Goodwin & Franklin, 1994; Shapiro, 2001). Ellram on the other hand examined vertical integration suggesting that organizations that owned their supply chains were much more likely to be able to manage them effectively (Ellram, 1991).

This tradition has been maintained through the works of different researchers: examining innovation strategies and lean supply in the automobile sector (Lamming, 1993); much of the work of the Industrial Marketing and Purchasing Group examining a variety of supply chain interactions across different industrial settings (Ford, 1990); world-class suppliers (Hines, 1994) examining continuous improvement (Hines & Rich, 1994; Hines, 2002b). The work examining value streams and value stream mapping conducted by Hines et al. (2000) builds on previous studies conducted into lean production and agile manufacturing. Investigations into a number of specific techniques such as lean production (LP), just-in-time (JiT), world class manufacturing (WCM) and total quality management (TQM) continue in this tradition. Harrison and Storey (1996, p. 63) classify these several operational supply chain concepts as new wave manufacturing (NWM). One could add to this list quick response (QR) originally developed through pipeline management projects in the US textile industry conducted by Kurt Salmon Associates and others (Hunter, 1990; Hunter et al., 1993; Hunter & Valentino, 1995). QR is viewed as a derivative method of JIT by some commentators. Harrison and van Hoek (Harrison & Van Hoek, 2002, p. 160) view QR as an application of JiT and lean thinking whereby customer demand is satisfied by producers and suppliers reacting quickly when demand is known rather than making for stock. Others view QR as a “management paradigm and a methodology” (Lowson et al., 1999).

*Time compression and responsiveness*

Most of the emphasis in QR was focused upon “pipeline” modelling to reduce time throughout the supply chain (KSA, 1987). However, in practice much of the controllable element was dyadic between the organization initiating demand and their immediate supplier (Iyer & Bergen, 1997). In some respects, it could be argued that the success of QR might be dependent upon a number of dyadic relationships that are co-ordinated effectively. Questions arise over who can effectively co-ordinate and who is allowed to? Take the example of a large clothing retailer who contracts the manufacture of own label fashion. The retailer’s often co-ordinate all suppliers including the textile mills supplying fabrics to the manufacturer, the trim suppliers, production

# Supply Chain Process Cycles

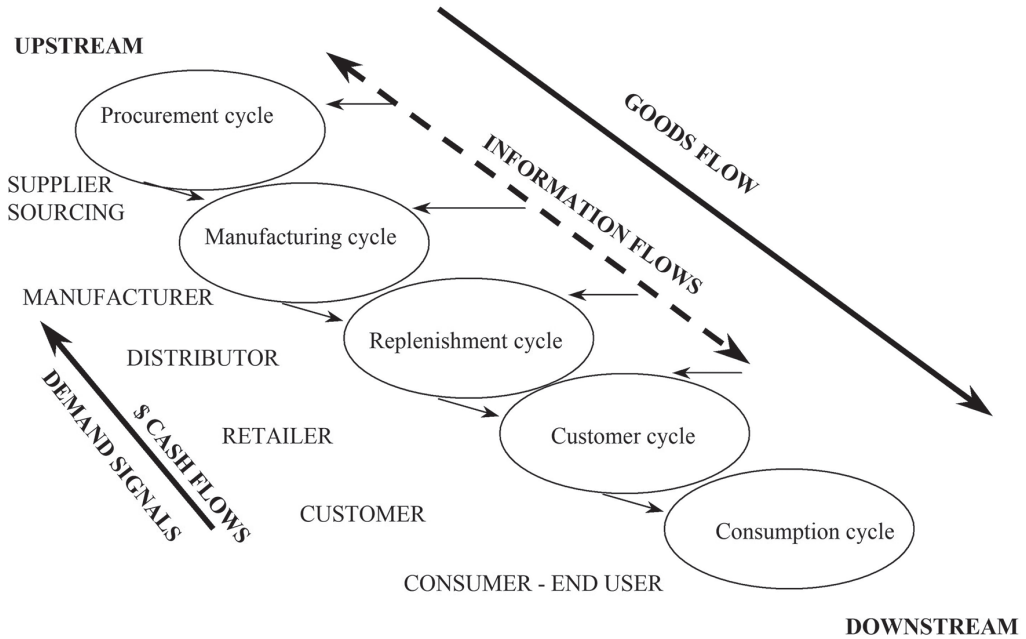


Figure 4.2 Supply chain process cycles

schedules and quality of the converter (contract clothing manufacturer) and logistics services to move goods between each one and deliver to the final destination. Each supplier in the chain has a dyadic relationship with the retail co-ordinator.

Time compression reduces costs by making each process cycle shorter. Shorter lead times in procurement, manufacturing, replenishment, customer purchasing and consumption result in faster throughput times in the supply chain system. Figure 4.2 illustrates the supply chain process cycles.

Efficient consumer response (ECR) is an extension of QR it was developed as part of a grocery industry analysis conducted by Kurt Salmon Associates in the United States (KSA, 1993). This work was conducted a few years after they had done their work in the textile industry on QR. ECR's purpose being to integrate supply chain management with demand management to create smooth flows of product through the supply chain to satisfy consumer demand efficiently (at lowest cost). The four pillars of ECR are: store assortment, promotion, replenishment and new product introductions. The focus of ECR is between the retail organization and its suppliers whereas the focus for QR is on manufacturing capability and efficiency to deliver promptly.

Guiding principles of ECR were defined by KSA (1993) as:

1. Constantly focus on providing better value to the grocery consumer: better product, better quality, better assortment, better in-stock service and better convenience with lower cost throughout the total chain.

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2. ECR must be driven by business leaders determined to achieve choice to profit by replacing the old paradigms of win/lose trading relationships with win-win, mutually profitable business alliances.
3. Accurate timely information must be used to support effective marketing, production and logistics decisions. Information must flow externally between partners through EDI using UCS standards and will informally affect the most productive and efficient use of information in computer-based systems.
4. Product must flow with maximization of value adding processes from the end of production/packaging to the consumer's basket so as to ensure the right product is available at the right time.
5. A common consistent performance measurement and reward system must be used to focus on the effectiveness of the total system. Better value through reduced costs, lower inventories and better asset utilization. Clear identification of the potential rewards (increased revenue and profit) and promotion of equitable sharing of those rewards.

Clear Supply Chain Themes emerging from ECR are:

1. Better value and efficiency in the total supply chain.
2. Profitable business alliances are key to managing the total supply chain.
3. High-quality information is needed to ensure supply chains are responsive to customer demands.
4. Bottlenecks must be identified and removed from the supply chain and activities that add value and lower cost for the consumer must be pursued vigorously.
5. Better performance measures that indicate effectiveness of the whole supply chain rather than focusing upon elements of it must be used if the total system is to respond better to market demand and better measurement is required for equitable reward sharing by those that added value to the system.

A number of important benefits were identified in the dry goods grocery segment in the United States when ECR was first proposed. They were:

1. Ten billion dollar saving in the segment.
2. If ECR was extended to other retail segments this would increase to \$30 billion with 41 per cent less inventory in the supply chain. This extension across segments is what happened when QR was introduced to the general merchandise segment.
3. Consumers are the primary beneficiary of ECR.

ECR is a concept that suggests in its name what it is. It is designed to replenish inventories efficiently by restocking sold items as they move through the supply chain. ECR does so by working with real-time demand data to do that where possible. ECR reduces the cycle time from procurement to replenishment, it optimizes inventory holding, reducing warehousing cost to that which is necessary by avoiding cost for holding excessive inventories. It helps optimize throughput in the supply chain by working with partners sharing data for this purpose. Moving goods from manufacturers, wholesalers, retailers and on to the final consumer as quickly as possible is the aim of ECR, that is, responding to consumer demand efficiently.

*Most retail supply chains today employ an adaptation of ECR even if they do not know the roots of its development.*

*Definition of supply chain strategy*

A new definition of supply chain strategy can be gleaned from ECR philosophy:

Supply chain strategies require a total systems view of the linkages in the chain that work together efficiently to create customer satisfaction at the end point of delivery to the consumer.

As a consequence, costs must be lowered throughout the chain by driving out unnecessary costs and focusing attention on adding value. Throughput efficiency must be increased, bottlenecks removed and performance measurement must focus on total systems efficiency and equitable reward distribution to those in the supply chain adding value. The supply chain system must be responsive to customer requirements.

ECR strategies focus on four key areas which are:

- ***Efficient assortment*** – Optimizing store assortment and space allocation to increase inventory turnover and category sales per square foot
- ***Efficient promotion*** – Reducing the non-value-adding cost of trade and consumer promotion
- ***Efficient replenishment*** – Streamlining the distribution of goods from the production line to the retail shelf
- ***Efficient new product introductions*** – Cutting the cost of developing and introducing new products

By being efficient in these four key areas, retailers can satisfy their customers through ECR (Figure 4.3). ECR strategies and concepts have since migrated to other industry sectors partly through consultants who peddle key ideas across different industrial and commercial sectors.

### **Category management**

Developing a customer-focused approach to category management is critical.

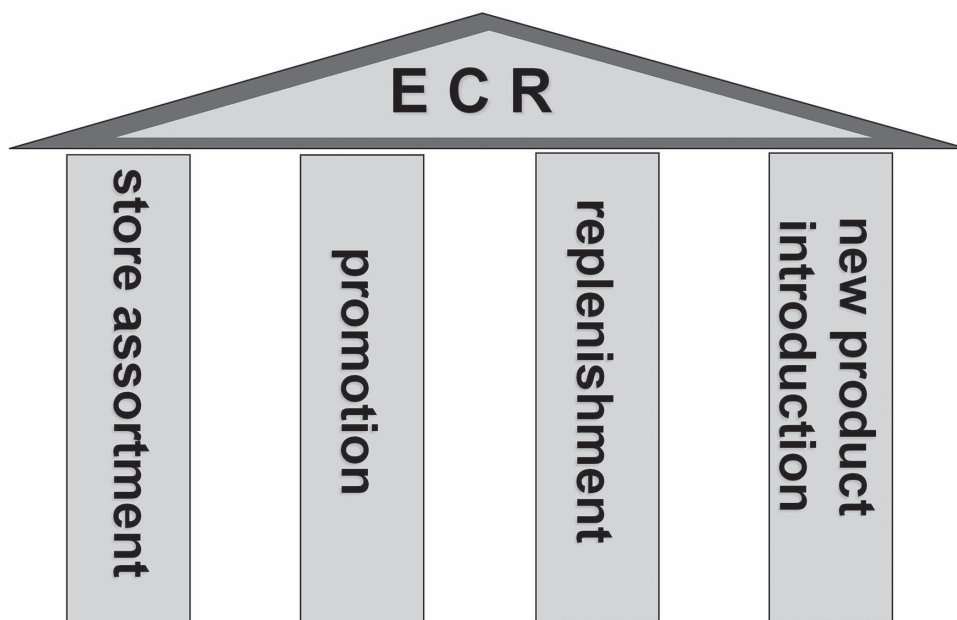
Terry Leahy was CEO of Tesco PLC (the leading UK retailer and second only to Walmart worldwide), for 14 years in arguably one of the most successful growth periods in the company's history. Leahy says the most basic lesson of all he learned while studying marketing at university in Manchester was that "successful companies don't just focus on what customers want, but put the customer at the centre of all they do" (Leahy, 2012, p. 18).

Elsewhere Leahy was quoted as saying that:

The customer marketing research we conducted . . . marked a turning point into us becoming a market-led company. We were determined to follow the customer – so the business would go wherever the customer took us, and we would never try to shoehorn the customer into what we wanted to offer. We stopped following the competition and followed the customer.

*Sunday Times Business Reporter* (2003)

### The four “Pillars” of ECR



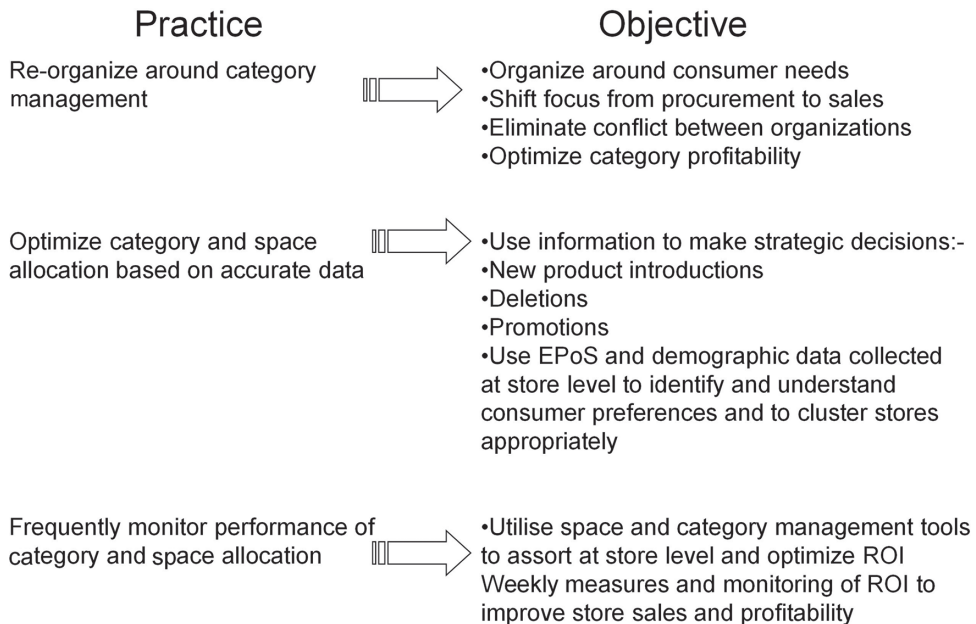
*Figure 4.3* The four pillars of efficient consumer response (ECR)

An important change in the way retailers have organized their businesses to become much more customer focused is through use of category management. Essentially this technique puts products together in different ways that reflect the ways that customers buy products rather than simply grouping products by brand and/or within ranges. In this sense, category management focuses on customer buying habits. It is heavily reliant on having timely, accurate and reliable information about customers in order to make category decisions. For example, Walmart in the United States gleaned information about their customer buying habits in relation to the correlation of sales of nappies and beer on Friday evenings and as a consequence grouped the products together as a category, which improved sales further. The best practice principles of category management are illustrated in Figure 4.4.

In order to manage categories effectively and improve volumes and profitability retailers need to be able to combine different pieces of information together to obtain an informed view of consumer behaviour patterns. Figure 4.5 illustrates the information needed for category decisions.

Accurate scan data is required from every store noting what has sold. Previously, retail organizations relied on warehouse shipment data to record sales but this is only a measure of what has been shipped to store and not what has been sold. Scan data does measure accurately consumer demand. Store level sales history based on scan data must be adjusted to take account of seasons and promotions to discern the underlying sales pattern, which can be used for allocating space. This particular algorithm has been most difficult for retailers to solve. Another important factor to account for is demographic data for the store area. If a store does not stock a particular product, is it because it does not sell, would not sell or because you have never tried it and your customers simply go elsewhere to satisfy their requirements. It may be that customers who go

## Best practice for efficient store merchandising



**Result +10 % volumes and 0.3-0.5 % margin improvement**

Figure 4.4 Best practice store merchandising example

elsewhere also buy all other goods elsewhere and if the store were to hold that item not only would it attract sales for that product but for several other products too which may be product unrelated. The item database needs to store information on case sizes, weight, case quantities, dimensions, other physical attributes as well as cost and price. Ability to continuously update this data is essential as prices, costs and other data change. These variables too will inform the space allocation decision. Activity based cost or direct product profitability cost data must also inform decisions. Typically, in addition to cost of merchandise there are rafts of other cost. Costs maybe indirect (overheads for light, heat, administration, etc.) for each SKU and direct costs of handling, storage and movement of goods, which are specific to the category.

Better performance measurement using activity based costing (ABC), activity based management (ABM), total cost of ownership (TCO) and direct product profitability (DPP) accounting methods are prerequisites for category management decisions. More accuracy in measuring performance can improve the quality of space allocation decision-making. Traditional accounting measures have focused on product level. New measures must focus on the customer. The concepts are illustrated in Figure 4.6.

Many retailers use hand held mobile devices (or apps on mobile devices) linked to cloud based systems to view category data and inform their decision-making as they walk the store. Space allocation is tactical, operational and strategic. At a tactical level, space can be adjusted for seasons, promotions and local events. At operational level, space may be allocated according to availability of merchandise. At a strategic level, decision will be taken to deliver customer satisfaction, which will impact sales volumes, profitability and return on investment (ROI).

### Critical input factors to space allocation

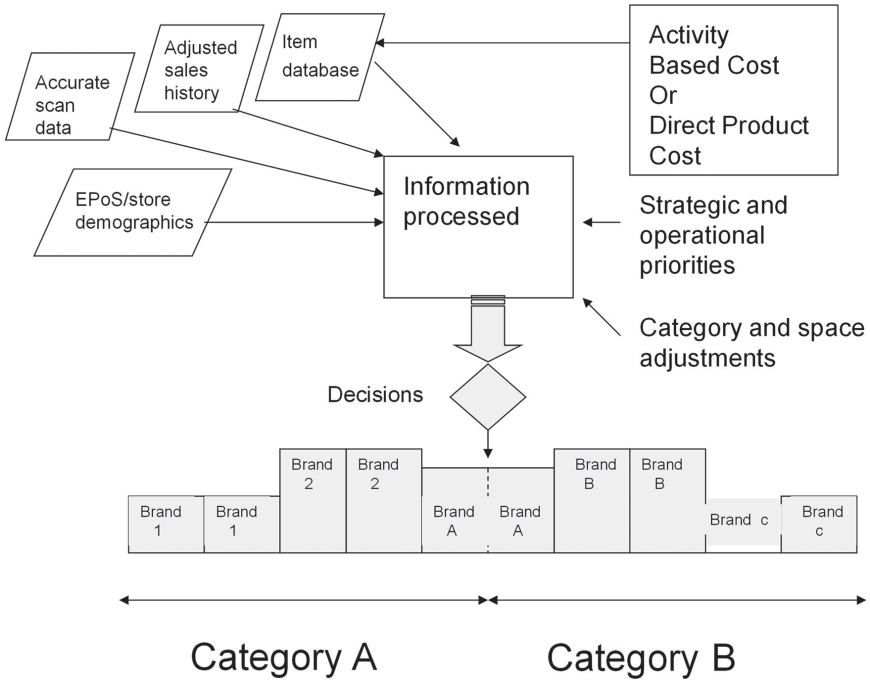


Figure 4.5 Category management

### Category Management Requires New Performance Measures

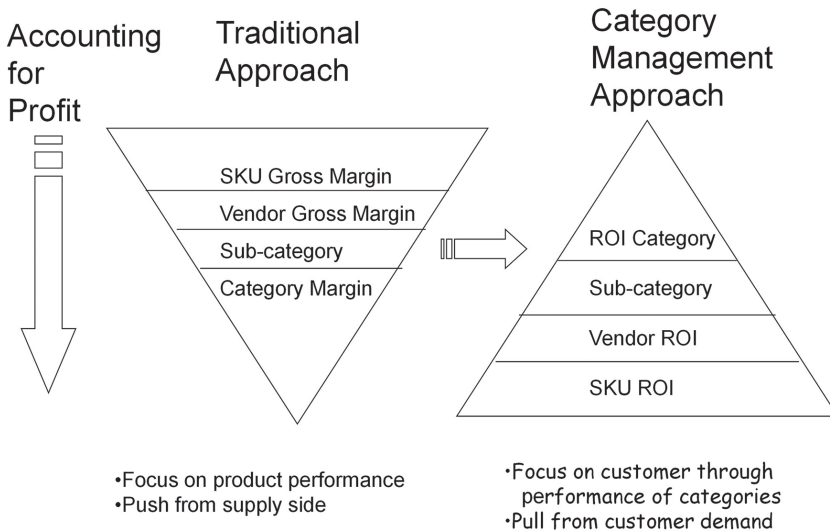


Figure 4.6 Category management and performance measurement



Key drivers of sales margin gains are:

- Store specific categories (local variations given epos/demographics) and space allocation.
- Timely space adjustment for up-trending and down-trending categories.
- Effective transitions to seasonal categories.
- Emphasis on high-volume or high-margin items.
- Improved pricing strategies to enhance ROI.

**Space for broader assortment within category or to develop new category integration**

Stevens (1989) recognized the importance of moving from functional silos towards an integrated supply chain. Figure 4.7 identifies the four stages that illustrate how an organization moves from being functional to integrated and in so doing offering improving customer service levels. Moving from the first stage baseline organization to functionally integrated combines areas of common interest focused upon serving the customer better. Functions integrate at this stage. The third stage is developing internal integration. It is recognized that at each stage material flows become smoother and inventory holding becomes less. The final stage is integration between the organization’s internal supply chain and its suppliers and customers. Flows of materials are optimized at this stage and blockages are removed from the supply chain system. Integration removes cost and time and adds value for the customer as a consequence.

Managing upstream and downstream relationships with suppliers and customers allows superior customer value to be delivered at a lower total supply chain cost (Christopher, 1992). It is argued that by integrating the supply chain, total supply chain costs are lowered. This is

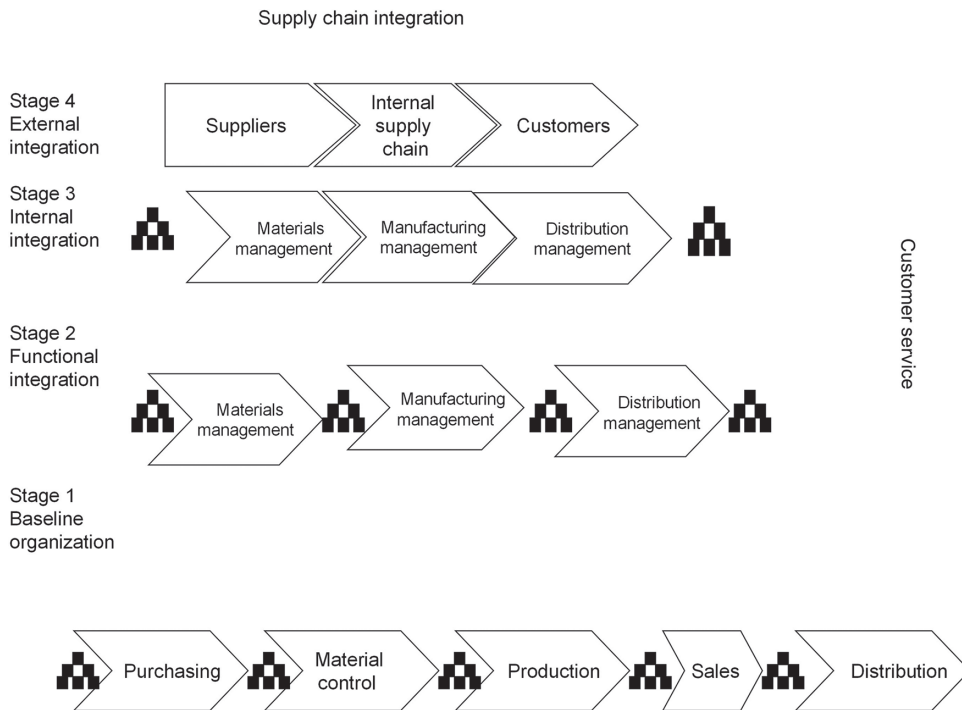


Figure 4.7 Supply chain integration – four stages of development have occurred

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important because it is critical to recognize that supply chains compete against each other not organizations. If a firm is part of an inefficient supply chain that is fragmented not integrated, that is inefficient rather than efficient and not delivering customer service as effectively as alternative supply chains then the customer will migrate to the integrated, efficient and more effective supply chain. Customers buy products and services that meet their requirements. For example, a consumer shopping for fashion on a Saturday afternoon may want to make a purchase from their favourite store to wear something out that evening. If the store does not have stock available, in the right style, colour and size then the purchase cannot be made from that store. The retail store is the end of a supply chain that interfaces with the consumer. It is not simply the retailer that loses out, their customer has and their suppliers have. More importantly, another retail store (a substitute) may benefit if they can supply an alternative item and their supply chain benefits not just the retailer.

***Ethical trading and environmental issues***

Sourcing, procurement and purchasing research has shown some interest in the ethics of buying products from low-cost offshore destinations where there is an impact upon the indigenous environment and community that may be considered detrimental (Green et al., 1998). For example, the well-publicized allegations against companies like Nike and GAP for the use of underage labour in their supplier factories in Indonesia and Bangladesh. Concerns with damage to the environment with pesticides used to protect cotton crops. Excessive pollution caused by dyeing plants not complying with industry wide standards on treatment of waste product. There have been countries where the local population is deprived of the nutritional value by exporting food products such as bananas. The issue of food miles has been raised whereby produce that could be supplied by a local farming community has been sourced from countries that may be many miles from the markets in which they are sold. There is a double concern regarding the impact of such decisions on the farming community that could supply the goods in the markets where they are sold and the concern that the transport pollution causes which is not fully costed nor paid for by those importing the goods.

***Strategic perspectives***

Operations can no longer stand alone in isolation the focus has shifted from what one may describe as operations management towards a strategic management perspective (Macbeth & Ferguson, 1990). Alliances and partnerships have provided the central focus for large-scale studies into supply chain strategies that have been adopted by some of the leading world organizations in major industrial sectors automobiles, aerospace, electronics, textiles, retailing and supporting service industries (Berry et al., 1994; Burt, 1984; Burt et al., 2003; Hines et al., 2000; Kanter, 1994; KSA, 1987, 1993, 1997; Lamming, 1993). Strategic capabilities are examined by Croom and Batchelor (1997), still following the traditions of manufacturing management. Themes in the mainstream strategy literature such as core competence (Prahalad & Hamel, 1990), capabilities (Stalk et al., 1992) and competing through time advantages (Stalk & Hout, 1990) have developed in parallel with research themes into supply chain strategies.

***Supply chain structures and relationships***

The term supply chain conjures up an image of a linear structure with a chain and links between suppliers and buyers at each link (i.e., dyads). Indeed, it is often represented in this way pictorially. However, the reality is much more complex. It has been recognized that the structure

is more akin to a network structure between a number of suppliers and a number of buyers (Christopher, 1992). It has also been recognized that the supply chain may be hierarchical with first tier, second tier and third tier suppliers and so on. In other words, the structures between one organization and a supplier may be further complicated by an array of arrangements at each tier point.

In the 1980s and early 1990s, there was a great deal of interest in why Japanese firms were so successful. Much of the success was attributed to the total quality approaches and continuous improvement (Kaizen) philosophy based on the works of Deming and Juran. Deming's (1986) fourth point of his 14 points on quality advocates that organizations work more closely with fewer suppliers. This is a practice that has been adopted by many retailing organizations throughout the 1990s following practices adopted by automobile manufacturers a decade earlier.

The literature on relationships in the supply chain discusses the traditional "arm's length" approach of purchasing in which adversarial relationships are a common feature on one pole and the "partnership" approach which often adopts the analogy of marriage at the other pole. Often the focus of these studies examines the relationships existing between firms rather than the key business relationships within a supply chain context. Examples of the first category focusing on firm relationships would be Kanter's (1994) examination of strategic collaboration, Porter's (1980) value chain approach, Axelrod's (1984) evolution of relationships, Ford and Farmer (1986) on make or buy decisions and Chao and Scheuing's (1992) study of purchasing relationships. The work of Carlisle and Parker (1989) represented a turning point in recognising that supply chain relationships and purchasing negotiations went beyond the adversarial discussions focused on price alone. Ellram (1991) recognized that these relationships could be much more complex and introduced the concept of networks to explain the types of relationships existing between suppliers and buyers to deliver products and services to the end customer. Around the same time, a number of researchers were examining Japanese supply chain practices in the automobile industry discussed earlier. Womack et al. (1990) introduced the notion of tiers of suppliers as did Lamming (1993), together with the "lean supply" concept; Sako (1992) suggested that companies adopting a partnership approach performed better than those that did not and identified trust as an important element of the relationship.

An interesting alternative perspective that runs counter to much of the relationship literature is offered by Cousins (2002) who identifies three key propositions. Firstly, partnership relationships do not exist. Rather there is a range of collaborating relationships, and they are all competitive. Secondly, organizations do not trust each other but rather they manage risk based on business objectives. Thirdly, and importantly, the relationship itself is a process not an entity and as such focuses on definable outcomes. For example, cost reduction through value engineering or joint product development and problem solving. The relationship observed will have been defined by the definable outcomes. This point of view is supported by Cox (1997) argued that the collaborative approach was not necessarily more effective than a competitive strategy in the supply chain.

## **Empirical evidence**

What differentiates much of the early work in the purchasing and supply literature from the later work examining contemporary supply chain issues are the shifts in focus that have occurred. Table 4.1 illustrates the timeline dimension. These issues are highlighted further through the empirical discussion that follows.

A capability to manage supply chains can prove to be a core competence for an organization. There are numerous examples of business success and failure being dependent upon supply

Table 4.1 Conceptual development of supply chain management

<i>Analytic focus</i>	
<i>From (pre-1990)</i>	<i>To (post-1990 to present)</i>
Predominantly internal focus	Predominantly external (dyadic, chain, network)
Operations	Strategies
Exchange/transactional focus	Relationship/structure focus
Functional processes	Integration
Cost efficiency (inputs/outputs)	Value added (outputs – inputs)
Physical processes	Financial, informational and virtual processes
Product quality (only major concern)	Service quality and total quality approaches
Simple (e.g., dyadic structures and relationships)	Complex structures, for example, networks
Traditional linear supply chains	Digital supply chains – for example, virtual twins (VSC)
Inventory management	Information and customer service
Product focus	Customer focus
Lean	Agile and Lean (leagile)
Rigid	Resilient
Non-responsive	Responsive to customer demand
Global, steady relatively low-risk	Volatile-global more complex, disrupted and riskier

Source: Author – purchasing and supply chain literature 1930s to present day

chain capabilities. Amazon.com is a relatively new e-retailing organization whose very survival and growth has been built around technical and organizational developments related to managing the virtual store and fulfilling customer orders. One important aspect of their development has been their ability to build relationships with organizations external to Amazon who already possessed capability to fulfil their promotional promises.

***Why quick response (QR)?***

QR is an approach to supply chain management based on the concepts of reducing inventory holding cost, postponing the commitment of resources in manufacture until a clearer picture of demand is known and having flexible manufacturing systems that are able to respond. QR techniques were pioneered in the textile industry during the 1980s. In 1986 Kurt Salmon Associates (KSA) a major US consultancy were employed by the “Crafted with Pride Council” a joint textile industry body to examine US apparel and textile supply chains. They went about the task by process mapping activities in the pipeline and discovered it took 66 weeks total time for all manufacturing operations to be completed and for the processes to move raw materials through production and into the retail stores. However, the total time taken in actual production processes (spinning, weaving, wet processing, cutting, sewing, assembly, packaging and distribution to retailers) took only 11 weeks. This meant that 55 weeks were wasted in inventory delays mostly in the warehouse waiting for the next operation to call them out. This wasted time cost the US textile and apparel pipeline \$25 billion according to KSA (1987). This was around 20 per cent of the total industry turnover and it was a cost that had been simply passed on to the consumer until faced with competitive pressure from overseas imports.

Another major success in applying QR principles during the 1980s to manage their supply chain was the Italian fashion knitwear retailer, Benetton. It is not simply QR but the network of suppliers that is important to provide flexibility for Benetton as orchestrator of processes. More recently the company has transformed its organization to develop larger retail formats and exercise more control over its supply chain through vertical integration (Camuffo et al., 2001).

The company has recently established ten “production poles” outside Italy and they are either wholly owned as in the case of Spain, Portugal, Tunisia, Hungary, Croatia or a 50 per cent joint venture in the likes of South Korea, Egypt and India.

It is interesting that Benetton is similar in size of turnover \$1.8 billion to Zara the Spanish fashion retailer, which is often credited with bringing products to market quickly. Zara too is heavily vertically integrated with in-house production in 23 production centres supported by a network of outsourced production suppliers in smaller firms in Spain and Portugal close to its home base in northwest Spain. This is in stark contrast to the majority of their competitors (e.g., H&M, Next and M&S amongst others) who mainly outsource production.

Since 1993 Giordano, a US fashion retailer developed successful QR techniques that today are practised by other retailers such as GAP and The Limited. In the United Kingdom, retailers like Marks and Spencer and Arcadia have also adopted QR principles for some of their more fashionable lines.

QR is a “pull system” and relies on consumer demand information being used by all parties in the supply chain. As a consequence, much of the early concerns were focused on the use of electronic data interchange (EDI) and compatibility between retailers and various suppliers’ systems (Hunter, 1990; KSA, 1987). It is a system that demands close co-operation between parties in a supply chain. A major concern for fashion retailers is that they do not really know whether consumers will like this season’s fashion until they see it and try it in store. It is not like many fast moving consumer goods (FMCG) categories such as detergent. Soap powder demand is much more predictable and does not have the complexities of a fashion item. Soap powder is bulk material, packaged in various sizes and promoted, for example, through coupons offering two for the price of one (buy one get one free). Fashion apparel may have five style variations, ten colours, ten size variations and fashion is perishable. Thus, one simple garment may have 500 variables ( $5 \times 10 \times 10$ ) to account for in the decision processes that the retailer makes. It is further complicated by the lack of standard sizing, which often means that consumers purchase different size garments from different retailers. For example, a consumer buying size 12 at M&S may need to purchase size 14 at Next.

Returns (consumers returning to the store a garment previously purchased) are also more of a problem with fashion. Goods are returned because they don’t fit properly. This may be due to sizing problems or it may be due to a whim. For example, the consumer just did not like it when they tried it on again at home or their partner didn’t like it. No one looks at soap powder and says, “I don’t like the packaging on that let’s take it back to the store.” So, what’s all this got to do with QR? Well, if bulk manufacturing and all the associated costs can be postponed until consumer demand is known rather than simply forecast there is less likelihood of wasting resources. Historically, retail buyers would have relied on forecasting fashion demand well in advance of the season and be committed to orders perhaps 18 months in advance of the selling season (i.e., six seasons ahead). Forecasting is, however, notoriously inaccurate in fashion. Forecast inaccuracy is also expensive. Supposing your gross margin is 50 per cent and you over-forecast on just a single line by 50 per cent, effectively you have no margin and should you need to reduce prices further to shift the stock then you will be incurring cost. This is why QR is so attractive for fashion retailing. QR means a retailer is able to lower risk by trying a product in a small quantity. If the garment sells, they need to be able to replenish the items quickly to maintain availability of product and hence provide customer service.

### ***What’s different at Zara?***

Table 4.2 illustrates some key differences between traditional apparel retailers and Zara’s business model.

Table 4.2 Traditional vis-à-vis fast fashion supply chains

<i>Characteristics</i>	<i>Traditional apparel retailing business model</i>	<i>Zara apparel retailing business model</i>
Supply strategy	Efficiency driven large volumes planned at lowest total cost	Responsive to customer demand; small- and medium-sized volumes in response to customer demand identified by store data
Manufacturing operations	Outsourced to a number of different supplying contractors based on best prices (often globally); do not own their supply chain but need to try and control it through standardized systems, policies and procedures; larger organizations are able to exert pressure	Backward vertical integration enables Zara to manage closely the different supply chain operations from design through to store; own much of their supply chain; what they do not own is closely controlled and relatively local in Spain, Portugal and Morocco with short lead times
Lead times	Long lead times 12—16 weeks fabric, six to ten weeks apparel production, two to three weeks shipping times	Short lead times eight to ten days on some lines, most within 15 days including store shipment
Demand based on	Forecasts well in advance of the selling season	Forecast much closer to season and heavily influenced by real-time demand data transmitted from stores
Replenishment	Inventory levels trigger automatic replenishment orders from suppliers at pre-agreed contract prices	No replenishment – when it’s gone it’s gone and move onto the next hot fashion
Designs	Based on trend forecasts 18—24 months in advance of selling seasons	Based on current catwalk shows; digital photography and ICT used to transmit visual data back to in-house design team to sample and cost; “knock-offs” as they are called in the trade for obvious reasons
Fabrics (textile chain)	Various fabrics produced to specification by textile mills 12—16 weeks lead times, production has to be booked well in advance	Mainly standard “greige” fabrics piece dyed to seasonal colours in demand

Zara’s business model is substantially different from that of traditional apparel retailers. It has been able to achieve a competitive advantage through exploiting these differences. In particular, its ability to get fashionable products to store quickly has meant that it has captured current customer demand effectively. The company has not invested heavily in originality of design, but is fast at copying and capturing current fashionable design trends from international catwalk shows using the latest digital technologies. Vertical integration also gives the organization control of upstream processes such as manufacturing and dyeing processes. Furthermore, vertical integration has meant that the conversion processes can be better synchronized to customer demand through visibility of transactional data at the production units. Zara store managers use palm top computers to gather and transmit store data back to their central headquarters in Spain. Close geographical proximity of production units also helps plan and control production processes and logistics to reduce lead times, particularly transportation. The use of standard fabrics and piece



dyeing technology has also ensured that production is not held up by the textile mills desire for efficiency. Finally, the fact that Zara stores did not adopt the replenishment concept that most large apparel retailers engaged in meant that they freed up time from having to manage the complexity of replenishing stocks and focused upon getting new products in store frequently. The benefits from this simple change have been enormous. Firstly, new products drive footfall through stores, as fashion conscious consumers are attracted to visit more frequently. Secondly, the risks from holding stock that customers may not purchase are significantly reduced when quantities are lowered and store orders are made closer to the selling season. Thirdly, consumers are educated into knowing that if they see something they like they better buy it now because there is no replenishment and consequently unlike many retailers that replenish lines at the end of a season only to find that the customer will now only buy stock if it is marked down, Zara avoids significant markdown costs.

Some of the problems being able to apply the principles of QR reside in the textile areas of the supply chain. Textile production has two main sources: agriculture and chemicals. Each source has its own time cycle. Natural fibres such as wool or cotton take the best part of a year to develop. Synthetic fibres can be made more quickly but production needs to be booked into the textile mills well in advance of the apparel manufacturing cycle. These cycles inevitably have consequences for retail purchasing and replenishment cycles. Many of the most successful QR practitioners are able to shorten these cycles by using “greige” fabric that can be died late in the process. This allows them to achieve the flexibility they require to respond quickly to consumer demand information.

Figure 4.8 illustrates the traditional concept of supply vis-à-vis quick response supply or fast fashion that retail organizations refer to (e.g., Zara). The quick response is achieved by utilizing “greige” cloth or stock fabrics, as previously explained. The longest part of the fashion supply chain is taken up in design, sampling, fabric sourcing and procurement. In the figure, three cycles are illustrated: the textile fabric cycle, clothing manufacturing cycle and the retail cycle to move the product to market and the customer. The shortest parts of the supply chain are the manufacturing and retailing cycles. If retailers can eliminate time and risk by producing closer to the selling period, they can predict demand better and avoid overstocks and understocks. *Postponement* has become a common strategy but has to work in tandem with quick response (Lowson et al., 1999; van Hoek, 1998). Zara are renowned for this and have been able to achieve success mainly by being vertically integrated and responsive to customer requirements. It is easier to apply quick response techniques to “commodity fashion” where consumers expect some fashion content but perhaps fabrics do not need to be innovative or the same as those on the catwalk, it is the look that is most important since the fashion is relatively cheap and almost immediately disposable. Young fashion is fast fashion. Commodity fashion is almost a contradiction in terms, an oxymoron. Fashion suggests difference and commodity suggests similarity. Strategies underpinning fashion exploit difference whereas strategies underpinning commodities are based on price alone. Fashion based on fabric differences are more difficult to translate into quick response. Fabric mills need lead times longer than the complete cycle for what passes for fast fashion. This is their challenge to produce economically and quickly in smaller quantities than they are used to supplying.



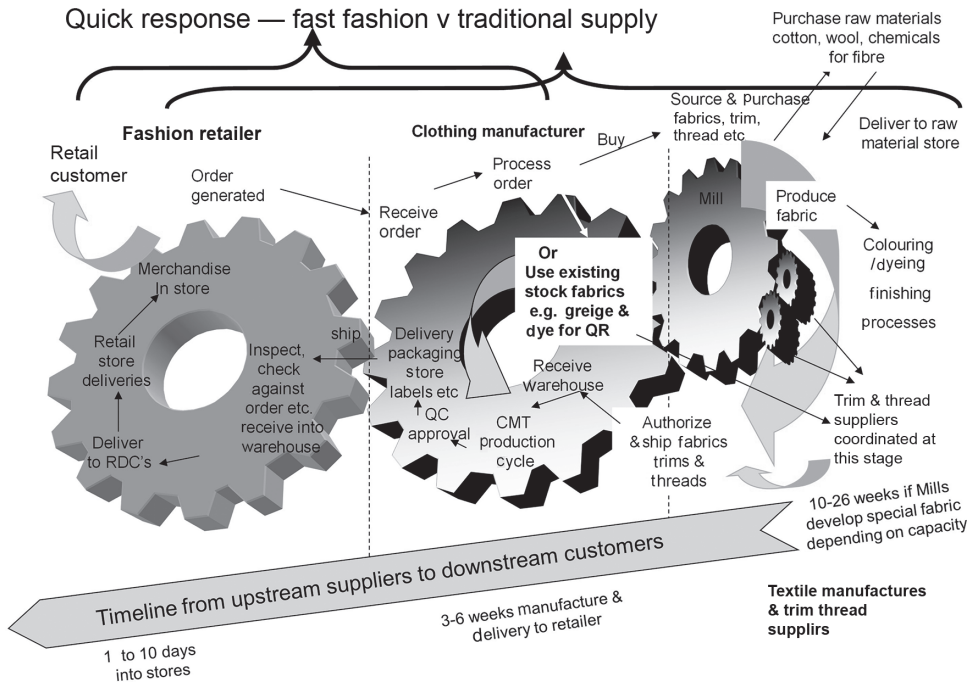


Figure 4.8 Quick response – fast fashion vis-à-vis traditional supply

### Fast fashion at Cecil Gee

Moss Bros started as a men's wear brand in 1851 focusing on formal wear. Many men have hired suits for special occasions from Moss Bros. (e.g., weddings, funerals and dinner suits). Cecil Gee (tailoring) is one of the more contemporary fashion brands the company owns. In the early 2000s sales increased by ten per cent and stock flows from warehouse into store cut from ten days to 48 hours. Total lead times reduced from an average of eight weeks to two weeks. The company placed smaller initial orders with suppliers. It wants suppliers to be more flexible to change colours and/or fabrics for the second or third orders. The benefit to Cecil Gee is they are able to reduce their risk by lowering the risk of uncertain demand patterns and providing the retailer with flexibility to react quicker to trends. Fabric inventory was reduced by 75 per cent.

### Mass customization

For a number of years, a number of retailers and suppliers have experimented with “mass customization.” These experiments have usually involved the production of relatively simple garments with customizations being limited but attractive enough to individual consumers for them to be willing to pay a premium over and above volume factory production prices. Two areas of focus have preoccupied those advocating the approach. Firstly, the development of camera technology that has been employed to take more body measurements than simply waist, leg, chest and collar sizes. These camera measurements have the advantage of being digitally

accurate and digitally storable on smart card technology. Measurements can be instantly transferred to simple CAD/CAM (computer-aided design and computer-aided manufacturing) equipment for customized production. Designs can also be customized (number of pockets, buttons, zips, styles, colours) from previously stored images or may be taken from designs presented by the customer. The second area of focus has been quick dyeing techniques that allow fabrics to be coloured to a chosen design pattern at the point of sale. I have seen examples of prototype production equipment in development in the United States, United Kingdom and South Korea. The equipment is mainly used presently for simple garments (t-shirts, simple dresses and shorts). It is both retail organizations and suppliers of clothing and textile products who see the potential benefits that these improving technologies have to offer. One major US supplier said they could foresee the day that every large store had a customization unit contained within it for certain clothing lines.<sup>1</sup> Levi Strauss has also had a widely publicized experiment with customizing jeans. Consumer benefits are clear if they can have a smart card that holds their personal data that retailers can use when they supply them with a garment, they can be sure it will fit them. From a retailer's point of view the advantage is the consumer is more likely to be satisfied and as a consequence, returns will be minimized, and inventories will be lower if they are able to customize products in store. Mass customization may not simply offer the quickest response of all but it may offer an accurate response lowering the risks for both consumers and retailers.

Key success factors in the fashion industry are often cited as responsiveness and flexibility. This has a specific meaning in a supply chain context. Flexibility means being able to adjust production quantities, styles, sizes and colours in line with the market demand. Responsiveness is being able to adjust the whole supply chain to the needs of the market.

### ***E-business strategies, fulfilment and digital supply chains***

Various commentators using terminologies that shape contemporary views on the topic describe contemporary supply chains differently. The adjectives applied include: flexible, responsive, agile, lean, value adding networks and value streams. Supply chains are more than the term suggests. They are value creation mechanisms for customers. They are not simply "supply" focused nor are they necessarily "chains." Supply chains are dynamic, efficient, effective response networks delivering customer requirements flexibly and on time. These high performance networks consist of customers, suppliers and information travelling through organizational "arterial systems." These arterial systems cut across functional, organizational and geographical boundaries. Supply chain strategies, structures and relationships are highly complex. Configurations will differ within organizations and between organizations.

Supply chain efficiency is critical to customer satisfaction. For example, retailers and their e-tailing operations are dependent on fulfilling the marketing promise. This is achieved through successful supply chain strategies and operations that are integrated and capable of delivering. Systems integration and effective use of information and communication technologies (ICT) is a key requirement. This might take the form of e-procurement, e-design collaboration, order tracking and delivery systems using satellite technology for logistical operations and so on.

What distinguishes the traditional supply chain approach from a contemporary view is the capability for customers to self-design products/services at a price they find acceptable. Collaboration is not simply between a supplier and buyer, but it is possible through digital supply chains to collaborate with the ultimate consumer. This e-enabler may offer scope for those retail organizations and suppliers such as Levi Strauss to transform experiments on customizing products into a mainstream commercial strategy. The storage of expensive items that no one wants

## Digital supply chain collaboration

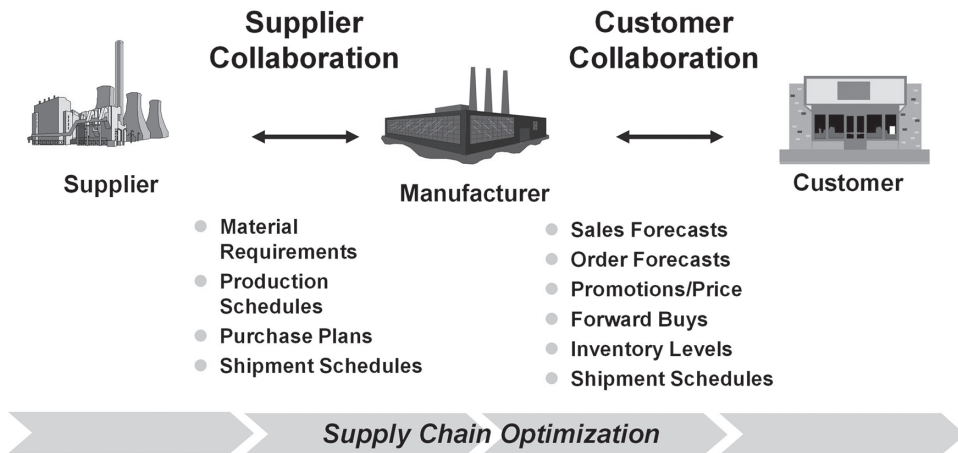


Figure 4.9 Digital supply chain collaboration

to buy is not necessary in a “digital supply chain.” Information, time compression, responsiveness and the flexibility to switch production and delivery routing may all be achieved through the application of “digital supply chain management.” Digital supply chain evolution has been a game changer for collaboration, cooperation and customization.

Benefits of digital supplier and customer collaboration are illustrated in Figure 4.9. Collaboration may include a number of benefits to supply chain parties and could include:

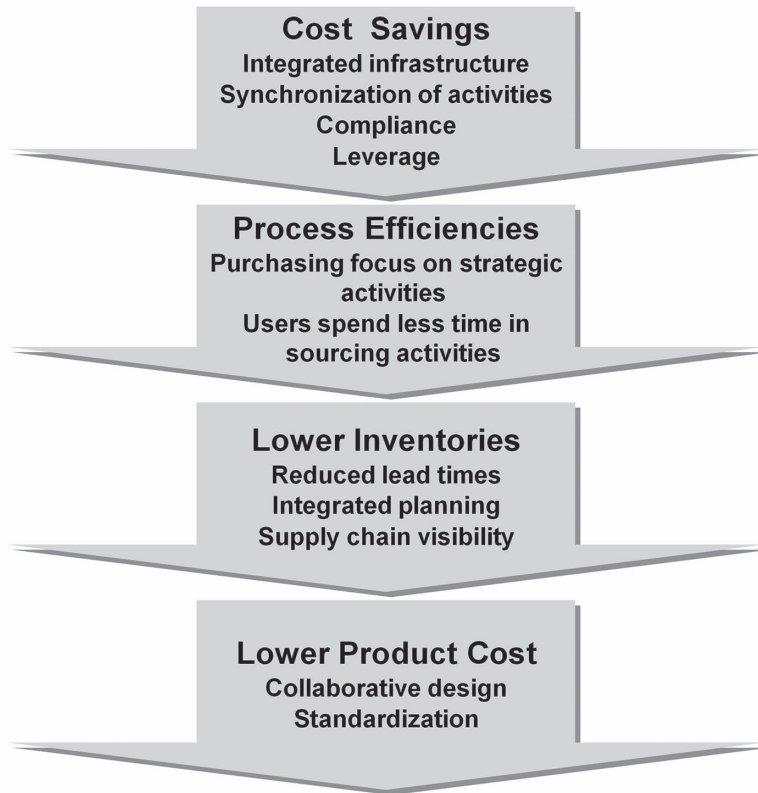
- Shared sales forecasts and production data.
- Shared infrastructure.
- Freight bundling.
- Rapid product development.
- Compressed supply chain cycle times.

Supply Chain benefits:

- Real-time connectivity.
- E-marketplace infrastructure to provide many-to-one-to-many connectivity across the entire supply chain.
- Visibility across the entire supply chain.
- Real-time communication creates a parallel supply chain.
- Responsiveness.
- Reduced time to detect demand, commit, produce and fulfil.

New collaborative supply chain activities span the entire continuum from the start to the end-point of the supply chain. They allow organizations to design, source, plan and analyze supply chain strategies and operations collaboratively. Supply chain benefits of successful collaboration are illustrated in Figure 4.10.

## Successful collaboration may lead to...



*Figure 4.10* Possibilities of collaboration

### Conclusions

This chapter began by exploring the roots of and developments in supply chain management. Supply chain issues, strategies and operations were observable before the term itself was coined in the early 1980s. Practising managers and academics in management and engineering disciplines had concerned themselves with efficiency of operations and how to get the best out of a given set of resource inputs. This may be compared to economists such as Coase, Heckert and Miner and later Williamson who concerned themselves with transaction costs and wider societal cost issues. In contrast, Penrose examined alternative theories to explain firm behaviours rather than simply focusing upon the single objective of profit maximization which previous economists had done (Coase, 1937; Heckert & Miner, 1992; Penrose, 1959; Williamson, 1964, 1971). Later writers have pursued these interests further in the context of managing supply chains (Grover & Malhorta, 2003; A Rindfleisch & Heide, 1997). These early practitioners and writers had a contribution to make in shaping thoughts and concepts that have developed and remained an important part of wider business management and more narrowly focused supply chain operations and strategies. There are clearly identifiable trends and developments that are observable in the literature from the concerns of early management and manufacturing writers examining

ways to lower inventory costs and yet still fulfil the operational requirements to produce goods as and when required by the customer. Early manufacturing operations were structured to build stock in advance of the sales period and in some industries, the time taken to build inventories might be half a year or more. So, it is not difficult to see why managers would be keen to reduce time taken in these processes and to lower their risks in holding stock for long periods before a selling period. A great deal of time and effort of practising managers and academics has been given to these activities and indeed still is with simulation and modeling techniques to search for better supply chain structures, strategies and operations that remove waste, unnecessary movement and bottlenecks from the supply chain system. Lean supply and lean manufacturing systems together with world-class manufacturing, and continuous improvement concepts (Kaizen), are all examples of developments that have been born out of these concerns. The techniques and tools of “New Wave Manufacturing” like quick response and efficient consumer response have developed from these concerns. The latter has its roots also located in marketing and concern with customer focus rather than simply technical or operational improvements to increase efficiency.

Integration was viewed as important from an operational perspective since it allowed firms to standardize operational procedures between different parts of the same organization and later between organizations comprising the supply chain. Modular manufacturing too was an opportunity for firms to standardize components and subassemblies within product building. For example, modern automobiles have standard parts that are interchangeable between different models made by the same manufacturer. This lowers inventory and lowers costs of manufacturing and procurement associated with those parts because they are common to cars across the brand range. Variability is limited. Previously, firms would have held many different parts unique to a single model. Toyota’s system of modular manufacturing changed the way automobile manufacturers designed and built vehicles.

Integration also meant that it became easier to create visibility between different parts of the organization and between organizations by investing in computer systems that could exchange data in standard formats using standard platform (e.g., i2 Technologies, PeopleSoft, SAP and Oracle). Just a few years ago, access to these technologies and standard platforms required a large capital investment but recent developments including widespread use of Microsoft Office and growing Internet usage have allowed smaller organizations and individuals to engage in the exchange of documents using standard formats and standard platforms for a much more modest investment. Furthermore, many software companies have created links between legacy hardware and software systems and more specialized modern software to further allow many large organizations to gain utility from their high investment costs, which would otherwise be obsolete. Merant is one such company that has been successful in creating bridging software products to integrate systems.

Recent supply chain concerns have focused upon wider environmental issues including ethical and ecological concerns. It is envisaged that these ethical and ecological issues will become even more important in the next few years as consumers, politicians, national and international interests are given a higher priority by all concerned. Ethical sourcing and procurement are already high on the agenda of many organizations. Consumer and political pressure groups such as “Behind the Label” which has been influential in exposing sweatshops in the garment industry and “Greenpeace” who have been influential in a number of areas such as greenhouse gas emissions, ozone depletion, genetically modified foods and wild animal protection. “Friends of the Earth” are another highly visible and influential pressure group. We have also witnessed the growing impact of protest groups such as “Occupy” and “Just Stop Oil” disrupting major cities. Greening the supply chain and being more energy efficient has been a focus for government

policy in the United Kingdom and this trend is likely to continue and get stronger. It is, therefore, essential for organizations to have sustainable supply chain strategies and to design supply chain strategies that lower risk from environmental, ethical and ecological pressure groups.

Strategic perspectives lift the study of supply chains above purely technical and operational concerns towards customer-focused concerns. Supply chain strategies focus on satisfying customer requirements. Operational management literature began to address the customer seriously during the 1980s influenced by the Kaizen philosophy for continuous improvement developed in Japanese manufacturing led by Toyota. The customer that literature addressed was referred to as the internal customer. Phrases like “your next factory operation is your next customer” and “the next department/section is your customer” became commonplace in factories implementing Kaizen. There was also a literature addressing external customers that had been developed over 50 years in the marketing discipline, which had largely been ignored by operational managers whose prime concern was efficiency. Towards the end of the 1980s and throughout the 1990s, this literature began to converge and the issues being addressed in relation to customer demand were mirrored in much of the purchasing, supply and operations disciplines. Being responsive to the customer became a prime concern in a fiercely competitive global environment. Now many organizations have strategies that are not simply responsive but rather they are customer centric, by which I mean they place the customer at the centre of everything they do – they are building customer focused strategies. Synthesising the issues, concepts and processes involved is in part one of the aims of this text. Being customer focused requires organizations to consider how best to address the needs of the customer. The customer in this sense is the end customer in the supply chain although it is accepted that there are indeed internal customers at stages in the chain. Members engaging, interacting and exchanging goods, services, information and value throughout a supply chain do so to satisfy some end customer. Economists have always been concerned with means and ends in the context of supply chain strategies; the end objective is to satisfy the customer and the means are the strategies, operations and tactics employed to do so. Strategic imperatives are how resources are employed and deployed to achieve those ends and in meeting organizational objectives, which might include profit, return on investment and other financial measures for profit motivated firms or service, value and benefits for non-profit motivated organizations.

A number of themes have been discussed recognising the emergence of supply chain strategy as a critical success factor for organization strategy. This final part identifies these particular themes and relates them to the 7V framework outlined in Chapter 2. A number of supply chain strategies that take the customer as the focus of attention are identified under each of the Vs value, volume, velocity, visibility virtuality, volatility, variety and variability. An indication of the literature where these matters are discussed is also given in Table 4.3. These themes are further discussed throughout the chapters in this book.

Many new challenges lie ahead and there is increasing uncertainty and risk. Many of the concepts developed to date and discussed in this chapter will adapt and change to meet the new challenges. If you need to be reminded about the road travelled during the pandemic years and the impact it had on supply chains McKinsey have some great articles you can read as a reminder (McKinsey & Company, 2021). A useful literature review on the challenges facing supply chains with regard to Industry 4.0 identifies 11 core technologies deemed critical success factors (CSFs) for supply chain performance (Rad et al., 2022). The authors of the systematic literature review say, “The study covers 221 articles from more than 100 different journals, comprising the Internet of People, the Internet of Things, cloud computing, big data technologies, blockchain, augmented reality, automation, robotics, additive manufacturing, simulation, and semantic technologies as core technological components of the Industry 4.0.”



Table 4.3 Conceptualization of themes identified in supply chain management literature

Focus	Concept						
	Value	Volume	Velocity	Visibility/virtuality	Volatility	Variety	Variability
Supplier (strategies built around 7 key concepts)							
Themes	Reduce cost, reduce risk and simultaneously meet customer demand Transaction cost. Economic value analysis Value chain analysis (states), Value streams (flows) Value building activity including structural and relational arrangements (e.g., vertical integration, managing boundary spanning activities, governance)	Flexibility (Lean/agile), postponement strategies, JiT, bullwhip, throughput, system dynamic capability, SC competence, forecasting based on “real-time” sales data, accurate demand forecasts needed	Responsiveness and anticipation timebased competition	Transparency in the supply chain ICT platforms and systems to communicate visibility to SC partners (information sharing), EDI, ERP, SAP, open source technologies, organizational knowledge and intelligence	There are different types of volatility Firstly, system volatility caused by external factors (PESTEL) Secondly, demand volatility (caused by changing market conditions) This type of volatility affects volume Thirdly, volatility caused by disruptive technologies and innovation Risk and uncertainty Risk assessment, avoidance and management Outsourcing, offshoring and exchange rate risk	Minimum number of choices to resolve uncertainty in a supply chain (see Ashby’s 1956 notion of requisite variety), product/service variety, EOQ, cost implications, for example, inventory holding modular manufacturing, modularity as a standardization and complexity reduction strategy Customization Co-creation	Reduce variability, lower cost, improve efficiencies and ensure quality World-class, TQM
Value proposition to customer	Offer customers value for money based on their preferences. Value not simply in exchange but through time and use (and usefulness)	Flexibility	Responsiveness Quick response (QR) Efficient Consumer Response (ECR)	Investment in appropriate technologies to enable effective supply chains that deliver on time and complete	Continuity of service Safe to deal with – reliable Trustworthy	Variety Range Choice	Zero defects, Right first time every time. Meet or exceed customer expectations. Deliver value controlling costs to maintain or lower price

Evidence where discussion is found (This evidence is indicative not exhaustive)	Everyday discussion in practice Plus (Bagozzi, 1979; Cannon & Homburg, 2001; Caruana et al., 2000; Day, 1990; Doyle, 2000; Geunes & Pardalos, 2003; Gruca & Rego, 2005; Grunert et al., 2005; P. Hines et al., 1998; T. Hines & McGowan, 2002; Lusch et al., 2009; Marx, 1976 [1865]; Mittal, 2001; Mizik & Jacobson, 2003; Niraj et al., 2001; Michael E. Porter, 1980; M.E. Porter, 1985; Raval & Gronroos, 1996; Reinartz & Kumar, 2003; Sirdeshmukh et al., 2002; Smith, 1910 [1776]; Srivastava et al., 1999; S.L. Vargo, 2008; S.L. Vargo et al., 2008; Venkatesan & Kumar, 2004; Williamson, 1971, 1975, 1996; Williamson & Haas, 1999)	Everyday discussion in practice Plus (Combe & Greenley, 2004; Forrester, 1961; Furrer & Thomas, 2000; Gnyawali & Madhavan, 2001; Goffee & Scase, 1995; Grewal & Tansuhaj, 2001; Hunt & Morgan, 1996; Lee, 2004; Teece et al., 1997; Wikner et al., 1991; Williams et al., 2003; Yi et al., 2011)	Everyday discussion in practice Plus (Dewsnap & Hart, 2004; J. Fernie, 1994; John Fernie & Azuma, 2004; Fiorito et al., 1995; N.A. Hunter, 1990; N.A. Hunter & Valentino, 1995; Iyer & Bergen, 1997; KSA, 1987; B. Lawson, 2001; B. Lawson et al., 1999; Stalk & Hout, 1990)	Everyday discussion in practice Plus (Accenture, 2009; Adewole, 2005; Cheng, 2011; Ciborra, 2000; Clemens et al., 1993; Kayas et al., 2008; Lee et al., 1997; Morgan et al., 2005; Nijssen et al., 1999; Aric Rindfleisch & Moorman, 2001; Spender, 1996) Rad et al., 2022	Everyday discussion in practice Plus (Accenture, 2008; Allison, 1971; Deshpande, 1999; Ellis et al., 2011; Gharajedaghi, 2006; Gleick, 1987; T. Hines, 2002a; Lewin, 2001; Liu & Nagurney, 2011; Lorenz, 1995; Meenah et al., 2011; Menon & Menon, 1997; Prigogine & Stengers, 1984; Sheffi, 2001, 2005; Suzuki et al., 2011; C. Tang, 2006; O. Tang & Musa, 2011; Thun et al., 2011)	Everyday discussion in practice Plus (Araujo & Spring, 2011; Ashby, 1956; Lau, 2011; Persson & Ahlstrom, 2006; Pine, 1997; Robertson & Ulrich, 1998; Sanchez, 1999, 2004)	Everyday discussion in practice Plus (M. Christopher et al., 1993; Cosby, 1979; De Ruyter et al., 1996; W.E. Deming, 1982; W.E. Deming, 1986; Faisal et al., 2010; Feigenbaum, 1956; Fotopoulos & Krystallis, 2003; Garvin, 1988; Hellofs & Jacobson, 1999; Ishikawa, 1985; Juran, 1988; Kirmani & Rao, 2000; Mentzer et al., 2001; Oakland, 1979; Rust et al., 2002; Sako, 1992; R. Schonberger, 1990; Sethi, 2000; Sivakumar & Raj, 1997; Taguchi, 1986; Venetis & Ghauri, 2004)
Customer requirements Customer drivers	Service Right customer focus	Suitability for the customer Right product/service	Speed of response Right place	Systems that make it easy to interact Right time	Sustainability Right quantity	Structures – relationships Right price-right value	Standards-quality Right quality

A number of new themes emerging from recent supply chain disruptions have become central to our present understanding of supply chains and inform supply chain strategies. These themes may be divided into macro and micro influences. The macro themes are discussed throughout the book and include environmental factors such as geopolitics, global shipping disruptions, capacity constraints, critical resource shortages, uncertainty and increased risk. Put these changes alongside shifts in global trade patterns, digital transformations underway with Industry 4.0 as well as developments in AI and cloud based information systems creating more supply chain visibility alongside concerns about climate change, environment sustainability goals (ESG) – decarbonization, population migration, modern slavery concerns and it makes for a perfect storm ahead. At a micro level, organizations face challenges to stability and systems that they had relied on for years threatening their normal supply chain strategies. These include changes to just-in-time inventory management, lean thinking, having to move to just-in-case inventories to build resilient supply chains which has pushed up average inventory holding and increased business risk from carrying extra inventories. Agility and responsiveness are critical skill in demand. In some industries, supply shortages have pushed firms to rethink their supply chain strategies to make them resilient by seeking new sources of supply and searching to reduce risk moving production operations to shorter and less complex supply chain arrangements. Some commentators have opined that global supply chain structures built up over the past century or more are changing to more regional supply chain hubs and at a national level we hear new terms like friend shoring gaining traction as geopolitical risk increases but the verdict is not conclusive. What is certain is that major changes are in progress in relation to restructuring many supply chains. These are discussed throughout the book. While this chapter has charted the path we have travelled, we now turn attention to what lies ahead.

The next chapter turns the spotlight on what it means to have supply chains that are demand driven and customer focused.

### **Discussion questions**

1. Several management disciplines converge to create the catalyst for the development of theoretical frameworks used in supply chain management. Discuss.
2. Explain why supply chain management is now seen as a critical success factor for contemporary organizations in different organizational contexts.
3. Cost and customer service are two critical issues that have historically been viewed as conflicting objectives requiring “trade-offs.” Explain why in contemporary organizations the two may be viewed as compatible.
4. Select one major theme from the “empirical evidence” and for an organization of your choice explain why it is important and how it influences their supply chain relationships and/or strategies.
5. Quick response was seen as a way of protecting domestic manufacturers from international competitors. Discuss.
6. How successful was QR as a means of achieving competitive advantage in the 1980s US apparel and textile supply chain?
7. “Fast Fashion,” in many respects, is the daughter of QR but what’s different about it than simply the name change?
8. ECR differs from QR – explain the key differences?

9. Discuss the importance of collaborative supply chain strategies and explain the possible benefits.
10. Explain why logistics fulfilment is critical to supply chain strategy.
11. Disruptive change presents different challenges and requires different strategies to manage supply chains. Discuss
12. What are the biggest challenges facing supply chain managers today?

## Note

- 1 Interview conducted with board members at the VF Corporation in North Carolina, USA, May 2000.

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## 5 Demand-driven customer-focused supply chain strategies

Several important concepts are examined. Market-driven decisions respond to demand signals from customers which is why supply chain strategies need to be customer-focused. There is a strong body of literature that traces the development of demand driven supply chain strategies (Tiedemann, 2020). Here we begin by discussing management functions and management integration across functional and organizational boundaries. The distinction between product push and market pull strategies based on demand signals is explained before discussing product and service attributes in the context of being customer focused in the supply chain. Supply chain strategies are discussed for products and service industries and a number of supply chain levers are discussed building a conceptual framework in which supply chain strategies are conducted. Market driven supply chain strategies are examined using Ansoff's product/market matrix before finally exploring order winning supply chain strategies.

A survey conducted by Gartner in 2021 analyzed results from 983 supply chain leaders in 2021 found 83 per cent wanted to move away from product focused supply chains to customer focused supply chains to improve the customer experience through digital business strategies and 62 per cent were investing in capabilities to “capture, analyze and leverage supply chain specific customer data to support reinvention of the supply chain to drive commercial innovation.” This refocus of attention on customers is pursuing growth rather than emphasising cost cutting (CIPS, 2022).

Gartner recommended three strategies to improve customer experience which are:

1. Collect “voice of the customer data” and share it across functions.
2. Improve the customer experience by aligning metrics to understand what the experience is.
3. Create a customer centric culture in the organization by getting engagement across the organization.

According to Gartner, building a customer focused supply chain requires best practice to focus on customer satisfaction, loyalty and profitability metrics capable of generating customer insight.

### **Organizational structure in relation to supply chain strategies**

Historically organizations were managed functionally to structure and co-ordinate different activities. For example, production was concerned with transforming inputs into outputs and the focus might have been on production efficiency. A consequence of production efficiency might be that unit cost could be lowered being achieved through scale economies. In this approach to managing the business functions there is a risk of “silo mentality” inside an organization,

which results in different functions working independently of organizational strategic objectives. Organizations become blind to inefficiencies and to opportunities. Production departments would be rewarded for efficiency even though their efficiency might result in “making for stock.” The consequences of this could be to increase inventory holding costs. Thus, the actions of the production department impact adversely upon the cost structure in the warehousing and distribution function. There is also an “opportunity cost” attached to this decision since capital tied up in inventories could have been applied elsewhere to earn a return rather than incur higher than necessary cost. Functional thinking also encouraged the organization to think in terms of “supply push” to move stock on to customers. The question was not one of: “does the market demand the product?” but “can we sell it?” Figure 5.1 illustrates how supply chains cut across organizational and internal functional boundaries to deliver products and services to customers. A network of supplier organizations provides inputs to the firm, that in turn, transforms into customer products and services.

An important question is: where does the process begin and where does it end? It begins with customers signalling demand for specific products and services. It ends with satisfied customers receiving the products and services they demanded. It is the marketplace where demand is created and markets drive business supply chains to fulfil the customer promise by delivering their requirements. Organizations, therefore, need to be customer focused to create value through their supply chain strategies. Figure 5.2 demonstrates that the starting point in creating value through supply chain strategy is to understand fully the customer needs. Customers drive markets and market demand.

From the customer’s point of view products and services have a number of attributes such as price, quality, time, functionality and fashion. How these attributes are bundled determines the value that customers place upon the products. In addition to the core product and service attributes one could add service, customer relationships, image and reputation.

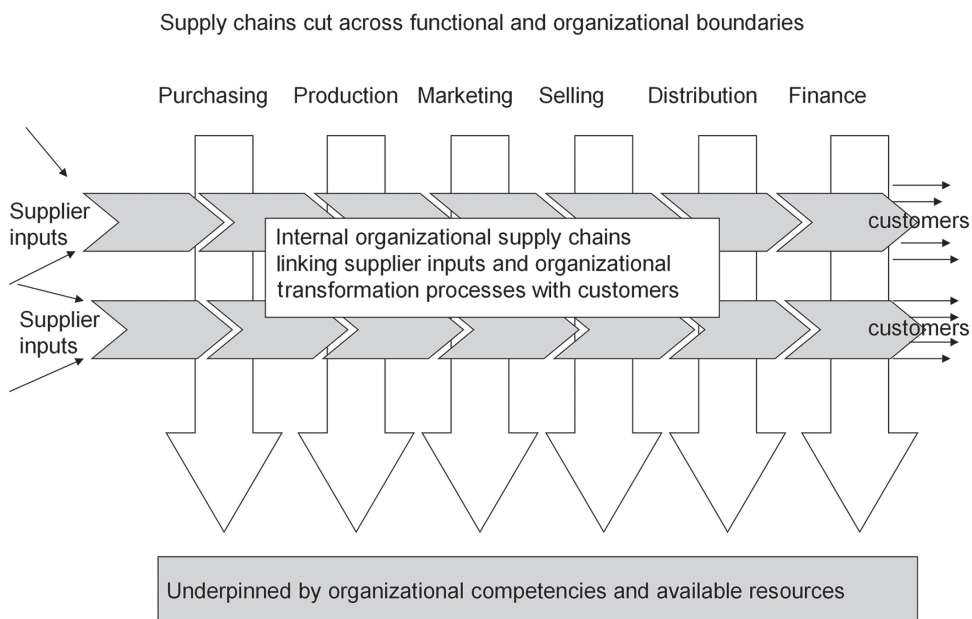


Figure 5.1 Supply chains – silos and integration



It has already been noted that market led supply chain strategies begin and end with the customer. Focusing upon the customer may also mean involving customers at an early stage of product or service design. Figure 5.3 illustrates an input, process and output model for the firm connecting to its supply networks and to its customers. The organizational boundaries are shown by the dotted lines illustrating the fact that in many contemporary organizations these boundaries are not as clear-cut as they once might have been. Take the example of the way automobile manufacturers interact with their suppliers and customers often involving them both in designing products, specifying product components or in the design of manufacturing processes. This form of co-production or co-creation is a central feature of many contemporary supply chain strategies (Vargo et al., 2008). Alternatively, take the case of service interactions with reality TV

**Strategic focus begins by being customer focused**  
**Understanding the customer perspective**  
**What does the customer value?**

	Product/service attributes	Relationship	Image
<b>Customer perspective</b>	price quality time functionality fashion	service relationships	brand reputation

Figure 5.2 Strategic focus means being customer focused

**Transformation processes apply equally to manufacturing and service industries**

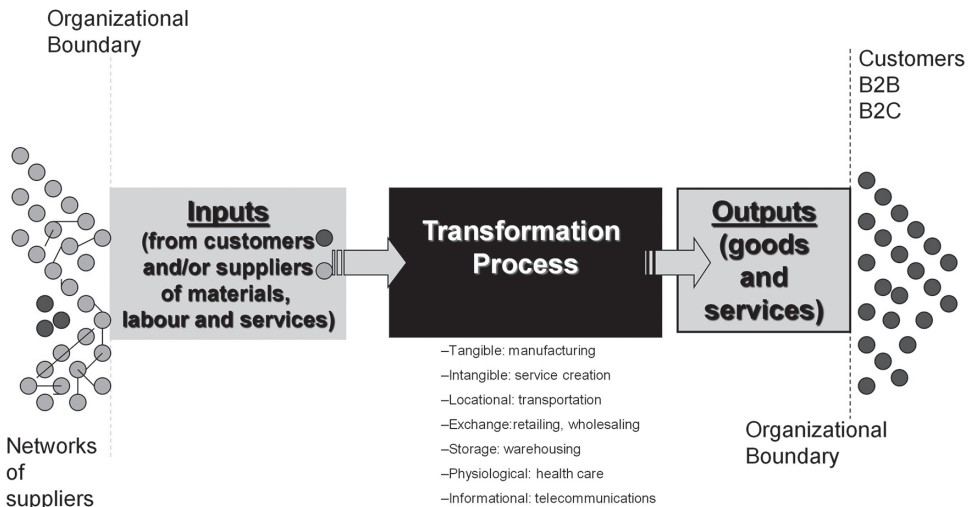


Figure 5.3 Transformation processes in supply chains

programmes where customers design challenges for contestants by emailing, texting or phoning the programme makers.

Inputs will come from two main sources the customers and the suppliers of materials, labour and other services. The transformation processes involved depend upon the particular organizational context. For example, healthcare providers are concerned with improving patient welfare as a strategic objective. In meeting this end, they will procure medical supplies from various sources together with the necessary medical expertise and physical assets (buildings, equipment, other resources) to deliver the health services required. The effectiveness of the healthcare provision will be dependent on technical and managerial core competencies and resources at the organization's disposal. The efficiency of the healthcare provision will be dependent upon the organizations capability to transform the combination of resource inputs into effective outputs at lowest cost. Customers in this context are patients. Effectiveness should take priority over efficiency in this context but efficiency cannot be ignored. It is through efficiency that better service and more effective use of resources will lead to improvements in healthcare. Efficiency means that more patients can be treated from the same resource envelope. Supply chain strategies that can achieve high-levels of effectiveness and efficiency are desirable.

### **Products (tangible) or services (intangible)**

Supply chain management tools and techniques were developed originally in manufacturing industry. The developments are fully explained in Chapter 3. Engineers, purchasing professionals and production managers concerned with lowering costs of manufacture in automobiles, aerospace and electronic products whilst maintaining or improving quality levels championed operational aspects of supply chain management. Managing supply chains not products became the focus of ways to improve cost structures and efficiency. Managing supply chains as a system in a way that the Japanese automobile manufacturers had practised focusing upon quality improvements and cost efficiency became fashionable in management during the 1990s. In 2000, manufacturing industry in Japan contributed 37 per cent to their gross domestic product (GDP) whereas for the United Kingdom it was 27 per cent and for the United States only 20 per cent (World Bank Statistics, Year Book). Conversely, service industries in these three countries represented 63 per cent, 73 per cent and 80 per cent of GDP respectively. By 2010 services in the United Kingdom had increased to 74 per cent, Japan to 72 per cent (2009 figure) and the United States 79 per cent (2009 figure). By 2020 services were closer to 80 per cent in all three economies. So, the question is: are supply chain strategies important and appropriate in all sectors of an economy? The answer has to be yes. The example, of health care has already been given to illustrate how supply chain strategies can improve well-being. Supply chain strategies and the operational tools and techniques developed for manufacturing industries are transferable and adaptable to different contextual settings.

It is recognized in the literature that theoretically businesses range from pure services to pure goods but that it may be very difficult in practice to identify these pure forms (Bateson & Hoffmann, 1999 [1989], p. 8). Therefore, most business will be delivering a mix of services and products. The degree of mix and how to manage the mix is the challenge facing most organizations. In developed economies the importance of services in the mix is increasing. Thus, as competition increases services become more important in that mix and may give rise to what Porter (1980) referred to as advantage through differentiation. In highly competitive environments firms competing on cost grounds alone only have one management lever that of cost control hence productivity improvement becomes a main focus of attention. Service and focus on service improvement is one way for a single firm to differentiate its competitive offering

in the market. Rathmell (1974) and Shostac (1977) recognized the importance of the product/service spectrum. The rise in the importance of services in the UK and US economies has been well-documented (Bateson & Hoffman, 1999). It is also important to recognize that even in developing economies the growth of the service sector has been instrumental to development. For example, India's service economy is now approaching 40 per cent GDP from a low base around ten per cent some 50 years ago. Services are important in economic development at the macro level. Service innovations are also a significant component of firm capability and ability to grow at a micro level. A number of propositions could be developed from these observations two of which are:

- P0 = Innovations in customer service lead to improved competitive positioning, higher profitability and higher return on investment.
- P1 = Firm growth is dependent on designing appropriate levels of service.

These may or may not be true we are simply hypothesising here.

### Bundles of goods and services

Many organizations offer customers a bundle of goods and services. The idea of what constitutes the bundle offered to a customer is given in Figure 5.4. It shows some combinations of goods and services. In the example, a food retailer is bundling 90 per cent goods and ten per cent service. At the other end of the spectrum, a marketing consultancy represents 92 per cent service and eight per cent goods. The tangible items may be consumed in the final report. These are only meant to be indicative and the particular context of the customer proposition would determine the actual bundling. For example, purchasing an airline ticket offers different bundles depending

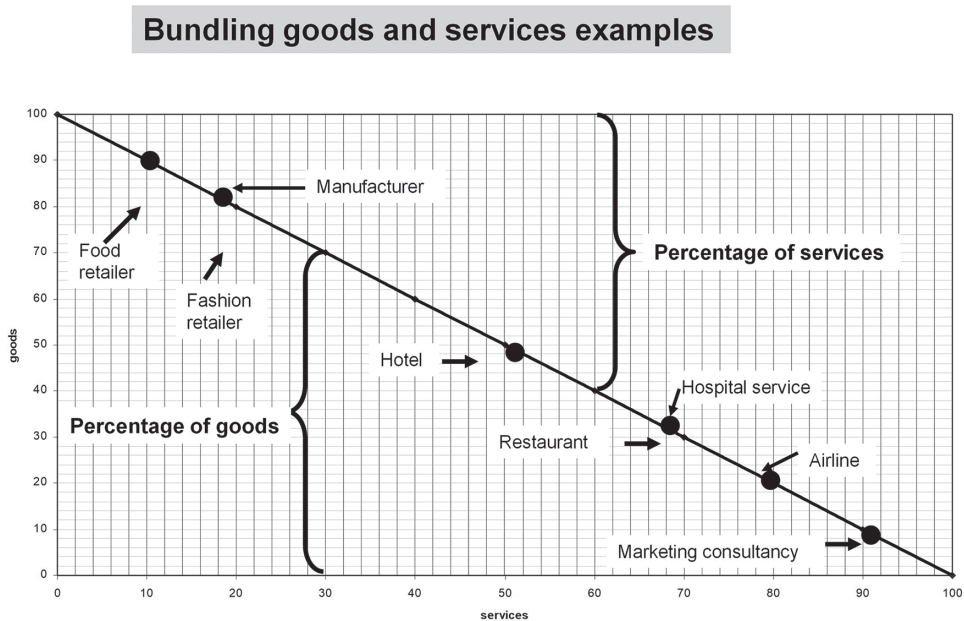


Figure 5.4 Notion of goods and service bundles

Table 5.1 Goods and services

<i>Element</i>	<i>Core goods example</i>		<i>Core service example</i>	
Business Core	Fashion retailer Men's and women's designer wear	Garden centre Plants and shrubs	Airline Flights	Hairdresser Cut, wash, blow dry
Peripheral goods	Accessories, costume jewellery	Garden chemicals, pots, tools, furniture	Inflight magazines, movies and duty free items	Hair related products – shampoo, conditioner
Peripheral services	Store credit	Advice	Pick up and delivery to airport	Manicure, skin care
Variant	Coffee lounge	Children's play area	Dedicated airport lounges	Internet café/reading lounge

on how much you want to pay and what class of travel is required. More services are bundled with first-class travel as opposed to flying economy.

Table 5.1 offers an analysis of the different elements that make up the core goods offer or the core service offer using two examples of each to illustrate what may be involved. Two examples are given for each category: core goods and core service. None of the examples are representative of pure goods or pure service industries, they are combinations or *bundles of goods and services* packaged for their customers. The ideas of elements relate closely to the concept of core products, augmented products developed by Levitt (1988). It has not been unknown for the peripheral goods and services to move to the core offer through trading experience. There are many business transformation examples where this has happened. For example, breweries operating public houses have given up brewing to concentrate on activities once regarded as peripheral to the core brewing activity such as retailing food and providing accommodation. Other examples include retailers offering a peripheral service of store credit to help support sales of their core products. These retailers have found it profitable to become banks or credit card companies, for example, Co-op, Tesco, Sainsbury's. Some premier league soccer clubs in the United Kingdom can generate as much, if not more revenue from the sale of corporate entertainment and hospitality than from match day ticket sales.

***Differences between manufacturing and service industries***

Services industries are different from manufacturing industries producing goods. A brief sojourn in the services marketing literature would identify four critical differences between the two sectors and these are highlighted here as follows:

1. Goods are *tangible* whereas services are *intangible*.
2. Goods can be *inventoried* whereas services cannot be inventoried they are *perishable*.
3. There is usually no interaction between customer and process in manufacture. The process of manufacture is *separate* from the customer, whereas there is always customer interaction between service and process. Service and service processes are *inseparable*.
4. Goods produced in factories are homogeneous (*same*) whereas services are heterogeneous (*different*).

These differences are important to recognize and understand because they determine the nature of supply chain strategies, structures and relationships that can be developed in the different contexts.

130 *Demand-driven customer-focused supply chain strategies*

The extended marketing mix developed in services marketing literature during the 1980s recognized the shift in developed economies away from industrial products to service based economies (Zeithaml et al., 1985). Delivering marketing activities based on theories developed for the US and UK economies of the 1950s became less tenable in the economic context of the final decades of the twentieth century. Many marketing academics questioned the appropriateness of the 4P approach that had remained the tenet of basic marketing texts since the 1950s. Some academics still have a problem with the P approach to marketing generally including the author. Nevertheless, the services marketing literature added a further 3Ps, people, process and physical evidence to address the gap in the ability of marketing theory to deal with service based industries.

*People*

People become far more important to service providers because they are in the front line whereas in the supply of goods the majority of people are in the back office or factory. The interaction between the person delivering services and the customer becomes a critical interaction in many service industries. People unlike machines may not behave consistently for whatever reason let's call it human nature, personality, attitude or individuality. This lack of consistency has been the major factor in distinguishing good service from poor service. If when a company is designing services, it can eliminate or design out inconsistencies in people behaviour then there is a better chance of the service supply and delivery being consistent. Management intervention through training may also be an important influence on behaviour, the nature of interactions and the customer experience.

*Process*

Processes are another important component in the service delivery interactions. If service delivery processes can be standardized through carefully designed operating systems and procedures the customer experience should be the same, that is, consistent for all customers purchasing the service. *Blueprinting* is often used as a technique to carefully analyze existing services and design improved or new services. Essentially this is a process mapping technique similar to those found in work-study. It offers a systems approach to the delivery of services. Carefully designed processes supported with staff training can offer the organization a way of reducing variability in their staff behaviours during customer interactions.

**Example of process mapping**

By analyzing processes an organization may be able to identify non-value-adding activities such as transport, storage, inspection and delay. The process times can be calculated and time wasted identified. Process mapping is the tool used to identify these non-value-adding activities. Process mapping tools have formed the basis of many industry studies examining supply chains to identify blockages in the supply chain. The DAMA Project and the KSA analysis of the US textile and apparel pipeline described in Chapter 3 both employed the technique to discover the blockages and delays. An example of how process maps might be used is given below.

Activity	Description of Element	ASME SYMBOL				
		operation	movement	inspection	delay	storage
1	Order goods from supplier	●	→	■	⊖	▽
2	Transmit specification for SKUs	●	→	■	⊖	▽
3	Check Prices by email	●	→	■	⊖	▽
4	Arrange shipment	●	→	■	⊖	▽
5	Check expected delivery dates	●	→	■	⊖	▽
6	Notify RDC of expected date of arrival	●	→	■	⊖	▽
7	Goods despatched from supplier to port	●	→	■	⊖	▽
8	Goods shipped by carrier to London	●	→	■	⊖	▽
9	Goods awaiting collection from Port	●	→	■	⊖	▽
10	Road Transport Carrier Arranged	●	→	■	⊖	▽

Source: Author

Note: Activities one to six are operations, seven and eight are movements, nine a delay and ten an operation.

The ASME symbols are used to chart the processes. In this example the business process re-engineering consultant would simply use a preprepared sheet with the symbols on it and enter the activities in sequence with a description and draw a line to link each activity step. Times taken might also be recorded for each of the activities.

Planning supply chain operations is a critical activity for the success of any organization. Operational plans may be delayed and that will impact on the strategic plans for the organization. Delays in sourcing or procuring supplies of raw materials, work-in-progress, components, finished goods and merchandise for resale would cause underachievement of revenue budgets and affect period profitability. This in turn has the knock on effect of disrupting the organizations strategic goals. Planning tools such as Gantt charts are useful for keeping plans on track. Microsoft Project part of the Office suite of programs is an example of such a tool. It has the advantage in being electronic that it can be quickly updated and plans can be posted to the Microsoft website to be shared by authorized parties who work on the project. For example, suppliers could access data and share the file details to make adjustments and inform supply chain parties including customers of necessary changes. Figure 5.5 illustrates a Gantt chart using Microsoft Project.

*Physical evidence*

Physical evidence is the final component identified in the services marketing mix. It is probably most easily explained using a hotel as an example of the service encounter. Entering through the front door the customer is greeted, a bellhop takes the customer’s luggage and the doorman guides the customer to the check-in desk. On entering the hotel, the customer feels a sense of comfort on site of the large luxurious leather seating areas, marble floors and walls, contemporary lighting and spacious entrance foyer with a thick pile red carpet clearly marking a footway to the check-in. The customer also walks past several hotel guests and they appear to be content smiling as they go about their business. One or two say hello as they pass by the guest, as do two members of staff. Arriving at check-in the guest is greeted by name by the duty manager and cannot help but be impressed by the hi-tech computer facilities that deliver a pre-programmed plastic room key and a safety deposit box key. The guest is introduced briefly to the concierge before being led past the large central staircase adjacent to the restaurants, leisure facilities and ballroom towards the lift. The guest arrives at her room and is amazed on entry at how spacious



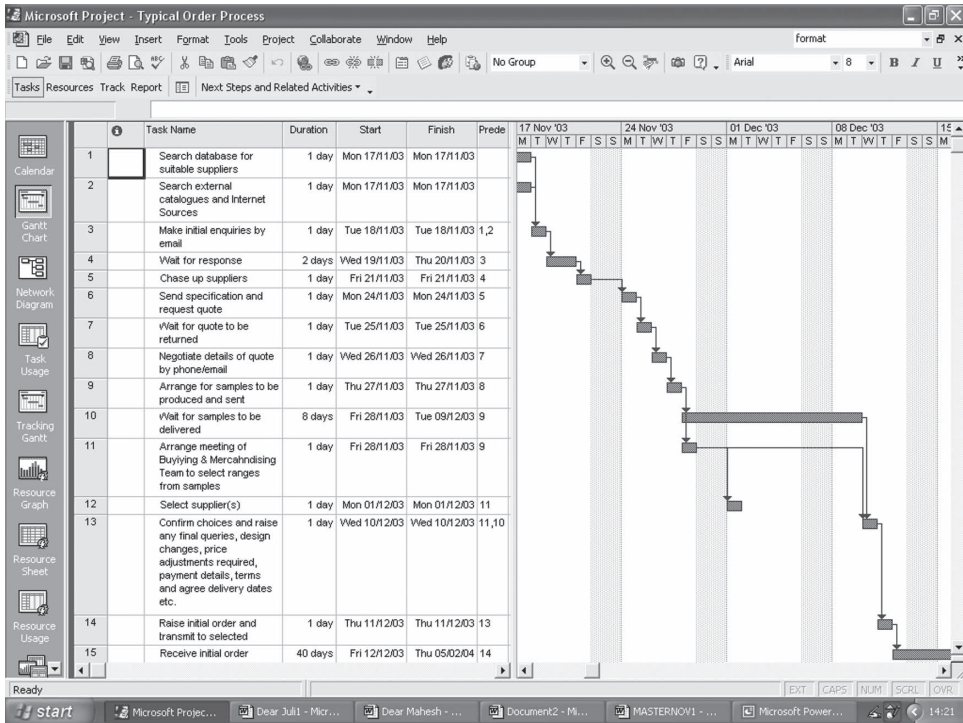


Figure 5.5 Gantt chart in Microsoft project planning tool

it is. It looks bright, clean and has a large window with views over the city and river below. The guest is pleased to notice that the cases have already been placed on the luggage rack. The member of staff points out the bathroom facilities and offers brief instructions on how to work the shower and hair dryer before doing the same for the TV, room lighting and electronic curtains. The guest cannot help but feel impressed as he leaves her commenting “if there is anything you require simply call the front desk.”

In the example, there are a number of service encounters with different members of the hotel staff and brief interactions with other customers but the overall impression of the customer’s experience is clearly shaped by the physical evidence. The hotel décor, design, cleanliness, facilities and technology to support a speedy check-in were all part of the physical evidence in this example.

Lovelock (1991) drew the analogy that many service operations are literally “factories in the field” which customers enter when they need a service. One difference between a factory and service has already been noted, that is the completed service is often consumed as it is produced (*inseparability*), and there may be direct contact between production (operations) and customers. The inseparability between production and consumption means that consumers are exposed to many aspects of a service operation that are kept hidden in manufacturing operations. Lovelock’s (1983) categorization questions are as important today as when first asked, focusing upon the nature of the service act, the type of customer relationship involved, room for customization on the part of a service provider and how the service is delivered. Much of the early work on service management concerned itself with consumer markets but interestingly the work of Langeard and Eiglier reported in Langeard et al. (1981) developed the “servuction model” based on a factory production system as a “metaphor” for service experiences.

The “servuction system model” developed by Langeard and Eiglier is illustrated in Figure 5.6. It explains that customers receive a bundle of benefits from each service experience, resulting from their interaction with visible elements of the service system. Visible elements may comprise all contact personnel employed by the service provider, aspects of the inanimate environment (physical evidence referred to earlier) and interactions with other customers.

Invisible elements comprise back-office staff, technological support systems, policies, procedures and organizational infrastructure. The invisible elements are often referred to collectively as the organization’s “technical core.” The model is useful in that it draws distinction between visible elements and invisible components of the system. It acknowledges the customer’s role in service production and provides a structural representation of services. It conceptualizes the service as having three overlapping systems:

- Service operations system (back stage, invisible to the customer and front stage contact points visible to the customer).
- Service delivery system.
- Service marketing system.

It also draws attention to the interaction between different customers and how that may shape the service experience. It illustrates integration of marketing, operations, human resources, physical (and or virtual) environments and emphasizes the customer perspective. It is for this latter reason that the “servuction model” is conceptually useful in strategic thinking applied to supply chain strategies for service industries.

## The Servuction Model

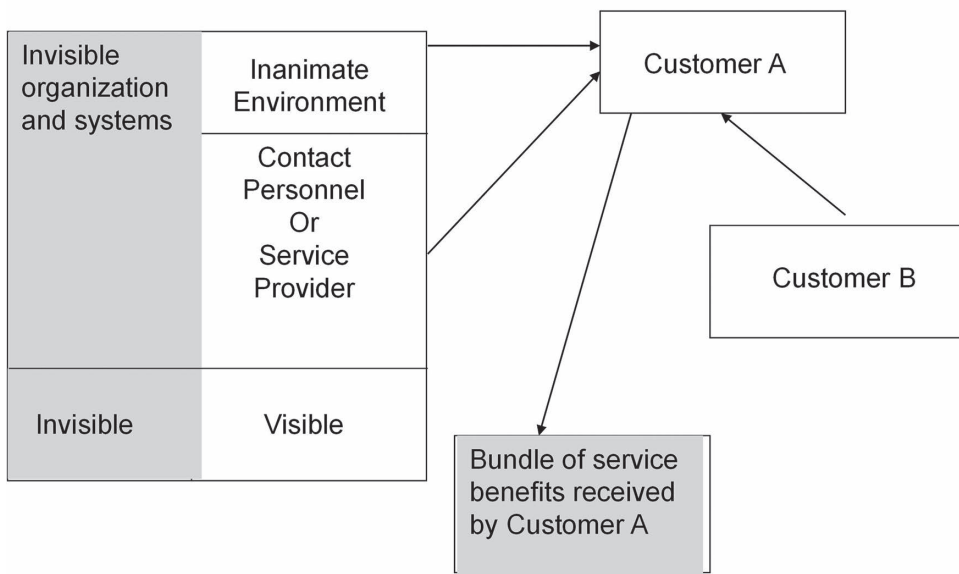


Figure 5.6 Servuction model showing back and front of house interactions

Table 5.2 Differences between services and goods Further important differences between services and goods

<i>Services</i>	<i>Goods</i>
Cannot be inventoried	Can be held in stock
Time dependent (perishable)	Not necessarily time dependent
Place dependent	Not necessarily place dependent
Consumers are always involved in the factory	Consumers hardly ever involved in the factory
Changes in the service operation always cause a change in consumer behaviour	Changes to factory operations do not necessarily affect consumer behaviour
Everyone and everything coming into contact with the consumer is delivering the service	Only front office staff deliver service
Quality cannot be controlled at factory gate	Quality control at factory before delivery
Contact personnel are like products they are part of the experience	Contact personnel not as important as how the product performs

There are some further differences between goods and services that become clearer from the servuction model and they are highlighted in Table 5.2. Earlier, the fact that services cannot be inventoried was identified. This is important because it means you can plan for service delivery and you can source, order and purchase the goods elements in advance of delivery but the service itself has to be created at the point of delivery. Supply chains for the service element are short, for example, from kitchen to restaurant. Food, beverages, cooking utensils, kitchen tools and aprons can all be procured in advance and inventoried until the point of service delivery. Services are usually time dependent, for example, a hotel room for the night, a hospital bed, completion of tax returns, a theatre production, a vacation. Services are also place dependent, for example, you need to go to a hospital, a theatre, a holiday destination and a hairdresser. Granted, some hairdressers may do home visits as do accountants for tax returns but usually many services are place dependent. This place dependency has coined the phrases “destination marketing” or “place marketing.” Consumption always takes place at the point of delivery and the consumer is involved in the creation process. The consumer experience is created at point of delivery. Consumers of goods hardly ever visit or become involved in factory production of the items. Changes to service operations will always lead to changes in consumer behaviour in the case of services.

The Virgin Upper Class Lounge at Heathrow made two noticeable changes to service in an attempt to lower staff costs after 9/11. The first was to change food and beverages from table service to self-service, reducing the variety of food and cutting the numbers of staff required. The second was to change the hair salon to first come, first served, where previously passengers were able to pre-book a timed appointment in advance by telephone or through e-mail. The reaction to these service changes from customers has been generally hostile. Passengers who experienced the higher level of service previously offered when waiting in the lounge often remark on the changes to other passengers and to staff. Some feel so strongly that they enter comments in the suggestion book held in the lounge. So far, these reactions have not caused changes to the service at Heathrow but passengers notice the difference and comment on it when they visit similar Virgin lounges that still offer the superior level of service that the London terminal previously did. Staff, customers and physical conditions interact to create the service experience.

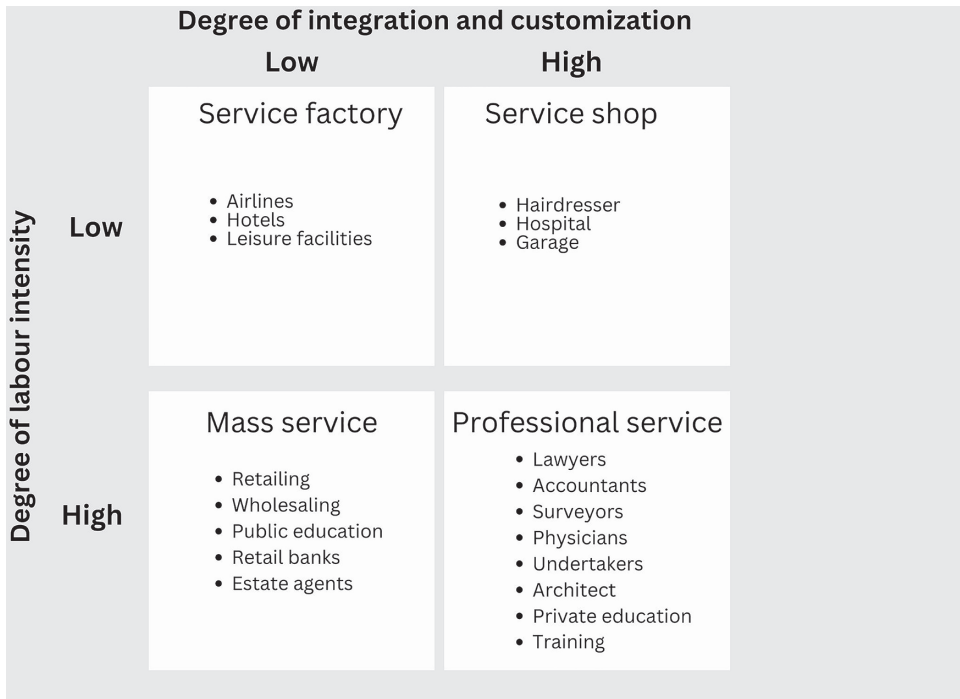


Figure 5.7 Degree of interaction, customization and labour intensification

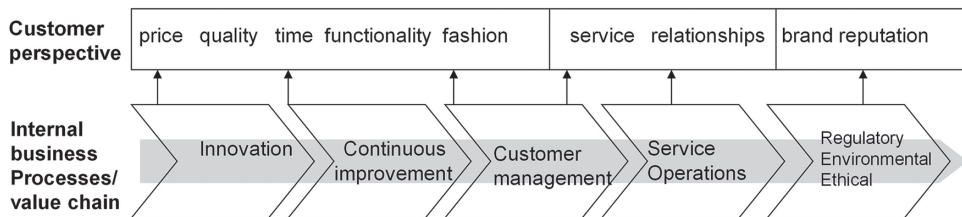
Schmenner (1986, p. 25) developed a conceptual model of viewing services as high- or low-labour intense organizations vis-à-vis degree of contact and customization involved. This model identified and differentiated four types: service factories, service shops, mass services and professional services. An adaptation of this model is shown in Figure 5.7.

A dimensional perspective is useful to observe. Mass-market suppliers of services require high-degrees of labour intensity but offer low customer contact and customization. Services are standard and market price is often a key competitive feature. Professional services too are usually labour intense but the degree of contact and customization is high. Professional services usually compete on grounds other than price and they are generally not price sensitive. Points of difference become a competitive dimension for these types of organization. Service shops also offer a high-degree of contact and customization but they are lower in terms of labour intensity. Services classified as factories are low on both dimensions.

### Customer focus

This section builds on the ideas developed in services marketing and the analytical frameworks used to identify the different elements of service degrees of customization, contact with customers, labour intensity and more particularly the useful constructs developed from the “servuction model” and service design using a form of *blueprinting* to examine supply chain strategies. Figure 5.8 re-visits the customer’s perspective but adds what can be called back office elements to the perspective. In effect, the diagram shows how the organization’s invisible elements support the attributes valued by the customer. These invisible elements form the organization’s “technical core,” for example, organizational competencies. The quality of these

**The next stage is to determine how the firm can deliver customer value. After having identified what the customer values and wants from the organization.**



**Develop or buy in competencies to improve organizational capabilities to deliver customer value**

Figure 5.8 Customer value and supply chain processes

competencies determines organizational capability to deliver customer products and services. In effect, these are the business processes behind customer service where the organization is able to create value for the customer and value and/or profit for the organization depending on the context in which the organization operates. It is, in effect, the organizational value chain in Porter's (1980) terminology.

The elements shown in the business processes reflect what the organization is able to do to support the attributes valued by the customer in broad generic terms. By briefly examining each of the customer attributes, the organizational competence needed to support this is identified:

1. **Price** is dependent on the organization's capability to lower cost and hence lower prices for the customer. If price is a key attribute for the customer, then the firm will need to find ways to lower cost through productivity improvements. These may be achieved through continuous improvement processes following Kaizen philosophy or they may be achieved through innovations (*breakthroughs*) in product/service design, product/service, service delivery and fulfilment, achieving economies of scale or scope. Another aspect of price may be that it is not simply the lowest price that the customer wants but rather value for money. This has similar implications for the competencies required but the focus is on delivering goods and services to the right value rather than the lowest price. Price, cost and value are discussed more fully elsewhere in the text.
2. **Quality** form the customer perspective involves two aspects: (a) product quality and (b) service quality. Both product and service quality are achieved through innovation and through the adoption of Kaizen, continuous improvement whereby quality of processes in production or service results in improvements to the finished goods or services. The customer focus is upon reliability and reputation when making choices between competitor offerings.

3. **Time** may be critical in some markets and to certain customers. If this is an attribute that is particularly valued, then the organization must develop business processes and competence to deliver products or services at the right time. Innovations such as quick response (QR) using a just-in-time (JiT) approach have helped manufacturing organizations to respond quickly to customer needs adopting agile manufacturing and flexible manufacturing systems (FMS). Retailers have developed efficient consumer response (ECR) techniques to deliver goods on time to consumer markets. If time is a valued attribute, then required action in the back office is to build competence that enable *responsiveness* to customer demand.
4. **Functionality**, if valued, will depend upon the organization's technical competence to meet the demands of customers and to compete within the market against organizations offering similar goods and services (substitutes). Technical competence once again can be improved through continuous improvement or through innovation.
5. **Fashion** is *time dependent* and *design dependent*. Organizations competing in fashion markets need to innovate and be responsive. Formal systemic approaches to innovation are often observed in organizations competing within this type of market. New product development or new service development becomes a paramount concern.
6. **Service**, if valued by customers, requires the organization to develop competencies in *responsiveness* and customer relationship management (CRM). CRM is not simply about technology but technology may well support or facilitate the quality of CRM. Competencies in managing the customer interactions are particularly important when organizations compete on this dimension.
7. **Relationships** are important to service operations. It doesn't mean all customers want a "special" relationship with the organization as we have seen there are different types of relationship and it is important for an organization to identify the level and intensity of customer contact that is required to meet the customer needs in the context of the market and the value placed upon the attribute by the customer. It is also important to be able to identify circumstances when customers do not require high-levels of contact. A matter that some service organizations often fail to recognize is the change from traditional "interruption marketing" to "permission marketing" where the marketing organization leverages *permission* from the customer over time to further marketing initiatives. Services and relationship marketing approaches together with CRM are ways to build competence in this area.
8. **The brand and reputation of the organization** will be an important focus for many customers in making purchase decisions. For the customer brands often guarantee quality through established reputation. Brands communicate differences in the product/service offer. Customers often feel secure selecting a branded product/service vis-à-vis an unbranded competitor's offer. A brand creates value for customers and value for the organization. This value is measurable through increases in revenue, profit and higher returns on investment with appropriate economic rewards for the organization and its owners. Organizations must develop competence in communicating their reputation through the brand if this is important to customers.

There are only two ways in which organizations acquire competence to build value for their customers: (a) they either develop it in-house through experience, learning and development some of which may be brought in from outside organizations, or (b) they buy in people with the competencies.



***Strategic thinking makes the difference?***

Peter Drucker (1954) once commented that there were only two functions of a business: marketing and innovation. In essence, this is a strategy statement. It is as relevant today as it was then. Supply chain strategies need to be configured to match customer demand by being customer facing and customer focused. This ensures that customer needs are identified and the organization must then assess whether or not it is able to satisfy the need profitably or in the case of public services within budget constraints. The ability to satisfy customer needs will depend on the organization's capabilities (the *visible* front office and *invisible* back office, *the technical core*) and how managers and/or entrepreneurs are able to configure resources at their disposal to supply bundles of products and services efficiently. Doing so will require creativity and innovation by managers or entrepreneurs. The concept of the entrepreneur has been deliberately introduced at this stage of the argument to demonstrate that entrepreneurial thinking is critical to generate creativity and innovation. The term entrepreneur has been used to describe the founder of an organization, an owner manager and an innovative leader. In this context creativity and innovation are key to the definition. The ways in which the product and service attributes are combined to deliver customer requirements is determined by entrepreneurial thinking. This develops from Schumpeter's (1950, p. 88) original idea that the entrepreneur is not simply someone providing capital or an inventor but rather the person with the business idea. For Schumpeter the entrepreneur's ability to see possible new combinations, do things differently or do new things was the key to their success. It is the notion of "creative destruction." Schumpeter drew attention to the fact that managers focus upon administering existing structures whereas the focus ought to be on how they create or destroys them. In contemporary organizations there is no reason why entrepreneurial thinking cannot be the province of managers. Drucker (1970, p. 10) took this view when he aligned entrepreneurship with management stating it was the entrepreneurial act, risk taking that was central to the business enterprise. In essence this is *strategic thinking*. This is a key factor why some managers improve the firm's performance whereas others faced with the same opportunities and threats and resource base are unable to do so. Strategic thinking makes a difference.

Reminded of this, consider the change in fortunes of Ryanair the Irish low-budget no-frills airline. Michael O'Leary is the 42-year-old CEO and an accountant by management discipline. He pioneered the business strategy to develop Ryanair as a low-cost supplier and identifies cost discipline as central to success. This is, however, only half the story because Ryanair is a marketing success story too. He took over the airline at a time when it had lost £25 million in four years and been through five CEOs who had failed to make a go of things. O'Leary was asked if he would take it over when he was financial director to which he reportedly replied, "close it f\*\*\*\*\*down it's a basket case, it's never going to make money." Finally, he did agree to accept the position for 25 per cent of the company profits in return. This was a good deal for the Ryan family when the airline was losing £3 million a year but not when it began to make money. When the airline turned a profit of £10 million the Ryan's had to write O'Leary a cheque for £2.5 million. He swapped the money at that point for a 25 per cent stake in the business. Effectively becoming an entrepreneur by the classic definition of being the risk taker. The company was floated on the Irish stock exchange in 1997 at a valuation of €500 million at current prices. In August 2003, the company was valued at ten times that value, €5 billion. Just six years later in the financial year ending in 2003 traffic growth was 41 per cent, revenue was up 35 per cent, profits up 59 per cent, earnings per share improved by 54 per cent, the load factor was up by four points and the business made 28 per cent profit after tax. Ryanair has continued to flourish even since the banking crisis of 2008 and continues to innovate in highly competitive markets. So, what was it that turned a basket case into a success? It is the ability of the entrepreneur to combine resources differently that makes the difference either through marketing and/or innovation. In Ryanair's case

both are evident. The company transformed itself from a “me too copycat” type airline losing money because it could never achieve the economies of scale required to turn a profit into a European low-cost no-frills US type supplier based on Southwest Airlines business model. An activity map of Ryanair’s strategy is shown in Figure 5.9.

It is important to note that Ryanair has a customer focused supply strategy even though service elements are limited. The company has identified a gap in the market for the supply of low-cost no-frills flights from A to B that offer a simple safe reliable and lower price alternative to conventional airlines. It is pursuing a profitable low-cost and clearly differentiated strategy from many of its rivals in the airline industry. Many traditional airlines serving different market segments have learned to adapt their own offerings following these low-cost airlines.

**Different strategies require different activities to be performed**

According to Porter (1980) organizations have two sources of competitive advantage (cost and differentiation) that lead to three main strategies (cost, differentiation and focus). Table 5.3 illustrates four different strategies, their definition and the types of activities that the organization would need to focus upon and develop competencies in order to pursue each strategy. The low-cost strategy has already been examined in the Ryanair case. Essentially this type of strategy is focused on value proposition customers, customers who buy lowest price items. These customers want a bargain. If the organization can offer bargains, the customers keep buying. There is a great deal written on customer loyalty and whether or not customers are loyal. It is often stated that value proposition customers are not loyal but this is not necessarily so. It is argued that these customers migrate when there are bargains to be had from alternative suppliers. This is also

**Activity Map of Ryanair’s Strategy**

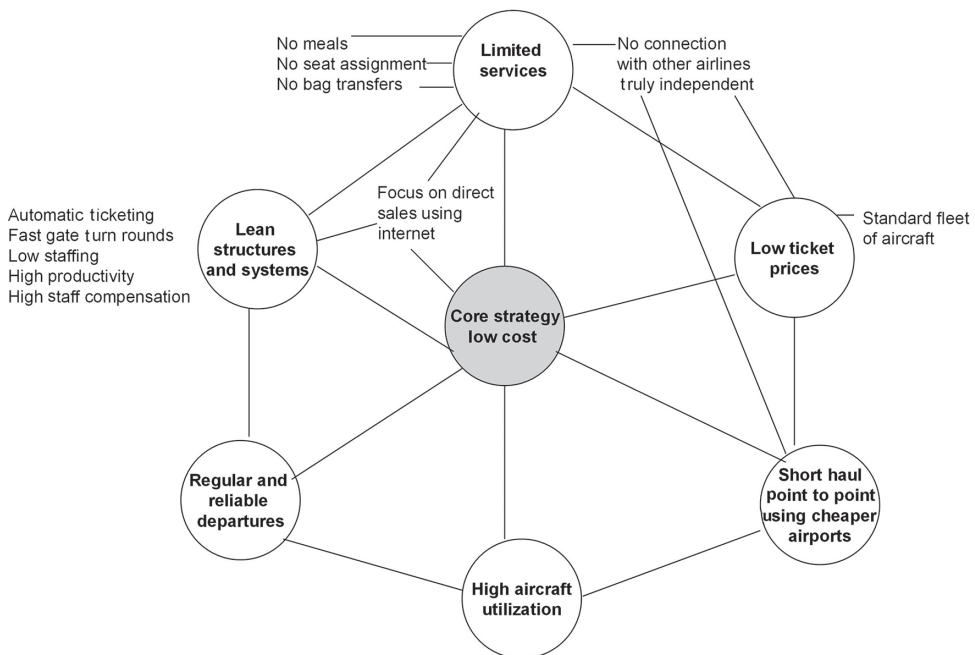


Figure 5.9 Activity map of Ryanair strategy

Table 5.3 Types of strategy and strategic activities

<i>Type of strategy</i>	<i>Strategy defined</i>	<i>Strategic activities</i>
Low-cost (mainly compete on low prices)	Producing the lowest cost products in the market.	<ul style="list-style-type: none"> <li>• Sourcing and purchasing products/services at lowest cost.</li> <li>• Efficient operations seeking to improve productivity.</li> <li>• Achieving scale economies (administration, purchasing, production, distribution and marketing).</li> <li>• Achieving economies of scope.</li> </ul>
Market segmentation (compete on price and/or differences)	Satisfying the needs of a particular market niche.	<ul style="list-style-type: none"> <li>• Target particular groups of customers based on characteristics, for example age, lifestyle, location, other identified customer attributes.</li> <li>• Focus marketing activities to match the target customer profile.</li> </ul>
Market differentiation	Offering customers perceived or actual differences through branding.	<ul style="list-style-type: none"> <li>• Promote differences through brand strategy and brand development, for example reliability, reputation, service.</li> <li>• Innovation and creativity in marketing communication.</li> <li>• Confuse the market and make product/service comparison difficult.</li> </ul>
Product differentiation	Offering products that differ considerably from competitor offerings.	<ul style="list-style-type: none"> <li>• Innovation and creativity.</li> <li>• Product/service development</li> <li>• Time to market – quick response</li> <li>• Continuous improvement (Kaizen)</li> <li>• Confuse the market and make product/service comparison difficult.</li> </ul>

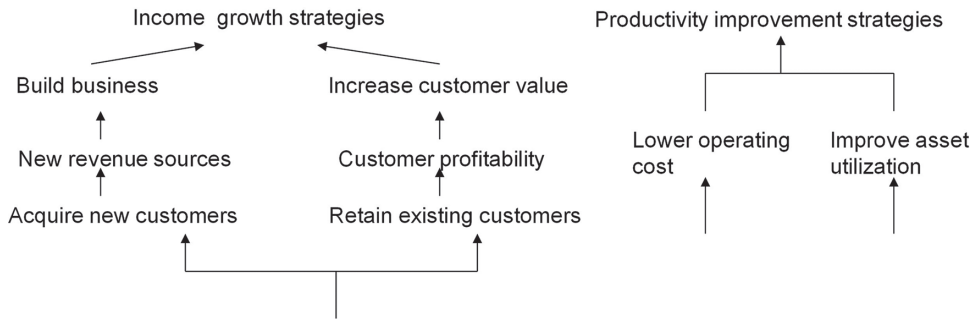
partially true. However, most of the literature fails to recognize that the same customers may require the value proposition for some purchases but require a different bundle of attributes for other items for which they will be prepared to pay a premium. Customer loyalty is much more complex than it is often reported to be. It is this complexity that makes it difficult for organizations to identify which buttons to press in designing a market driven supply chain strategy.

A market segmentation strategy requires the organization to focus upon a particular group of customers. If you consider the metaphor of an orange, you are now focusing attention on one part, a segment, rather than the whole orange. In marketing segmentation terms, the organization must identify groups of customers with similar characteristics such as demographics, psychographics, geographics and lifestyles. An illustrative example might be a niche retailer such as Agent Provocateur that targets the young and sexy lingerie market or convenience stores targeting time-poor cash-rich busy professionals. This strategy is what Porter referred to as a focused strategy. A market differentiation strategy creates difference through reputation, reliability, branding and service elements. Note the product or indeed service itself may not be that different from competing offers but the way it is communicated to the marketplace will be. The final strategy is product or service differentiation: a better product, more features, more benefits bundled for the customer to make the product or service more attractive to the customer. Perhaps more peripheral goods and services are included in the offer or the variant is more attractive to the customer. For example, the hairdresser with DVDs and a coffee shop while waiting.

An interesting approach adopting and adapting a segmentation strategy to develop supply chain strategies identified demand profiling at an item level (using volume and variability classifiers) as the primary driver of supply chain strategy (Godsell et al., 2011).

Supply chain strategies are market driven. For example, signals from the market place such as a sharp fall in sales for a particular product may indicate that customers are no longer favourably disposed to the products and services supplied by the organization. This has an impact upon the whole supply chain. Finished goods inventories rise because the goods in question do not sell as quickly, work-in-progress and capacities need to be adjusted swiftly downwards so as to avoid inventory build-up elsewhere in the organization. Purchase orders need to be changed to accommodate lower sales volumes and suppliers connected in the chain will mirror these activities. Investigative work will be needed by the organization to determine reasons. Cause and effect diagrams such as the Ishikawa or fishbone diagram, as it is sometimes called, may be used for this purpose. There may be other analytical tools at the organizations disposal to identify causes such as focus group analysis with small groups of customers, individual interviews with particular customers to determine why they have stopped buying the organization products. This type of research is in the domain of marketing researchers. Organizations may need to bring in expertise if they do not have the knowledge and skills in-house. Once the reasons for the sharp fall in sales have been established, the organization may be able to enhance product/service features to improve the customer offer. In the longer term, the organization may develop a range of new products and new service that will recapture the customers. In the short-term, the company may decide to offer a discount against competitor goods to stem the tide and retain customers. This is really a tactic rather than a strategy since it is only a short-term solution to the problem. For example, you may continue to sell old technology (video recorders) by offering lower prices short-term but as DVD technologies improve and products have more features that consumer's value it will be difficult to give them away.

Figure 5.10 takes a more optimistic view of market driven supply chains identifying growth strategies and productivity improvements.



**Strategies to grow the business –**

**New markets, new products,**

**Innovations in new business ideas, inventions, adaptations (NPD+NSD)**

**More business with existing customers through better marketing**

**Increase market share**

**Strategies to become more efficient – better at what you do.**

Figure 5.10 Income growth strategies and efficiency strategies

### **Promotions cause disruption to supply chains**

Sometimes promotions cause disruptions to supply chain efficiencies. Take the example of a retail store offering “buy one get one free” or BOGOF deals as they are called in the trade. These can be unpredictable and give rise to uncertainty. Promotions can introduce volatility into stable flow systems. If your promotion is successful, you will find that your stock is pulled through the supply chain at a faster rate than normal demand. If every customer took up the BOGOF, you would need twice as much stock to meet demand. You may also find that increased demand results in a stock-out occurring. This is very risky and will cost lost sales. Your promotion may simply sell products at your competitor stores. Although competitors may not have the promotion, they may have stock and they may make sales at full price, which is more profitable for them.

Avoiding such risk is the responsibility of marketing and supply chain strategists. Supply chain visibility making the supply chain effect of promotions transparent is key and having metric tools of analysis that provide real-time data about the impact of promotions. Supply chains then need not be disrupted through promotional activity and increased volume sales may improve total profit at a lower unit profit level.

Markets generally drive organizational behaviour. In business, this is certainly the case. In the service sector too, markets are artificially created where they do not exist, for example, in public services transfer prices are agreed between service providers and customers. In a sense all organizations respond to markets. How much they do is a matter of degree. All markets are regulated either by laws or by government and quasi-governmental policies, for example, the National Health Service in the United Kingdom and Health Authorities under the Department of Health. In business organizations, the signals are much clearer because the market determines revenue streams and profitability. Unless businesses generate profits, they cannot survive in the longer term.

The signals from the market drive behaviour in business activity. Entry into new markets, developing new products (NPD) or new service development (NSD) may be planned to increase revenues. In actual performance these strategies carry risk and risk means cost. If the organization decides to enter a new market and it is not a success then resources are effectively wasted. There is an opportunity cost. Laura Ashley the fashion retailer sold a batch of 11 stores in Belgium, Luxembourg and the Netherlands for €2 in August 2003. The business was expected to lose £6.5 million in the next financial year as it withdrew from Europe. City analysts also questioned the appointment of two CEOs, neither of whom had experience of UK fashion retailing where the company stated it now wanted to focus its efforts. In effect, these are the consequences of failed previous strategic decisions. This illustrates the notion of strategic risk. It also demonstrates the doubt over the management competencies to deliver the new strategy.

On the right hand side of Figure 5.10 productivity strategies are highlighted. These improvements are also often market driven. Pressure is placed on the organization from competitors who are able to deliver goods and services of equivalent or better value at lower prices. Some organizations even signal this to their customers through advertising. For example, Asda, now Asda Walmart in the United Kingdom, are part of the largest retailing group in the world with access to their supply chains and economies of scale. Their customer focused strategy states “Asda price, rolling prices back.” The technical core of the organization has supply chain competencies to deliver the customer focused strategies. They lower operating costs through efficient asset utilization and by squeezing supplier margins. They assist their suppliers to search for efficiencies in their own business in this process. Once again, the supply chain is market driven.

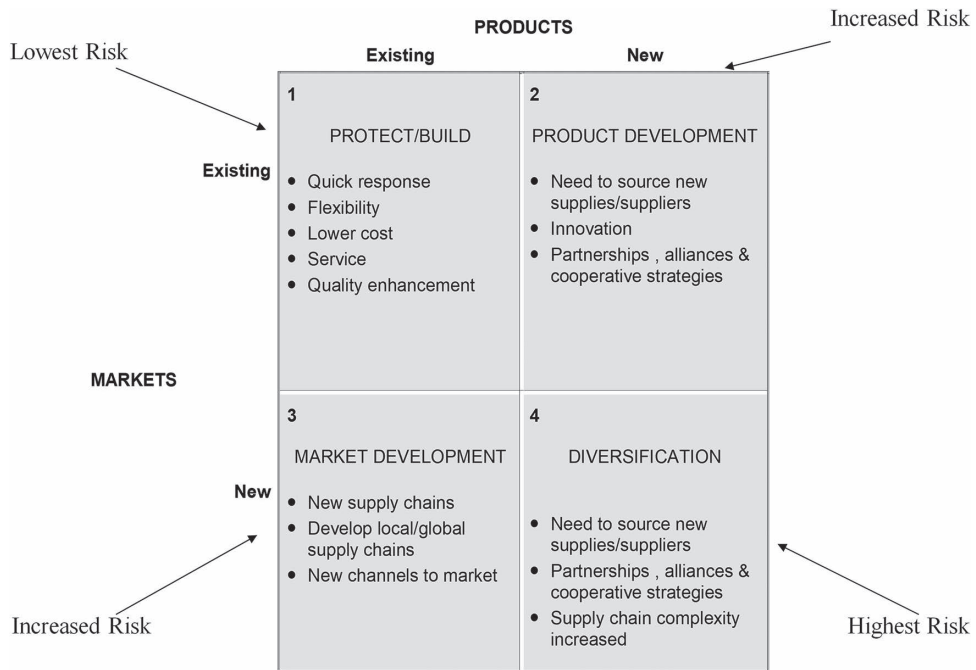


Figure 5.11 Product – market supply chain strategies

Figure 5.11 illustrates a number of possible market driven supply chain strategies focusing upon product/market improvements using an adaptation of the Ansoff Matrix.

**Existing products in existing markets**

The purpose of this strategy is to protect markets and build markets through existing products and services. It is a strategy that carries least risk for an organization. In effect, they need to maintain and improve what they are already doing. Doing things better is the means to grow the revenue streams. Supply chain strategies to support this business strategy might include:

- Quick response (QR).
- Flexibility/agility.
- Lowering costs.
- Quality enhancement.
- Service improvements.

*Quick response (QR)*

Faster response times getting product to market improves the chances of achieving higher revenue streams. One important financial measure of business performance has been stockturn ratio. This particular measure examines the speed at which a business is able to sell goods.

$$\text{Stock - Turnover Ratio} = \frac{\text{Cost of Goods Sold}}{\text{Stock at cost on balance sheet}}$$



144 *Demand-driven customer-focused supply chain strategies*

Consider an example where a manufacturing business supplies customers with memory chips for computers. Examining the profit and loss account for the current financial year indicates that invoiced sales achieved were £600,000. The gross margin achieved on sales is a standard 50 per cent. Therefore, you know that the cost of stock sold is £300,000. Examining the average stock held during the financial year, you ascertain from stock records for the category that during the 12-month period the average stockholding was £60,000. It is now possible to compute the stock-turn as follows:

$$\frac{£300,000}{£60,000}$$

= 5 times in the period

This would indicate that stock is turning over at the rate of five times in a year or alternatively you could translate it to days as follows:

$$365 \text{ days} / 5 \text{ times} = 73 \text{ days}$$

Supposing customers had indicated that if the business were able to improve its lead times to fulfil orders, they would place double the number of orders. By speeding up its supply chain operations and assuming average inventory holding remained constant at £60,000 the performance would improve as follows:

$$\frac{£600,000}{£60,000}$$

= 10 times in the period

$$365 \text{ days} / 10 \text{ times} = 36.5 \text{ days}$$

The business is now turning inventories at ten times per annum owing to increased sales caused by the company's improved capability to offer quick response to customers.

Quick response strategies applied not simply to the business but to its suppliers would offer further improvements in performance. For example, assuming the business was able to lower its average inventories to £20,000 and sales remained at £600,000 the business would turnover stocks 30 times per annum, that is, just over 12 days. Reducing inventory holding in this way enables the business to become more efficient, secure new business and maintain current customers and it reduces cost and risk. Costs incurred in storing and insuring stock can be lowered, and the risks (redundancy, obsolescence) are lowered.

*Flexibility/agility*

Flexibility is the firm's ability to reorganize internal processes to align them with customer demand requirements. It is also referred to as agility. For example, if an automobile company has ten different car configurations in production in a factory it may forecast in advance of the sales period how many of each type will need to be produced. However, it may postpone purchases of the "bill of materials" making up the cars until closer to the selling period. When actual sales orders are known, the manufacturer may confirm orders and operate just-in-time

systems with its suppliers. At this point the manufacturer will reprogramme production schedules and move materials, labour and machinery between different production lines to match actual demand. The capability to realign processes, people, machinery and materials in this way is what gives the organization flexibility. Organizations are able to respond more effectively to customer demand as a consequence. Having standard components that are interchangeable between different products is one way in which flexible manufacturing systems (FMS) are able to respond. The flexibility advantage allows an organization to be more responsive and to gain business from customers competing on time. An organization is able to protect and build market share through developing competencies in flexibility. Honeycutt et al. (1993) put the flexibility advantage succinctly when they describe a situation where a manufacturer is asked the question “what business are you in?” The traditional manufacturer responds by describing products whereas the flexible manufacturer is customer focused and replies “whatever business you want us to be in.”

#### *Lowering costs*

In highly competitive markets where there is little to distinguish one supplier (product or service) from another, the customer may simply make choices by focusing upon cost. In these markets it is important for the supplier to find ways of increasing productivity. The productivity advantage lowers cost and helps the firm compete. This particular strategy is difficult to sustain because there is always someone either in the market or entering the market who is able to achieve a lower cost. A technological breakthrough (innovation) or greater economies of scale (production, purchasing, technical, administrative) are a means of lowering cost.

#### QUALITY ENHANCEMENT

Quality enhancement is appropriate to keep ahead of competitors. This is essentially a continuous improvement approach whereby the organization continuously strive to do things better. The quality advantage is covered more fully in Chapter 8.

#### SERVICE IMPROVEMENTS

Service improvement is similar in many respects to quality improvement. It is a continuous process. Customer focused service organizations seek opportunities to improve the level of service offered to customers with a view to gaining a sustainable competitive advantage. Many of the service improvements discussed in this chapter fall into this category and are illustrative of how, what and why organizations focus attention on improving service operations as part of their supply chain strategies.

#### **Product development**

New products in existing markets – this is a difficult strategy to pursue. Developing new products takes time. The strategy may consume resources that could be better applied to different strategies. Product development strategies may require sourcing of new suppliers, innovations or collaboration with partners to deliver timely new products to market. Organizations must carefully evaluate the strategic opportunity costs involved. Statistics have shown that across a number of different industrial sectors the chances of successfully introducing new products to market are slim. Failure rates of 80 per cent are not uncommon

(i.e., four out of five products introduced, fail). Conversely, an organization may have only a one in five chance of success. It is essential that organizations understand their customers. Understanding customers requires knowledge of their requirements, budgets, buying habits, preference factors and values. For example, in consumer markets understanding customers through their lifestyles has become much more common. Lifestyle data tracked through EPoS systems, RFID, credit card expenditures and other means of electronic data monitoring are now very common. The recent introduction by large retailing groups combining to share data through “loyalty cards,” for example, Nectar and through own brand credit cards, for example, Sainsbury, Tesco, M and S (and More Card) are all means to an end of understanding consumer behaviour better. It is important to understand both rational and emotional drivers of behaviour in order to target the customer better and offer goods and services in different ways through different category channels to enhance sales. It is not simply a case of using data to develop new products but to offer existing products and services in different category channels. That leads to market development.

### **Market development**

Existing products in new markets – this strategy requires the organization to be creative in bringing its existing goods and services to new markets. One way to do this has just been discussed. New supply chains may need to be developed closer to the new markets being served. The organization may need to learn how to manage its supply chain structures and relationships differently to accommodate the new markets being served. New channels to market may need to be developed. Once again, these strategic options could involve heavy investment. Options need to be carefully considered before resources are committed. For example, international market development strategies are often viewed as a means of taking existing products into new markets. Once again this has to be carefully researched and the differences between existing market structures, relationships and behaviours need to be considered vis-à-vis new markets. Market entry too can be a very risky strategy. Many organizations with good product offers in home markets have tried and failed to penetrate overseas (e.g., Boots in Japan, M and S in the United States and parts of Europe, Laura Ashley in Europe and the United States). Entry modes and business models need to be carefully developed. Franchises, joint ventures, concessions, licensing and distribution arrangements are all ways to enter new markets without the risk of direct investment.

### **Diversification**

New products in new markets – this is the riskiest of all strategic development. Developing completely new products for completely unknown, untried markets is high-risk. Supply chain complexities will be increased in pursuing this option. Complexity may involve sourcing, structures, relationships, lead-times, co-ordination and management capabilities.

### **Supply chain strategies that win orders**

The framework developed by Hill (2000) of order qualifiers and order winners is useful to help understand what the customer might value from your firm as supplier. Process mapping tools are often used to help identify the key issues from a supplier perspective. In the figure, a number of possible qualifiers and order winners are identified over time. For example, in the 1950s it may have been sufficient for suppliers to compete on the basis of cost alone. However, during

each decade there have been different factors that have been the key to order winning strategies for many organizations. In many respects, it is simplistic to argue that there are generic order winners that are the same for all products in all market conditions. There are indeed differences between customer requirements even in the same market. However, it is often the case that there are factors that organizations focus on and that in many cases these are time specific and common across different sectors. In many respects, the market is full of paradox and complexity. Spring and Broaden (1997) claim that order qualifying and order winning criteria are often linked and it is difficult to say whether it is a qualifier or a winner. Organizations may produce the same or similar types of products for two different markets from a single production process. It is important to understand it is not products or processes that win orders. The market makes choices on the basis of the benefits from the product or service that are valued by customers, for example, value for money in comparison to competitor offerings are judged in terms of different benefits gained from the purchase. Reputation and branding may enter the decision equation also. One doesn't often hear anyone comment that they bought the product because the production process was efficient, better or superior to competitors. However, one does hear buyers drawing comparisons between the benefits that different particular suppliers, products or services offer them.

The example of order winners and order qualifiers is illustrative and offers a generic temporal perspective. Sustainability of strategy is an important consideration for organizations. Strategies wear out just like assets. However, unlike many assets the finite life of strategy is difficult to predict. In Figure 5.12 a life cycle proposition is shown whereby, for approximately a decade from introduction to maturity, the effectiveness of the strategy is gradually reduced as it becomes mature. Maturity in this sense means that the numbers of competing suppliers in the industrial sector or markets in which the organization operates increases over time thus ensuring

### Life cycles for supply chain strategic advantage Differentiating between order winners and order qualifiers

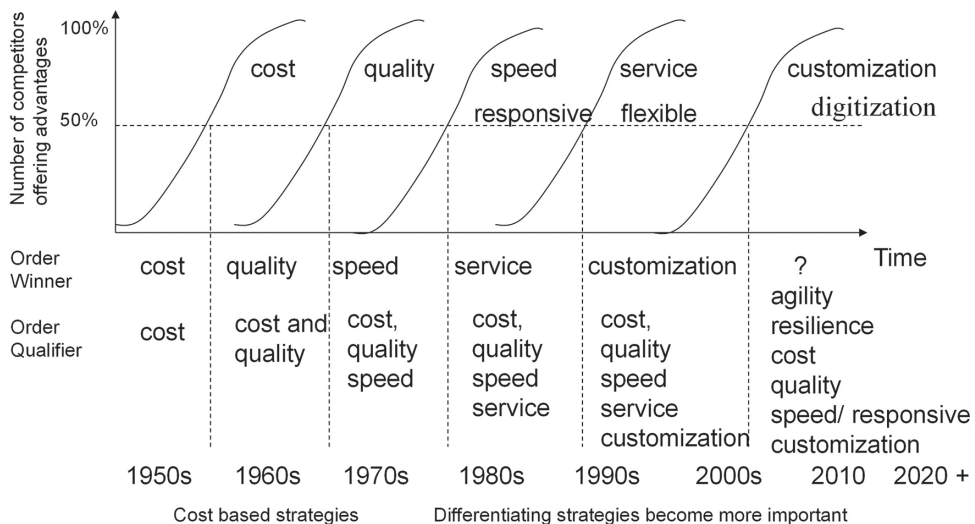


Figure 5.12 Key emphasis for supply chain strategies over time

that the strategy is eroded over time and that a new strategy is needed to compete in the next decade. Each time period into the future the competitive intensity increases. Cost initially won orders and was a qualifier in the 1950s, by the year 2010 and beyond, maybe customization is the order winner and the qualifiers are a list of previous order winners that have by now become simply order qualifiers. Although one suspects that there are variations between sectors, products and service elements, which make this problem more complex than it first appears. Translating market requirements into operational capabilities is necessary if organizations are to win orders from customers. Being responsive to customer requirements and building capabilities to become agile is key.

A further dimension to this competitive environment is the type of operation the organization is engaged in. Figure 5.13 illustrates types of manufacture from project through to continuous flow. Increases in volume lower cost and competitive advantage is achieved through having economies of scale in production. Organizations that operate on projects and jobs require different sources of competitive advantage built on achieving economies of scope. Order winning criteria for firms bidding for projects and jobs would focus on one or more different competitive attributes. The example lists five such attributes design, innovation, quality, delivery and capability. The higher the complexity of the product or the market the higher the need for order winning attributes apart from price. In product markets where economies of scale are important to lower cost it is more likely that the order winning criteria is price and one or other attributes simply become qualifiers to get the order. These products are more likely to be “commodity type” products where differences do not matter so much and competitor substitutes are perceived as equivalent.

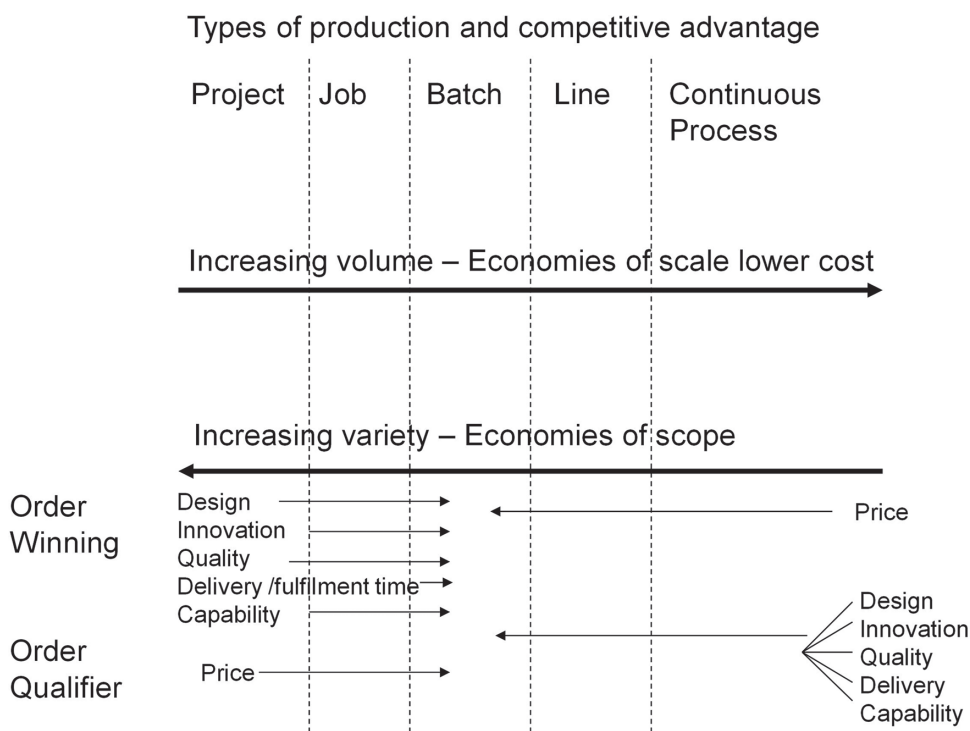


Figure 5.13 Types of production and competitive advantage

In many supply sectors and many markets organizations discount cost at their peril. Cost is always important the key question for an organization is how important is it to your customer. It is not therefore simply absolute cost but relative cost that is important and suppliers need to know. Lowering cost creates flexibility for suppliers it may allow them to negotiate on price or it may allow them to negotiate on a range of other issues when price is fixed. A supplier may precisely know its cost and in so doing it creates room for manoeuvre to offer enhanced products or services when a customer is drawing comparisons with a competing supplier.

### **Service, operand and operant resources**

Notions of service have been reconceptualized in the marketing literature. Contemporary ideas of service move the focus beyond transactions concentrating on value creation processes of service. Service implies exchange and exchange in turn suggests that it is value that is being exchanged in the service process. All exchange is an exchange of service. It is claimed that service transcends any bifurcation of services (intangibles) and products (tangible) (Vargo & Lusch, 2004).

It is service that adds value for customers. If organizations focus on service, they do not need to make a distinction between services with an “s” (e.g., retailing, hairdressing, healthcare, education, accountancy, legal) or products (e.g., automobiles, aircraft, ipods, washing machines, fridges, televisions) since both offer customers service. This is a useful way of studying supply chains. Since supply chains are, in effect, service systems. Supply chains satisfy customer demand by being responsive and agile. Operant resources are people. These operant resources have the capacity to learn and by doing so enable flexibility for organizations to become both efficient and effective. Operant resources build specific competence. Other competences such as adaptability, agility and flexibility reside with operant resources. In classical economics it was assumed that factors of production (land, labour and capital) were fixed. In 1798 Thomas Malthus predicted gloom as population growth caused misery for the masses in England unable to feed themselves because of these fixed endowments; factors of production. Malthus thought that population growth (geometric progression 2, 4, 8, 16, et. seq.) was faster than food sources growth (which was arithmetic 2, 4, 6, 8, et. seq.). His proposed solution to this problem was to cut the birth rate. Productivity might alleviate the situation, but Malthus underestimated the capability of operant resources to expand capacity. In evolving to service-dominant logic (S-DL) distinctions are made between operand (those resources that operations and acts are performed upon, e.g., land) and operant resources (those which act upon other resources, e.g., human knowledge and skill). The arguments in service dominant logic claim that operant resources have solved the Malthusian forecast dilemma through innovation and productivity creating capacity. There is recognition that resources, far from being fixed in time and space as Malthus had assumed, can change through human endeavour, creativity and skill. People in organizations can absorb ideas that change the way in which service is created without recourse necessarily to additional resources. It is referred to as “absorptive capacity” (Cohen & Levinthal, 1990). This “absorptive capacity” allows organizations to re-configure their service systems including supply chains. It means that there is no path dependency assumed in the Malthusian worldview and that fixed resource endowments become flexible creating *dynamic capabilities*, which if realized lead to different possibilities for the future (Zahra & George, 2002). Learning is an especially important supply chain competence.

This notion of service is central to supply chain thinking which is market-driven and customer focused. It can equally apply to public bodies as well as private enterprise (Wright et al., 2012).



## Summary

This chapter has introduced a number of key concepts involved in developing supply chain strategies that are demand driven and customer focused. It explained the importance of developing organizational structures to integrate systems and information to serve customer requirements more effectively. The nature of products and services were fully discussed. This has implications for what the customer values from a supplier. Strategic thinking and strategic options were also discussed using theoretical marketing frameworks as the basis of that discussion. In particular the Ansoff matrix was used to consider market driven supply chain strategies before finally considering what factors are likely to win more business in highly competitive markets and how these factors change through time. The next chapter considers sourcing and procurement decisions and their role in supply chain strategies in more depth.

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## 6 Supplier sourcing, procurement and evaluation

### Introduction

All organizations face decisions of supplier selection, sourcing, risk evaluation, legal and ethical considerations. Organizations need to source supplies from a variety of different organizations locally, nationally and/or globally. Each type of sourcing has its own merits and they are discussed in the first part of this chapter. The iceberg theory of cost comparisons in sourcing and procurement decisions are then explained and examples are given relating to hidden costs in the decision-making processes. In explaining these hidden costs, a number of influencing factors are discussed including the ways in which organizational performance and buyer performance is evaluated and the consequences of the measures on the decision-making processes. The next part of the chapter discusses supplier selection criteria and examines the role of manufacturers, wholesalers and distributors as intermediaries. Also examined are single and multiple sourcing strategies and their relative merits before assessing environmental and ethical issues related to sourcing and procurement. The final part of the chapter focuses on supplier development programmes and their role in supply chain sourcing strategies and the modern trend towards supply base rationalization.

### Sourcing and procurement decisions

One of the most important considerations for any organization is where to source product and which suppliers to select. Building an effective supply base is critical to the success of most organizations. The decision to source is often divided into three geographical considerations: local, national and global.

#### Buying locally

Many supply managers prefer to purchase from local sources when prudent to do so. Local purchasing has a number of advantages that may include:

- Close co-operation through close proximity, for example, enabling JiT solutions.
- More certain delivery dates since lead times not affected by transport delays and other risks may be reduced depending on location (e.g., natural or human disasters may be more prevalent in certain parts of the world such as earthquake zones or nearby volcanos and wars).
- Short lead times may eliminate inventory.
- Faster replenishment possible from local source.
- Discrepancies and disputes may be more easily resolved.
- Implied social responsibilities to the local community may be satisfied.

However, local suppliers may lose out to national or global suppliers where:

- Local cost of the items is higher.
- Particular goods cannot be supplied locally to the same standard, specification or price.
- Markets supplied are not local and therefore it makes more sense to source closer to the market.
- Better service is possible from a non-local supplier.
- Restrictions may limit the local supply source, for example, quota restrictions as was the case in the clothing industry under the Multifiber Agreement (MFA) until its abolition in 2004

### **Buying nationally**

May have the following advantages:

- National sources offer better quality and/or;
- Faster delivery and/or;
- Cheaper prices through economies of scale (or scope).
- National companies may provide better technical back-up and support services.
- Greater production flexibility may be achieved through national sourcing.
- Shortages may be less likely because of their size or extensive supply networks.

National supply sources may lose out to international sources for the same reasons local suppliers may lose out to national suppliers listed above.

### **Global sourcing**

Global sourcing may yield large rewards but risks are often higher than when sourcing supplies locally or nationally. The main reasons that organizations decide to source from overseas are as discussed in what follows.

#### ***Uniqueness***

Some goods are unique to a specific location and may only be sourced from that location. For example, minerals have to be sourced from the mine location (e.g., diamonds in South Africa, oil in the North Sea or Middle East). Agricultural products may be unique to a location (e.g., tea from India, Sri Lanka and China). Certain locations may offer unique products where the indigenous population have developed unique skills (e.g., Turkish carpets or silk products from Como).

#### ***Superior quality***

It may only be possible to achieve the superior quality required by buying goods from global suppliers. Some organizations may only be able to source and procure supplies from certain suppliers who have the necessary expertise or access to resources or quality of goods demanded by the buying organization. For example, purchasing minerals is determined by geographical endowments and organizations that have rights to those deposits are the only organizations a buyer may deal with.

**Better timeliness**

Order lead times may be better than could be achieved from local or national suppliers. This makes suppliers more dependable. Competitive forces are such that time compression may lead to an organization achieving competitive advantage. In such cases, it may be that suppliers located in different parts of the world may be able to meet the timeframes of the purchaser better than a local or national supplier. For example, in seasonal produce local suppliers may be constrained by climate whereas an overseas source may be able to supply the produce because their climatic conditions and seasons are different and favourable to them supplying at different times (e.g., grapefruit for UK retailers from South Africa in December, from the Canary Islands in April and so on).

*Lower cost*

It may be possible to achieve overall lowering of “total cost” by sourcing supplies globally. Nevertheless, there are “hidden costs” associated with sourcing products overseas. To illustrate this point in the clothing industry Hines (2002), has estimated that for UK retailers to source product from outside the United Kingdom they need to ensure that the total cost of purchase is at least 50 per cent lower to account for what he refers to as “iceberg costs,” that is, hidden costs associated with the supply. Similarly, Burt et al. (2003) estimate that the same is true of the computer industry where US manufacturers need to be sure that global suppliers are 20 per cent lower to take account of hidden cost.

*More advanced technology*

Some countries may gain advantage by having access to better technologies that gives them a better competitive position. For example, it may only be possible to access a source of supply because the organization in a particular country has developed a unique product or alternatively better technology makes their supplies more efficient or cheaper as a consequence.

*Broader supply base*

Sourcing globally may allow the purchasing organization to spread risk by widening its supply base. Broadening the supply base does not necessarily mean having more suppliers. It may mean fewer but better quality suppliers. Better collaboration may be achieved by broadening the supply base. In addition, if a problem occurs with one country the purchaser may switch between different suppliers to maintain supplies.

*Expanded customer base*

Sourcing globally may lead to the identification of new market opportunities where those suppliers are based. However, it is important to recognize that trade barriers may exist.

**Airbus A380**

The Airbus company employs 134,931 people of which 13,000 are employed at two sites in the United Kingdom (Broughton and Filton) and has subsidiaries in the United States, China, Japan and Middle East. It had annual revenues of \$61 billion in 2021. Airbus

accounts for nearly half of all passenger aircraft sales. The average list price of the A380 is around \$446 million subject to design weights, engine choice and level of customization.

The Airbus A380 is the world’s largest airliner. The double-deck A380 has capacity to carry 525 passengers in a comfortable three-class configuration, and up to 853 in a single-class configuration. It provides wider seats than competitor products. Furthermore, the A380’s two decks offer 50 per cent more floor surface. It has a range of 8,300 nautical miles. The A380 is 15 tonnes lighter than a conventional all metal plane. It is built at several locations around Europe and final assembly is in Toulouse, France. There are also components and other parts sourced from different locations around the globe. Airbus has 1,800 suppliers in 30 locations around the world.

The main build operations for the A380 are shown in Table 6.1.

Table 6.1 Build operations and location

<i>A380 build</i>	<i>Location</i>
Wings	Broughton, North Wales (Nr. Chester)
Fuselage	Hamburg, Germany
Tailfin	Stade, Germany
Rudder	Puerto Real, Spain
Nose	Saint Nazaire, France
Fuselage and cockpit sub-assemblies	Méaulte, France
Horizontal tailplane	Getafe, Spain
Final assembly	Toulouse, France
Cabin installation and painting	Hamburg, Germany

The supply chain for building such an aircraft is complex and time critical. For example, the Airbus A380 wings made at Broughton are exceptional sized loads, each wing is almost 50 metres long and 14 metres wide, weighing 36 tonnes. They are transported by sea, being too big and heavy to transport by air. However, firstly they have to travel 15 miles by river from Broughton to the port at Mostyn before being shipped to Bordeaux before being moved by road to Toulouse for final assembly.

**Some key facts**

The A380 is 15 tonnes lighter than it would be if made entirely of metal.  
The 4400m<sup>2</sup> surface of the A380 is covered in three layers of paint weighing around 500 kg.  
During take-off the A380 wing will flex upwards by over 4 m.

*Problems in global supply*

There are also many potential problems associated with global sourcing and these include:

*Cultural issues*

Many different problems can occur as a consequence of cultural differences. For example, it may be inappropriate to place an order for four units in China where the number four is associated with death. Alternatively, it may be that the country has a culture of “countertrade” whereby it



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is considered normal to make payments or partial payment in goods rather than money. Foreign governments often impose countertrade to gain access to foreign exchange or foreign technology. As a means of overcoming cultural differences large organizations sometimes establish international procurement offices (IPOs). Their benefit is to gain knowledge and local/cultural expertise and then to apply it to procurement within a country or region.

*Long lead times, risk and volatility*

Greater volatility may result from sourcing globally often due to such things as: shipping schedules, customs practice, strikes, storms at sea all of which require greater co-ordination of the supply chain. Sometimes airfreight is used to offset the problems identified but there is a cost “trade-off.” Often an organization will purchase additional inventories to lower risk in sourcing globally. For example, if lead times are variable the organization may compensate through inventory to ensure supplies are maintained. Alternatively, these “buffer stocks” may be kept low where supply managers rely on airfreight to compensate for time delays. Any additional inventory carrying costs incurred as a consequence of global sourcing should be added to the cost of purchase along with freight and administrative costs to evaluate the purchase decision.

*Lower quality*

This can result in potential re-work or scrap costs. Lower quality may be an issue but it is not unique to global sourcing often the problem exists for all types of supply. However, it achieves a greater significance in global sourcing because it may result in further delays and higher risks in not being able to satisfy the final customer.

*Social and labour problems*

There have been newsworthy cases of supplies being sourced from factories where child labour is prevalent in the apparel industry. When these issues are highlighted, ethical sourcing is brought to the forefront. Many large retailers have signed up to ethical trading statements that charge them to uphold labour standards and maintain social conditions. This has been a problem in countries where labour laws are weak or where they have laws that are simply not enforced. This is an issue that will probably get more coverage in the next few years especially as China and other developing economies get a greater share of world-manufactured goods.

*Higher costs of doing business*

There are often communication problems sometimes because of language and sometimes culture. There is a need for translators and visits to ensure compliance. In addition, currency costs, banking costs, logistics support and communication systems all require investment and incur additional cost.

*Opacity, transparency or opportunity*

It has long been known that global sourcing incurs additional risks. Price-Waterhouse Coopers, London, along with input from the Milken Institute in the United States developed something called the “Opacity Index” (The Opacity Index, 2001). It addressed the following areas: corruption in government bureaucracy, laws governing property rights and contracts, economic

policies, accounting standards and business regulations. China was a country where the Opacity Index score was high and the United States achieved a low score because it has less bureaucracy, fewer government restrictions, more liberal economic policies and very little corruption. “It is a broad measure of the effectiveness of a country’s economic and financial institutions, as well as its overall risk . . . based entirely on empirical observations” (Kurtzman & Yago, 2009, p. 1).

These measures of opacity are attempts to measure risk in global markets. The PWC index has developed further and is now called a transparency index (Transparency, 2022). A score of 100 means no corruption and a score of zero extremely corrupt. Data are gathered on 180 countries. Denmark at the time of writing in 2023 has a score of 90 and is the highest ranked index score. The United Kingdom has a score of 73 and has an equal ranking of 18th with Japan and Belgium while the United States has an index score of 69 and a rank of 24th. Somalia has a rank of 180th with an index score of 12. Milken have since developed their own index the Global Opportunity Index (Milken Institute, 2021).

## **An iceberg theory of cost comparison**

### *How buyers make decisions*

When making comparisons between two sources of supply, a decision is often taken based upon a straightforward cost comparison. This cost concept will usually be bought-in cost. This type of decision has been articulated in the financial decision-making literature as “make or buy” decision-making because it often uses the analogy of making a product in-house or buying it in from an outside supplier. This decision-making concept is similar to that applied to outsourcing discussed in the purchasing and general management literature. The figure for bought-in cost is usually defined as the invoiced price per unit. It is the delivered price (i.e., the price delivered to the buyer’s warehouse). For example, in clothing manufacture, a labour intensive industry, labour costs are often the most significant cost of manufacture. Production units located overseas are often favoured with lower labour costs than similar plants in the United Kingdom. Average direct hourly wage rates in a UK plant were around £6 per hour in 2000 whereas, India were less than £1 and nearer to home in Morocco under £2. Thus, labour wage rates provide non-UK suppliers with an immediate comparative advantage compared with UK rates. The other two major cost elements are materials and overheads. Material costs are often similar because fabrics and trims will be bought from a single source for both a UK or an overseas supplier. There are exceptions to this when remote plants choose local sources for fabric and they may gain a further price advantage. However, where a retailer is purchasing bulk materials to distribute to selected manufacturing units throughout the globe fabric prices do not affect the manufacturing decision. The final cost is overhead and will usually be higher in the United Kingdom than offshore. The two significant areas of disadvantage for UK suppliers are labour and overhead costs.

### *How buyer’s own performance measures affect their decisions*

Buyer performance is often measured by examining target margins and actual margins achieved. This is a very important determinant of choice. A buyer will want to achieve target margins in order to meet specific price points for the merchandise in-store. Bought-in price and retrospective discounts can help the buyer meet their targets. This will be further explained a little later. The rational choice faced with the visual representation given in Figure 6.1 is simple. The non-UK manufacturing source would be chosen because it appears to give the higher margin (the perceived saving gap).

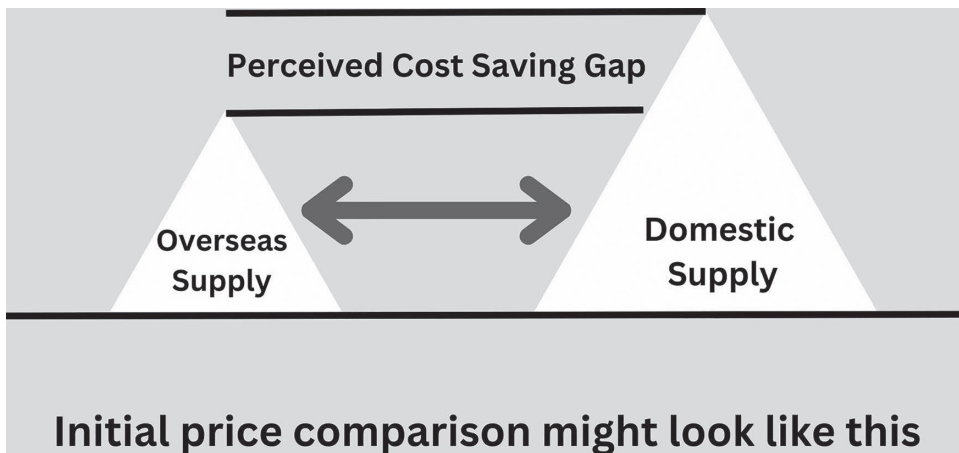


Figure 6.1 Iceberg theory of cost comparison (Hines)

### *The iceberg of non-transparent costs*

Figure 6.2 illustrates an iceberg where substantial cost is hidden below the waterline. Buying teams may be motivated to procure garments from overseas because they are judged by performance measures that are outdated. Gross margin measures are not sufficient because they ignore the “iceberg” costs, that is, the hidden cost of procurement. Domestic supply might appear on the face of it more expensive than an alternative source of supply from an overseas source. Nevertheless, in drawing a comparison the buyers may be deciding simply on the basis of direct cost or rather the bought in price comparison. Their performance will be judged on the basis of target gross margins achieved and this single criterion may be the most important to satisfy the condition. Such a comparison would ignore any additional costs incurred as a result of management time and resources expended in managing an overseas source of supply. Such a decision may not be in the organization’s best interests. Managers often articulate other requirements in terms of flexibility and responsiveness but buyers in the final analysis will base their decision on price alone to protect their own interest.

It is assumed in Figure 6.2 that all hidden costs relate only to non-UK supply. In reality there may well be hidden costs associated with some UK sources of supply. However, the iceberg of hidden cost can equally apply to a UK source.

The theory of an iceberg of cost that buyers do not fully understand or appreciate and that may actually help to disguise buying inefficiencies is one possible explanation for the preference given to overseas sources of supply. Nevertheless, it is important to recognize that real costs play a part too. Certainly, there is no doubt that growing import penetration in the UK clothing market has been hastened within the past five years as a result of increasing overseas sourcing by major UK retail groups. Ignoring the iceberg allows a buyer to:

- Compare bought in prices without recognising other costs that might make a difference to their decision.
- Achieve target margins and price points.
- Ignore organizational costs that will never be tracked back to the specific stock keeping units (SKUs).

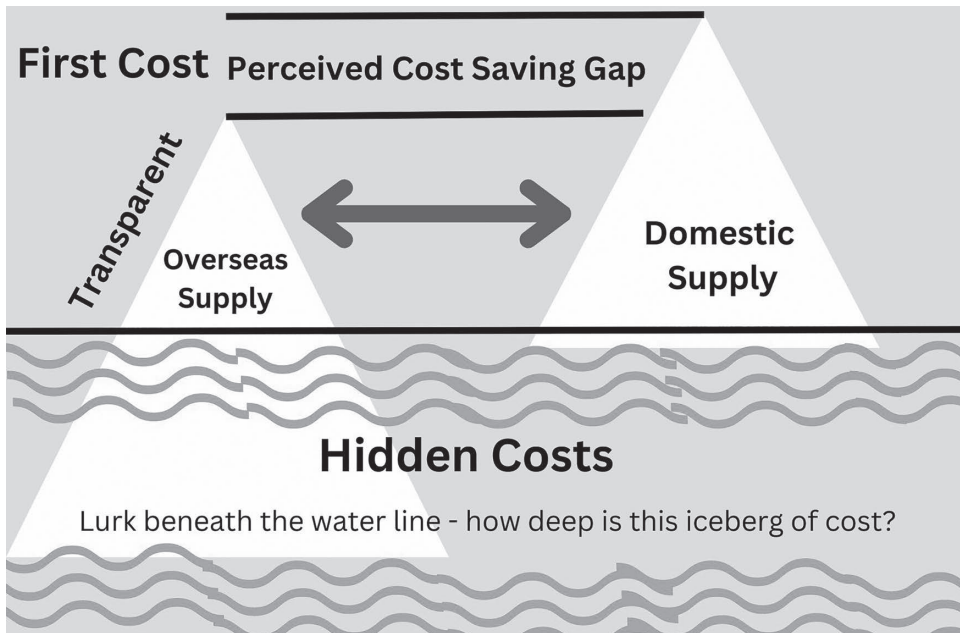


Figure 6.2 Icebergs transparent and non-transparent cost

However, the iceberg may not be the only explanation. There are of course other reasons why buyers would want to source from outside the United Kingdom:

- To offer customers something different.
- To search for lower price merchandise that offer better customer value.
- To acquire different fabrics.
- To obtain different designs.
- To develop new offshore sources to service a growing global distribution network.

#### *The iceberg costs in more detail*

This iceberg beneath the waterline contains a number of hidden costs that are often ignored in supplier sourcing and purchasing decisions. The hidden costs identified could be substantial. Furthermore, these costs are often disguised or never traced back to the stock keeping units (SKUs). Examples of some of the hidden costs are given in the model illustrated in Figure 6.3. Iceberg costs include procurement, management time consumed in pre-acquisition searches, acquisition, monitoring progress, re-work or post-acquisition costs including ownership costs. More importantly, something that is hardly ever measured in practice is lost sales due to late delivery or incomplete delivery (e.g., wrong size ratios, wrong style mix, wrong colour mix).<sup>1</sup>

Inventory carrying costs for may also form part of the iceberg. Many organizations store redundant, obsolete or scrap items unnecessarily. Inventory is classified on a balance sheet as an asset but when it is no longer saleable (obsolete) or has a value that is lower than bought in cost (redundant or scrap) it too can form part of the iceberg (hidden cost). This is why transparency is such an important concept in stock management.

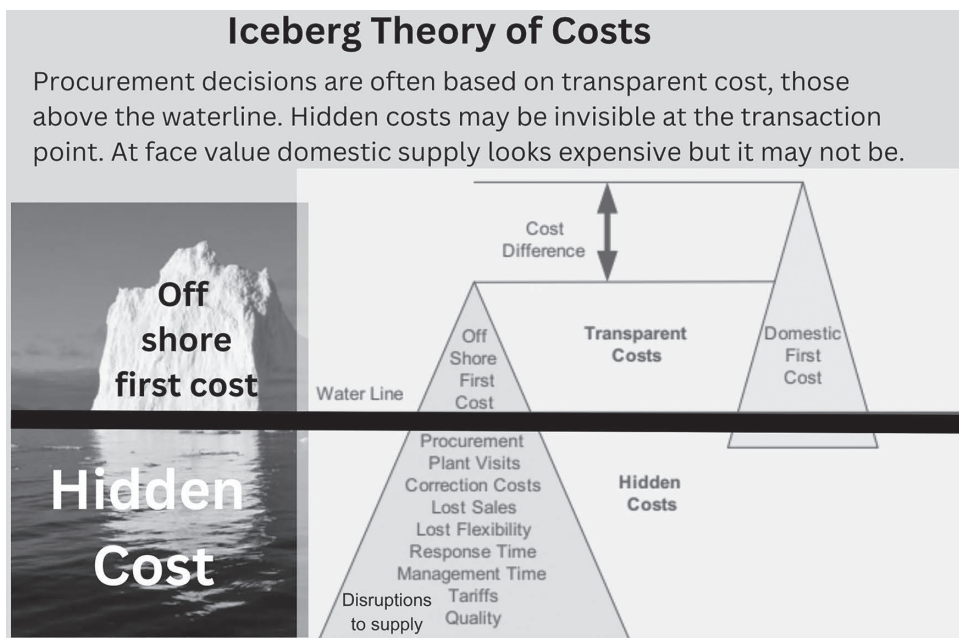


Figure 6.3 Icebergs cost and competitive advantage

#### *Procurement costs*

Anecdotal evidence from a number of retail fashion buyers who spend a significant amount of their time travelling abroad searching for new products suggests that the cost is not unimportant. Buyers often spend two or more months travelling to source merchandise during any given year. The cost includes airfares, hotel bills, telephone calls and subsistence payments not to mention the human cost of broken relationships, loneliness and fatigue results that often reflect in inefficiencies and staff turnover measures. Furthermore, if one considers the time spent against orders placed there will be times when the cost of procurement is extremely expensive and significantly more than the final invoiced bought-in price which may be the only cost that is measured. Thus, procurement costs incurred in sourcing the products and suppliers at the pre-acquisition stage may never be traced back to products. Such costs are more likely to reside in an overhead category. What is more, such costs may be allocated or apportioned arbitrarily to products that did not incur the costs when overheads are apportioned.

#### *Management time*

Management time is consumed communicating with suppliers before acquisition, during acquisition and post-acquisition. The number of managers involved and the amount of time spent can be significant. One major retailer has a team of managers that co-ordinate activities with offshore suppliers in Morocco. The management teams frequently visit the plants to monitor and plan production, to resolve operational difficulties and to help improve efficiencies. The time spent is not always traced backed to the products that are consuming this resource. Activity based costing would be a useful tool in these circumstances to gain accurate information.

*Opportunity cost of lost sales*

By far the greatest cost and perhaps the most significant part of the iceberg could be the opportunity cost of lost sales. If merchandise is not available within a store at the time the consumer wants to buy it the sale is lost. Consumer behaviour theory might suggest substitution. However, substitution of one product for another may not happen within the same retail store. Substitution may unwittingly help competitors to achieve a sale. This part of the iceberg is where an overseas supplier is at greater disadvantage. A UK supplier is closer to market and a short delay in production will not necessarily result in late delivery or incomplete delivery. Whereas a delay in production from an overseas source would more probably result in missing a shipping date. This may require drastic action to airfreight goods which adds significantly to cost and a cost that has not been built into the retailer's price point. Typically, it takes eight to 12 weeks to deliver merchandise from a Far Eastern source whereas it may be four to six weeks from a UK source and perhaps just one week more from Morocco, Portugal, Egypt and Eastern Europe.

Figure 6.3 illustrates the iceberg costs together with potential areas whereby UK suppliers could build competitive advantage. Assuming that the iceberg costs for a UK supplier are less significant than for an overseas supplier would suppose that UK suppliers could build on strengths that an overseas source would find it difficult to achieve.

*Sources of competitive advantage for UK suppliers*

The iceberg theory identified in this research reveals a number of possibilities that would enable UK suppliers to achieve competitive advantage vis-à-vis an overseas supplier even an overseas supplier located within near reach of Europe. However, it is not simply the iceberg but the size of the iceberg that will determine the relative advantage. In some cases, an iceberg may exist but it may not be sufficiently deep to allow the UK supplier to exploit it. The stronger the relationship is between a supplier and a UK retailer the less likelihood of a large iceberg lurking. Conversely, the weaker the relationship is between a UK retailer and a supplier the more likelihood of a larger iceberg that may be exploited by an alternative supplier. Strength of organizational relationships is therefore a central issue in exploring the iceberg.

Competitive advantage has two sources according to Porter (1980), cost and differentiation. A UK supplier can either compete on cost or differentiate itself in some way from its competitors. The cost disadvantage that seemed so clear-cut when drawing comparisons between a UK supplier and a supplier from overseas (refer to Figures 6.2 and 6.3) where labour cost and overheads are substantially lower may not be so clear-cut if organizations examined more closely their iceberg costs. Caution is the clear message in considering organizational sourcing decisions.

**An example of the iceberg effect**

INTAKE MARGIN	£	
Target selling price	20	
Bought in cost	10	
Gross margin	10	50.00%

A retail buyer plans to purchase 10,000 units of merchandise at £10 bought-in price or total delivered cost.<sup>2</sup> The proposed target-selling price per unit is £20, which gives the retail buyer a forecast bought-in margin<sup>3</sup> of 50 per cent. The buyer decides to purchase 10,000 units at the



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price of £10 per unit. A total cash outlay is made of £100,000. The demand pattern turns out to be worse than forecast. Unplanned management time has been consumed in a number of activities associated with the purchase sorting out customs documentation, duties and quality problems with the merchandise. In addition, there were substantial sourcing costs incurred before the purchase was made. The retailer is only able to sell 40 per cent at full price and a further 30 per cent are sold at 30 per cent mark down. The price achieved being £14 per unit. Remaining SKUs have to be written off at cost as they are unsaleable. In addition, the retailer has developed a total cost of ownership (TCO) approach and traced a number of additional costs to the particular merchandise. Details are given in the financial statement.

<i>Demand pattern</i>	<i>Units</i>	<i>£</i>	
Sell at full price	4000	80000	
Sell at mark-down	3000	42000	
Sales revenue achieved		122000	
Cost of sales	7000	70000	
Stock remaining at cost written off	3000	30000	
Gross margin		22000	18.03%
Hidden costs in supply chain	COST		
Inventory holding	1000		
Procurement	5000		
Management time	3000		
Additional administration	500		
Promotional cost	1000		
Pre-acquisition sourcing	10000		
Post-acquisition	2000		
Total hidden cost		22500	
Net margin		-500	-0.41%

As a consequence of the hidden costs in the supply chain which have now been traced to the SKUs the retailer has made a loss overall. Furthermore, the planned intake margin of 50 per cent has turned into an actual gross margin of only 18.03 per cent. A large iceberg indeed.

In summary, the post-acquisition margin does not look as good as the target margins forecast by the buyer.

<i>Post acquisition margin</i>	<i>£</i>	<i>Percentage</i>
Unit sale price achieved	12.20	100.00%
Cost of sales	10.00	81.97%
Margin on sale	2.20	18.03%
Hidden costs in supply chain	2.25	18.44%
Loss on product line	-0.05	-0.41%

Research in the USA adopted Hines (2002) iceberg model and applied it to a small number of manufacturer and retail scenarios confirming validity of the model in that specific context (Hartman et al., 2011). One of the biggest challenges this research identified was persuading retailers of the value of identifying “iceberg (hidden) costs.” In the retail context in the study Hartman et.al. identified quality, mark-downs and inventory carrying costs as important hidden costs. When sourcing overseas they also identified tariffs.

### Discussion

Kaplan and Cooper (1998, p. 206) refer to “choosing low cost not low price suppliers” this is an extremely important lesson for an organization’s sourcing and supply chain strategies. The purchase price is only one component that makes up the total cost of acquisition and ownership. A supplier may deliver at the best price but they may not be the lowest cost supplier. There are a number of possible reasons why this can be so, a low-cost supplier may achieve a competitive advantage over their low-price competitor for some or all of the reasons listed:

- Transparent and timely information flows enable the retail buyer to determine more accurate delivery dates and avoid losing sales by being late to market.
- Suppliers using electronic data interchange over virtual private networks or via web-based systems are able to provide better levels of customer service that help retail buyers with their decision making – for example, avoid costly stock-outs or overstocking by having early warning information (two way) about demand and supply.
- Zero defects.
- Just-in-time supplies.
- Vendor managed inventory.
- Co-ordinated category management from suppliers, for example, skirts, tops and matching accessories arrive in store simultaneously.
- Collaborative product development may reduce retail and supplier costs.
- Electronic document exchange reduced time in process (purchase orders, invoices, specifications).
- Electronic fund transfer increases cash flow for good suppliers encouraging them to achieve results on the retail buyer’s behalf.

Cyert and March in their seminal work in 1963 identified differences between organizational goals and the goals of individual managers as cause for concern. Prior to that economists had assumed that all organizations in business had a single objective – to maximize profit. Whilst maximising profit may be a sound business objective it is not the only one that is important or practised. Cyert and March (1963) noted that even when the organization’s goal is to maximize profit not all the people who work in the organization would be adopting behaviours to achieve this objective. Individuals have their own objectives such as maintaining or improving their own job prospects. In doing so they will act in ways that benefit their own position and this may not necessarily coincide with the objective of maximising profit. In certain circumstances *satisficing* behaviour will replace maximising behaviour. An example of this may be found in sourcing and procurement decisions. For example, it was known for many years in the latter part of the twentieth century that organizations purchasing computer equipment chose IBM because “Big Blue” was a safe bet. It may not have been the cheapest price; it may not have been the lowest cost supplier as discussed above but as the person responsible for the purchase you were not going to get fired as a consequence of this decision.

### Supplier selection

In making decisions where to source supplies, it is not simply a question of location. Decisions focus on product, service and capability of the supplier. In addition, there may be decisions regarding procurement direct from the manufacturer, through a wholesaler or distributor. Key influencing factors apart from cost include quality, responsiveness, flexibility and reliability. These influences are discussed thoroughly in Chapter 5. In recent years, the

environment and ethics have also entered the equation of who to source from. This section focuses on these issues.

***Manufacturer, wholesaler, distributor?***

Capability, service and access will determine the selection of the supply source. Capability of a supplier to meet the need is of paramount importance. Is the supplier technically competent to achieve the purchase specification? Assuming there are several suppliers equally able to meet the technical specifications of the purchase, such that there is no noticeable variation in the product, then it comes down to service. Which of the suppliers will offer best service to the customer? It is often service that differentiates a chosen supplier from those who were considered but not chosen. Determinants of supplier choice will be considered more thoroughly below. Finally, it may be access to a supplier that is important. Sometimes organizations may identify capability and service but they may or may not have access to a supplier. Some suppliers do not want to deal directly with a customer because the amount they will supply is insufficient for them to want to engage directly. In such cases they may refer a small customer to a wholesaler or distributor who is able to “break bulk” on their behalf. In addition, sometimes distributors offer specialist services that make it worthwhile for the purchasing organization to deal with them rather than dealing directly with the supplier who may not be able to offer the same services. Often a distributor will also stock competitor products and have a larger range than can a single direct supplier. This may offer the purchaser a considerable advantage in terms of lowering their risk as opposed to dealing directly with a single supplier. In such circumstances it is possible for the purchaser to place a single order with a distributor who is able to supply several different products from several different suppliers. Unit prices may be higher than dealing direct but the total order cost may be lowered when ordering through a distributor and the cost of inventory may also be lowered because the goods are ordered as required rather than for “buffer” stock.

***Single or multiple sourcing strategies?***

One question that is often paramount in the mind of the purchaser is should they rely on a single supplier or should they have several? The simple answer is it all depends. So, what does it all depend on?

The arguments for having a single supplier include the following:

- Long term contracts stemming from long term relationships with that single source.
- The supplier may own a patent or other intellectual property rights (IPR) that the buyer cannot acquire from anyone else. In other words, a unique source of supply.
- The supplier offers better, faster cheaper sources of supply than anyone else does.
- An order quantity may be too small to split the order.
- A buyer may obtain better prices by purchasing from a single source.
- Purchasing from a single source may lead to economies of scale for the supplier and as a consequence the buyer obtains a discounted price on the product or is able to achieve lower transport costs.
- A single supplier may be more interested in the supply because it represents a substantial proportion of their business.
- It may be easier to establish EDI links with a single supplier.
- It may be easier to implement just-in-time systems with a single supplier.

- It may be easier to share information with a single supplier.
- Effective supplier relationships require considerable investment in time and effort and it may be that fewer suppliers are easier to integrate into effective supply networks. Single sourcing may lead to effective partnering.

Multiple sourcing is preferred when:

- It is important to spread the risk and when a single supplier may be regarded as a risk.
- It is important to lower cost since the competition may spur a current supplier to become more efficient.
- It may be necessary to ensure supplies are not disrupted through strikes, breakdowns or acts of God beyond the control of any party.
- It is deemed necessary not to rely on a single source for any reason.
- An organization has a historical track record of being able to deal with multiple sources.
- It is necessary to lower the “total cost of ownership” by having multiple sources that are able to offer a bundle of both low-cost and service options.
- Strategic reasons are an issue and it is deemed unreasonable to rely on a single source, for example, military contract supplies.
- The capacity of a single supplier is full.

The trend in sourcing is to have fewer suppliers and to build better relationships with those suppliers. For example, many retailers in the United Kingdom have reduced the numbers of suppliers they are prepared to deal with on a regular basis. Bookstores have reduced the numbers of publishers they deal with. The purchasing and stocking policies of larger bookstores have forced smaller publishing houses to use consolidators or wholesalers such as gardeners who purchase stocks at high discounts from the smaller publishers to supply bookstores at a lower discounted rate taking their margin from the difference in purchase and supply prices.

#### ***Environmental considerations in the supply chain***

“Greening” the supply chain has been considered in a number of ways:

1. Purchasing materials which are recyclable.
2. Liability considerations for disposal of hazardous wastes at any stage in the supply chain
3. Reducing the distances goods travel to their final destinations

Many purchase decisions have alternatives or substitutes that can be used to do the same job. For example, wine bottles can be stoppered with cork, plastic or screw tops, which may be metal or plastic. The purchase decision will focus on cost and functionality. However, it may also be influenced by recyclability too. It is often not difficult to obtain supplies that meet cost, technical functionality, aesthetic design considerations and are environmentally friendly through recycling, for example, biodegradable packaging materials, paper used in book production, plastic goods such as milk cartons, fibres and fabrics used in clothing, glass containers, drinks cans.

Coase (1937) developed an economic theory to deal with a firm’s responsibility to manage hazardous waste and pollution it caused in the community. The premise was simple that firms did not pay the full price of production and so they should pay a tax equivalent to the difference between the production cost and the cost of pollution caused by the process it managed. Only in such circumstances is the full cost of production borne by the producer. In recent years

governments, policy makers and pressure groups such as Greenpeace have all shown an interest in Coase's ideas. Responsible suppliers now attempt to meet stringent environmental requirements placed upon them by governments. Environmental consultancies specialising in "greening" the supply chain have grown in recent years as the demand for their services has grown. Large public corporations employ such agencies too ensure they comply with appropriate laws relating to hazardous waste and to protect themselves against public liability.

In food retailing one issue that has received a great deal of attention is the concept known as "food miles." Suppliers of grocery produce may be located thousands of miles away from their final market place. Often there appears to be little logic in the location of a supplier being great distances from market especially when local produce is ignored and a source of supply is chosen that is thousands of miles from the market. For example, potatoes, tomatoes, peas and other fruits and vegetables may travel great distances. The full cost of these journeys is neither borne by the producer nor by the customer. Road traffic congestion and increased pollution from transporting the goods is the burden of a wider community.

### **Ethical considerations in sourcing and procurement**

In recent years, organizations have become more aware of the ethical dimensions. Often the ethical consideration is made out of self-interest. For example, bad press can have a major impact on a brand, product or organization. There have been a number of reported incidents that needed careful management to minimize the impact of the bad publicity generated from press reports. For example, Marks and Spencer, GAP and Nike suppliers were allegedly said to be employing child labour in North Africa and the Far East. Another ethical issue might be animal testing of products by drug companies. More recently in the food industry businesses are reflecting consumer concerns regarding animal welfare by clearly labelling produce from organic farming or welfare approved environments. Tea plantations in Kenya provided examples of physical abuse of female employees by hiring managers reported by BBC Panorama. One consequence of these reports has been for large organizations to enforce compliance measures on their suppliers to ensure that they meet ethical trading standards set by the buying organization.

### **Cleaning up**

The Clean clothes campaign, Labour Behind the Label and Remake are activist groups that put pressure on brands in the fashion industry to do the right thing when it comes to employment rights, fair wages and improvements in working conditions. The image of a sweatshop industry prevails. It has been demonstrated in fashion supply chains around the world retail brands have disregard for the millions of people (mainly women) making their clothes in places like Myanmar, Vietnam, Sri Lanka, China, Dominican Republic, Guatemala, El Salvador and Africa. Physical abuse, sexual harassment, poverty wages and unsafe working conditions are commonplace. When workers try to organize unions to defend their rights, they often face severe harassment, are fired and sometimes are even physically threatened, harmed or killed simply for demanding fair pay and clean working conditions.

Big fashion brands often claim that they are not responsible. They claim they have strict compliance codes of conduct that suppliers have to meet. The problem is that they are not always adhered to, according to the Ethical Trading Initiative. Checks on second and third tier suppliers are almost nonexistent as distance creates blindness.

When it comes to big brand retailers, they need to clean up their act rather than simply cleaning up.

The above case illustrates some of the difficulties facing organizations when they source materials from suppliers around the globe. There are many pressure groups like Labour Behind the Label that monitor and report what they see as injustices. Buyers and suppliers can unwittingly become embroiled in these difficulties unless they take care. In order to minimize the negative impact of these episodes buyers need to:

- Select suppliers carefully.
- Set down and agree appropriate standards.
- Monitor compliance with the agreed standards.
- Identify areas for supplier improvement.

Suppliers must:

- Comply with the agreed standards laid down by the buyer or risk de-listing.
- Take responsibility for their own continuous improvement.
- Act legally.
- Act ethically.
- Engage in supplier development programmes.

Child labour is not just a recent phenomenon of course. We have our own industrial heritage in the United Kingdom as the first industrial nation and we too are all aware that in the nineteenth century there were many developing industries where the conditions identified in the case study could well have applied.

### ***European pressure groups***

In Europe, there are a number of organizations concerned with ethical trading. These organizations act as pressure groups exerting influence over organizational behaviours and government. In many ways, they moderate the effects of pure commercial transactions by modifying behaviour in favour of wider societal interests. The following are just a small selection.

*Transnationale.org* ([www.transnationale.org/anglais/default.htm](http://www.transnationale.org/anglais/default.htm))

Transnationale.org is published by Transnationale, a French not-for-profit organization created in October 1999 in Martignes (France). This website searches and publishes relevant information about large companies, and includes information on brands, political influence, factory locations, working conditions, as well as company policies on the environment, global issues, social and financial strategies.

*No sweat campaign against sweatshops* ([www.nosweat.org.uk](http://www.nosweat.org.uk))

The No Sweat Campaign Against Sweatshops website is an interactive online campaign that includes retailer surveys, opinion articles about current labour rights issues, information about upcoming events and a mailing list, among other things.



*Clean clothes campaign (www.cleanclothes.org)*

The Clean Clothes Campaign is an international European network with the goal of improving the working conditions in the garment industry worldwide. The network is comprised of a wide variety of organizations, such as trade unions, consumer organizations, researchers, solidarity groups, women's organizations, church groups, youth movements and world shops.

## **Ethical case**

### **Ten per cent of the world population live on less than two dollars a day**

#### *Why do we think it is OK?*

The world population reached eight billion in 2023 (UNPFA, 2023). Approaching one billion people across the world live on less than two dollars a day. These people exist in extreme poverty with meagre resources. No matter how hard they work they find it impossible to improve the quality of their lives. Consumers in the United States and Western Europe benefit from the products that these workers make often in sweatshop conditions. Clothing, food, toys and even micro electronics are produced for the rich world by workers who cannot afford to buy the products they make. Why do we think this is OK? Consumers do not like to think of the almost feudal conditions that exist in these newly industrializing countries. For the workers in the developing world there is a poverty gap and a poverty trap meaning that they are less wealthy than others in their own communities as well as substantially worse off than workers in the developed countries and there is a trap because it is impossible to break the cycle of poverty. "In the poorest countries, extreme poverty, food insecurity, inequality, high death rates and high birth rates are linked in a vicious cycle" (UNPFA, 2011, p. 3).

"Much of the work in textile mills is done by women and children" is a quote from an economic history of the textile industry in eighteenth century England (Hill, 1961, p. 69). Simply put, women and children were paid less, many children were orphans and they were brutally treated in England during the world's first industrial revolution. Poor living conditions close to places of employment spread disease quickly. Tenements of jerry built houses emerged quickly in the newly industrializing towns like Manchester leaving a legacy of social problems for generations that followed well into the twentieth century. New factories had poor ventilation and squalid conditions spreading fever fast. It was named "factory fever" (Typhus). Humid atmospheres were important in cotton mills to keep the material in good condition to sustain high prices for the owner. However, this could well apply to the textile industry in developing countries today. Many mainly young female labour live close to, if not actually in or behind the factory in dormitory communities working double shifts 16 hours a day to support themselves and their families. *Plus ça change plus c'est la même chose*. Children help their parents or work alone and many of the machines are unguarded to increase machine efficiencies and earn better piece rates for the workers. One factory I visited had young girls of school age working at embroidery machines without dust masks and with guards off the machine. As I approached in my western suit looking more like a representative of a

buying organization rather than a researcher they quickly put on their masks and replaced the guards on the machines.

Bangladesh is a Muslim country and a large producer of clothing for US and European markets. Branded goods are churned out for pennies to be sold at \$20 and more in sophisticated stores, a far cry from the factories where the goods are produced. Disney merchandise, baseball caps for Ivy League universities, branded T-shirts and other clothing items selling in some of the largest international retailers, Walmart, Marks and Spencer, Carrefour and J.C. Penney. With more than four million people mainly women (70%+) working in the 4,500 clothing factories in Bangladesh, there are strained relations between employers and employees, which have witnessed violent protests according to BBC News sources. Nevertheless, the garment industry is a success story and has been for 30 years in an impoverished country. It earns hard currency. Exports were worth \$43 billion in 2022. It is the second largest garment exporter in the world. Still, neighbouring country factory owners remark that they do not want to “race to the bottom” when drawing comparisons between themselves and Bangladesh’s very low prices. Bangladesh has more than tripled clothing exports within the past ten years. If you get an aeroplane to Dhaka out of London, Dusseldorf, Paris, New York and yes even Milan you will no doubt sit amongst brand buyers and sourcing executives making their way to the clothing factories of Bangladesh in search of these low prices to maintain their organization’s value chain.

The minimum monthly wage for garment workers in 2023 is \$96. This has increased by more than 50 per cent since 2018. Trade unions claimed it was the lowest wage rate anywhere in the world in this industry at that time. However, this is not so now as that unwelcome honour belongs to Ethiopia garment workers where the minimum is just \$26 per month. Do we still feel comfortable buying our baseball caps, T-shirts and clothing brands from retail stores complicit in keeping people at the bottom? Economists argue, reasonably they say, that these workers survive because they are part of a global supply chain supported by these retailers. Without these retail purchases the situation would be much worse. But how much worse can it really be when you are at the bottom of the supply chain? Some argue that just a small increase in the prices paid to suppliers would lift the quality of life for these workers and their families to break the vicious circle of poverty. Others counterpoint that paying more simply moves the sourcing somewhere else in the globe. One thing is perhaps more certain, if wage rates remain fixed at the lowest level and industrial disputes increase, supply will be disrupted. Then there are no winners only losers. And yes, the biggest losers will be those at the bottom.

### **Review questions**

1. What can organizational buyers do to ensure that they are not accused of unwittingly becoming involved in unethical sourcing and procurement?
2. How can suppliers protect their business interests by being both competitive and engaged in ethical trade?
3. What are the risks involved for business organizations who simply choose to ignore ethical considerations in sourcing and procuring goods at the best possible prices from anywhere in the world?

### **Supplier development programmes**

In many organizations, suppliers account for well over 80 per cent of overall cost. Efforts to manage these costs are often left to the annual negotiation on price, normally eroding profit margins and increasing other risks to the supplier. How then, can organizations secure cost reductions and still maintain a highly motivated and competitive supply base?

Supplier Development programmes are aimed at seeking out areas for improvement in the supply chain and developing mutually beneficial solutions with key suppliers. Key benefits are the elimination of waste, lower total acquisition costs (TACs) and the development of first-class suppliers. The aims are to develop commitment throughout the supply chain, increase co-operation and understanding between companies and their suppliers, to strategically focus manufacturing, engineering, design and purchasing teams to provide a structured approach to improving value.

Among the techniques used in this process are process mapping, value stream analysis, responsiveness matrix, gap analysis, demand amplification maps, quality filters, Kaizen approaches, metaplanning, brainstorming and team presentations. Benefits to organizations engaged in supplier development programmes are:

- Lower total acquisition costs (TACs).
- Developing world-class suppliers.
- Commitment throughout the supply chain.
- Structured approach to improve value.
- Better cross-functional co-operation within the company and with suppliers.
- Elimination of waste.
- Strategically focused purchasing teams.

The key to supplier development is making sure that the organization wanting to develop suppliers follows some simple criteria:

- Selecting the most appropriate suppliers to develop.
- Identify how well suppliers' capabilities meet business needs.
- Use diagnostic methods to establish cost drivers in the supply chain and
- Thereby develop a value improvement plan.
- Establish key measures of performance and implement effective feedback systems.
- Generate trust and commitment with suppliers.

Supplier development may involve a detailed examination of some of the following issues with the supplier: value stream mapping, assessing the cost of quality, demand amplification and promotions management, manufacturing and maintenance systems development, efficient consumer response, lean production and supply, agility and supply chain integration using the supplier association approach.

Some of the outcomes and benefits of the programme included the development of a portfolio of tools for mapping key dimensions of performance and to identify waste down a value stream (e.g. process mapping, responsiveness matrix, quality filter, demand amplification map), the identification of inter-company waste and creation of joint improvement activities on areas with the greatest potential gains, and the development of new software programmes to facilitate the use of the value stream mapping toolbox.

### **Supply base rationalization**

In recent years there has been a trend in most organizations to rationalise their supply base. This approach to managing suppliers has a number of benefits:

- Fewer suppliers to deal with require less management time.
- It means that organizations can work more closely with fewer with the management time released.
- Processes in the supplier organizations can be integrated with those of the buying firm.
- Processes and operations can be synchronized to reduce lead times, stock-holding and associated costs.
- Supply base rationalization creates efficiencies.

Since the 1990s and throughout the twenty-first century many organizations have reduced the number of supplier accounts. Thinning the supply base has both potential benefit and risk. Those suppliers who remained were expected to conform and comply with the standards of supply that many larger organizations began to implement. It was recognised by the buying companies that they often had to spend a great deal of time dealing with many supply companies that were either unable or unwilling to respond to the demands the buying organization placed on them. Many smaller organizations often did not understand the need to comply or were unwilling to undertake the investment to be able to comply. Fewer suppliers meant fewer accounts payable and an opportunity to get those who remained to meet the needs of the buyer better. The main risk in reducing the number of suppliers is that you might limit capacity to respond if there is a sudden surge in demand.

#### **A 30-year-old book case shelving old ideas**

W.H. Smith (WHS) in common with many large retailing organizations began to investigate its own supply chain during the 1990s in a search to be more efficient and to be more effective in meeting customer needs. Book publishers were notoriously inefficient in managing their businesses and had been used to some protection from market forces that might have sharpened their management capabilities in the form of the net book agreement (NBA). The NBA effectively allowed publishers to set the selling prices for their books and to operate mainly standard discount terms with booksellers of any size. Large and small booksellers alike received these standard discounts. During the late 1980s, a revolution began in this sleepy market sector with the inception and development of Terry Maher's Dillons bookstores. Maher a trained accountant was well aware of the importance of gaining economies of scale and using that market power to negotiate better terms including higher discounts. The success of Dillons did not go unnoticed by WHS who were the largest UK bookstore chain and they too began to exert their market muscle. One of the difficulties in this market is the number of suppliers. In the 1980s there were large numbers of publishers in the United Kingdom many of whom were SMEs by any definition and many well-known imprints that readers would know well were actually very small in size. Their reputation being out of all proportion to the size of their business. The abandonment of the NBA in the 1990s led to a number of structural market

changes. These changes included retail consolidation and a number of new entrants to the market from the United States like Borders; many small publishing houses merged or were taken over by other publishers and it was generally argued in a series of articles in the Bookseller (the organ of the book trade) that size was important for publishers to have a critical mass in dealing with the large chains of bookstores that had now taken over the high street. In the 1980s there was a plethora of new national chains. Following Dilons successful strategies to establish a national chain, Waterstones (founded by a former WHS employee Tim Waterstone), Hatchards and Blackwells began to establish larger and national chains of stores. The volumes of books supplied by the biggest booksellers accounted for a substantial proportion of all UK books sold. This retail consolidation in turn led to publishers merging to fight their corner and attempt to maintain their share of the profits.

The pressure applied to all publishers to comply with stringent supply agreements covering deliveries, product compliance (e.g., barcoding), invoicing and payment terms meant that many smaller publishing houses were either unable or unwilling to do so. Electronic ordering systems developed, better information on availability of products was achieved through Whitakers and the Teleordering systems and later through BookTrak. Small bookshops and small publishers found this high street revolution a painful challenge to their conservative industry. However, worse was to come.

At the start of the twenty-first century, Amazon.com, a new business start-up in 1994, started by Jeff Bezos and originally known as Cadabra. The business leaked cash in the first few years of existence. Many thought it would not survive into the new century until it began to take market share away from traditional booksellers. Their business model as a retailer has one very large advantage which is it does not have expensive high street real estate but rather large warehouses on industrial land which is much cheaper. The investment is in information technology systems to support the supply chain. Amazon has its core competence in purchasing and distribution underpinned by information technology. The Amazon advantage in books was its ability to open up the back catalogue since it did not need to store them physically it just needed to list them as available and get suppliers to do the work. The digital age meant that this was now possible since a single-copy book could be scanned and printed and later not even printed but distributed digitally too. Amazon's move into eReaders has enabled its Kindle book reader to dominate the market in digital books. Books are delivered electronically using whispernet software that brings a book in seconds to your reader. Kobo, Sony and the Barnes Noble Nook compete strongly in this market too. Although this market has grown so too has the overall market for books. Physical books and digital books currently sell side by side often to the same customer or consumer. Amazon now not only sells and distributes books but many other products too. Amazon has over one billion stock-keeping units today.

*Source: Author*

## **Summary**

Several prominent issues relating to the sourcing and procurement of supplies have been discussed within this chapter together with their implications for developing appropriate supply chain strategies. Local supplies vis-à-vis national or global sources and influencing factors in those decisions were thoroughly examined. The complexity of the decision-making processes

was addressed through the “iceberg theory of cost comparison” and other influences including ethical and environmental factors. The next chapter will turn attention to supply chain structures and relationships and their role in influencing supply chain strategies.

### Discussion questions

1. Identify the main criteria for sourcing goods locally versus globally.
2. Evaluate the merits of sourcing goods from global suppliers and draw comparisons with the merits of sourcing local suppliers.
3. There may be an iceberg of cost involved in purchasing from certain suppliers and supply sources that do not enter the usual criteria for decision-making. Discuss.
4. Sources of supply can be a means of achieving competitive advantage. Discuss.
5. Identify and evaluate the main sources of competitive advantage involved in supplier sourcing strategies.
6. Supplier selection criteria may vary from industry to industry. Discuss.
7. Supplier development programmes can assist suppliers to meet their customer requirements more efficiently and effectively. Discuss.
8. Environmental and ethical considerations sometimes get ignored when sourcing supplies. Discuss.
9. Explain why buyer performance measures may lead to sourcing decisions that may not be in the best interests of the whole organization.
10. The recent trend towards supply base rationalization has caused many organizations to re-evaluate their risk profile. Explain what you understand this statement to mean and why it is important if not essential to consider risk in reducing the number of suppliers.

### Notes

- 1 The National Textile Center at North Carolina State University together with TC<sup>2</sup> developed a game “sourcing simulator” that illustrates the effect of lost sales on an apparel/textile pipeline. In practice, however, lost sales data is virtually impossible to capture and measure accurately with current technology and data capture systems. To do so, except under experimental conditions, would be very expensive.
- 2 These terms are used by retail buyers and indicate cost incurred.
- 3 Gross Margin is what retailers often call bought in margin. It is the difference between sales and cost of goods sold.

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## 7 Supply chain structures and relationships

### Relationships and structures

Early investigations into the relationship between strategy and structure by Chandler (1962) recognised ambiguities, complexities and dependencies. Relationships and structures within the supply chain are determined by a number of factors: Industry structure, characteristics, competitive rivalries, numbers of suppliers, buyers, nature of products and services, industry and organizational cultures. Relationships exist between organizations (interorganizational), between specific groups of people inside the organizations in business relationships, for example, buyers and sellers, and inside the organizations themselves (intraorganizational). One way to begin to understand the types of relationship and structures is to examine purchasing and procurement decisions. The chapter begins by defining purchasing and procurement and recognising different types of purchasing before examining the purchasing decision and different types of supplier relationships moving from adversarial through to partnerships and strategic alliances. Different supply chain strategies require the organization to have different types of relationship and different organizational structures to deal with those relationships. The relative merits of different types of relationship are discussed.

### Purchasing and procurement

Purchasing and procurement are often treated as meaning the same thing. However, strictly speaking procurement is wider than purchasing and involves acquisition of goods and services in any way possible. For example, this could include expropriation and other means of acquisition than buying goods and services in exchange for money. Lysons (2000, p. 1) defines purchasing as follows: “Purchasing is the function responsible for obtaining by purchase, lease or other legal means, equipment, materials, components, suppliers and services required by an undertaking for use in production or resale.” You may be thinking that the definition is remiss in not mentioning services especially when 73 per cent of the UK economy gross domestic product (GDP) is made up of services. Lysons explains this stating that the term “production” is used in the economic sense of creating utilities, for example, goods and services.

Organizational buyers are responsible for purchasing decisions made by companies, local authorities, government offices, charities, partnerships and even sole traders. Organizational buyers have been identified as belonging to buying groups. A typology of organizational buying is given in Table 7.1.

For a typical manufacturing company in the United Kingdom the proportion of total manufacturing costs accounted for by purchased materials and components represents over 60 per cent today compared with under 40 per cent 20 years ago. Organizational purchasing decisions are therefore far more significant today and can play a large part in determining company

Table 7.1 Typology of organizational buyers

<i>Types of organization</i>	<i>Characteristics</i>	<i>Examples</i>
Industrial/producer	Purchase of goods and services for some tangible production or significant commercial purpose.	Manufacturer; primary extractor – agriculture, forestry, fishing, horticulture, mining.
Intermediary	Purchase of goods and services for resale or facilitating resale in industrial or consumer markets.	Distributors, dealers, wholesalers, agents, buying offices/groups, retailers, banks, hotels and service trades, e-purchasing auction sites, portals, etc.
Government and public sector	Purchase of goods and services for use by public sector bodies including local and national government. Not always commercially significant.	Central, local government and public utilities.
Institutional	Purchase of goods and services for use by institutions buying on their own behalf.	Universities, colleges, schools, hospitals, voluntary organizations.

profitability. Purchasing is critical when it represents such a large proportion of the cost. Other reasons when purchasing is important could be due to:

- Short run price fluctuations.
- When fashion and innovation are involved good judgement is required.
- When markets for finished goods are highly competitive.

Purchasing will be less important when:

- Costs of bought-out items form only a relatively small proportion of total cost.
- When prices are relatively stable.
- When innovation or fashion content is low.

Modern organizations often regard purchasing to be of strategic importance. We have just observed why this may be so.

### **The purchasing decision**

Purchasing activities involve buying decisions to ensure that:

- The right goods.
- Are in the right place.
- At the right time.
- At the right price.
- And at the right quality.

These are the sometimes referred to as the 5Rs of purchasing.

#### ***The right goods***

Acquiring the right goods sounds common sense and it is but there are many considerations in deciding on the right goods or the right service. It was often stated by buyers of computer

hardware in the 1970s and 1980s that “nobody was ever fired for buying IBM, Big Blue as it was known.” This demonstrates the importance of reliability another R perhaps. Reliability is often communicated to buyers through the brand identity and the attributes and perceived benefits that the brand communication conveys to the buyer. In many organizational settings the buyer will specify exactly what the organization requires (based on needs) rather than simply buy from catalogue (what’s on offer). Sometimes of course the two may coincide and often when this is the case better prices can be achieved because the supplier does not have to customize the product.

### ***More Rs***

Another issue when the organization is buying on specification is responsiveness, another R. Responsiveness will be important to the buying decision when “time is of the essence” as they often write in the legal purchase document. Responsiveness is the time it will take for the supplier to respond (i.e., to supply/make and deliver the item). When an organization makes a first purchase from a supplying organization it is always important to check the response times not only on the first order but in the case of replenishing the stock.

### ***The right place***

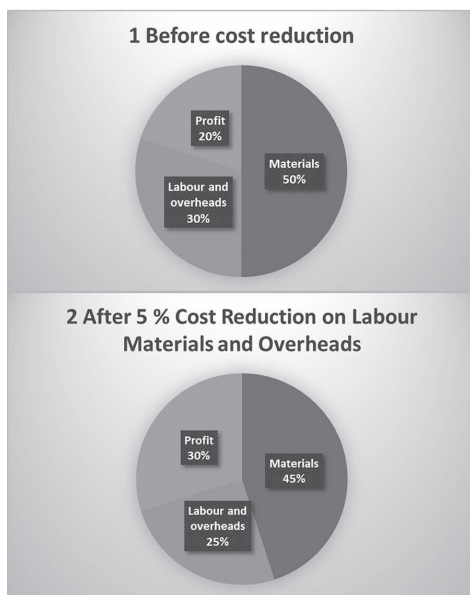
In making the buying decision it is important to provide detailed instructions on how, when and where deliveries are to be made. For example, many retail organizations will instruct their suppliers to deliver to a central distribution depot or directly to store. The advantage of delivering directly to store is it avoids double handling and hence additional transport and storage costs for the retailer. If goods have to go to a depot first, they need to be recorded, stored and later transported at the retailer’s cost to the store that requires the stock.

### ***The right time***

Ensuring that stock arrives when it is needed is fundamental to an efficient supply chain operation. Just-in-time (JIT) systems are built on the notion that suppliers will supply when the stock is required. This avoids stockholding costs and lowers working capital requirements since the stock is purchased later in the cycle, cash-outflows happen later and indeed may well coincide with the cash-inflows from the sale if the supply chain operations are synchronized.

### ***The right price***

Achieving the right price is important since this will affect the purchaser’s cost structure and ultimately the margin achieved (i.e., profitability). Obtaining goods at the right price often involves negotiation and good negotiation skills are pre-requisite for successful buyers. Negotiations will revolve around a number of important buying variables such as delivery dates, time to manufacture, quality, volumes and discounts. However, price is still a very important factor and buyers need to be very careful in making “trade-off” calculations between price and these other factors. To illustrate just how important price can be see Figure 7.1 which demonstrates visually the effect of a simple five per cent reduction in cost for materials, labour and overheads and the impact on profit. As a consequence, the profit margin has improved by ten per cent. This is why it the price of materials purchased is important.



Cost is always important as this simple example shows.

By cutting labour, material and overhead costs by 5 per cent overall this has improved profit by 10 per cent in the example.

Figure 7.1 The effect of a five per cent cost reduction on profit margin

### Supply chain management a job with a long shelf life

Careers in retailing usually conjure up images of busy stores filled with customers. For some, however the challenge is how to get the goods from the grower or manufacturer to the shelves. Most shoppers are unaware that getting the right transport, warehousing and distribution is critical to getting perishable goods to a store near them with almost military precision. Getting the right goods onto shelves at the right time is the guiding principle of “supply chain management.” Supply chain efficiency can make or break a business. Retailers invest large sums of money ensuring stock appears on the shelf at the right time and in the right condition. This is especially important in food retailing where thousands of dairy, chilled or frozen lines are delivered to stores daily. Forecasting demand using sophisticated modelling systems that take account of past weather patterns is commonplace. Retail recruiters say that there are some important key skills such as thinking logically, attention to detail, being numerate, ability to communicate effectively and capabilities with technology. Continuous stock replenishment, efficient consumer response and parallel chains are common buzzwords. They simply mean the process of getting enough of what shoppers want into stores. A recent recruit now a primary distribution manager with Sainsbury’s tells me one of his jobs is to reduce the food miles that each item travels and to ensure it is handled as little as possible to avoid spoilage or possible contamination.

Source: Author

Figure 7.2 identifies key variables in the purchase decision. The 5Rs identified and discussed in much of the practice and academic literature is depicted on the right-hand side of the figure and these are basic buyer requirements. On the left-hand side of the figure are three more Rs

The Purchasing Variables – More Rs

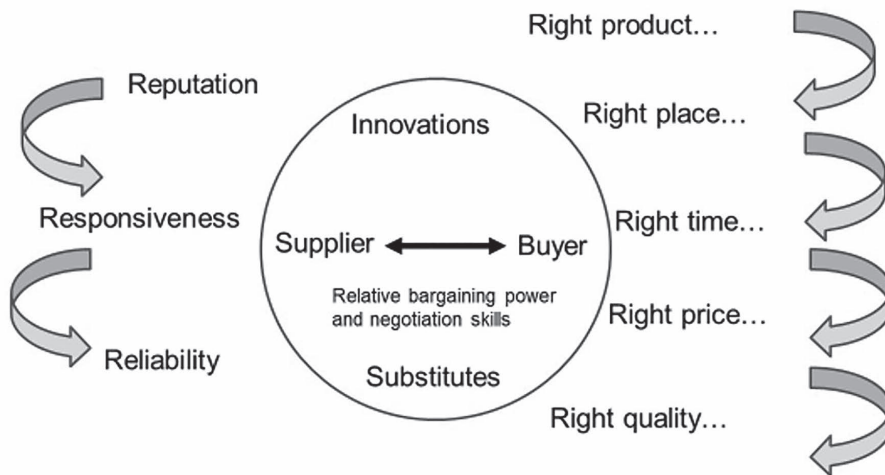


Figure 7.2 Purchasing variables more Rs

attributed to the supplier and in which the buyer will be interested. Reputation includes the brand, product or company reputation which may be communicated in a number of ways to the buyer. For example, reputations are built through word of mouth, through performance, through advertising and through experience of dealing with the supplier.

Responsiveness covers issues such as how flexible the supplier can be when meeting buyer requirements. For example, is the supplier able to produce products quickly when required? (speed to market, lead times.) Is the supplier able to switch easily between different buyer requirements without too much difficulty? (Fast production enables suppliers to delay commitment of resources through postponement until the last possible minute – sometimes referred to under the umbrella term “quick response.”) Responsiveness may be very important to some buyers allowing them to postpone their commitment to production or purchase quantities when they have better customer information regarding volumes. For example, a retailer ordering fashion clothing in season would want to delay a large part of its production until it was able to analyze data on sales quantities, colours, styles that were popular rather than simply base the purchasing decision on forecast data.

Reliability is the final R attributed to the supplier and involves ensuring that the purchased items arrive in full on the date required.

Information is an important resource to purchasing managers. Information is required in relation to:

- Price.
- Quality.
- Specifications.
- Terms of business (supplier conditions, payment terms, delivery, after sales service, ownership transfer, insurance, etc.).



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Further information will be needed on a number of different aspects of the purchase before a decision is taken.

**When you don't have the Rs**

According to the Boston Consulting Group (BCG):

When the right products aren't in the right place at the right time, things can get ugly: stockouts and lost sales; inventory pileups, markdowns, and write-offs; poor capacity utilization and declining service levels. These costly problems are often symptoms of a broken sales and operations planning (S&OP) process.

Aparajithan et al., (2011)

Purchasing decisions need to take account of the best available information relating to:

- Potential shortages and surpluses of materials and their relative price sensitivities.
- Comparative power of buyers, suppliers and competitors.
- Impact of new material developments, new product developments and obsolescence.
- Technological developments and innovations.
- Changing market conditions – consumer, customer changes in preference.
- New sources of supply.
- Current capacity and competencies of existing suppliers.
- Security of supplies.
- Value analysis of alternatives vis-à-vis current purchased items.
- Usage and/or throughput.

**Purchase frequency**

Purchase frequency has implications for cost, storage and customer service. Purchasing frequency is important because it may mean that more frequent purchasing can be made routine through systematic buying and replenishment buying. It is often the case that with frequent purchases they can be triggered automatically.

**Example**

The development of electronic point of sale (EPoS) equipment has allowed many retail organizations to link sale data to inventory and automatic order replenishment. When an item is passed through a scanner at the till the bar code is read for price and the item is recorded as a sale to the customer. Simultaneously the barcode reader has recorded a stock movement, that is, one item moving out of stock. This data is automatically transmitted through the store stock control system to central logistics and purchasing. When the total store stock falls to the specified re-order point an automatic replenishment instruction is transmitted to the central distribution depot (CDD) who invoke the necessary logistics to get these items to the store. The CDD also has to record movements out so that its automatic replenishment system triggers a new purchase order to the supplier when CDD stock needs replenishment. With frequently ordered stock keeping units (SKUs) this is fairly simple and replenishment can be automated. In these cases, there is

seldom a need for human intervention. Soap powders, detergents and certain basic food items would all fit into this category where stock movements are predictable.

It is more difficult to deal with ad hoc purchases or purchases that require careful monitoring such as fashion items. Purchasing decisions and their relative characteristics will vary between different parts of the organization and between different organizations depending upon the types of items being purchased.

### ***Categories of purchasing activity***

Purchases may be classified into different types of activity as follows:

1. Ad hoc or one off purchase.
2. Regular or routine supply of purchase items (e.g., automatic replenishment of stock keeping units SKUs).
3. Contract purchases (e.g., goods purchased from sourced and approved suppliers for a particular purpose or to a particular specification).
4. Catalogue purchases (this is a US term for purchases made from an approved supplier from their catalogue of what they have to sell as opposed to purchase to specification).

These categories of purchasing activity are related to frequency of purchase. Ad hoc suggesting irregularity through to routine, regular implying frequent purchases.

It is important for the organization to clearly identify the different types of purchase activity and design systems and procedures that enable effective execution of purchase orders.

### **Supplier relationships**

Establishing the right kind of supplier relationships is very important. An organization is only able to do this if they know exactly what they want from their suppliers. We have already observed that historically many of the purchasing relationships were “arm’s length” and often adversarial in nature. As a professional buyer, the aim was often a simple one focused upon getting the best price. It is now recognized that this type of approach may not have always served the needs of the buying organization. Supply base rationalization is a trend in most industrial sectors and some of the main reasons for that trend were discussed earlier in Chapter 6. It is important to re-visit that trend because it impacts upon the ways in which supply chain relationships are established and what the parties in the relationship expect to get from it.

There are some interesting research opportunities around the topics examined in this chapter. An interesting piece of research examined how different types of supply chain relationships influenced how sustainability goals were embedded in practices in retail food industry supply chains in Australia (Rezaei Vandchali et al., 2021). Another interesting article examined how value can be unlocked from developing supply chain relationships it talks about how survival and performance are dependent on supply chain relationships (Ahmed et al., 2022). Sometimes collaborative arrangements are necessary and important to improve supply chain performance positioning and planning as well as relationship conditions influence how conflicts can occur and be resolved. These authors looked at the influence of relationship conditions which included partner selection, power asymmetry, opportunistic behaviour and conflicting interests to see how they impacted outcomes (Meena et al., 2023). Partnership selection was critical in this example in an emerging economy context looking at sustainability. Co-ordination, collaboration and co-operation can bring with it a range of benefits such as information sharing that leads to innovation.

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According to Chen et al. (2017):

Strategic buyer-supplier relationships have been credited with vital outcomes such as lower costs, faster lead times, and better product quality. As such, by the 1990s, U.S. automakers have been moving away from traditional arm’s length relationships – and towards strategic relationships – with their suppliers.

These authors go on to argue that it has not worked as well as it might have been hoped for with the US auto mobile manufacturers as it did in Japan which might indicate that there is something cultural in Japanese strategic relationships that is missing from US automakers.

The fashion industry is notorious for the use of power with buyers often applying unreasonable demands on small and medium sized supplying firms. I examined this issue on a number of occasions (Hines, 2002; Hines & McGowan, 2002, 2005). An interesting paper examining this topic looked at this very issue again more recently and the findings are similar (Talay et al., 2020). These authors build on the earlier work of the IMP Group discussed in this chapter and examine how small suppliers are dealing with this power problem. I first looked at this issue in the 1990s and it would appear that power remains a tool in the armoury of buyers in this industry. In 1998, I gave a presentation at Bloomberg in London to senior managers in the UK fashion industry and it was widely acknowledged then that the use of power was viewed as both normal practice and necessary to achieve intake margins retailers required.

**Buyer – supplier relationships**

Examining interaction variables provides insights into buyer-supplier relationships one useful model was provided by Campbell (1985, p. 265) The work takes as its starting point the IMP<sup>1</sup> model illustrated in Figure 7.3 which is mainly concerned with industrial marketing and purchasing and develops a way of examining the interactions and their impact upon buyer-seller

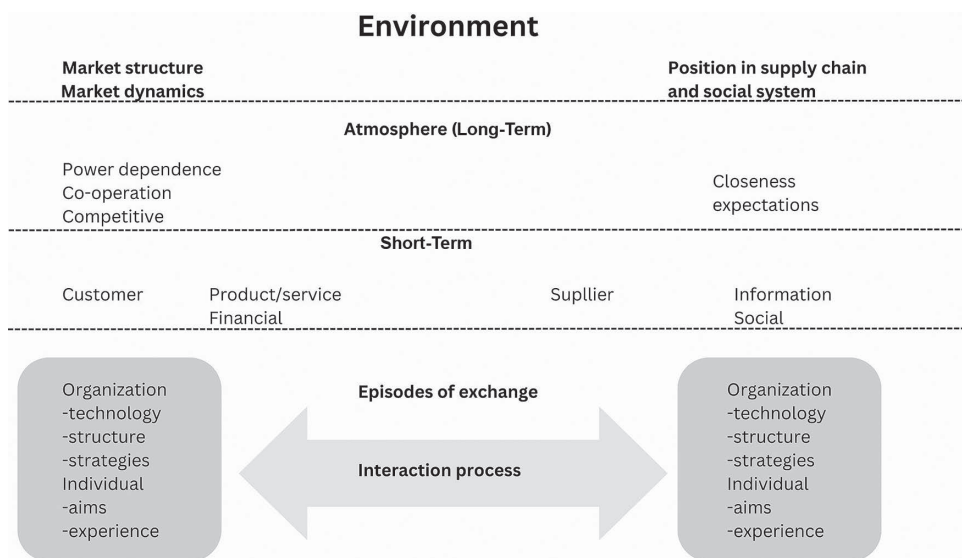


Figure 7.3 IMP interaction model of relationship structures

Table 7.2 Interaction variables

<i>Buyer</i>	<i>Interaction variable</i>	<i>Supplier</i>
Product	<ul style="list-style-type: none"> <li>• Frequency of purchase</li> <li>• Switching costs due to physical and human investment</li> </ul>	Product
Industry characteristics	<ul style="list-style-type: none"> <li>• Product complexity</li> <li>• Concentration</li> <li>• Number of alternative partners</li> <li>• Intensity of competition</li> <li>• Rate of technical change</li> <li>• Technology platforms used</li> <li>• Traditions and norms</li> </ul>	Industry characteristics
Company characteristics	<ul style="list-style-type: none"> <li>• Relative size</li> <li>• Preferred interaction style</li> <li>• Relative familiarity</li> <li>• Centralization of purchasing</li> <li>• Technology platforms used</li> <li>• Strategic competence</li> <li>• Operational efficiency</li> </ul>	Company characteristics
Individual characteristics	<ul style="list-style-type: none"> <li>• Relative familiarity</li> <li>• Preferred interaction style</li> <li>• Perceived importance of the transaction</li> <li>• Risk aversion</li> <li>• Strategic choices</li> </ul>	Individual characteristics

Source: Adapted from Campbell (1985)

strategies. The interaction variables used in this research are given in Table 7.2. The model could be extended to take account of relationships described as buyer-supplier networks or indeed supply chain networks. The model is fairly self-explanatory and it is a way of examining interactions at different levels – product, industry, company and individual.

The original IMP model is shown in Figure 7.3.

The original model assumed that the two organizations operate within an environment that is determined by external factors such as market structure, dynamism and internationalisation, social structure and channel position. The terms originally used by the IMP model is now referred to and understood as equating with the supply chain. The IMP model referred to a “manufacturing channel.” The description given “the position of an individual relationship in an extended ‘channel’ stretching from primary producer to final consumer” (Ford, 1990, p. 17). Atmosphere describes the conditions within which the interactions between the parties take place. This is dynamic and is affected by episodes of exchange between the parties. Relationships between the parties are shaped by organizational factors: technology, strategy and structures; and by individual factors including aims and experience. Organizational strategy can be affected by both long-term relationships and by the short-term episodes. Atmosphere maybe described in terms of power-dependence relationships, the state of conflict or co-operation and finally, closeness and distance of the relationship. It is in the development of these variables that Campbell’s (1985) work is located.

Cooper and Gardner (1993) referred to a continuum of relationships and identified six distinctive types which are:

- Arm’s length.
- Typical small account.

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- National account selling.
- Strategic alliance.
- Joint venture.
- Vertical integration.

Companies tend to deal with the different types of suppliers differently. It is important to recognize that “relationship” is often not really the warm and cuddly type but that it may be quite the opposite. All relationships in this context should be based on commercial needs and will revolve inevitably around the needs of the different parties at that point in time.

In arm’s length relationships price is the key negotiating point. These relationships are often referred to as “win-lose” and they often involve adversarial or conflict negotiation techniques. Power is an important issue in this type of relationship. If the buyer is representing a very large organization and the supplier firm is small it may be that there are many alternative suppliers willing and able to meet the large organization’s demands. When this is the case, the small supplier is at an obvious disadvantage and may often give way on price to get the order.

Small accounts are relatively expensive to conduct and there has to be a unique proposition that the small account supplier is able to provide to the large customer if they are to remain a viable supplier.

National account selling usually involves the supplier firm dealing with one organization that may have multiple sites to supply with their products. These are often handled centrally by the buying organization that may handle distribution to their multiple sites from a centralized depot or through their own supply networks. The detailed arrangements will vary from organization to organization.

***Use or abuse of power in supply chains***

Everyone benefits when supply chains are efficient because it means that service is provided when it is needed. If goods are involved, they need to be delivered to customers on time and complete (right time, right place, right quantities). There is no denying that some organizations within a supply chain are more powerful than others. Ethical trading organizations ensure that such power is not misapplied and works to benefit all those engaged in the supply chain. Distribution of value amongst supply chain partners and the end customer need to be fair. However, there are occasions when fairness is not easily identified.

Supermarkets manage many different supply chains and they need to balance the needs of different stakeholders in their supply chain. Supermarkets need to be efficient to earn their best profit. Having efficient supply chains is essential. It lowers waste and unit cost which in turn adds value for the customer, the supermarket and the suppliers. Supermarkets have become essential to many suppliers to help them achieve volume sales albeit at lower unit margins. Supermarkets have been drivers of efficiency by serving their customer needs to lower price and widen choice. However, they occasionally get it wrong and when they do it makes headlines in newspapers. One such example is milk.

**Are retailers milking farmers?**

Retailers have power in the milk supply chain when it comes to setting prices. Farmers have been absorbing higher costs of producing milk. Farmers feed their dairy herds a mixture of maize, soya, wheat and grass. The cost of grain has increased due to drought

and increased demand since Russia’s war in Ukraine began. Farmers have incurred higher input costs for labour, energy, other raw materials such as fertilizers and shipping costs as fuel costs rise. In 2022, the annual inflation rate for farm feed was 31 per cent, fuels 58 per cent and fertilizers 118 per cent.

Dairy cows need about 50 kg of feed a day. Retail shelf prices increased by around 30 per cent in the past year 2022—2023. The wholesale price for milk hit 51.5 pence a litre in December 2022 according to the Royal Association of British Dairy Farmers (RABDF). Since then, in 2023 they have fallen below 40 pence per litre and continue to fall. Meanwhile retail food price inflation across the board reached an all-time high, 18.3 per cent in May 2023.

In April 2023, farm gate prices for milk averaged about 40 pence per litre. In Northern Ireland it was 34 pence per litre. An earlier conversation I had with a dairy farmer in the United Kingdom said it cost him about 43 pence per litre to produce milk. So, you can see that the costs incurred in production and prices paid by supermarkets do not add up if you want to make a profit. In a functioning market suppliers would simply raise prices above the cost line. In the UK milk supply industry this is not so simple as retailers hold all the cards.

Back in 2015, the BBC reported an analysis for prices and costs of two litres of milk based on data from the: Agriculture and Horticulture Development Board (AHDB), National Farmers Union and Royal Association of British Dairy Farmers (RABDF). The numbers showed that the retail price per litre then was 47 pence and farmers were paid 24 pence per litre. The farmers estimated their costs at an average of 31 pence per litre. So, they lost seven pence per litre at the farm gate while processors and retailers made 23 pence per litre profit shared between them.

Back in 2012, the analysis of this market that I did showed the structure to be similar then too. This with a higher retail price than 2015 around 56 pence per litre. Farm gate price at 26 pence, process intermediaries taking 13 pence before selling on to retailers at 38 pence earning the retailer a margin of 20 pence per litre.

*Liquid milk margins in pence per litre*

	<i>Farm gate price</i>	<i>Processor gross margin</i>	<i>Processor selling price</i>	<i>Retail selling price</i>	<i>Retail Gross Margin</i>
2023 July	39	10	49	80	31
2023 February	40	11	51	93	42
2015	24	12	36	47	11
2012	26	13	39	56	17
Five year rolling average for milk price 2019—2023					
AHDB	Apr-23	33.63	Mar-23	33.41	

Sources: AHDB, RABDF, DEFRA, DAERA, consuming future research

Lobby groups such as RABDF and AHDB have been asking for fairer prices and more transparency in contractual arrangements. They say trust needs to be rebuilt in this supply chain if dairy farming is to have a future in the United Kingdom.



**Key facts**

Intermediaries such as Arla and Muller fix farm gate price paid to farmers and negotiate with retailers to fix the price they will contract to sell at. Retailers, however, set limits on what they are prepared to pay on the basis of the retail-selling price they set given their intake margin. Supermarkets lowered prices in June 2023 and there is pressure to lower the prices further. Aldi lowered its price by ten pence on a four-pint bottle driving it down to £1.45 for four pints. This equates to a retail price of 80 pence per litre.

- The co-op, Marks and Spencer, Sainsbury’s, Tesco and Waitrose guaranteed they will pay prices above cost of production. Some other big retailers have not.
- There has been a reduction of dairy farmers in the past ten years of more than 40 percent.
- The average cow produces 7,500 litres of milk in its lifetime.
- Farmers calculate that their herds cost them more than the income they earn from them.

**Types of supplier relationship**

Traditional supplier relationships have been viewed as buyer and seller relationships. The bow-tie depicted in Figure 7.4 illustrates the adversarial nature of buyer and supplier relationships that are common in commodity type markets. It represents a situation where the buyer and seller are locked in negotiation, which is focused on price. In this type of relationship there is often a single one-to-one relationship between two organizations, for example, a sales representative

**From adversarial to relationship marketing**

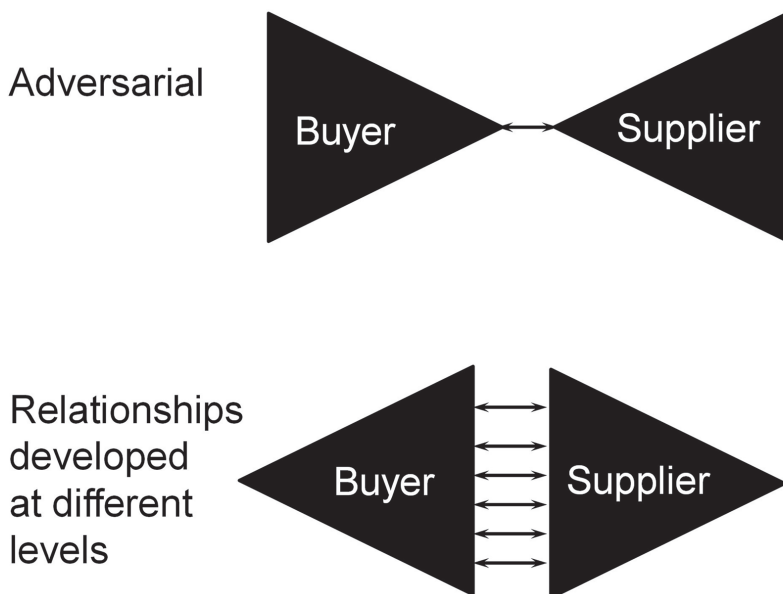


Figure 7.4 From adversarial to relationship collaboration

and a buyer. Single point commercial relationships often involve buyers trying to push costs back along the supply chain, and suppliers trying to hold prices firm to secure profit. In this type of relationship neither buyer nor supplier is working together to eliminate unnecessary costs in the supply chain.

In more complex purchasing and supply chain relationships there are a number of different people in each organization who are regularly in contact. Multiple levels of contact are often symptomatic of relationship marketing and supply chain relationships when the products are more complex, and the markets served require a co-operative rather than adversarial arrangement.

### *Supplier networking*

There is an extensive literature on networking. Network theory potentially provides a way of explaining business relationships. The reality is that the literature relating to networks is full of ambiguity both in terms of terminology and conceptually (Szarka, 1990, p. 10). Johannison (1987) identified three types of network, which are:

1. Production networks between trading organizations.
2. Personal networks based on friendship and trust.
3. Symbolic networks based on social bonds, community ties and conformity to collective values.

Mitchell (1973) recognized exchange networks, communication networks and social networks, which are closely aligned to those categories given by Johannison. Although these typologies may be useful in different contexts to examine the nature of relationships, they may in themselves be limited or constraining when examining supplier relationships that could potentially have characteristics of all three types identified.

The language to describe supplier networks more usually refers to partnerships and alliances; whereas networking per se refers to formal and informal networks based upon exchange/production, personal/social or communication/conformity.

Strategic alliances are usually formed because the two or more parties involved in the alliance have something to gain and each to offer something different and something of value to the other parties. The automotive supplies industry has many strategic alliances to share expertise and investment cost. It may also be a way of meeting customer demand requirements better and to enhance service levels.

Joint venture agreements usually involve two organizations that decide to conduct mutually beneficial business. For example, it may be in the commercial interests of a supplying organization to enter into a joint venture with another supplying organization to meet the needs of a common group of customers more effectively. You may be wondering how this type of arrangement is different from a strategic alliance. The answer is that in joint venture both parties invest financially in the venture and agree to share the rewards from the venture in accordance with the agreement. Often the joint venture itself will be a separate entity. A company set up for the specific purpose of the joint venture. Strategic alliances may or may not involve cross-investments. More often than not they will share some markets or some facilities but the parties act as independent organizations. Many airlines have strategic alliances and they are formed to share facilities: booking tickets, engineering maintenance, routes and to facilitate bookings for customers wanting to fly with one of the alliance airlines in specific territories. In this way, it is hoped the alliance members benefit by increasing their total and individual market share. Airline service presents a number of interesting supply chain challenges from balancing capacity to

meet customer demand through to scheduling flights, managing maintenance and operations pre and post flight and ordering in-flight catering, entertainment and duty free goods.

Fully vertically integrated organizations have ownership and control of their routes to market. For example, the Spanish retailer Zara has its own retail stores throughout Europe and has manufacturing facilities in Northern Spain that it owns. These manufacturers supply the retail stores with merchandise. It is argued by many commentators that this is one of their critical success factors (CSFs) enabling Zara to produce “fast fashion.” Lead times of two or three weeks are often reported from design to store for many of their popular lines.

Figure 7.5 illustrates two different organizations that are vertically integrated. There are four stages in the examples. The first organization owns farms growing cotton for fibre inputs to its owned textile mills who produce fabric for its owned manufacturers of apparel who then in turn supply the organization’s own retail stores. In these types of organization, the supply chain is both owned and controlled by the organization. It is important to recognize that the benefits of vertical integration may be outweighed by the risks and costs of owning the whole supply chain. One can envisage circumstances when it would be lower cost to buy supplies in the open market rather than incur all the ownership costs and produce goods that are more expensive.

### *Outsourcing*

The trend to demerge businesses has led to a growth in outsourcing. Outsourcing is the term used to describe the buying in of goods and services deemed to be non-core activities of the firm. This particular trend leads to interdependencies that require relationship management skills. One issue of concern explored by Fitzgerald (1995) and identified by Harland (1996) is the important question of what firms deem to be core or non-core activities. Outsourcing is often pursued to

## Vertical integration

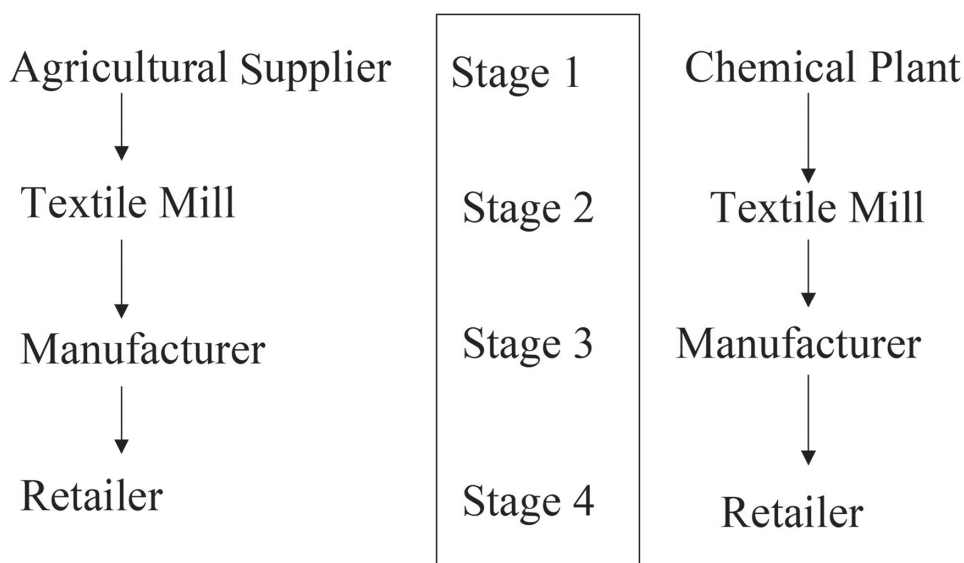


Figure 7.5 Vertical integration in supply chains

Table 7.3 The top five reasons to outsource

*The top five reasons given for outsourcing*

Outside providers more efficient than inside the organization	70%
Keep focus on own products and growth	45%
Save costs	42%
Less overhead investment or debt required to capitalize investment in assets	41%
Ease regulatory compliance burden	21%

Source: Adapted from Montgomery-Garret (1994)

realize a cost advantage and sometimes as a means of protection from being locked into obsolete technologies (Abernathy, 1978; Miles & Snow, 1978, 1986). The decision making approach to outsourcing is also often viewed from the perspective of the traditional “make or buy decision” (Lui & McGoldrick, 1996; McIvor et al., 1997). Coopers and Lybrand an international firm of management consultants list five major reasons for firms to outsource and these are shown in rank order in Table 7.3. The reasons were drawn from firms across all industries and in a US context and some time ago. Nevertheless, they provide an indication of reasons why a firm may consider outsourcing in the first place. These reasons are much the same today. You could add to these top five reasons further reasons such as: access to talent or resource based competences beyond the organizational boundaries. Hence, not just efficiency, which is given as the number one reason, but also effectiveness to meet customer demand and profitably is important.

The reasons given in 1994 are as relevant today as they were then. Most organizations search for cost savings and efficiencies to be gained from outsourcing non-core activities to specialist providers. A Forbes (2021) article suggested similar benefits commenting that firms can grow more rapidly, retain flexibility, bring in top talent at lower cost and maintain focus on core activities, e.g., products and growth.

*Crowdsourcing*

Crowdsourcing is a new form of outsourcing brought about by the use of Internet technologies (Howe, 2006). It is now possible to move activities outside organizational boundaries quickly by using crowds linked together through web and mobile technologies. This can range from the simplest tasks to complex operations and the crowd can be located anywhere in the world. Virtual communities can be established in seconds whereas in a pre-internet age it might have taken months or years to achieve a network now it is a matter of hours or days. It is a form of distributed problem solving which can be very useful for supply chain strategists. Crowdsourcing can offer fast, cheap, flexible solutions to a problem and you can use the “wisdom of the crowd” to build a solution.

*The spectrum of relationships*

The spectrum of relationships examined in the area of supply chains ranges from an integrated hierarchy as in the vertically integrated firms to a pure market view (see Figure 7.5). Marshall (1923) and Coase (1937) both recognized alternative forms of organization to either market or vertically integrated firms. Ellram (1991) explored relationships in the supply chain from the point of view of obligational contractual relationships or those relying on good relations. Firms adopt acquisition strategies to gain control of a supply chain, take an equity interest or form joint ventures. Long- and short-term contracts form the basis of contractual or relational exchanges.

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This particular perspective has its origins in an industrial organization and contract view (Aoki et al., 1990). Christopher (1992) has defined supply chain management as an alternative to vertical integration.

***Supplier partnerships and alliances***

Partnerships and alliances are terms often used in relation to supply chains to gain a thorough understanding of meaning it is important to examine definitions of the terms.

*Definition of terms*

A great deal of the more recent literature related to the supply chain has emphasized a partnership approach (Christopher, 1996; Gattorna & Walters, 1996) and referred to the strategic nature of partnerships, (Kanter, 1994). Partnerships usually involve a relationship between two or more different types of organizations at different stages of the supply chain. For example, a retailer and a contract clothing supplier are linked in a vertical chain. A partnership is distinguished from a strategic alliance, which is more usually referred to when two or more organizations at the same part of the chain agree to co-operate. For example, a number of retailers combining to supply a particular market segment, to cover a specific geographical area or to create a purchasing consortium would be partnership arrangements. This distinction is clearly shown in Figure 7.6.

*Importance of building supplier partnerships*

Wheelright and Clark (1992) recognized that firms are able to get new products to market faster and more efficiently by establishing strategic partnerships with suppliers. Strong relationships between a lead supplier and other outside suppliers nearby plays a fundamental role in flexibility according to a number of commentators who have observed the Japanese automobile industry (Fruin, 1992; Imai, 1986; Lipparini & Sobrero, 1994). Nishiguchi (1993) referred to



Adapted from the work of Macbeth and Ferguson (1994) who were early to develop the idea of intermediate relationships to build supplier partnerships which they addressed through ownership structures mainly. The driver was often vertical integration and ownership of supply chains in this conception.

*Figure 7.6* Intermediate type relationships

this phenomenon as “clustered control.” Much attention has focused upon strategic alliances in the automotive industry (Lamming, 1993; Smitka, 1991; Womack et al., 1990). “Co-makership” and lean supply are terms used to characterize customer driven integrated systems of manufacture and informational relationship systems (Hines, 1994; Lamming, 1993; Womack & Jones, 1996; Womack et al., 1990). Bonaccorsi and Lipparini (1994) argued that two dimensions were particularly important in supplier partnerships: the timing of involvement in the product development process and the degree of competition among suppliers. The importance of these two dimensions is further supported by the work of Merli (1991) and Stevens (1989) whose research is discussed in a later section in the chapter.

*Strategic alliances*

Table 7.4 gives a useful delineation between strategic alliances, operational partnerships and opportunistic partnerships. Many supply chain relationships could be categorized into one of these three types.

Supply chain efficiency and cost reduction are control relationships whereas the other themes emerging would be categorized as co-operating relationships. Co-operating relationships might well lead to cost reduction and efficiency and therefore could be seen as causal relationships. However, cost reduction or an efficiency gain in the supply chain could be the catalyst to move towards co-operation. It may be a necessary condition that could cause change to happen but in itself may not be sufficient to determine co-operative behaviour. Nevertheless, co-operation is likely to be a necessary and sufficient condition for a firm to achieve both efficiency and cost reduction in any supply chain.

Table 7.4 Types of supply chain relationships identified

<i>Strategic alliance</i>	<i>Operational partnership</i>	<i>Opportunistic partnerships</i>
Integrate core competencies of each partner and perform the activities that add most value to the relationship	Partnership based on one partner leveraging another partner’s core competence	Based on one party performing activities that the other no longer will
Power is moved towards the consumer and the alliance with equal partners act to serve the consumer	Power equality exists at only one place in the supply chain	Power inequality results in greater demands being placed on one party
Consumer enjoys measurable value from the alliance	Both partners benefit but not always equally	Results in one partner gaining at the others expense
Information analysis is performed jointly and information is shared	Risk is greater for one of the partners	Risks are always greater for one party
The alliance results in a more efficient supply chain	Consumer receives only some value from the partnership	Consumer does not receive greater value as a result of the agreement
	Information is shared on a selective basis	Information is rarely shared
	Partnership has the effect of shifting costs and efficiencies within the supply chain	Cost reduction or inefficiency in the supply chain is ignored



Source: The table is adapted and developed from KSAs description of different relationships that exist in industry between merchant and vendor (retailer and supplier)



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Table 7.5 illustrates what Kanter (1994, p. 100) referred to as “Eight I’s that create successful we’s.” The work examined eight variables that characterized strategic alliances. Kanter (1994) argued that all the criteria had to be met if an organization was to achieve what she termed a “collaborative advantage.” In order to be successful in forming a collaborative advantage it was necessary that both organizations in the partnership had something of value for each other and that by focusing those combined values it would enable new opportunities for both parties. Both parties needed to have long-term goals where their mutual objectives could be realised and where interdependence was essential as each leveraged complementary assets and skills (competences) to achieve their objectives. Tangible signs of commitment would be cross-investment, sharing of information, integrated policies, procedures and systems thus “institutionalising” the relationship. Mutual trust was seen as a necessary condition for the relationship to survive.

Despite all the discussion and rhetoric relating to managing the supply chain however addressing issues to do with partnerships, alliances and relationships, the reality is still somewhat

Table 7.5 Eight I’s that create successful we’s

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Individual excellence	Both partners must have something of value to contribute to the relationship. Both partners are strong. Motives for the relationship are positive and focus on opportunities. Reasons for entering the partnership should not be negative to mask a weakness or to escape from a difficult situation. Supply chain relationships and trust are built around excellence. For example, being world class to serve customers better.
Importance	The relationship must fit in with each partner’s strategic objectives and they must make it work. Each partner must have long-term goals in which relationships play a key role. Commitment to supply chain relations is necessary these are usually easier to arrange than to leave and therefore long-term commitment is needed by partners.
Interdependence	Each partner needs the other. They have complementary assets and skills. Neither can accomplish alone what both can together. This ensures that there is a balance of power in the relationships and that each supply chain partner needs to contribute.
Investment	Partners invest in each other (for example through equity swaps, cross ownership or mutual board service) to demonstrate their respective stakes in the relationship with each other. They show tangible signs of long-term commitment by devoting financial and other resources to the supply chain relationship.
Information	Communication is reasonably open. Partners share information to make relationships work. This includes objectives, goals, technical data, knowledge conflicts, trouble spots or changing situations. Transparency or visibility in the supply chain can only be achieved if information is shared.
Integration	Partners develop linkages and shared ways of operating so they can work together smoothly. They build connections between many people at many organizational levels. Partners become teachers and learners. Supply chain integration is necessary for efficiency and effectiveness.
Institutionalization	Relationships are given formal status, with clear responsibilities and decision processes. It extends beyond the people who formed it and cannot be broken on a whim. This demonstrates the importance of having supply chain agreements between organisations and that will not crumble when the person who set them up leaves the organisation.
Integrity	Partners behave honourably to each, other, which enhances mutual trust. They do not abuse information gained from working together to undermine each other. Their needs to be trust in the supply chain relationship.

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Source: Adapted from Kanter (1994, p. 100)

different. According to Cox (1999, p. 167), the predominant orthodoxy of supply chain management thinking is devoted to,

Discovering tools and techniques (quick response, lean supply, co-makership, agile manufacturing, value streams) that provide increased operational effectiveness and efficiency throughout the delivery channels that must be created internally and externally to support and supply existing corporate product and service offerings to customers.

Cox goes on to attribute this thinking to studies of the Japanese automobile industry in the 1970s and 1980s by Womack et al. (1990). These views are in contrast to the views expressed by Fearné (1998) which emphasize the importance of the customer and building relationships – “a philosophy of doing business.” These two approaches highlight the differences between product push (supply) and market led (demand) strategies. The first approach is essentially internally focused on efficiencies. Whereas the latter is a market-focused approach taking account of the firm’s external environment and simultaneously creating “strategic fit” between the supply networks and their customers.

Cousins (2002) identified three key propositions that support Cox’s point of view. Firstly, partnership relationships do not exist. Rather there is a range of collaborating relationships and they are all competitive. Secondly, organizations do not trust each other but rather they manage risk based on business objectives. Thirdly, and importantly, the relationship itself is a process not an entity and as such focuses on definable outcomes. For example, cost reduction through value engineering or joint product development and problem solving. The relationship observed will have been defined by the definable outcomes. Cox (1997) also argued that the collaborative approach was not necessarily more effective than a competitive strategy in the supply chain. If these assertions are correct, it is even more important to recognize where power within a supply chain resides.

One interesting way to view power relationships in a buyer-supplier dyad was demonstrated by van Weele and Rozemeijer (2001, p. 92) using a portfolio approach illustrated in Figure 7.7.

Power positions are discussed in terms of strategic positioning using the Boston Consulting Group matrix. This is a simple four-box model comparing relative market growth vis-à-vis relative market share. A supplier assesses the product position and segments the market from their perspective relative to the customer perspective. Suppliers who supply strategic products recognize that these are very difficult for their customers to replace in the short-term. They are, in effect, high-growth and high-share supplies critical to their customers’ needs and would have

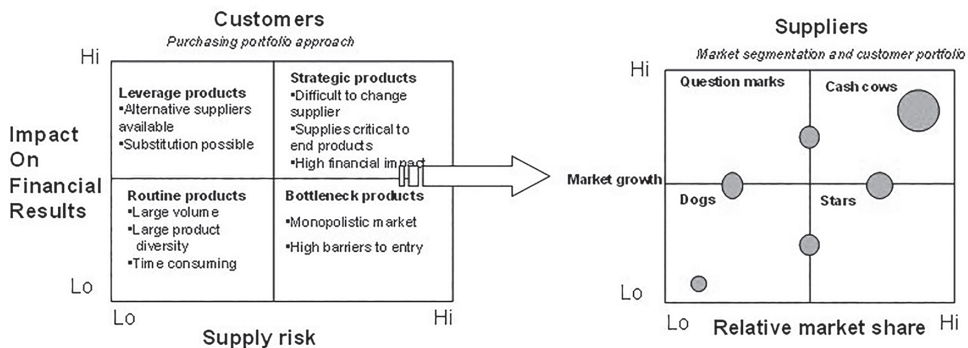


Figure 7.7 Customer and supplier risk and reward strategies

a high financial impact both on their customer and themselves. An organization that supplies products in this category is high-risk for their customer especially if the supplier became vulnerable to takeover or failure. Business history is littered with examples of such supply firms being purchased by their customer(s) to secure supplies as a last resort. Bottleneck products have a monopoly or oligopolistic market and they are difficult markets to break into because of high barriers to entry. There is little or no alternative supplier and the risks for the customer are extremely high. Market share of the supplier is usually high and growth may be possible in immature markets but limited in mature markets. It is shown between a star and cash cow in this example. Routine products are shown as dogs with low market share, low growth, large volumes, small value and time consuming. These are category C products in ABC analysis terms. Leverage products are high growth, high value but low market share because there are many competing suppliers and substitution is possible. Figure 7.8 illustrates power strategies when customers are dominant and, conversely, when suppliers are dominant. The model identifies four categories of product in relation to supply risk and the impact upon financial results. Strategic products carry high-risk and have a high-impact upon the financial results. These products require strategies that minimize these effects. Partnerships, alliances and collaborative strategies are required for these types of supply. In the case of routine products, there is low supply risk and little impact upon the financial results. Routine products are, in effect, “commodity products” there are many suppliers for this type of product and many substitutes. Price is the most important attribute. In customer dominant and supplier dominant products there are a number of useful power strategies and they are listed below.

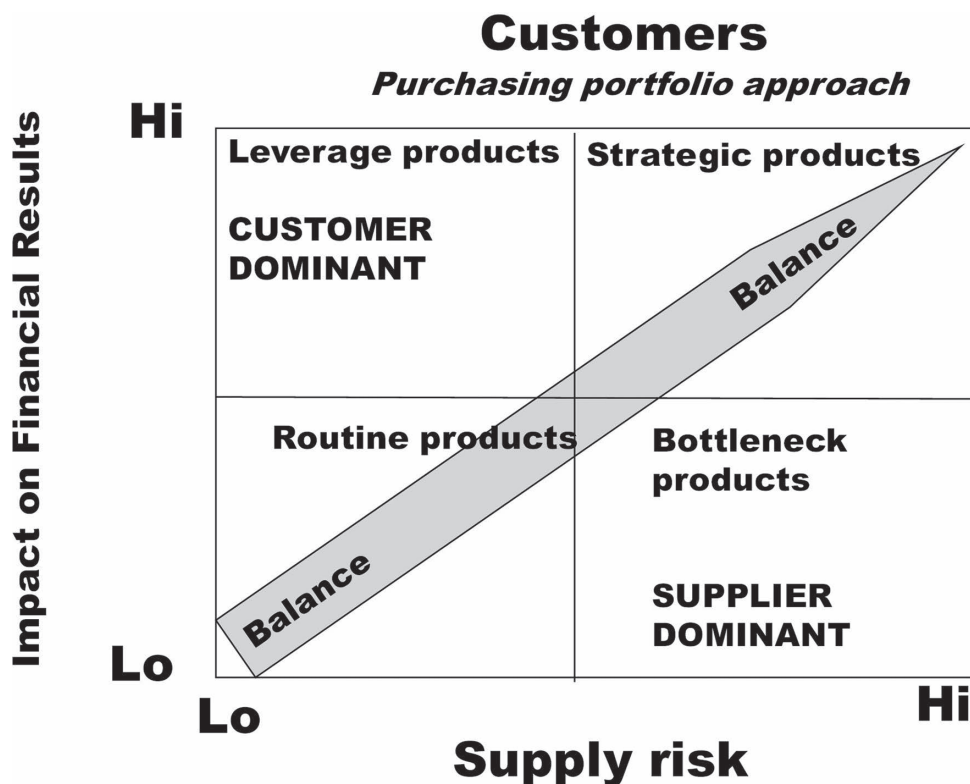


Figure 7.8 Customer portfolio approach – risk and reward strategies

Power strategies when customers are dominant include:

- Purchasing co-ordination: combining volumes.
- Multiple sourcing.
- Competitive bidding.
- Cost down programmes.
- “Open cost” or “open book costing.”
- Consortium buying.

Power strategies when suppliers are dominant include:

- Technological innovation.
- Value added services.
- Take over customer tasks.
- Offer technical support.

### **Make or buy decisions**

Organizations need to make strategic not just operational or tactical decisions in relation to purchasing. For example, a simple operational decision to stop making a product and use resources to make other products may lead the organization purchasing the previously made item because it is lower in cost. This type of supply chain decision is often referred to as “make or buy.” If an organization produces goods, it incurs the full costs of owning plant and manufacturing capacity. It could choose to buy in those goods from another supplier and dispose of assets, resources and competencies it owns. The organization will need to carefully evaluate the risks in taking this course of action. Organizations have been known to make the switch from “make to buy” on cost grounds alone only to realize that in the short term they still carry the fixed costs (factory, plant, machinery and people) or have disposed of key assets and discarded key competencies needed elsewhere in the business. Make or buy decisions must ensure that the resources and competencies can be better applied elsewhere or disposed of if the organization stops making and buys in products instead.

### **Purchase portfolio matrix**

The purchase portfolio matrix is presented in Figure 7.9. It is based on an earlier model known as Kraljic’s<sup>2</sup> sourcing tool. It assumes that customers seek to maximize purchasing power. Key factors affecting the relationship are strength of the buying organization in the buyer-supplier relationship and the number of suppliers able and willing to supply goods in a given time period.

**Bottleneck** items are those where the buyer has little power and few alternative sources of supply. The best strategy in these circumstances would be to try and reduce dependency on the source of supply and search for alternatives that meet the requirements of the buyer. Searching for alternative sources and substitute products is appropriate in these conditions. The buyers should try and work with design teams more closely to remove the bottlenecks and to ensure that lead times are maintained or reduced. Design is an important competence for the buying organization to have or to buy in since a combination of design and value engineering may be useful to ensure that cost is removed from the supply chain and value is added.

**Strategic** items are those where the buyer has strength but few alternative sources of supply. The best strategy in these circumstances would be to draw the supplier into longer term

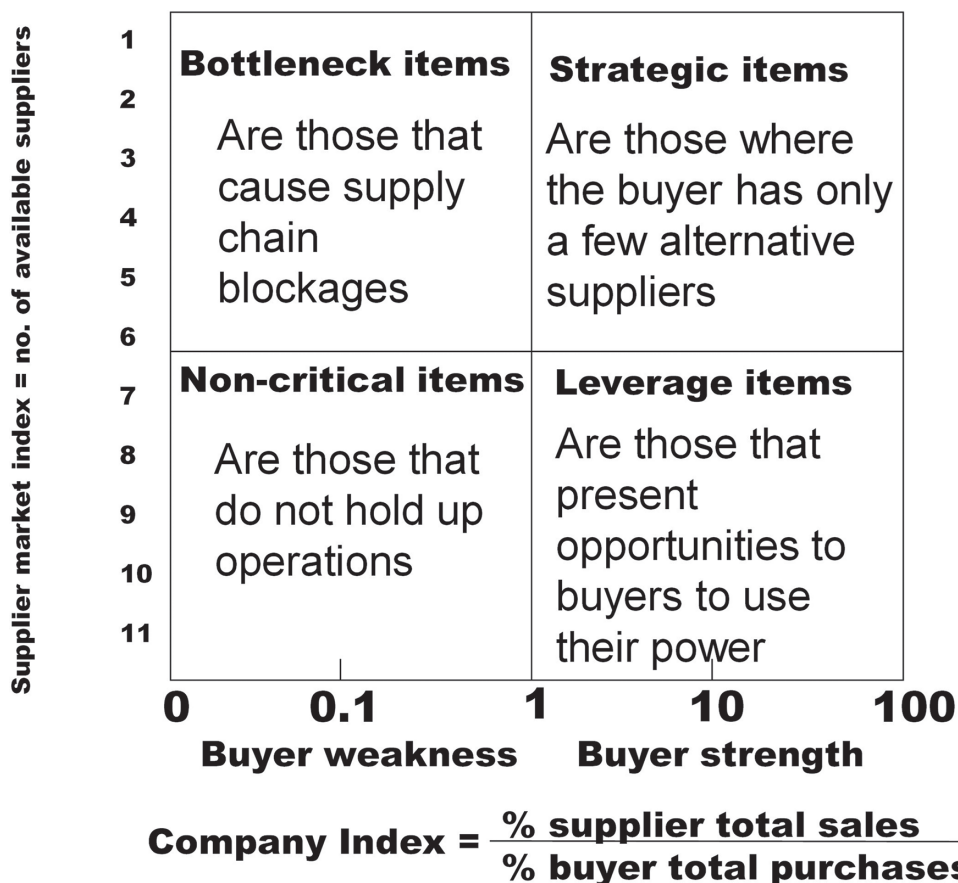


Figure 7.9 Purchase portfolio matrix

contracts to ensure future supplies. Establishing and maintaining successful long-term relationships are critical to the purchasing organization in this context.

**Non-critical** items are those where there are many suppliers and perhaps in a context of using standardized parts. Competitive tendering may be the way in which these goods are acquired. These types of supply have the following characteristics:

- Not jointly developed.
- Unbranded and standardized items.
- Low investment in specific tooling and equipment.
- Do not affect performance and there is no safety risk involved.

**Leverage items**

Leverage items present opportunities for the buyer to use market power amongst many suppliers to get a good price and preferential treatment. Larger organizations are often able to exert this type of leveraging because of the volumes of business. For example, a large publishing company such as Elsevier would be able to use its market strength when negotiating with print

suppliers to get good prices and to negotiate other benefits like flexibility to schedule in their books before other smaller organizations and to get good production and delivery lead times.

Relationships are dependent on the relative market power relationship between buyer and supplier. In many economic sectors, those organizations that have direct contact with final customers often hold the balance of power. For example, in retail the top ten leading grocery retailers have enormous market power because they have access to a very high proportion of the market. This is known as retail concentration. Because of this these organizations can often dictate the terms on which they will do business with many suppliers. This is particularly the case for non-branded suppliers. In these circumstances it is essential for the supplier to become strategically important to the retailer perhaps forming a partnership, co-operative or collaborative relationship. One example might be for the supplier to offer exceptional service, be responsive or flexible in its dealings with the buyer. Another example might be a transport logistics company offering additional services as part of a contract package (e.g., pre-retail services, quality control, inspection, ticketing, tagging, packing, reviving or reworking small corrections in the case of clothing).

### **Activity**

For an organization of your choice, develop a purchase portfolio matrix and plot the names of the top ten customers and top ten suppliers. Suggest strategies that could be adopted to improve the organizational performance.

### ***Supply chain partnering***

Partnerships or co-operative relationships have some or all of the following attributes:

- Information sharing.
- Trust.
- Co-ordinated planning arrangements.
- Shared risks.
- Mutual benefits.
- Recognition of independence.
- Shared goals.
- Integrated processes.
- Shared culture, compatibility and understanding.
- Open book accounting.

Collaborative arrangements require the sharing of demand and supply information to reduce the “bullwhip” effect of holding excess stocks in the system through over-amplification of demand. Many key or core suppliers have access to retail or customer data in order to plan and co-ordinate resources for efficient and effective supplies. For example, in a vendor managed inventory (VMI) system this type of information is critical to its success. In this context, the supplier manages the inventories at the point of sale for the retailing organization who will allow the supplier to manage the retail space attracting customers, maintaining adequate throughput and profitability is in the interest of both parties. The retailer will therefore want to share electronic point of sale (EPoS) data with the supplier to help that supplier plan the inventories in store and to organize production to co-ordinate supplies with demand. In this situation, there



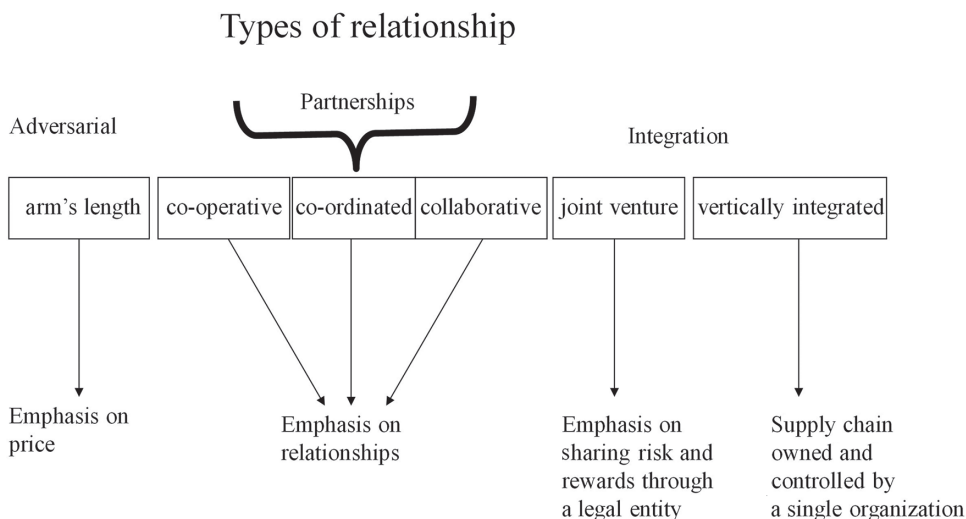


Figure 7.10 Types of supply chain relationship

Table 7.6 Types of partnership relationships

<i>Partnership type</i>	<i>Activities</i>	<i>Timeframe</i>	<i>Scope</i>
Co-operation	Fewer suppliers Long term contracts	Short-term	Single functional area
Co-ordination	Information links EDI	Long-term	Multiple functional areas
Collaboration <i>(co-creation has become another term used to explain such collaboration but it can extend beyond firms to customers)</i>	Supply chain integration Joint planning Shared technologies Process and administrative integration	Long term	Collaborating firms view each other as extensions of their own organization

is a shared risk and there is mutual benefit. Processes are integrated and probably open book accounting since the retailer will only pay the supplier for the goods when sold from the store. Both organizations remain independent but co-operate.

Figure 7.10 demonstrates six broad types of relationship identified in the literature together with the key emphasis and the nature of focus for the relationship clustered into three categories: adversarial, partnership and integrated.

Focusing upon the partnership types, we are able to identify activities, timeframe and scope of activities in Table 7.6. Firms may co-operate with each other or agree to co-ordinate activities such as information flows using EDI or they may agree to fully collaborate sharing platforms, integrating systems, planning and processes. The latter two tend to be longer-term commitments. The changing nature of supply chain strategies emphasising the customer as the end focus of all activities means that organizations have also turned their attention to getting customer involvement in their creative processes. Service organizations have always recognized the importance of customer involvement. For example, the rise of self-checkouts in supermarkets depends on customers who want to pack and pay for the goods themselves rather than being served by staff. This automated service is expected to save time but of course it does not always

but customers may feel that they are in control and so their frustration is limited unless the systems fail. Customers in this situation are co-creating the “customer experience” according to retail analysts and marketers. There are many other forms of co-creation in service settings. A further example may be the significant purchase of an automobile when the customer chooses from a menu (limited variety) to select various components, trims and colours to customize their car. Customers with Dell have co-created computers they purchase. Co-creation creates value by offering choices to customers before, during and after their service encounter.

### **Summary**

The chapter started by identifying key elements of the purchasing decision developing a conceptual model of the Rs in purchasing: right goods, right place, right time, right price, right quality. The model also examined factors valued by the purchaser from the supplier organization: reliability, responsiveness and reputation. These variables were examined in a dynamic competitive environment where innovation and substitution were likely to influence decisions as well as the bargaining power of buyers and suppliers. Purchasing frequency and supplier relationships were discussed before examining a number of supply chain strategies involved in purchasing decisions. A range of collaborative strategies were examined from cooperation through to partnerships. These relationships are often structural decisions too, in that they force organizations to develop new organizational structures in order to deliver the chosen strategy. Chapter 8 examines technologies enabling supply chain integration adopting e-business strategies.

### **Discussion questions**

1. Explain why purchasing is not exactly synonymous with procurement.
2. Discuss when purchasing is critical to the organization and illustrate your discussion with specific examples.
3. Explain why purchasing may be considered to be of both operational and strategic importance to an organization of your choice.
4. Purchasing may be critical to the survival and profitability of an organization. Discuss when this might be the case and explain why.
5. Purchasing decisions revolve around the 5Rs say what these are and discuss their relative importance to the buying decision.
6. This chapter identified another 3Rs that were required from a supplier. Identify the additional 3Rs and discuss their relative importance to the buyer.
7. Identify and explain the types of information required before a purchase can be made.
8. Supplier relationships may be determined by organizational structures within each of the organizations involved in a supply chain. Explain why integration is necessary to reduce total supply chain cost and give examples of how integration may be achieved.
9. Explain the difference between different collaborative approaches in developing supply chain strategies.
10. Ultimately organizations involved in the supply chain must be competitive. Explain how co-operative arrangements can be competitive and describe conflicts that might occur through supply chain co-operation.

## Notes

- 1 IMP, The Industrial Marketing and Purchasing Group has been conducting research into buyer-supplier processes since 1975. David Ford, University of Bath was instrumental in bringing together a group of academics and practitioners concerned to know and learn more about interactions, relationships and networks in business markets. Buyer perspectives and relationships mainly in industrial markets, which have been the foci for this work.
- 2 Kraljic was a consultant who worked for McKinsey in the United States, and he originally developed a sourcing tool based on Pareto's 80/20 rule, the matrix identified the four types, and it was first discussed in the *Harvard Business Review* in 1983.

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## 8 Supply chain technology

### **Demand-driven customer-focused supply chains**

Demand-driven customer-focused supply chains ensure resources are aligned and optimized for service delivery. Supply chain systems must integrate information, physical movement of goods and monetary flows to facilitate a demand driven and customer focused strategy. Competing technology platforms and incompatible legacy systems are hampering firms from reaping the benefits of the digital age. A legacy of investment in different systems makes movement of data between systems difficult or impossible. Both technical and creative solutions are required if systems integration is to occur. This requires vision with technical skills to make it happen. There needs to be tighter control and co-ordination of all links in the chain to meet market demand efficiently. Being efficient means getting the service to where it is needed at the right time, right price (cost), right quality by having a responsive synchronized supply chain. This is underpinned by technology that enables this to happen.

### *Examples of types of integration in supply chains*

Since the 1960s, businesses have been talking about integrating systems but computing power was insufficient to build applications on the scale that can be achieved today. Although the term enterprise resource planning (ERP) was coined back then, it was mainly a human rather than computer activity. ERP systems have changed dramatically from precursor systems like integrated control (IC) packages and material resource planning (MRP) systems. They continue to evolve with the advent of cloud computing, as well as digital innovations like artificial intelligence. They have become much more integrated and their reach across organizations has become greater. No longer just an inventory management tool or quality control system, it integrates data from across the organization so it can be shared to make effective decisions.

Supply chain integration is difficult even inside a single organization, especially when they are coordinating multiples site activities. However, this problem is magnified when supply chain collaborations involve many different organizations and multiple locations across the globe. Many large organizations are vertically integrated or have a degree of vertical integration in their company supply chains. For example, energy businesses such as Shell, BP and Exxon own the supply chain from extraction of fossil fuels through to distribution of refined products, for example, petrochemicals, diesel and petroleum products. It is not always necessary, of course, to have control solely through ownership of the vertically integrated supply chains. There are other ways of working in partnership where you can control but not own the supply chain. Vertical integration requires large investments of capital, and it is riskier to own the supply chain this way if things go wrong. On the other hand, control this way can also



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reduce risk when upstream suppliers you own prioritize your supplies over external companies when there is a crisis. Many retail organizations viewed vertical integration as attractive to secure supply chains through backward vertical integration. For example, furniture stores owning production facilities and even forests. Whisky distillers investing in farms to secure potato crops or brewers of beer and cider owning farms where hops and apples are grown. Examples of forward integration are when companies that manufacture products decide to acquire their own retail outlets.

Horizontal integration often occurs when a business decides to take over a competitor's business and increase market share. For example, in 2022 Asda had agreed to takeover Sainsbury to become the clear market leader before the Competition Markets Authority stepped in to stop the merger because they said it would not be in the best interests of the consumer.

The best way to integrate and coordinate supply chain activities is to adopt appropriate supply chain technologies, even if you do not own the supply chain. You can tap into the existing ecosystem of technologies offered by third-party suppliers to leverage value, without being an expert in all the technologies. You just have to evaluate suppliers and their services in the same way that you would evaluate any supplier.

Always, the first step in creating any strategy is to have a vision or mission in mind that you want to achieve.

### **The United States Department of Defense**

Has a vision statement for its supply chain that states:

- Establish and maintain actionable policies that deliver efficient, sustainable, cost-effective end-to-end supply chain performance.
- Establish integrated solutions for inventory management that are managerially and technically sound and adequately resourced to provide desired levels of readiness to support the war fighter.

*Source:* US Department of Defense: Defense Logistics Agency (2021)

As the twentieth century closed it was claimed that “e-Business had emerged as the most cost effective model for driving supply chain integration and deriving the maximum benefits from that effort” (Lee & Wang, 1999).

### ***Technologies to build integrated supply chains***

Cloud applications, web services and control towers have all been part of the technological evolution to develop visibility and supply chain integration. Internet of things, blockchain, artificial intelligence, robotics, automation, sensor technologies and 3D printing are all having an impact improving supply chain integrations connected through the cloud. For example, AI is embedded in many production, warehousing, logistics and tracking systems allowing humans to free up time to perform more complex tasks. Sensor technologies have been important to track and trace inventory movements, shipping and logistics. And 3D printing has been used to produce on demand products, tools and prototypes.

Blockchain technology allows information required for completion of a transaction to be stored securely in transparent, shared databases to prevent it from being deleted, tampered with

or revised. There is a digital record of every process in the chain including payments. Authorization is identified, validated, stored and shared with the parties who need it. Shippers, freight forwarders, carriers, ports, along with banks, insurance and other authorized parties are using blockchain to provide secure transmission of data.

The aim of the integrated supply chain is to improve and streamline the flows of information and materials between multiple partners that make up the supply chain. Supply chain integration increases visibility. It is a holistic approach to managing the movement of goods and materials throughout the supply chain, from raw materials procurement to manufacturing to distribution and delivery. For example, in an integrated supply chain a network of suppliers, manufacturers and distributors coordinate and communicate with each other to carry out the goods warehousing and distribution processes as effectively as possible. Combining sensor technologies, Internet of things and robotics AI can track and trace movements in the total supply chain. Production, shipments and delays are revealed in the data enabling accurate information on locations, traceability and factors impeding supply chain flows such as weather patterns, factory production delays, bottlenecks and blockages, for example, shipping and port delays. Robotic process automation (RPA) can routinely manage and monitor inventories without human intervention. Blockchain technology is used to integrate supply chain processes with partners sharing data securely. This reduces delays and provides real-time data needed to act and respond as necessary. It has also been possible to be responsive using 3D printing to produce on demand inventories. Each of the technologies become tools that provide specific advantages in different aspects of creating supply chain integration. Cloud technologies employed in supply chains are illustrated in Figure 8.1.

Having integrated supply chains increases flexibility, responsiveness and agility to make necessary adjustments in flow to customer requests, competitors' actions and external events within the industry. It can speed up and smooth the flow eliminating unevenness, increase throughput time, reduce waste and lower costs.

Building integrated supply chains is not without challenges. Top team buy-in is necessary as are collaborations with supply chain partners. The top team needs the knowledge, skills and

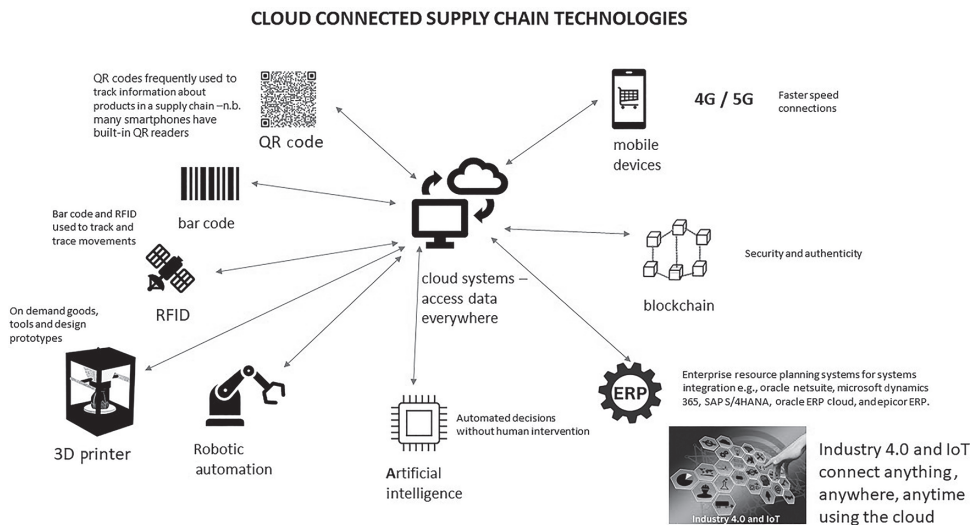


Figure 8.1 Cloud connected supply chain technologies

foresight to understand the benefits that supply chain integration can achieve adopting new technologies and working practices. Agreements with supply chain partners about processes, responsibilities and leadership need to be reached. There may also be a mismatch between existing technologies and legacy systems within a single organization and across partnering organizations in the supply chain. These challenges require careful navigation if the benefits are to be realized.

Technology is a shifting landscape and innovations change the opportunities and applications of technology that can be used in supply chains. There is little doubt that technology continues to enhance the customer experience and it also makes it easier to integrate data and work flows. Industry 4.0 has changed the scale of these enhancements and continues to do so (Rad et al., 2022).

### ***Virtual reality and the virtual supply chain***

Virtual reality is a digital environment which may replicate a physical environment. So, in a supply chain context a digital twin of the supply chain is constructed in digital space. A virtual supply chain (VSC) is a digitalized representation of the physical supply chain that can simulate the real supply chain. You can access the supply chain using virtual reality goggles and you can walk around it just as if it is real and examine details of what is happening when changes are made. For example, if you change line speeds in production units you can see the impact it has on flow and on the next operations. Businesses are using VSCs to collaborate with supply chain partners and to work through improvements. Essentially you can experiment with different strategies and examine the impact in your VSC. It is a means to simulate reality. The VSC can be built to match real-time data in the physical supply chain so changes made mirror what happens.



Figure 8.2 Virtual supply chains – digital twin  
(Image Freepic.com with author additions)

### **Virtual supply chains in action**

A company called “Supply Co.” specialized in manufacturing and distributing products all over the world. Supply Co. faced many challenges in managing its complex supply chain, including coordinating with suppliers and partners, tracking inventory levels and responding to changes in demand.

The firm decided to implement a VSC to improve its operations. A VSC is a digitized representation of the physical supply chain, it mirrors the real supply chain. Using the VSC, Supply Co. was able to visualize its entire supply chain in real-time, allowing it to quickly identify and respond to issues as they arose. For example, if there was a sudden spike in demand for a particular product, Supply Co. could use the VSC to quickly coordinate with its suppliers and partners to increase production and ensure that the product was delivered to customers on time.

The VSC also allowed Supply Co. to collaborate more effectively with its supply chain partners. Using the VSC, Supply Co. could hold virtual meetings with its partners, allowing them to discuss and resolve issues in real-time. This improved communication and collaboration helped Supply Co. to build stronger relationships with its partners and deliver better service to its customers.

In the end, Supply Co.’s implementation of the VSC proved to be a great success. It allowed the company to improve its supply chain operations, collaborate more effectively with its partners and deliver better service to its customers.

### **Demand-driven supply chains (DDSC)**

Contemporary supply chains are uncertain, volatile and demand is often difficult to predict with any degree of certainty. Therefore, any steps we can take to improve the quality of the data we access, with real-time information flows and sharing information between supply chain partners and customers will enhance visibility in the supply chain.

The demand driven supply chain is responsive to demand signals in the system. DDSCs provide collaborative responses and solutions to demand by sharing and acting on data faster. Traditional supply chains can be slow to respond it could often take weeks to share information across supply chain partners whereas it is now possible in hours or minutes, which creates the responsive supply chain removing the opacity previously present.

Building the demand-driven supply chain (DDSC) has been the aim of supply chain strategists. Linking customer demand to the supply chain is key to reducing waste, lowering risk and improving profitability. DDSC lowers risk by replacing forecast data with real-time data which has the advantage of being more accurate. Volatility risk may be reduced adding value for supply chain partners. However, DDSCs have until now existed in the strategist minds rather than in reality for many organizations. Now the integration of information systems and technology platforms is making it possible to build a demand-driven supply chain linking the customer with supply chain service systems that deliver their requirements. According to research by the Boston Consulting Group, some companies with advanced DDSCs reduce inventories by 33 per cent, improve delivery performance by 20 per cent and reduce total supply chain costs.

Stockouts cost retailers \$1 trillion annually (Keenan, 2023). Did you know that ten to 30 per cent of stockouts happen due to inventory shortages and other supply chain challenges. The bulk of the problem when it comes to why inventories are not available arises from a failure to replenish stock in a timely manner. So, 70—90 per cent is down to slow response when it comes to replenishment. Customer focused DDSC is a way to be more responsive.

The changing dynamics of supply chains eats away at value. Managing demand effectively is critical. There are some key questions to ask. What drives value? This is perhaps the single most important question, and it demands attention. Focus on what the customer values and that will drive value in the supply chain. Having suppliers that are reliable, responsive, resilient, agile and flexible means receiving goods and services on time, complete and in good time to serve their customers. So, you will likely find that some, if not all these factors will be important. Investing in technologies that support your plans to deliver what the customer wants is a good starting point. Technology has the ability transform capabilities. It is a game changer when it comes to answering the value question. It will improve visibility, responsiveness, resilience, agility and reduce risk of being caught short. It will do this by replacing forecast demand data with real-time or near time data forecasts giving more accuracy which means not only quick response but accurate response. This in turn lowers inventory risk of holding too much stock because you have a forward window (visibility) on accurate demand. You also have the ability to gain visibility into supply chain partner systems to plan and control flows with appropriate technology and agreements with those partners. This protects supply chain value and serves customers effectively. Digital and cloud-based technologies result in having better control over the end-to-end supply chain. Some of the top companies operating in the cloud include AWS, Google Cloud, Microsoft Azure, IBM Cloud, SAP, Oracle, Alibaba, VMWare, Salesforce and ServiceNow.

One of the factors that organizations have to tackle if they are to successfully negotiate digital transformation is to upskill the existing workforce. Development strategies will be critical to grasp the opportunities that digital transformation presents. Öykü Işık is Professor of Digital Strategy and Cybersecurity at the Institute for Management Development – IMD, Lausanne, and she observed that the digital skill gap has been growing for years. It is not just people lower down the organization but those in the C suite too and this is one explanation for why so many digital transformations fail (Işık, 2023).

### **Digital transformation at IKEA**

IKEA is the biggest furniture retail company in the world with more than 63 million products sold annually. The business is “becoming a more accessible, affordable and people and planet positive retailer” IKEA. The company adapted at speed during the pandemic to introduce “*new digital initiatives*” to meet customer demand. “This brought greater agility in our approach to complex problem solving. We now know just what is possible when we align as a business.” They also comment on how difficult it was to plan their business with the additional disruptions caused by protracted Brexit arrangements between the United Kingdom and European Union. The regulatory arrangements they would need to comply with the additional frictions in their supply chains and the uncertainty all adding to cost. Research (Hagberg & Jonsson, 2022) on the digital transformation taking place at an early stage revealed “We put everything in one basket and said that e-commerce was the same as digitalization. It took a while before we understood that they’re two different things” (Supply Manager, IKEA Supply AG, Logistics). Another perspective on the digital transformation project is given by Barbara Martin Coppola who was brought in to lead the digital transformation given her previous experiences in the technology sector with Google, Samsung and Texas Instruments:

Inventory management, logistics, fulfilment, and supply chain overall had to be modernized through data, which in turn brought in new ways of working and operating.

For example, stores became fulfilment centers. We're also embedding new skills and people who bring new agility (Stackpole, 2021).

A further quote from the company report states "The IKEA value chain is our circle of life. It starts, ends and re-starts as we reach out to current and potential customers to understand their needs and dreams and listen to their feedback" (IKEA, 2022). Barbara Martin Coppola said that IKEA recognizes that 80 per cent of all customer journeys start online.

In March 2022, Coppola left IKEA to become Chief Executive Officer at Decathlon.

### *Maintaining throughput in the supply chain system*

In demand driven supply chains the emphasis switches from cost to flow. We need to understand that flow is necessary to move goods as quickly as we can to customers to reduce risk, avoid uncertainty and satisfy customers. Blockages and delays are threats to supply chain flow. Once we identify a blockage or delay, we need to identify the cause and set about a remedy to correct flow. Decoupling points are necessary to achieve this return to glow. Just like plumbers fix your water system, by using isolation points between two connected parts of a system to carry out a repair so do supply chain managers.

Cost is important, but satisfying demand flow is necessary. One problem in most supply chains is that goods move for just five per cent of the time they are in the system, meaning they are idle for 95 per cent of the time. Waiting time destroys flow and reduces throughput rates. Time delays occur when goods are stored at any point or between processes. Any variability in supply chain throughput will reduce flow. If demand amplification causes a bullwhip effect, we must act to smooth throughput by removing blockages and delays. A good analogy is road traffic waiting at traffic lights, causing hold-ups to the flow.

Queue time is essentially the wait time from the point where something is scheduled to the time that the activity occurs. Planning, scheduling and sequencing the movement of goods all takes time. Then if holdups occur, it adds to waiting times. Little's law can help understand the issues and calculate times as discussed in Chapter 1. For example, when ships arrive at ports they must be unloaded and then the container boxes might have to wait for trucks to pick up containers and move them to the planned destination. If any delays occur and dwell times increase the flow of goods is interrupted. It stops the flow of goods. Hence throughput times increase. Fast flow is better than slow flow and that in turn is better than no flow. In the summer and autumn of 2022, many ports in the United States, Europe and China experienced delays due to the pandemic and this impacted the flow of goods through many interconnected supply chains.

### *Technology helps understand flows in the supply chain*

Two illustrative stories about how supply chain flows can be improved with the help of technology help understand how central technology is to supply chain solutions.

#### **Pete's story**

Pete was a truck driver who was always frustrated with the long waiting times he had to endure at the docks loading and unloading. He would often complain about the lack of communication between shippers and carriers and the inadequate staffing at the port. One



day, Pete decided to take matters into his own hands and came up with a plan to reduce dwell time in the supply chain. He suggested that his company offer a digital check-in option to reduce driver on-site time and provide better load balancing (i.e., optimize inbound and outbound load volumes across the days of the week to bring down dwell). His company implemented these changes and Pete was finally able to spend less time waiting at the docks and more time on the road.

### **Sarah's story**

Sarah is a supply chain manager who is always looking for ways to increase throughput and flow in her company's supply chain. She decided to implement several new technologies to help her achieve this goal. First, she implemented an automated inventory management system (AIMS) that used RFID tags to track inventory in real-time. This allowed her to quickly identify bottlenecks in the supply chain and make any adjustments as needed. Next, she implemented a transportation management system (TMS) that used predictive analytics to optimize routes and reduce transportation costs. This system also allowed her to track shipments in real-time and quickly identify any issues that arose. Finally, she implemented a warehouse management system (WMS) that used automation and robotics to increase efficiency and reduce errors. This system allowed her to process orders more quickly and accurately, which helped her increase throughput and flow.

Here are some examples of how technology is being used by businesses to connect their supply chains with customer demand. One example of this is Amazon's web services (AWS) supply chain technology. Amazon uses advanced algorithms and machine learning to optimize its supply chain operations. This has enabled Amazon to offer same-day delivery to its customers in many areas. Customers can track their orders in real-time and receive updates on their delivery status via text message or email. A further example is how FedEx uses advanced supply chain technology to optimize its delivery routes and reduce delivery times. This has enabled FedEx to offer same-day delivery to many of its customers.

Another example is Walmart's supply chain technology. Walmart uses RFID (radio frequency identification) tags to track its inventory in real-time. This has enabled Walmart to reduce its inventory carrying costs and improve its supply chain efficiency. Customers can also benefit from this technology by being able to check the availability of products online before visiting the store.

Supply chain technologies have connected customers with supply chains in ways that were not possible less than a decade earlier. It has enabled customers to receive real-time updates on their orders and track their deliveries more easily. Overall, supply chain technology has revolutionized the way businesses operate and interact with their customers. It has enabled businesses to optimize their operations, reduce costs and improve customer satisfaction. Supply chain technologies increase visibility, reduce variability by identifying and removing bottlenecks and mitigate risk caused by volatility when it happens. Making the demand driven customer focused supply chain a reality.

### **Forecasts and real-time data solutions**

Real-time data solutions can help improve supply chain performance by providing managers with better insight into trends and demand, the ability to improve forecasting and reporting so



that the organization has better planning capacity. Real-time data are essential to achieve supply chain visibility too. Having accurate, timely data reduces risk.

### **Bosch replace inventory with real-time data**

Bosch created a virtual supply chain detailing physical flows of goods, which it can track in real-time with intelligent software systems. Analysis of data the system provides helps manage and further improve processes. Successful data sharing across the company has been one of the project's major achievements. Standardized data is exchanged and shared between companies seamlessly and in real-time. This makes it possible to optimize production and supply networks.

We sometimes had such high inventory levels that you couldn't even see the machines anymore by introducing the flash production system. We equipped our kanban cards with an RFID tag. These tags allow us to monitor our inventory in real-time and order replenishment exactly when needed. We managed to reduce throughput times as well as the storage space and now we put RFID tags on our products as well as our containers. The warehouse now knows that replenishment is needed at the exact moment a product is removed. It also knows exactly where a specific product can be found. The flows of information and products happen simultaneously. Integrated industry has enabled us to reduce inventory levels by up to 30%. In addition, we can reduce non-value added work and this frees up more time for machine optimization.

(Bosch employee)

*Source:* Bosch Global (2023)

### **Technology and supply chain integration**

The biggest impact that the Internet has had on commercial life so far is in restructuring the ways in which organizations communicate both internally and externally. Many organizations have established intranets (in effect a mini-Internet) to share information throughout their own organization which may be established at different geographical locations. For example, most universities have their own intranets that connect a number of different departments and locations. Large commercial organizations have also established their own internal networks (intranets). Organizations link their own intranets to establish extranets and virtual private networks (VPNs) allowing suppliers and customers secure access to their own internal networks. For example, documents such as orders, specifications, despatch notes, invoices, credit and debit notes are just a selection that can be exchanged electronically. This can reduce time taken to process orders and cash payments. There are many procure to pay providers that offer system solutions to allow purchasers, vendors and suppliers to improve cash flow.

The standard language used by the computers linked via the Internet is called internet protocol (IP). Telecom and cable providers have also invested in IP telephony that allows digitized voice, compressing it, cutting it up into data packets and transmitting it across a data network to be reassembled for reception at the destination. Asymmetric digital subscriber lines (ADSL) has allowed faster and larger volumes of data to travel over the networks which has improved data transmission speeds. Data can be kept secure through encryption technology.

## 212 *Supply chain technology*

Producing quality products and delivering excellent customer service requires synergies across the supply chain. A combination of smart resource planning, procuring the right materials, at the right time and getting them to the right place demands co-ordination and synchronization of partners: suppliers, logistics and customer service. Supply chain technologies are needed that work together seamlessly to maintain and coordinate the flows through the system. Frequent changes in demand, quality issues, inefficient processes, volatility, uncertainty and complexities eat time, money and resources. These can be avoided through careful planning and better processes underpinned by technology and skilled people ensure that supply chains are both efficient and effective. Synchronising activities between sales, (demand management) production (operations) and logistics (customer fulfilment). Co-ordination of pickups and deliveries means large amounts of data and information constantly changing with an increasing number of constraints. The strategic purposes are to lower cost, provide the required level of service and most of all keep the goods flowing to customers reducing downtime, delays, bottlenecks, stock-outs and other disruptions. Choosing appropriate modes of transport that reduce time needed to load and unload avoids waiting times (dwell). This provides flexibility to fulfil customer demand and build resilient supply chain strategies.

### *Platform leadership*

Platform leadership has been driven through technological innovation. Intel, Microsoft and Cisco have been dominant in establishing platform leadership. Paul Samuelson, Nobel Laureate Economist has commented: “the choice of technological platform is of critical importance for individual companies jockeying for position in the marketplace, for emerging industries trying to ensure maximum market growth, even for nations trying to achieve technological leadership” as an endorsement to Gawer and Cusumano (2002). The ability to reconfigure platforms for competitive advantage is supported by research studies (Fontana & Greenstein, 2021). Establishing technology platforms for business is critical because it is these platforms that make integration possible. Being a leading innovator has strategic implications for other technology firms that follow producing software and hardware that integrates with the established platform. One of the problems faced by supply chain strategists has been choosing common platforms that all in the network use. Platform leaders “provide the technological foundation on which all other products, services and systems” are constructed (Gawer & Cusumano, 2002). Common platforms have made supply chain integration a reality.

### *Bluetooth technologies*

Bluetooth is now one of those older new technologies having been around over 20 years or so, but it is still used to connect devices (using short wavelength radio transmissions in the ISM band from 2400 to 2480 MHz) where other wireless protocols are not used such as Wi-Fi which is more widely established and has largely limited Bluetooth’s value for connecting networks and many devices including but not limited to printers, phones, communication devices, cameras, data storage devices. You have probably used it or seen the Bluetooth logo on devices such as digital cameras, mobile phones and headsets.

## **The internet of things (IoT)**

### *IoT at home*

We are now at a time when your devices can connect to the internet if you allow access through AI systems without any human intervention apart from the initial permission. Household hardware such as TVs, washing machines and fridges with Wi-Fi are able to access data directly

to update their firmware, undertake minor adjustments to repair a fault and to communicate with other connected devices to schedule run times. Home heating systems too, communicate directly with cloud-based systems to control energy usage, temperature and schedules, for example, Hive.

“Bluetooth” is being replaced in most connections by Wi-Fi technologies. Where Bluetooth is used it is mainly for close proximity transmission between local devices. As more household gadgets connect the possibilities for smart homes increase. For example, grocery replenishment can be done automatically. The various electronic sensors fitted in household storage facilities pass instructions to your local retail stores. In effect, an automatic kanban controlled by IoT devices without human intervention.

Six quick facts about technology and internet usage:

- In 2013 there were 20 million sensors in the world, and by 2023 there were over one trillion and the number is set to rise to around ten trillion by 2030 according to Deloitte. Many of these sensors are employed in supply chain movement monitoring and tracking in real-time.
- Demand for international bandwidth is doubling approximately every two years. According to Cisco ([www.cisco.com](http://www.cisco.com)), global IP traffic was projected to reach 330 exabytes per month by the end of 2022.
- While 10 GigE remains a relevant increment of IP transit, particularly in more emerging markets, its share of the transaction mix continues to yield to 100 GigE.
- About 2.8 billion people globally watch YouTube videos and it consumes around 21 per cent of global bandwidth. People in India (467 m), United States (246 m) and Brazil (126 m) watch most.
- About 63.8 billion photographs are shared on Instagram and everyday people upload 27.6 million to Instagram (May 2023).
- Around 2.1 million new Android devices are activated daily.

*Source: Consuming Future (2023)*

***Benefits and risks of e-business***

Cisco Systems ([www.cisco.com](http://www.cisco.com)) note distributed denial of service (DDOS) attacks are increasing annually 63 per cent year on year. Other cyberthreats are also increasing taking businesses offline along with ransomware attacks. The UK government reports 56 per cent of SMEs are currently using the Internet to sell products, deliver services or cut procurement costs. Eighty-four per cent of all UK businesses use the Internet. In the United States the Boston Consulting Group ([www.bcg.com](http://www.bcg.com)) estimate that companies using e-procurement strategies have cut their material costs by 15 per cent and transaction costs by up to 65 per cent.

Figure 8.3 illustrates the possible opportunities that could lead to benefits for organizations employing e-supply chain strategies. The diagram shows an Ishikawa diagram (cause and effect) leading to strategies competing for the future. The context is a retail organization locked in a supply chain with suppliers and manufacturers who supply them with goods and services to satisfy retail customers at some future position. Design and technical considerations can all be influenced by e-supply chain strategies selected by the retail organization. The retailer may

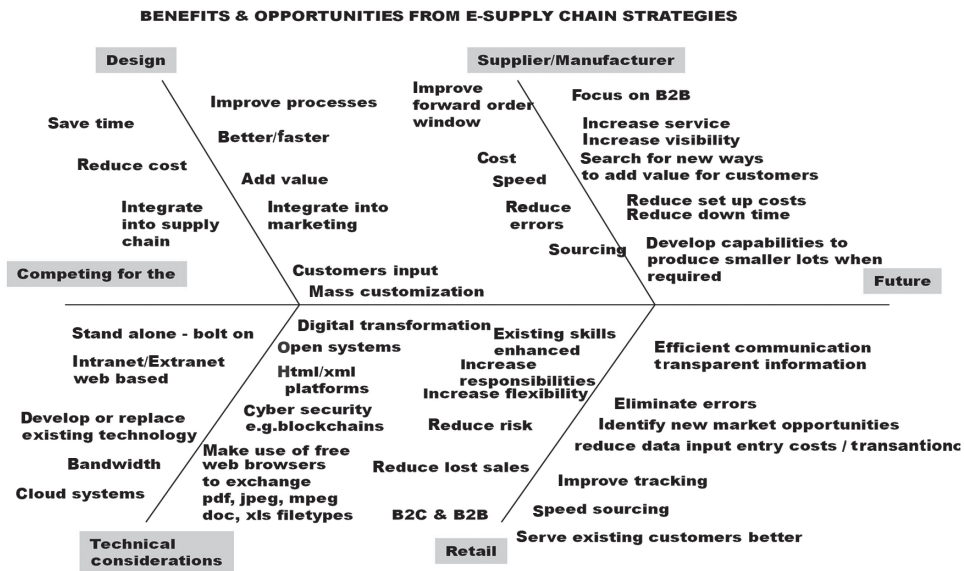


Figure 8.3 An Ishikawa (fishbone diagram) showing strategic possibilities

require their suppliers to use particular technologies to communicate information with them and other supply chain organizations. By using the Internet to transmit design information and specifications time can be reduced in the supply system. Technical considerations include choice of technologies, software and platforms to exchange standard data. A retailer may use a large ERP system provider like SAP or i2 and it may expect suppliers to invest in systems and technologies that link with their technology in order to achieve integrated systems. On the other hand, it may choose to offer links into the system using open web-based platforms requiring little investment. The biggest opportunities created by e-supply chain strategies are risk reduction through postponement possible through time saved in communications (sourcing, sampling, purchasing and co-ordinating processes between the various supply chain partners).

### Software sees soft shoes inventories spike at Nike

In the early 2000s, Nike was experiencing difficulties with their new demand and supply software, which they had purchased as part of a \$400 million revamp. The brand was forced to airfreight in shoes to get the latest designs into stores on time. Revenues in the quarter were expected to be \$80—100 million short of forecast with a knock-on effect on profitability. The company said it would take six to nine months to lower inventories to normal levels.

### Digital transformation expected to add value

Since then, Nike has invested further in its ERP system to improve speed of flow and gain control of inventories through increased supply chain visibility. It is a complex business with many suppliers around the globe. Mathew Friend, CFO at Nike said in a statement that he expected Nikes largest investment in its digital transformation to deliver value.

This year, we will begin to see value from our biggest investment in Nike's digital transformation, our new ERP. As we shift to an increasingly direct-to-consumer future, an ERP will be foundational for increasing speed and agility across our supply chain.

At the mid-year point in 2022, inventories were \$8.4 billion, up 23 per cent year-on-year. Friend said this was due to raised levels of in-transit inventories because of extended lead times caused by supply chain disruptions. There were also lockdowns in China factories, which is a significant supplier country. Andrew Campion, COO at Nike said, "We'll continue to leverage the experience that we've had over the last two years, navigating through this environment from a supply chain complexity and congestion perspective." Sport fashion brands always face fickle demand and complex supply problems at the best of times but clearly the pandemic coupled with supply chain disruptions have taken their toll.

### **Disruption and uncertainty**

A year earlier in June 2021, at the height of Covid infections, in Vietnam the factory closure of its biggest supplier, which accounted for around 50 per cent of the shoes had to shut down disrupting supplies and threatening inventories. The factory in Ho Chi Minh City employed 56,000 people. It is easy to see why in such circumstances businesses such as Nike want to hold higher buffer stock levels when they can get supply. This in itself of course is problematic in a fashion business and it increases risk.

In October 2022, Nike held excess inventories worth \$9.7 billion because of these supply chain disruptions in Vietnam and elsewhere. As the situation improved not all was good news for Nike. Transit times improved, lead times improved and the arrival of delayed orders flowed in which meant that they saw in transit inventory levels rise sharply by 85 per cent in the first quarter of 2023. Mathew Friend CFO said, "As a result, we are taking decisive action to clear excess inventory, we've seen quite a bit of volatility in transit times." Many other big retail brands found themselves in a similar situation to Nike.

### **Conclusion**

Early investigations into the relationship between strategy and structure by Chandler (1962) recognised ambiguities, complexities and dependencies. One of the lessons here is that you can do many of the right things and make big investments in normal times, but volatility can disrupt the best-laid plans. Risk coupled with uncertainty makes it worse.

## **Looking upstream – a consumer perspective**

### ***Front-end supply chain activities***

At the front end of any supply chain is the customer. The customer may be a business-to-business (B2B) customer where goods and services are supplied from one business to another business. The customer may also be a consumer of the product. For example, in retail markets people buy goods from high street stores and supermarkets often with the intention of consuming those goods themselves individually, or by their family members or in the case of gifts their friends. The consumer of the product is the final link in any supply chain. The terminology used by supply chain professionals is "upstream" moving away from the consumer to a retailer, onto their supplier, manufacturer, raw material provider until the primary source is reached, for example, farm, mine,

chemical plant. “Downstream” is the reverse movement from the original source through to final consumer. Consumer issues are examined in relation to e-supply chains in the next section.

Some benefits of e-commerce to the consumer:

- Presents an environment in which the descriptions and prices for a range of goods and services can be quickly compared quickly and easily, for example, books, music, clothing, travel and accommodation. This has been referred to as the “commodotization” process meaning that such comparisons effectively turn the buying process into commodity purchases
- May speed up transactions
- Reduce time spent on shopping important for time-poor but cash-rich consumers
- Reduce delivery times especially where digital delivery is possible through the Internet
- Convenience of home delivery removing the need to visit stores, such as, virtual shopping rather than physical shopping
- Creates a more competitive marketplace as information transforms the market allowing consumers to make more informed choices about their purchases by being able to search and find a larger variety of competing products and services
- Competition in turn creates lower prices. Although it has been suggested by some that price rigging happens in certain cases when suppliers collude to maintain their higher prices

### *Secure payment systems*

One issue is often put forward as a barrier to the uptake of B2C e-business – the risk of presenting credit card details for payment online. However, organizations like Amazon and Apple iTunes do not appear to suffer from this problem. One explanation for this might be that the customer segment has a broad knowledge of the underlying technology and have reached a conclusion that the risks are no higher than paying with a credit card in a restaurant when the waiter disappears with your card for a few moments or in paying over a telephone when you give your personal details to an unknown telesales person. Perhaps there is no such thing as a perfect security system. Nevertheless, encryption systems protecting consumers have become more sophisticated. Encryption codes scramble the data so that they cannot be read or tampered with by anyone not authorized. Netscape developed the principle of secure socket layering (SSL), which is, in effect, a private key – your personal digital signature. There are also digital certificates, issued to companies alongside a public key that confirm websites and transactions are valid. So, when you visit a website, you see https and not http indicating the site has this extra layer of security to protect visitor data shared with the site. These certificates are only issued after scrutiny and are changed regularly to prevent “hackers” and fraudsters accessing the data. Your browser will recognize and alert you when a site is not secure. In such circumstances the person can make a reasonable judgement whether to proceed or not with the transaction. Digital certificates and signatures formed the basis of an emerging standard for VISA and MasterCard known as SET (Secure Electronic Transmission), which they used to verify transaction data from 1996. This has been superseded by 3-D Secure.

### **How secure are payments online?**

Section 75 of the Consumer Credit Act 1974 is a UK law that provides protection for credit card purchases. Under this law, the credit card company is jointly and severally liable for any breach of contract or misrepresentation by the retailer or trader. Many online payments



systems use SSL to encrypt data and credit card companies have their own encryptions to ensure that payments are safe such as 3-D Secure, which has replaced SET.

Many online payments are made using PayPal which has established a reputation for secure payments online with 435 million users worldwide, in more than 200 countries. “PayPal does not make you liable for unauthorised payments made to or from your account and covers you for any money that you have lost from fraudulent activity” (Finder, 2023).

### ***E-fulfilment***

On the supply side the biggest problem for suppliers has been e-fulfilment. This is especially the case for pure “clicks and clicks” dot.com organizations. Traditional “bricks and mortar” companies who have established a “bricks and click” offering have tended to succeed better with their fulfilment. For example, they can offer “click and collect” services as well as home deliveries. Those retail organizations that had experience of catalogue retailing were far more ready than even they realized to compete effectively in the world of e-business because they already had established supply chains. These businesses were also able to handle returns better too because of their previous experiences in the analogue space.

Reverse logistics can be costly for business. In 2020, US data showed that returns accounted for ten per cent of retail sales valued at \$428 billion. The National Retail Federation estimated the cost of those returns at \$101 billion to retailers. Auto parts (19 per cent), apparel (12 per cent), home improvement (11.5 per cent) and homeware (11.5 per cent) were the leading categories of return (Shopify).

### **Business-to-business supply chain strategies (B2B)**

Business-to-business (B2B) e-commerce offers many benefits to organizations incorporating the technologies within their supply chain strategies. Technology has evolved rapidly in recent years. Figure 8.4 illustrates the major changes. There have been rapid developments in the marketplace driven by the technological innovations over a short period of time which has created opportunities for organizations to move from simply EDI to e-procurement and to B2B e-markets.

New entrants to the market can often avoid the cost of legacy systems by investing in new technologies. Although technological developments have been evolutionary the opportunities for organizations wanting to develop appropriate e-supply chain strategies can be revolutionary. Technological innovations allow firms to “breakthrough.” Furthermore, opportunities are not just for large firms as relative cost falls and standard web-based platforms (adopting XML) replace older bespoke technologies B2B opportunities are democratized and available to a wider business community including small firms. The next section discusses some of these opportunities.

### **E-supply chain opportunities**

Several areas have been identified where e-business developments have facilitated opportunities for better supply chain management. These areas are:

- Collaborative demand planning between retailers and manufacturers of products.
- Synchronised production planning.
- Joint product development between buyers and sellers.

## Supply Chain Technology Timeline

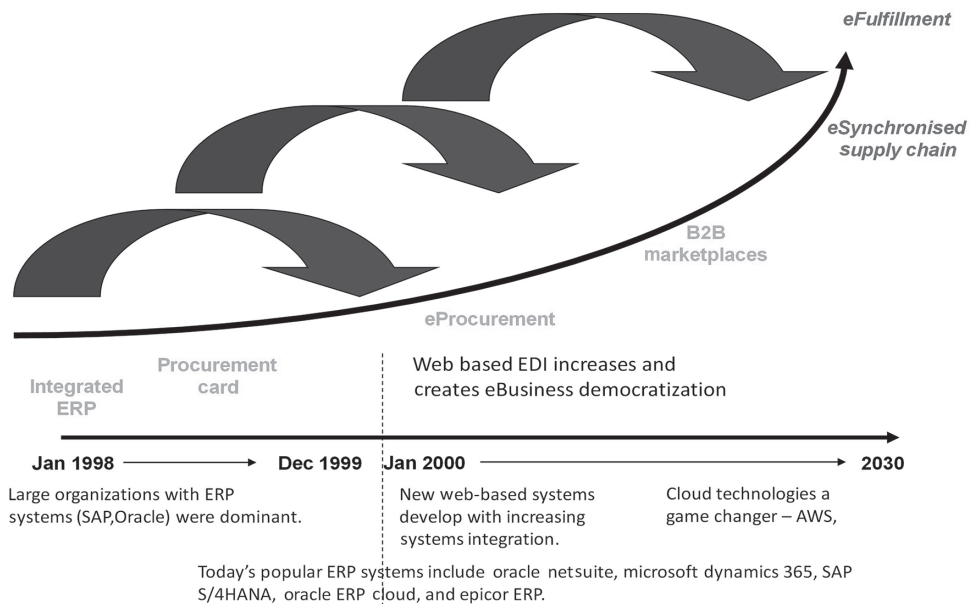


Figure 8.4 B2B e-commerce evolution

- Better logistics planning with warehouses and freight carriers.
- E-procurement.
- Auctions/reverse auctions.
- E-market places.
- Bar coding, RFID, sensors and EDI.
- Intranets/extranets and virtual private networks.

Each opportunity will now be discussed in the context of enterprising supply chain management.

### *Collaborative demand planning between customers and suppliers*

Collaborative demand planning has been made possible in recent years through the development of information and communication technologies (ICT) such as those explained later in this chapter (Intranet, extranet and virtual private networks). Collaborative planning allows the retailer and their suppliers to acquire real-time or forecast demand data and to plan their procurement, production and supply activities in such a way to minimize stockholding and meet customer demand efficiently.

### *Synchronized production planning*

Synchronization is a similar concept to collaborative demand planning. The idea is to synchronize all aspects of the supply chain to ensure that goods are produced on time. Simultaneously stockholding can be minimized. Synchronization can be achieved more easily through use of web-based systems.

***Joint product development between buyers and sellers***

One of the biggest opportunities for achieving a more efficient supply chain has been the development of products jointly. This type of co-operation can significantly reduce the time it takes to get a new product to market. It also allows the partners to co-operate to iron out any faults and modify product designs as the product develops.

***Better logistics planning with warehouses and freight carriers***

Better logistics planning is possible with the development of improving information and technology communications (ICT). Carriers are able to plan their activities to maximize efficiency of deliveries and to minimize their costs. Moving goods around supply chains is a very costly business. The principles must be to move it once, don't double handle and make sure the goods get to the right place at the right time.

Planning loads, tracking goods and ensuring compliance with transport, health and safety legislation is essential. Because logistics is quite a specialist activity and can be a substantial cost to any business, many organizations have decided to outsource the activity and contract third-party providers. The benefits of contracting third-party suppliers of logistics can include:

- Professional planning with the specialist providers operating the latest software and hardware to help plan and control activities.
- Experience from a number of contracts developed through time provides you with expertise you may find it difficult to buy in or develop.
- Costs are certain since the contract will specify what the third-party will be paid for the service.
- Risks are removed, for example, cost of owning, insuring, maintaining and managing your own fleet, warehousing and storage are removed along with those costs which could be less predictable than those of third-party contracts.
- Many logistics providers now also offer additional services, for example, quality control, ticketing, labelling and packaging.
- Specialist logistics firms have the latest technology to track deliveries, for example, satellite tracking.

***E-procurement***

E-procurement is an important opportunity for businesses to speed up, get what they want and get better value for money. Electronic procurement is conducted in a number of ways. Some e-procurement simply moves the paper-based systems to electronic paperless systems using the Internet to transmit the order documents and the various other documents involved in the purchasing and supply cycle. However, one of the major benefits of e-procurement is that the buyer can search the world for supplies from their desktop, laptop computers or mobile devices. This allows a customer to search supplier catalogues around the globe. It is important that suppliers pay attention to their catalogue data and keep their Internet sites user friendly and up to date.

Some major benefits can accrue from e-procurement include:

- Consolidated spend.
- Direct ordering through the internet.
- Reduced lead times and reduced delivery times.
- Reduced stock holding through faster replenishment.

220 *Supply chain technology*

- Remove administrative overheads by allowing direct purchases to be made by authorised personnel.
- Automated approval and workflow.
- Combined purchasing.
- Price transparency.

Typical purchase categories where e-procurement is used:

- IT equipment – computers and peripherals.
- Furniture.
- Office equipment, copiers, stationery.
- Telecoms equipment.
- Electronics components.
- Electrical goods.
- Magazines.
- Flowers.
- Production supply.
- Marketing.
- Canteen supplies.
- Maintenance equipment, components and staff.
- Building equipment.
- Tradesmen (e.g., fitters, electricians, joiners, painters).
- Vehicles.
- Art.
- Giftware.
- Travel (air, sea, rail, automobile) and hotel accommodation.
- Conferences and conference facilities.
- Education.
- Consultants.
- Temporary workers.

Figure 8.5 illustrates new capabilities acquired through e-procurement, benefits and financial impact on buyers using e-procurement strategies.

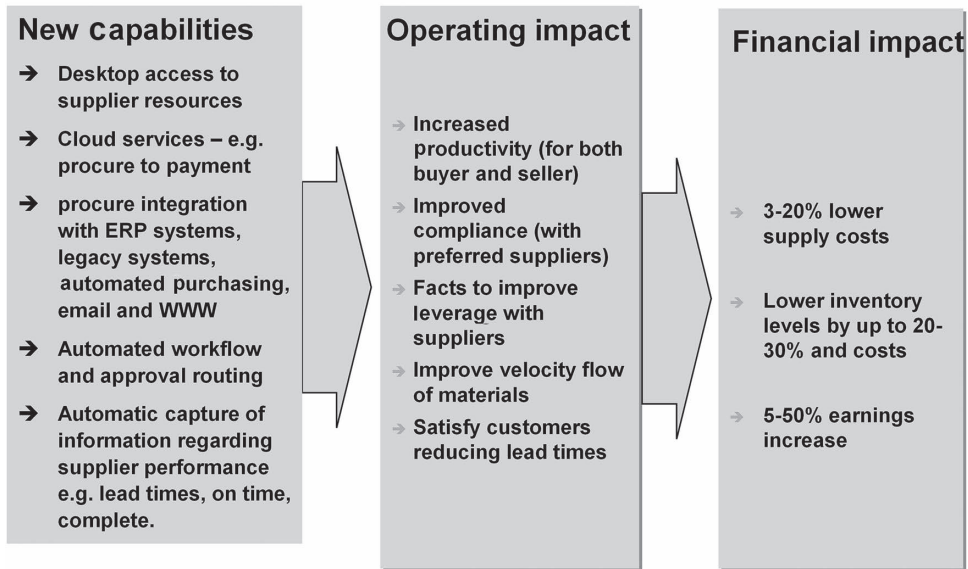
It is claimed by Accenture management consultants that e-procurement can give rise to benefits through lowering supply costs by between three and 20 per cent depending on the maturity of the e-procurement system. As organizations become better at e-procurement more benefits accrue.

However, some of the more interesting purchasing and supply developments in many business-to-business situations has been the development of auctions and reverse auctions to procure goods and services.

### ***Auctions***

Auctions can take place through electronic networks such as the Internet in a similar way to how they take place in physical space, in “auction rooms.” A seller places an item for sale and prospective customers place their bid. The only difference being that the bid is made electronically to the seller. This has enabled many sellers to supply goods over the Internet at prices that often exceed what they might have sold the goods for had the seller fixed a price initially. In some

# e-procurement benefits



***e-procurement lowers operating costs by increasing purchasing productivity.***

Figure 8.5 Benefits of e-procurement

situations, customers have been able to get a lower price but it really does all depend on supply, demand and error free or error prone systems.

### ***Reverse auctions***

Reverse auctions are an interesting concept because instead of the buyer bidding a number of sellers bid to supply the customer. In some markets this is very efficient especially when the product required has a particular specification. This makes it easier for a customer to compare supplier offerings and achieve a best price.

Companies spend approximately 60 per cent of their revenues on goods and services. Their competitiveness depends on strategically managing procurement. Companies are searching for ways to reduce expenditure and improve sourcing practices. B2B exchanges have emerged with new procurement tools and technologies to meet the needs of these companies. Therefore, e-procurement is valuable, but mostly limited to indirect spending, while the bulk of value lies in direct spend (materials and components). Traditional strategic sourcing needs to be enhanced with Internet capabilities in order to maximize value from this tool.

Procurement tools using web-based technology enable true “dynamic pricing.”

Procurement groups can use this tool to implement “reverse auctions,” where sellers compete for procurement contracts bid-out by the buying organization.

Accepting bids on-line allows buyers to open the bid to more sellers – increasing competition. Increased competition among sellers can result in lower prices for the buyer. Sellers see where they are positioned in the marketplace and can adjust their prices in real-time. Procurement

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contracts can be for goods or services, exactly like an RFQ or RFP process. On-line bidding is suitable for goods and services with one or more of the following criteria:

- Well-defined and well-understood specification.
- Relatively standardized product (commodity or near commodity).
- Time sensitive (producer will be prepared to reduce prices as an expiry date approaches, e.g., airline seats, perishable goods).

Savings on average of 20—30 per cent can be achieved through reverse auctions.

The stages involved in the process are to:

- Identify the opportunity.
- Clearly define and understood specification.
- Recognize that the process is only suitable for standardized products (commodity or near commodity).
- Only suitable when the product or service is time sensitive (producer will be prepared to reduce prices as an expiry date approaches, e.g., airline seats, hotel bookings and perishable goods).

Figure 8.6 illustrates the change in price occurring during a reverse auction over the period of one hour. Competing sellers force prices down, adding value for the buyer in the process of bidding.

### Online auctions deliver value - Fast

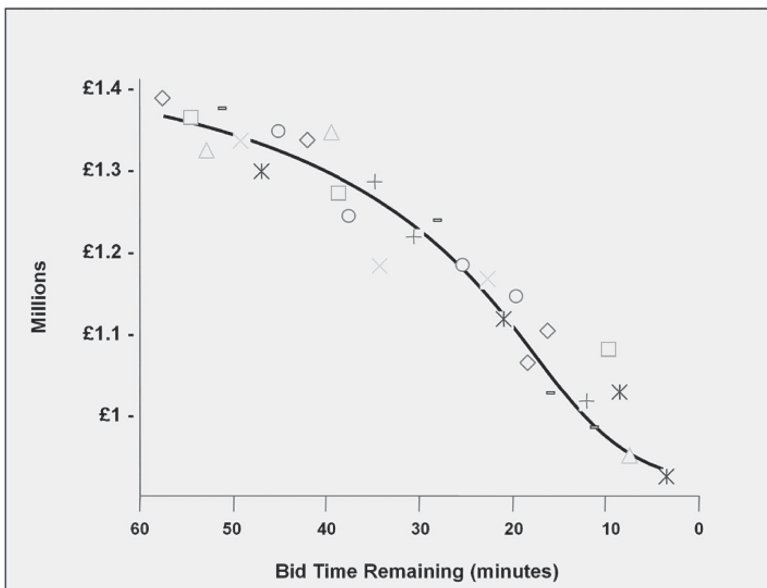


Figure 8.6 On-line auction purchasing

Note: The symbols in this figure represent different suppliers bidding in the online reverse auction. Each one is competing to supply as prices fall until a winner emerges. In this example the winner entered the market to supply at £1.3 million and won the contract to supply at just £250,000.



### ***Electronic data interchange (EDI)***

Electronic data interchange (EDI) is simply a generic term for the exchange of different types of information between parties using electronic networks. The most common forms of EDI have been exchanges using bar code technologies, emails and electronic document exchanges.

### ***Bar coding***

Bar codes began to appear on a wide range of products sold through supermarkets in the 1980s. Prior to that it was very difficult to keep track of stock movements from distribution centres to store and onto customers. With the emergence of bar code technology, it was possible to track stock movements throughout the retail supply chain. Retailing MIS provide an opportunity for the retailer to:

- Gain control over the supply chain.
- Utilize in store space more efficiently by stocking only those lines that are moving quickly.
- Identify effective in-store sales locations for particular goods.
- Electronic point of sale (EPoS) systems allow low stock holding.
- EPoS means rapid replenishment of fast-moving stock items.
- EPoS allows the identification of slow moving stocks.
- Electronic funds transfer at point of sale (EFTPoS) allows the rapid exchange of goods for funds from the customer (e.g., Switch cards; Smart cards, etc).

### ***EDI and electronic point of sale (EPoS)***

Retailing businesses have been revolutionised by EPoS systems. Next time you enter a supermarket or visit the high street stores observe the way in which your purchasing transactions are dealt with. Goods will usually have a bar code on them and the sales assistant passes that bar code over a scanner at the checkout. The bar code holds information on stock item identification, price and store location amongst other things. When your purchase is complete the stock account for the store will be updated, the difference between the selling price and cost price will be recorded to furnish profit on the item and if needs be the item will be automatically replenished by the EPoS system triggering a re-order. Further consider the types of information such systems can provide instantly:

- Sales by stock item (stock code).
- Sales by department.
- Sales by store.
- Sales by in-store area location.
- Fast moving stock items.
- Slow moving stock items (items to delete).
- Hourly or daily or weekly sales.
- Sales by customer.
- Sales by staff or till location.
- Overs and shorts reports.
- Inventory analysis.
- Trigger automatic replenishment orders.
- Analysis of exception reporting.
- Profitability/contribution by stock item.
- Transaction type: cash, credit card, Switch card, cheque, etc.

Computers allow a company to locate a product in its warehouse, to devise a delivery schedule, which makes the most efficient use of its vehicle fleet, and to track a consignment on its way to its final destination. Managing the supply chain can lead to considerable reductions in the amounts of stock which have to be held. This efficiency enables firms to save money tied up in working capital. Concentrating all of a company's delivery activities in one centre not only reduces the levels of stock, which have to be held, but also means that a wider range of stock is available to customers and allows the distribution centre to add extra services.

***Radio frequency identification – power within the supply chain***

“Information is power” is a quote attributed to an anonymous Roman general. Supply chain managers are relearning lessons of the past. It is no accident that the power balance within retail supply chains has shifted towards the retailer in the latter part of the twentieth and beginning of the twenty-first century. This has happened because retailers have become prominent in the chain by managing the information for the whole chain. Developments from bar coding and scanners, their increasing capability to gather vast amounts of customer data and use it to target promotional activity, develop new markets and new products and their ability to learn from their retail customers have been contributing factors to their increasing power.

The development of radio frequency identification (RFID) tags has enabled some retailers to experiment with how they can use customer data to generate even more sales. Supply Chain Advantage (2023) estimate there are 30 billion RFID tags produced and used each year. The market is expected to more than double within a decade. RFIDs enable suppliers to track products throughout supply chains creating visibility. Payment devices may include watches and mobile phones and they too will have RFID chips that can authorize payment at the checkout or wherever. RFIDs have the capability to revolutionize product and data management. Suppliers, logistics providers and retailers can enter their data via the RFID and they can track progress of the item from start of the supply chain through to the end consumer. RFIDs also have potential to be used by marketers to target particular customer segments and individual customers or micro markets using the data gathered en route. RFIDs are destined to replace bar code technology and have a number of significant advantages over bar codes which are shown in Table 8.1.

**Walmart – More than 60 years ago today Sam taught the Mart to play**

Walmart opened for business on 2 July 1962 and is customer-focused and market-driven. It established customer and supplier relationships and built efficient supply chains to deliver its promise. Ten things that changed the game of retail for Walmart were:

1. Direct relationships: Walmart cut out the middleman and established direct dialogue with suppliers.
2. Serving the underserved: Walmart targeted smaller, rural locations not served by larger retailers.
3. Everyday low prices: Walmart's pricing policy focused on everyday low prices.
4. Communication: Walmart invested in a large internal communications network to track inventory and sales instantly.
5. Changing local retail environments: Walmart has attracted bad press by closing small retailers down by being price aggressive.

6. Purchasing Asda: The acquisition of Asda offered Walmart a foothold in the United Kingdom.
7. Entering Africa: Walmart's entry into South Africa with Massmart is an important new market with growth potential.
8. Collaboration: Walmart is famous for working closely with suppliers to develop new products and work on innovation in its supply chain.
9. Technology: Walmart revolutionized retail with uniform product codes, bar codes and RFID tags to track goods through the supply chain.
10. Efficiency: Walmart has established efficient supply chains, lowering cost and using well-planned logistics to leverage scale.

Table 8.1 Bar code and RFID technologies used in supply chains

Bar codes	RFIDs
Identify the SKU only	Identified individual items within a SKU not just the SKU
Can be written to only once	Data can be read from and written to the RFID as many times as you like
Contain only small amount of data 12—15 characters	Can store hundreds of characters of data
Readers use light emitting diodes (LEDs) to scan codes	Readers scan radio signals from the tag
Handheld and fixed point scanners have to be close and in line of sight to work properly	Readers can be anywhere they do not have to be in close proximity but within a specified range and they do not have to be in line of sight
Currently has a cost advantage	Slightly more expensive

Source: Author's own research and Forrester Research

RFID tags cost anywhere between 25 cents and five dollars depending on volume, specifications and storage capacity.

RFID tags are everywhere today and have been used commercially for more than 30 years, radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags attached to objects using a transponder and receiver. Back in 2003 *Drapers Record* reported that Marks and Spencer United Kingdom launched a trial of radio frequency identification devices in menswear at its High Wycombe store in October that year (*Drapers*, 2003). Today many retailers use RFID tags to improve inventory management and supply chain efficiency. RFID tags can be attached to products, allowing retailers to track their movement through the supply chain, from the warehouse to the store floor. This technology can help retailers keep track of their inventory, reduce stock shortages and prevent theft.

In the United States there is a consumer pressure group called CASPIAN, Consumers Against Supermarket Privacy, Invasion And Numbering. Dr. Katherine Albrecht is the founding director of CASPIAN which she started in 1999 to advocate free-market, consumer-based solutions to the problem of retail privacy invasion. Albrecht wrote a book with Liz McIntyre entitled *Spychips: How Major Corporations and Government Plan to Track Your Every Move with RFID*.

***Mobile technologies***

Mobile technologies particularly the development of smartphones has developed further possibilities for consumers and businesses to purchase and supply goods and services on the move. Tracking movements is possible at every stage of a supply chain using small handsets. These are sophisticated devices that with a variety of “apps” can be turned into a data powerhouse and information system on the move. You can create and transmit digital, photographs, video and audio data throughout the world in seconds.

***Key benefits of mobile technology in the supply chain***

Handheld radio frequency (RF) devices, PDAs and lift truck mounted RF scanners ensure that real-time data is available. The use of mobile devices gives improved data accuracy, flexibility and convenience, reducing human errors.

The key benefits of mobile technologies in the supply chain are:

- Real-time RF-based mobile transaction user interfaces ensure real-time data.
- Reduces data entry errors, allows label printing and bar code scanning on the move.
- Support for transactions and inquiries in receiving inventory, discrete and process manufacturing, quality and shipping data (Oracle, 2012).

***Intranets/extranets, virtual private networks and supply chains***

Intranets are internal computer networks. Intranets may link different departments or different functional areas of the business. For example, an intranet might be established to link financial accounting with purchasing and sales departments to exchange data about customers, procurement, payments and receipts.

Extranets are similar networks of computers but they involve external organizations and allow them to access part or all of the company’s internal network from remote locations. For example, suppliers and customers may be allowed secure access to an organization’s system to check on production, to bid for orders, to check product specifications, to submit tenders, to invoice the company and so on. Extranets usually require the external organizations to have a password and ensuring security by having appropriate “firewalls.”

Virtual private networks (VPNs) are networks that are restricted between organizations that want to share certain types of information between a number of organizations who are allowed to access the network. VPNs may be more secure than extranets but act in a similar manner sharing electronic data between the parties. VPNs were developed earlier than the extranets, which use Internet technologies and commonly used software based around HTML or XML code.

The purpose of these different networks is to make links between:

- Different parts of the same organization – intranet.
- Different organizations – extranets sometimes regarded as less secure.
- Different organizations – VPNs sometimes regarded as more secure.

These technological networks have enabled organizations to better manage their supply chain. Figure 8.7 illustrates the place of the Internet, intranets, extranets and VPNs in organizational relationships.

**Place of Internet, Intranet, Extranets and EDI in organizational relationships**

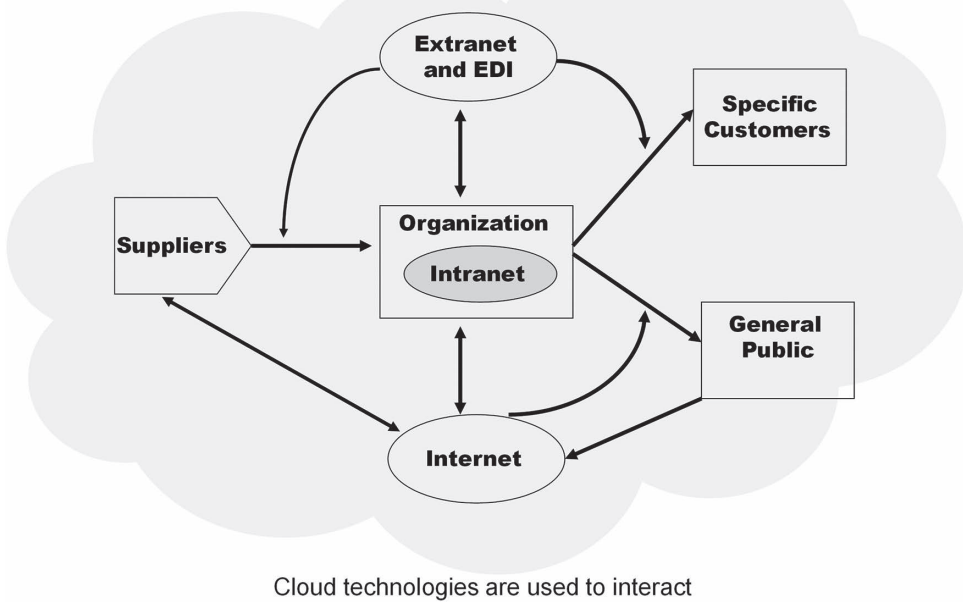


Figure 8.7 Organizational relational strategies built through technology

**Benefits to SME suppliers**

These supply chain opportunities are no longer simply available to large organizations. Small- and medium-sized enterprises (SMEs) can benefit from being part of an electronic supply chain network especially if they are efficient. Some of the most important benefits that SMEs are able to receive are:

- Acquire customer demand data through the network.
- Tender to supply.
- Bid for orders through reverse auctioning.
- Acquire data regarding specifications a customer makes available.
- Share information between the customer and themselves to mutual benefit.
- Bill their customers electronically.
- Receive payments electronically.
- Reduce lead times.
- Reduce sampling and development times.
- Reduce production cycle times.

**Customer relationship management (CRM)**

Customer relationship management (CRM) is an essential part of supply chain management because it creates value for the supply chain by matching products and services with the needs of the customer. Whatever channels customers use to communicate with the business CRM customers are recognized by the organization and an intelligent response is made. It is regarded by

many as a natural extension to “precision marketing.” It provides a means of creating a single cohesive view of the customer.

- CRM systems provide metrics to develop customer-focused strategies by understanding customer behaviour which helps supply chain planning.
- CRM systems have the means to build and maintain relationships with customers.
- Tracking customer behaviours is easier with CRM and data are used to develop supply chain strategies to meet demand.
- CRM helps target marketing by influencing customer prospects more likely to buy.
- Customer facing teams are able to liaise effectively with supply teams to adjust inventories and have them located near to where demand is likely.

CRM is, in effect, a simple acknowledgement of the Pareto concept in action whereby 80 per cent of the lifetime value from customers may be attributable to 20 per cent of your customer base. Identifying, collecting and keeping these customers are the very essence of CRM. ABC and ABM are a means of identifying costs and revenue streams attached to specific customers by measuring activities that the organization has to perform in order to generate the revenue from that particular customer. Research shows CRM improves organizational performance (Guerola-Navarro et al., 2021).

### ***Omnichannel strategy***

An omnichannel strategy focuses on connecting all of a company’s touchpoints, such as brick-and-mortar shops, social media, website, email and mobile. CRM is a technology that manages all your company’s relationships and interactions with customers and potential customers. Figure 8.8 represents customer interactions with the retail organization. Customers can interact through different communication channels as indicated. The organization has to develop capabilities to present a consistent response to customers. Policies, systems and procedures need to be consistent across the different channels. Policies, systems and procedures can be supported in this objective by the retail organization having technologies to support each of the channel interactions. For example, when a customer makes an email enquiry it is logged on the system together with the response given. If or when the customer makes a follow up enquiry by telephone, in-store or through the website, the information is retrievable by the person handling the enquiry and they know what the previous responses by other personnel in their organization were. Customer attrition rates are likely to be lower as a consequence, and it is hoped that the customer will become loyal as a result of consistent standards over time through dealing with the supplier and building trust. A second major benefit of CRM is for the supplying organization to identify:

- a) How customers interact with the organization.
- b) What they purchase.
- c) How often they purchase.
- d) When they purchase.
- e) How they pay.

Combining these data can enable a supplier to segment customers and target offers that are more likely to be taken up by their customers. Thus, the two most powerful commercial



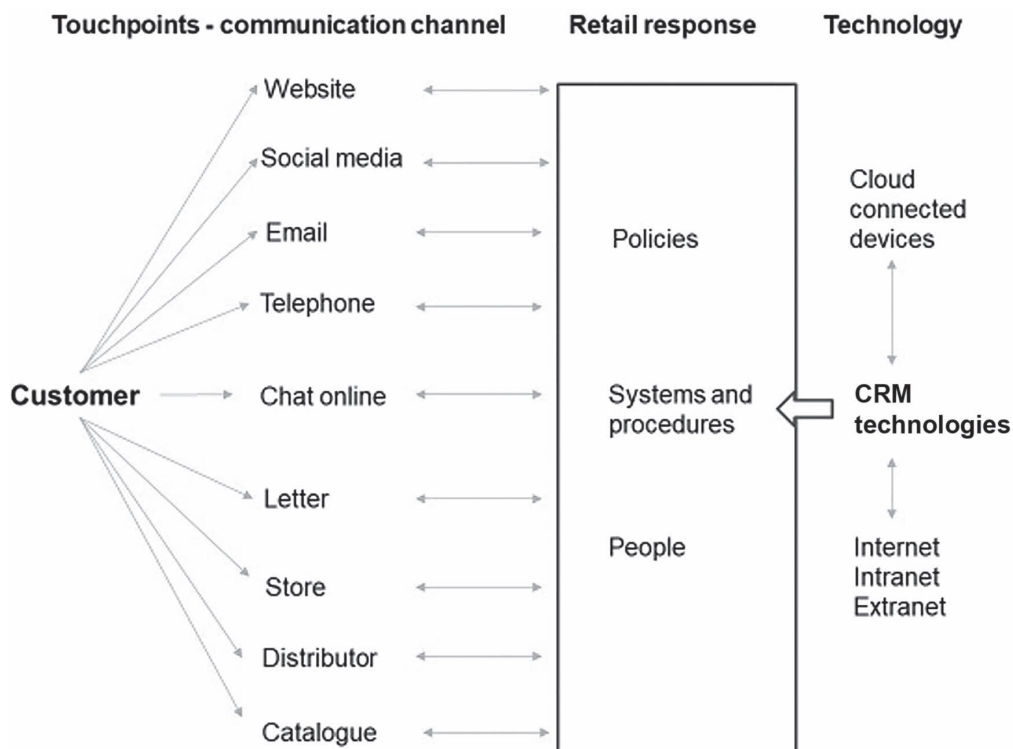


Figure 8.8 Touchpoints and technology for omnichannel retail strategies

reasons for adopting CRM are to develop loyalty through trust and to identify profitable customer segments.

**Is it possible to build customer loyalty?**

Research shows it costs six times more to attract a new customer than to retain existing customers and small increases in retention rates can result in disproportionate increases in profitability. Identifying customers who are more profitable is the key to success as is recognising that it may cost more money to deal with some customers, thus outweighing the value of their potential revenue stream (Zeithaml et al., 2001). Supposing you can identify profitable customers and encourage them to be loyal it is likely to lead increasing turnover and profitability (Dowling & Uncles, 1997; Foss & Stone, 2001; Johnson, 2002). In theory, loyal customers ignore competitor offerings, make repeat visits, are satisfied with their purchase experience and as a consequence spend more with the organization of choice during their lifetime relationship. Loyal customers are not rational consumers in the economic sense looking for the best value bargain. These customers are emotionally bonded with the supplier of choice according to the CRM literature (Foss & Stone, 2001). They feel positive about their experiences with that organization and encourage others to spend there too. The positive effect of “word-of-mouth” recommendations can be of great benefit. Getting up close and personal is the name of the game when it comes to encouraging loyalty (Stone, 2006).

***The CRM process***

CRM is data driven (Rigby et al., 2002). According to this study 55 per cent of CRM technologies and methods do not produce results. There are five basic steps in developing effective CRM:

1. Collect customer data.
2. Analyze customer data with the aim of identifying target customers.
3. Design CRM programmes to encourage emotional ties.
4. Implement the CRM programmes.
5. Evaluate the CRM programmes and adjust as appropriate.

Constructing a *customer database* is the first step. The database needs to hold a transaction history (purchase date, price paid, payment mode – cash, credit, Visa, SKUs bought and additional data such as whether the purchase was part of a promotional response). It also needs to hold records of interactions that the customer has with the organization including visits to the retailer website, phone calls, inquiries through in-store kiosks, direct mail responses and personal interactions in store and with customer service departments. Customer preferences need to be established and recorded – likes, dislikes, colours, brands, fabrics, sizes, etc. Descriptive data using geo-demographic data (where they live and life stage) or psychographic profiling (identifying lifestyles) is required too. These data can be used to segment customers differently.

***Does CRM really mean suppliers can get a bigger share of the customer's purse?***

The answer to this question is yes, if and only if, organizations buy into the philosophy of CRM. People inside the organization need to be trained to recognize opportunities, to have common sense in dealing with customers, to be empowered to respond effectively as well as consistently and not to rely too heavily on technology alone but use it to support decision-making. Some simple lessons in implementing CRM activities are:

- Target customers and prospects with clearly defined offers.
- Handle enquiries consistently and record interactions as soon as the prospect has shown interest in the offer. Track the interactions through to purchase completion and after sales, if appropriate. Learn customer likes, dislikes and requirements so you can satisfy them and increase profitably.
- Welcome new customers and get to know their requirements through data collection about their interactions with your organization.
- Identify profitable customers through clear segmentation.
- Handle complaints effectively, identify the causes and eradicate them as well as thank the complainant for acting as your unpaid consultant and reward them, if appropriate.
- Develop strategies to win back customers who become disaffected, especially if they have been identified as belonging to a segment deemed to be profitable.
- Be prepared to lose unprofitable customers but be very sure first – have the information to hand.

Total global revenues generated by consultancy firms in CRM has risen to around \$40 billion. Some of the leading firms include: IBM, Cap Gemini, Oracle, NCR, Fiserv and SAS Institute. Where once CRM was the province of big business many providers now offer smaller businesses the opportunity to benefit from CRM these include: Pipedrive, Monday sales CRM and HubSpot.

## Summary

Supply chains today are both physical and digital environments and technology enabled supply chains create visibility and reduce risk. As supply chains become strategic assets for organizations technology continues to play its part in innovation to support physical processes. This chapter discussed supply chain technologies and their impact upon supply chain strategies. It began by examining the changes in technology and the impact upon business-to-consumer markets before turning attention to the implications for business-to-business markets and supply chain opportunities and potential problems. Fulfilling the customer promise has been a particular issue in e-business transactional models. The final part of the chapter considered specific opportunities for supply chain strategies related to e-business strategy. E-procurement, collaborative planning, synchronization, auctions, EDI, CRM and RFID developments were all discussed. The next chapter moves on to assess cost, value and measurement in relation to supply chain strategies.

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## 9 Strategic supply chain cost, value and measurement

### Introduction to cost and value concepts

It is particularly important for organizations to know and understand in detail their cost and value structures in relation to managing their own supply chains. All organizations form part of a much larger value system that links with other suppliers and other customers locked in a single or multiple supply chain structure. For example, if your organization supplied just five customers and two of those customers accounted for a substantial proportion of business it would be very important to know cost drivers and value creators for the two major customers since following the “Pareto” concept. It is essential for managers to focus their activities on the areas where there is high-risk or high-returns.

It is often stated that cost is fact. There is some truth in this statement since many costs incurred are invoiced or determined from exogenous suppliers. These are often regarded as unavoidable costs. Nevertheless, there are a number of costs that are determined by people managing the organization. This second category of costs is avoidable depending upon the decisions taken by managers. We will return to this later.

### *Value added*

Value added is essentially a financial concept. It may be explained by the difference between input cost and output value. For example, if you are familiar with the concept of value added tax (VAT) you will know that this tax is paid on the difference between sales value taxes added to the invoice of customers and input taxes paid on purchase invoices in a period of time. For example, if a firm incurred £1,000 in input taxes and had to charge £3,000 in output taxes they would pay over the difference (the value added tax element) £2,000 to HM Revenue and Customs. Figure 9.1 illustrates the value added concept.

Value is created only when someone is prepared to pay the price that the value represents. This is a very important point to understand. The number of times one hears reads or observes people discussing value creation when what they really mean is cost incurred is astounding. Value is only realized when someone external to an organization creating value is prepared to pay the price, which equates to the value placed on the item by the producing or supplying organization.

### *So how do you know value has been created?*

The truth is when you receive something of value, for example, money in exchange for outputs created. An organization may of course place an internal value on its production based upon input costs but until the product is sold there is no extrinsic value. It is the market that ultimately

### Value Added Concept

#### Inputs to supply chain

- Materials
- Labour
- Facility overheads

#### Outputs from supply chain

Finished Goods  
supplied to customers



Value Added or Value Created  
is the difference between these two figures  
£10,000

*Figure 9.1* Value added concept explained

determines the value of a firm's output. Until goods reach their market and are exchanged for money through selling to organizations and people who demand the product, there is only cost. It is a myth to believe otherwise and all organizations whatever their size would do well to reflect on this salutary lesson. Figure 9.2 illustrates this argument using a simple input, process and output model.

Figure 9.2 demonstrates a model of inputs, processes and outputs from an organization supply chain. The inputs to the firm's supply chain system are categorized in terms of inbound materials, labour and facility and other costs classified as overheads. These elements are inputs to a manufacturing process or service process. Outputs from the system take the form of tangible goods or intangible services supplied to a customer. In such a model presented in Figure 9.2 inputs and processes are costs and value is only recognized when the customer pays for the outputs. It is important to understand where the value is created inside the organization but it is essential to recognize that value is only created when the customer pays the price and that this price is a figure above the cost incurred.

#### *Value chains, value systems and their strategic relationship with supply chains*

Value in a supply chain is not simply the organizational value but it is the value created across different organizations that combine to create the supply chain. In strategic terms supply chains cross organizational boundaries and are part of a wider value system. This can be illustrated conceptually adopting Porter's (1980) value chain analysis (VCA). Inside an organization Porter (1980) identified nine key areas that need to be examined when examining how value may be

## Cost or Value Creation?

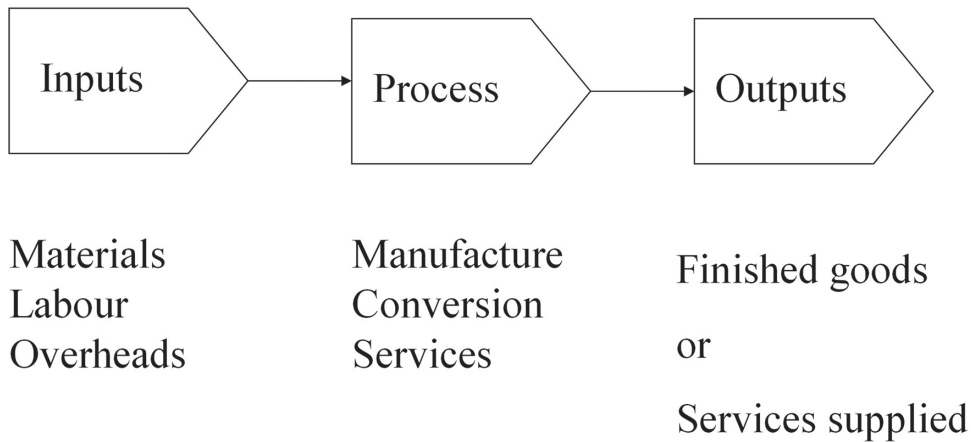


Figure 9.2 The input-output model showing cost or value creation

created. He divided these nine areas into what he referred to as primary activities and support activities. The primary activities included inbound logistics, processes, outbound logistics, marketing and sales, customer service. The support activities included technological developments, human resource management, procurement and firm infrastructure. Identifying and examining each of the nine key areas would provide the organization with an audit of capabilities. This audit could be compared against competitor profiles and gaps may suggest opportunities or weaknesses in the organization’s strategic capabilities. It was further argued by Porter that the firm’s individual value chain was part of a larger value system in which the firm participates. This is very similar to an internal supply chain within a single organization and a number of supply chains that are linked together in a value system that is created to satisfy the ultimate customer, the consumer.

Figure 9.3 shows a diagrammatic representation of Porter’s (1980) value chain. Figure 9.4 shows a number of value chains locked together in a value system.

In the diagram of the value system Figure 9.4 the example illustrates an organization with three suppliers: A, B and C. The suppliers have their own value chains, which are individual to each separate entity. The organizations they supply in this example have three channels or routes to market: through an agent, through a retailer and wholesaler. Each of the channel firms has their own value chain and finally, the customers that they supply have their own value chains. All these organizations form part of a value system. In effect, organizations locked together in any supply chain form part of the value system for each of the organizations involved. If the suppliers, channels and customers illustrated were the only ones involved with the “organization” at the heart of this system then this would represent the complete value system for that particular organization.



## The Value Chain

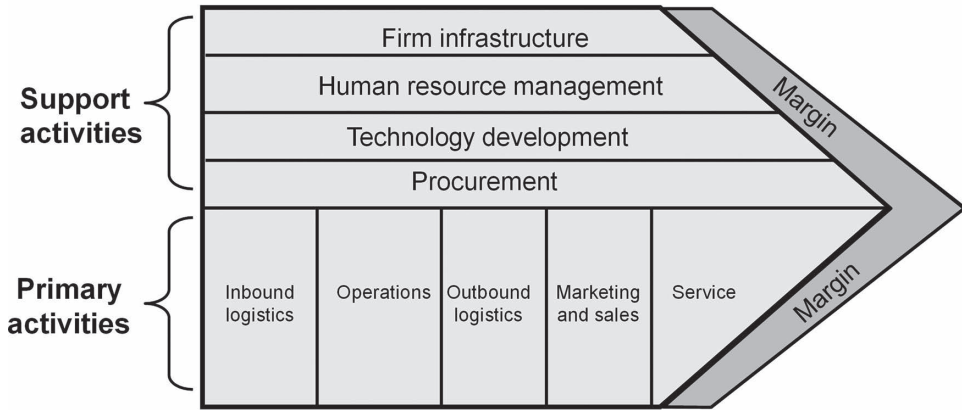


Figure 9.3 An organization value chain

## The value system

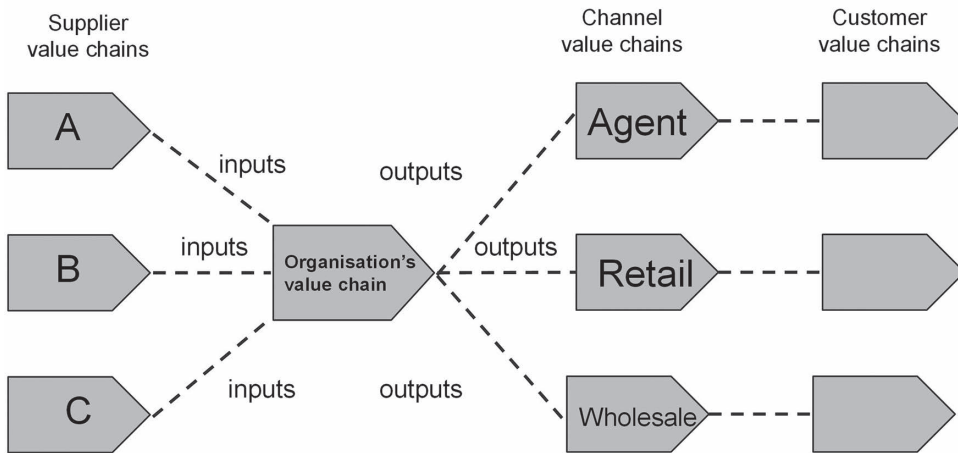


Figure 9.4 The value system in supply chains

### Supply chain cost and control

#### Nature and characteristics of supply chain costs

Supply chain costs accrue based either on time or activity undertaken. For example, storage costs have both a time based element and an activity element. Financial managers regard the time-based cost element as the overhead cost. This cost is often referred to as a “fixed cost.” It is said to be fixed because the cost of storing goods requires physical space to be rented or purchased and both rental and purchase costs relate to time. If property is rented it has an annual

rent. If property is purchased, the cost of using the property has to be amortized over its lifetime use. Activity based costs (ABC) are often referred to as the variable cost of performing the activity. For example, the higher the throughput in a warehouse facility then the greater the cost of labour to handle the volumes. It is important for supply chain managers to make the distinction between costs that will be time-based and those that will be activity based. In essence the identification of annual fixed cost and variable cost elements.

Supposing the cost elements were identified for a particular organizational supply chain activity and separated into two categories labelled fixed and variable the data might be as indicated in Table 9.1.

From the chart in Figure 9.5 you will be able to see that fixed costs do not vary with changes in volume. In other words, those costs remain fixed regardless of changes in output. The variable costs of course do change they vary according to output quantity. The table may make this distinction clearer for some of you. Fixed cost remains constant at £100,000 from 1,000 through to 10,000 units of output. The variable cost changes at each level by five pounds per unit of

Table 9.1 Fixed and variable cost

Output quantity	Fixed cost	Variable cost	Total cost
1000	£100,000	£5,000	£105,000
2000	£100,000	£10,000	£110,000
3000	£100,000	£15,000	£115,000
4000	£100,000	£20,000	£120,000
5000	£100,000	£25,000	£125,000
6000	£100,000	£30,000	£130,000
7000	£100,000	£35,000	£135,000
8000	£100,000	£40,000	£140,000
9000	£100,000	£45,000	£145,000
10000	£100,000	£50,000	£150,000

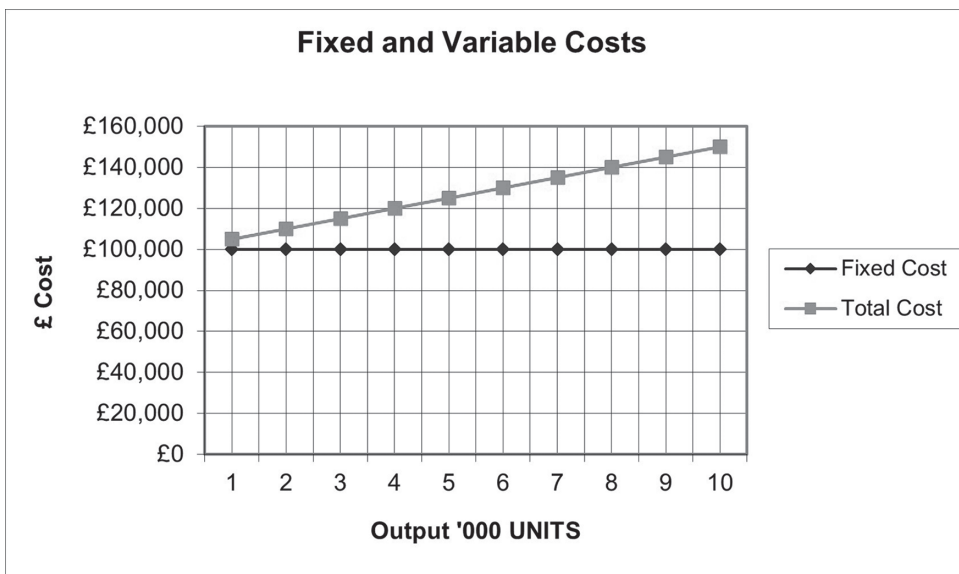


Figure 9.5 Fixed and variable costs illustrated

output. For those of you mathematically inclined you may have noticed that the equation to represent this would take the form of:

$$y = a + b(x)$$

Where:

a = fixed cost

b = variable cost

x = quantity or output

Notice in the example that the fixed costs were said to remain fixed between an activity level of 1,000 and 10,000 units. Supposing that to increase storage beyond 10,000 units the firm had to acquire a further storage facility at an annual cost of a further £100,000 the picture for the volume of output in the range from 1,000 to 20,000 units would look as shown in Figure 9.6.

This type of cost is often referred to as a “step cost” because when the firm reaches a certain level of activity the only way it can deal with the increase is to incur further fixed costs as in the example an extra storage facility. Figure 9.7 clearly illustrates the step cost at 11,000 units of output. Suddenly cost has increased not simply by the variable element £5 per unit but by a further £100,000 plus the £5,000 variable element to a total cost of £255,000. It is very important to understand the effect of this change on total cost and unit cost. At 10,000 units the total cost was £150,000, that is, £15 per unit. However, increasing storage costs to hold an additional 1,000 units at 11,000 units has raised the total storage costs to £255,000 and the unit cost to £255,000/11,000 units = £23.18 per unit. This assumes that the total cost is to be spread over the full range 11,000 units. However, in essence the incremental element of the cost is £105,000 (the additional storage cost £100,000 and £5,000 variable cost) for the first £1,000 units, which make these units £105 each to store. The new storage facility does not become efficient until maximum capacity is reached at 22,000 units. This incremental effect is illustrated in Figure 9.7.

Figure 9.8 demonstrates the effect of volume change on unit cost assuming the costs are spread over the full range of output. The data on which the figures are based are given Table 9.2.

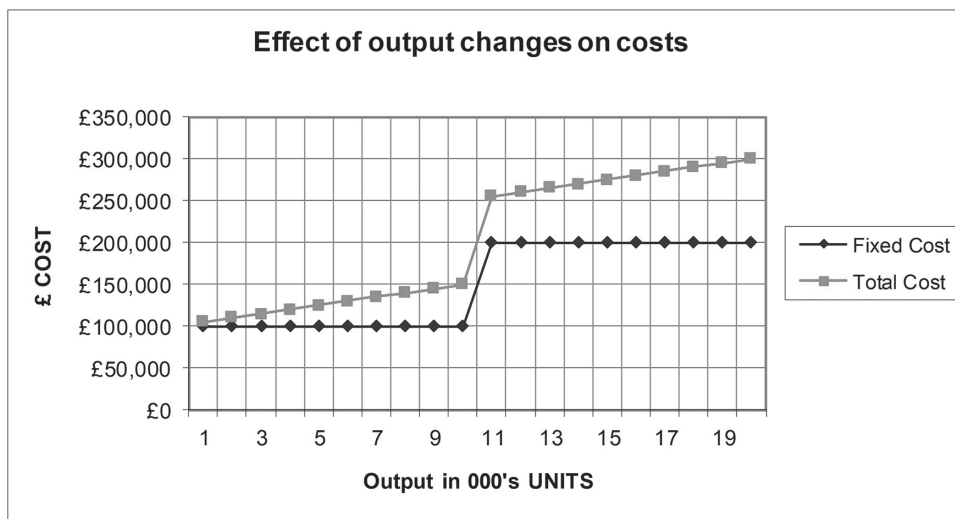


Figure 9.6 The effect of a change of quantity on cost

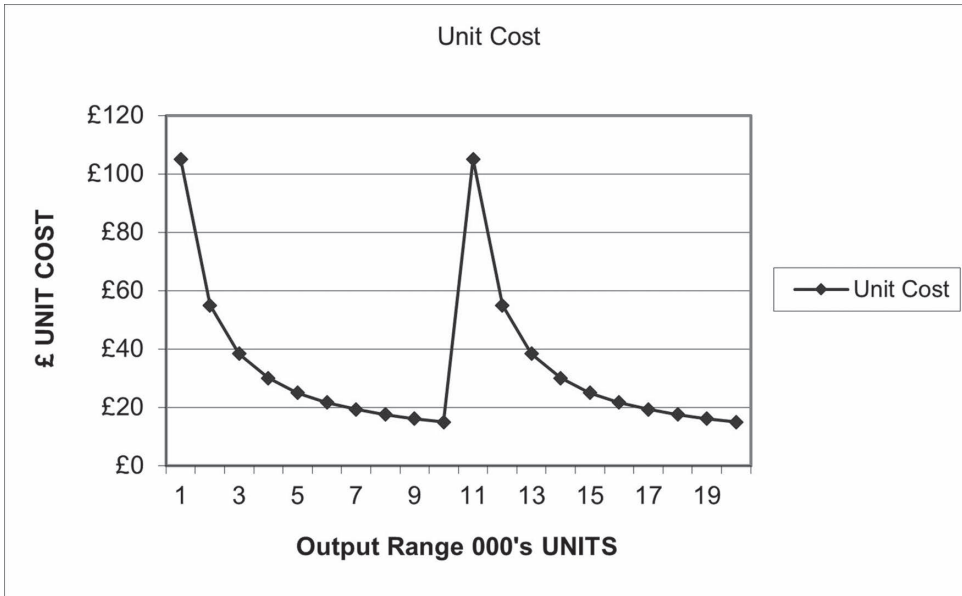


Figure 9.7 How unit costs change as volumes increase

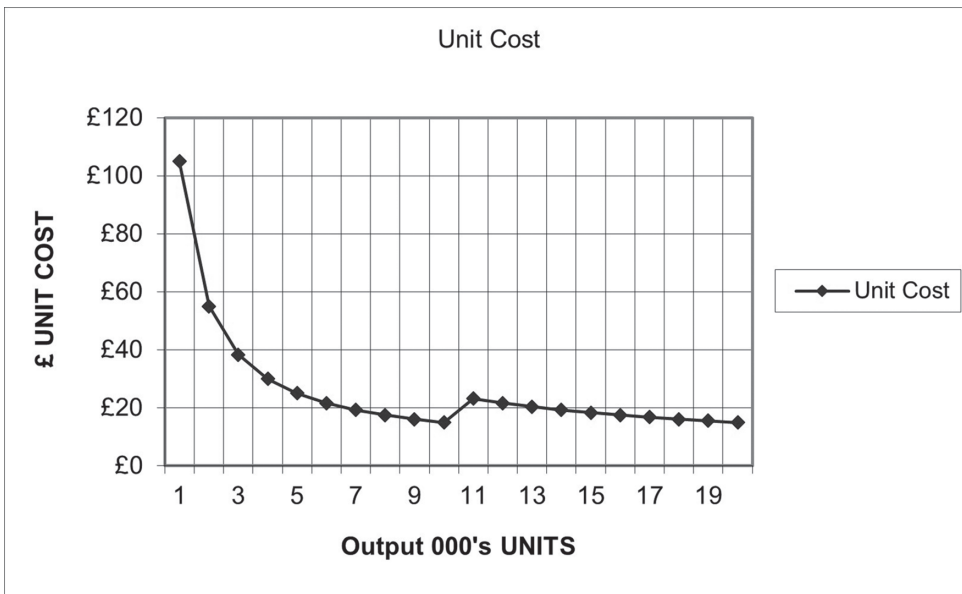


Figure 9.8 Another example of unit cost as quantities produced increase

Unit costs fall as volumes increase. You will note that the lowest unit cost of £15 is achieved at 10,000 units and again at 20,000 units.

Table 9.2 Data showing differences in unit costs as quantities increase

<i>Output quantity</i>	<i>Fixed cost</i>	<i>Variable cost</i>	<i>Total cost</i>	<i>Unit cost</i>	<i>Incremental unit cost</i>
1000	£100,000	£5,000	£105,000	£105	£105
2000	£100,000	£10,000	£110,000	£55	£55
3000	£100,000	£15,000	£115,000	£38	£38
4000	£100,000	£20,000	£120,000	£30	£30
5000	£100,000	£25,000	£125,000	£25	£25
6000	£100,000	£30,000	£130,000	£22	£22
7000	£100,000	£35,000	£135,000	£19	£19
8000	£100,000	£40,000	£140,000	£18	£18
9000	£100,000	£45,000	£145,000	£16	£16
10000	£100,000	£50,000	£150,000	£15	£15
11000	£200,000	£55,000	£255,000	£23	£105
12000	£200,000	£60,000	£260,000	£22	£55
13000	£200,000	£65,000	£265,000	£20	£38
14000	£200,000	£70,000	£270,000	£19	£30
15000	£200,000	£75,000	£275,000	£18	£25
16000	£200,000	£80,000	£280,000	£18	£22
17000	£200,000	£85,000	£285,000	£17	£19
18000	£200,000	£90,000	£290,000	£16	£18
19000	£200,000	£95,000	£295,000	£16	£16
20000	£200,000	£100,000	£300,000	£15	£15

*Forecasts and budgets and the internal supply chain*

Some definitions might help you think critically about the important distinction between a forecast and a budget. A forecast is a prediction about future events based on some past and current data. It is essentially an experiential approach. Just consider for a moment a weather forecast reported on TV. The forecaster demonstrates what the likely outcome for the next day or next few days is likely to be based upon recent past data. For example, cloud patterns, wind directions and comparisons with previous seasonal data allow the forecaster to make a prediction about the short-term future. In business too past data about business performance matched to current business and wider environmental conditions allow a forecast to be made. These forecasts are better than guesswork and are based on previous data. The downside is that sometimes businesses past experience may not provide a good indication of the future. Only if the business conditions are continuous rather than discontinuous is the past data going to be useful. Supposing the business has entered new markets, developed new supply chains and distribution channels and developed many new products? In these circumstances it is unlikely that past data will provide a good indication of future events.

David Hume (1711—1776) one of Britain's greatest philosophers, an economist and an empiricist noted this notion of discontinuity when tackling *the problem of induction* as a means of generating knowledge. This is often put forward in the argument that proposes that we cannot be certain something does not exist just because we do not sense it through experience. For many years it was assumed by Europeans that all swans were white until black swans were discovered in Australia in 1697 on the Swan River. Causal expectation is built on inductive reasoning and we therefore expect the future to build on past experience which is not always so and dissolves our certainty. Thus, there is no certainty that past data can be extrapolated to predict the future.

*Definition of a budget*

A budget is a plan in financial and/or quantitative terms. It may show volumes as well as values. It is normally for a specific period of time, for example, most organizations will prepare an annual budget which will normally be split up into smaller control periods – say one month. Budgets are prepared for the various activities undertaken by the firm or they may be for products, locations (sites or strategic business units) and functions (e.g., production, sales, marketing, administration, etc.).

Note a budget is not a forecast. Forecasts are used as inputs to a budget, which is a plan. For example, sales forecasts establish the likely revenue streams; cost forecasts provide input data with regard to labour, material and overhead costs. Within the supply chain budgets are very important and set performance measures with regard to efficiency (input/output measures) and effectiveness (e.g., comparisons with previous time periods, comparisons with competitors). Establishing budgets and budgetary control are essential supply chain management tools. Benchmarking and performance measurement are discussed more fully elsewhere.

Budgets are needed to establish:

- *Plans*

To help formulate plans for different activities and co-ordinating plans to prepare a budget for the whole organization.

- *Control*

To produce reports that compare performance of actual outcomes against the planned performance. These reports are sometimes presented as variance reports.

- *Organisation*

To ensure that the accounting reporting and information system is closely aligned to the organizational structure and organizational goals.

- *Communication*

To ensure plans are communicated and that appropriate feedback mechanisms are in place in the system.

- *Motivation*

To motivate employees to meet performance objectives through the budgeting process.

The budgeting process inside an organization is mapped in Figure 9.9.

***Budgetary control***

To be effective in achieving any plan their needs to be control. Budgets are controlled by breaking the plan into smaller control periods and measuring variances between the actual results and

### The Budgeting Process

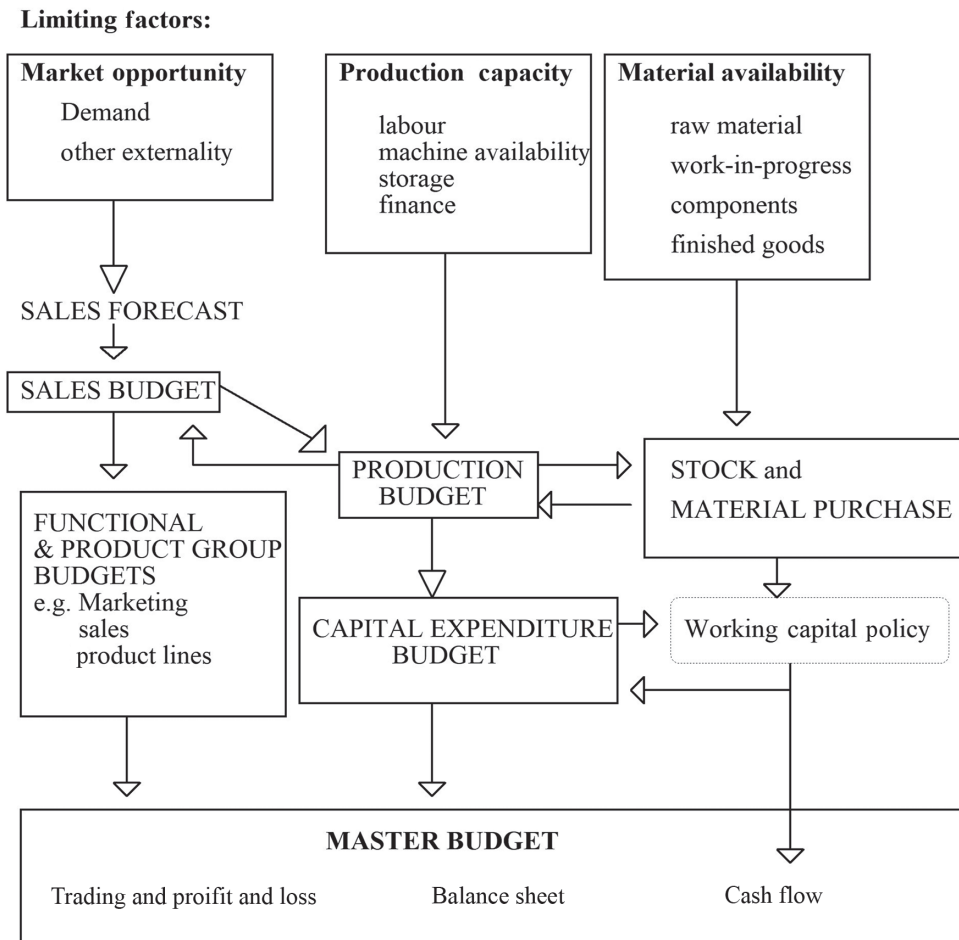


Figure 9.9 The budgeting process inside an organization

the plan (budget). Action will need to be taken as appropriate either to adjust the budget or to adjust the actual activities to keep to the plan. Variances may occur for these reasons:

#### Internal factors

1. The organization may change in terms of structure and therefore the planned expenditures are not appropriate within the budget headings originally assigned. For example, if previously when a budget was set and agreed, sales and marketing was a single departmental function, but during the budget period it was re-organized into two separate departments, one for sales and one for marketing, then the budgets would need to be adjusted in some way to reflect the change.
2. Productive capacity may change owing to the purchase of new plant and machinery or methods of working.



3. Sales and marketing policy may become more effective thus penetrating new markets or by increasing market share. Opening up new markets may mean that a revised sales budget is needed.
4. Other personnel may become more or less effective in their roles and this may be identified through efficiency variances actual against budget.
5. Constraints originally imposed when the budget was set may have been removed, for example, shortage of capital for expansion.
6. The firm may develop new products and services that require a switch in the way resources were originally allocated. Alternatively, existing products or services may be deleted.

#### ***External factors***

1. Market conditions may change causing a shift in demand.
2. Government policies with regard to the industry or the particular type of business may also change, for example, increased or reduced taxation, legislation and general attitude.
3. WTO or trading bloc policies have the same impact as government policies (e.g., ASEAN, EU, NAFTA, CARICOM, EFTA, CEFTA, PIF, UNASUR, AU, EAEC and SAARC).
4. Inflation may increase costs and revenues. In monetary terms variances may occur but in volume terms the budget may be achieved.
5. Exchange rate fluctuations affecting imports and exports.
6. Changes in the demand and supply for labour and other resources which give rise to price changes and wage rates.

These lists are not exhaustive but rather they give some measure of the considerations to be made when budgets are formulated, and furthermore show why longer periods than one year are difficult to plan for. Nevertheless, most businesses of medium or large size will tend to plan strategically for periods of three to five years. This is often referred to as the corporate or strategic plan. The annual budget will be only one component in that plan.

#### ***Activity based cost and management systems***

Cost systems are designed to perform three primary functions according to Kaplan and Cooper (1998, p. 2):

1. Valuation of inventories and the measurement of cost of sales.
2. Estimation of the costs of activities, products, services and customers.
3. To provide managers with feedback on their performance and operatives about process efficiency.

ABC systems emerged during the 1980s as a response for more accurate information about the cost of resource demands with an emphasis upon products, services, customers and channels. ABC systems support decision making by presenting a clearer picture of costs. Indirect or support costs are driven first to activities and processes, and secondly to products, services, customers and channels.

The clearer picture obtained from ABC led to the development of activity based management (ABM). Figure 9.10 divides ABM into operational and strategic issues, which an organization manages. Operational ABM is about doing things right focusing upon efficiency, cost reduction and asset utilization. Resources are released by changing business processes, by eliminating

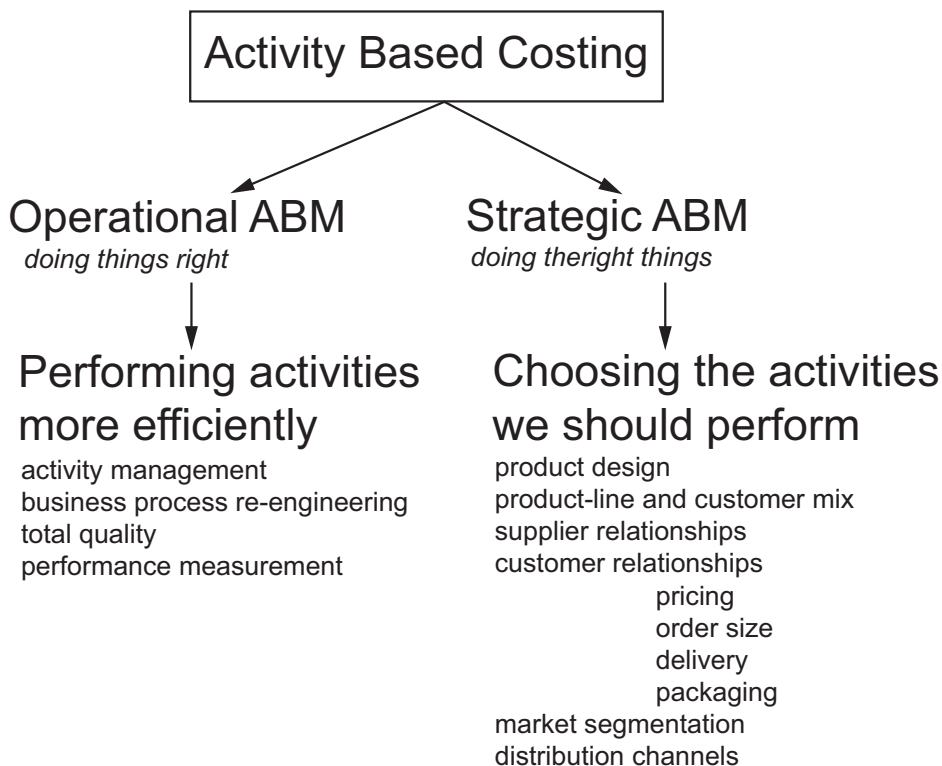


Figure 9.10 How activity based costing turns into activity based management

activities that do not yield value in excess of their cost or by increasing the efficient use of assets. Cost reduction programmes may provide better use of existing resources and therefore obviate the need for further capital investment.

Strategic ABM focuses upon doing the right things and in so doing attempts to lower the demand for resources. For example, by designing products or services better it may be possible to lower resource requirements. It is estimated that 80 per cent or more of manufacturing costs are determined during product design and development (Blanchard, 1978; Michaels & Wood, 1989). Unprofitable activities can be identified and eliminated. Effective suppliers and profitable customers can be developed and the ineffective and unprofitable ones can be removed. Information can be used by marketing managers to explore ways of increasing incremental revenues and reducing incremental costs by identifying highly profitable products, services, customers or channels. Similarly, low-cost rather than low-price suppliers may be expanded.

Table 9.3 demonstrates the shift in focus away from expense categories towards activity analysis. In the example, four expense categories are re-analyzed to yield an activity based costing.

#### *Accounting for customers rather than products*

Traditionally, accounting methods have identified and analyzed product costs. However, what may be more relevant particularly when considering customer service is a way of measuring customer profitability or customer account profitability (CAP). Activity based costing (ABC)

Table 9.3 From traditional to activity based costing

<i>Traditional costing by function</i>					
Salaries	£250,000.00				
Occupancy	£100,000.00				
Technology	£150,000.00				
Materials	£50,000.00				
Total	£550,000.00				
<i>Activity Based Cost Analysis</i>					
<i>Activity</i>	<i>Salaries</i>	<i>Occupancy</i>	<i>Technology</i>	<i>Materials</i>	<i>Total</i>
Process customer orders	£50,000.00	£12,000.00	£30,000.00	£500.00	£92,500.00
Purchase materials	£37,500.00	£15,000.00	£22,500.00	£600.00	£75,600.00
Schedule production	£45,000.00	£22,000.00	£27,000.00	£250.00	£94,250.00
Move materials	£17,500.00	£5,000.00	£10,500.00	£8,500.00	£41,500.00
Set up machines	£25,000.00	£4,000.00	£15,000.00	£2,500.00	£46,500.00
Introduce new products	£50,000.00	£41,000.00	£30,000.00	£35,000.00	£156,000.00
Resolve quality problems	£25,000.00	£1,000.00	£15,000.00	£2,650.00	£43,650.00
	£250,000.00	£100,000.00	£150,000.00	£50,000.00	£550,000.00

is a way of viewing costs differently. It has often been difficult for operational managers to obtain the types of financial data that they require to manage more effectively. For example, there has been a general ignorance of the true cost of servicing different customers, different segments and different channels of distribution. This is because costs have focused upon the product and not the market. In other words, inputs to the product rather than outputs to the customers. Conventional accounting systems are functionally oriented rather than output focused. They have been designed not as a management tool but as a reporting tool of what happened in the past. Even when accounting systems or parts of the system have tried to look forward, they have not focused upon market issues but rather the product has been central to the analysis. This is not to say that it is unimportant to identify product costs but rather to recognize that this is only one perspective for cost management. Furthermore, full costing (absorption costing) is based upon a number of key assumptions relating to the ways in which overheads might be recovered.

Essentially, ABC is concerned with the identification of activities that cause cost. Such activities might be the order cycle times required by customers, the availability of stock, frequency of delivery, technical support, order status information and visits to customers by sales personnel. There will of course be many other types of activity. Activity based management involves four key steps:

1. Activity analysis
2. Cost reduction
3. Product/service “offer” profitability
4. Development of an integrated activity based costing system

**Direct product profitability (DPP)**

This is a concept that has been extensively used in retailing environments. The logic behind the concept is that in many transactions the customer incurs costs other than the agreed purchase price of the goods from a supplier. These hidden costs can be substantial and can in some cases eliminate profit on a particular product line. Table 9.4 shows how DPP is applied.

Table 9.4 Example of direct product profitability

DPP		£
Sales		100
Less Cost of Goods Sold		25
Gross profit margin		75
Add allowances and discounts		10
Adjusted gross margin		85
Less warehousing costs		
Labour costs	6	
Occupancy cost	5	
Inventory cost	4	15
		70
Less transportation costs		5
Less retail costs		
Stocking labour	3	
Occupancy cost	2	
Inventory cost	4	9
		9
Direct product profitability		56

**Exhibit 1**

From this exhibit you can see that the selling price for a particular item is fixed at £100 and that the invoiced cost of the item from a supplier is £25. The gross margin before any adjustment is 75 per cent. Suppliers may give the retailer a discount for early settlement or an allowance as part of a promotion from the supplier or an allowance in respect of the quantities the retailer is prepared to take or for some other reasons. These allowances or discounts have an effect upon the gross margin the retailer is able to achieve. So, in this case we have an adjusted gross margin as a result of the allowances given by the supplier. However, the retailer incurs other costs in relation to warehousing, transportation and the very business of retailing itself. These additional costs have been grouped together and are then deducted from the adjusted gross margin to provide the retailer with direct product profitability (DPP). This information will then be used to compare similar products across a particular range. The buyers, buying teams or decision making units (DMUs) will take decisions regarding which products to stock. These decisions are not purely financial decisions they are in reality marketing decisions. Marketing managers must be involved in this process. It would be foolish to base the decision regarding which products to stock simply on the basis of this financial information. Nevertheless, it is important to be informed about which products achieve higher profits after all the costs of ownership are taken into account.

**Question**

You are told that a particular item retails for £25 and that the supplier’s invoiced price to you is £5. The supplier has agreed further discounts amounting to 20 per cent off their price if you agree to take a minimum quantity. Warehousing costs based upon average inventories that you expect to hold, the space the items will occupy in the warehouse and labour handling costs are estimated to add a further £4 per item. Additional transport costs moving goods from the regional distribution centre (RDC) to the stores are expected to

add a further £2 cost per item and retail costs will add a further £3 per item. You are asked to compute the direct product profitability for this item assuming you will take the minimum order quantity and hence the additional discount.

**Answer**

<i>DPP</i>	£
<i>Sales</i>	25
Less cost of goods sold	<u>5</u>
<i>Gross profit margin</i>	20
Add allowances and Discounts	<u>1</u>
<i>Adjusted gross margin</i>	21
Less warehousing costs	4
Less transportation costs	2
Less retail costs	3
<i>Direct product profitability</i>	<u>12</u>

**Total cost of ownership (TCO)**

The purchase price of any item is simply one component of cost of material, product or service. The total cost of ownership (TCO) is important to understand because it represents not simply purchase cost but other costs that comprise the TCO. Ownership and post-ownership costs are often ignored in the analysis of cost. For example, a retailer purchasing stock for resale (SKU) may simply decide to make the decision to buy on the basis of cost price and target margin. The target margin or the “intake margin” as it is often referred to, assumes paramount importance but it may be ignoring a raft of other costs that make up the TCO. Manufacturers purchasing materials as inputs to a manufacturing process also are able easily to identify the purchase cost but additional ownership costs may be ignored. In service environments the position is similar organizations may purchase insurance or other services and overlook additional costs and benefits when making decision choice.

TCO is an important concept. Ownership costs essentially fall into three categories: acquisition costs, ownership and post ownership costs. The focus for many purchasing decisions is simply that of the first category acquisition cost. The overemphasis on this category is likely to lead to flawed decision-making. Ellram (1996) reported that the generally accepted purchase cost figure for a capital purchase represents only 30—50 per cent of the total cost of ownership. A TCO analysis is time consuming to perform and generally not worthwhile for low-value or low-impact items. It is an approach that can bring benefits for larger value or high-impact items. Systems and procedures need to be set-up to capture the cost data easily. It is a useful continuous improvement tool and a useful means of strategic cost analysis. TCO is a philosophy to understand supply chain costs. Automobile manufacturers have, for example, identified new ways to reduce TCO for customers by improving their own manufacturing processes (re-design, re-engineering) and have been able to pass these benefits on to car owners in the form of fewer breakdowns, improved warranties, longer service intervals and improved fuel consumption.

TCO applies a number of different concepts to the analytical process from eclectic disciplines. For example: net present value (finance), product pricing and costing (accounting), reliability and quality measures (operations management), customer measures (marketing), systems

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integration (IT), material movement (logistics) and minimum average total unit cost of production (economics).

Lowering the cost of goods sold and associated overhead costs (procurement, inventory holding costs and selling) improve the “bottom line” profitability. Firms will spend much time searching for ways to lower these costs especially when markets are difficult and it is not easy to increase prices or volumes to improve overall profit. As a consequence, some large retailing organizations have empowered major suppliers to manage their inventories for them adopting a system known as vendor managed inventory (VMI). VMI allows the supplier to manage the inventories by managing store space allocated by a retailer in return for guaranteed minimum returns and filling it with their merchandise without reference to the retailer. This allows the vendor to replenish stocks quickly to capture sales, avoiding stock-outs and allows the suppliers to manage their capacity planning and manufacturing processes more effectively since they get a forward window on what is and is not moving through store. The advantage to the retailer is that they do not have the headache of managing the inventory nor do they incur procurement and inventory holding costs in advance since the supplier only gets paid when the stock is sold through the store.

TCO analysis will inevitably involve managing a number of trade-off situations to achieve a minimum cost. Those employees working in key areas of the supply chain should identify TCO analysis and the detail may differ between different organizations. The analysis may include:

- Product design (value engineering and value analysis techniques).
- Manufacturing infrastructure costs (machines, equipment, storage and transport facilities).
- Make or buy (outsource or self-manufacture).
- Responsiveness of first, second and third level tiers of suppliers within the supply chain.
- Any taxes, duties, quotas.
- Transport costs and times.
- Legal and regulatory costs.
- Foreign exchange and risk.
- Inventory risk relocation, damage, obsolescence, shrinkage.
- Political and economic stability.
- Quality costs.
- Communication costs (includes language requirements in overseas environments).

Most of these items can be quantified in cost terms but some will inevitably require qualitative judgements to be made.

***The three component costs of TCO***

1. Acquisition costs.
2. Ownership costs.
3. Post-ownership costs.

*Acquisition costs*

There are a number of dimensions to this cost which are:

***Purchase price paid*** – This is the invoiced price paid for materials, a product or service. The invoiced cost may include a charge for freight, delivery, site preparation (in the case of

capital purchases, training, installation and testing. What is included in the invoiced price will be dependent on the purchase contract and the prior negotiations that agreed the price to be paid. Effective negotiation by purchasing professionals may well reduce the price by agreeing quantity discount, prompt payment discounts or through specifying standard parts or by aligning standard specifications across products such that components are standardized. The key to successful negotiation is not to compromise longer-term ownership costs for a short-term gain.

**Planning costs** – These are costs incurred in planning an acquisition including development of requirements and specifications, price comparisons, cost analysis, supplier selection and sourcing, contract determination, order processing and monitoring. An increase of spending in these areas may well achieve future benefits by lowering TCO. For example, reconfiguring designs to use standard parts across different product ranges may lower purchasing costs, inventory carrying costs and future maintenance and repair costs for the customer.

Adopting e-procurement, B2B e-commerce or electronic supply networks may further lower acquisition costs. Research time, paperwork, ordering and processing specification approvals, deliveries and payments can all be speeded up.

**Quality costs** – Often higher initial engineering costs to improve quality at a design stage impact upon future ownership and post-ownership costs. In addition, quality costs can be lowered by having established long-term (strategic) relationships with suppliers. Process costs, communication costs, innovation and development costs can all be lowered through effective relationship management.

**Taxes** – Often represent a hidden cost that provides the purchaser with a sting in the tail. Hours are spent focusing upon the unit price of a purchase and then negotiating a satisfactory price. However, this may all be in vain if the purchaser fails to recognize taxes that have to be incurred. Direct taxes (e.g., duties and processing fees) and indirect taxes (e.g., fuel taxes, tolls, facility fees, etc.) must be identified. Janis (2000) recognized the following examples:

- *Customs duties and tariffs* – Plan to minimize their effect, ensure compliance and avoid penalties.
- *Virtual warehousing* – Within the EU information about goods flows through centralized virtual customs clearing houses while the physical goods move unhindered from source to destination.
- *Regional trade agreements and Free Trade Zones* – Goods sourced and produced in these areas have the benefit of lowering or removing all duties and tariffs.
- *Income-base shifting* – Apply transfer prices to legally avoid tax by shifting the incidence from high- to low-tax areas.

**Financing costs** – Any cost incurred to finance the particular purchase of material, inventory, facility, acquisition, capital purchase. Mortgages, loans, bonds, lines of credit, capital lease, sale-leaseback, securitization of receivables, equity financing and the associated opportunity cost<sup>1</sup> including straightforward cash purchases.

#### *Ownership costs*

These are costs incurred after the initial purchase, for example, energy use, downtime, maintenance, repairs and financing. In addition, there are costs that arise from ease of use (does it save time?), unplanned additional training, and ergonomics (to reduce fatigue or increase productivity).



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There are also costs related to:

- Risk.
- Cycle time.
- Conversion.
- Non-value added.
- Supply networks.

### ***Risk costs***

These are “trade-off” costs involving management judgements about issues such as maintaining excess inventory to satisfy possible customer demand and avoid a stock-out. Just-in-case (JiC) inventory can be very expensive. It is a form of waste and is treated as such in the literature relating to just-in-time (JiT) systems. The costs associated with JiC should be eliminated or at very least minimized. Excess inventory costs include reduced cash flows, lost interest on cash tied up in inventory, additional storage and associated costs, additional financing cost when borrowed funds are used to make purchases and finally, the risks associated with obsolescence, redundancy and shrinkage.

Dependability is an important issue when dealing with a new source of supply and a reason why firms adopt dual or multiple sourcing. Dependability is also referred to as reliability in the literature. This is critical to organizations that operate just-in-time (JiT) systems with fewer and fewer suppliers.

### ***Cycle time costs***

Faster cycle times and/or increasing throughput reduce the time cost elements. This improves profitability and return on investment (ROI) by lowering total cost. Strategies for reducing cycle time cost include:

- Implementation of JiT inventory flows.
- Forming strategic alliances with key suppliers to reduce cycle times.
- Co-operation or collaboration in the new product development cycle.
- Cross functional alliances within the organization to speed up cycle times.

### ***Conversion costs***

Purchasing inappropriate material, inadequately trained labour, excess inventory, poor design of materials, products and processes can all add to the cost of conversion unnecessarily. As mentioned earlier spending less on planning may result in higher operating costs when manufacturing. Production methods (e.g., assembly lines vs. cellular manufacture, labour intensive V automated production) may also alter the nature of cost of conversion. The assignment of overheads to the unit of product or service and the particular accounting methods employed can also influence these costs adversely.

### ***Non-value added cost***

Non-value added cost has been estimated at as much as 40 per cent of all costs. These costs include:

- Unnecessary materials movement.
- Double handling materials.
- Poor facility layout.

- Poor scheduling.
- Duplication of processes.
- Inefficient processes.
- Random routing of materials and production flows rather than systematically routing to reduce times and distances travelled.

The Japanese Kaizen approaches require the identification of unevenness in production or process flows (mura), difficulty in conducting operations (muri) and waste (muda). The objective being to remove obstacles or blockages that cause the unevenness, improve process design for smoother operations and eliminate waste. In other words, Kaizen is a means of striving to achieve continuous improvement (CI) with the aim of lowering or eliminating non-value added costs. Tools that assist managers with these processes are:

- Total quality management (TQM).
- Activity based costing (ABC).
- Activity based management (ABM).

An alternative to the CI approaches identified above is business process re-engineering (BPR) which is essentially a form of innovation or breakthrough as it is sometimes called. BPR is revolutionary change whereas CI is evolutionary change.

Process mapping tools are used to identify non-value added (NVA) times in business processes. Processes are then re-designed to eliminate NVA. When applied to supply chain solutions BPR may have an impact upon all organizations examined within a single supply chain.

### ***Supply network costs***

The extended enterprise is effectively how some commentators refer to the single supply chain explained above. Thus, efficiencies and cost reductions can be implemented across organizational boundaries in a single supply chain or supply network.<sup>2</sup> Organizations that outsource non-essential or non-core activities may eliminate many non-value added costs and improve efficiency by focusing on what they do best. Figure 9.11 Kaizen-continuous improvement: a concept of continuous improvement to remove waste (muda), difficulties (muri) and unevenness (mura) by configuring people, materials, machines and methods differently to add value for customers. Continuous improvement may require trade-offs between resources (people, materials, machines and methods) to achieve these aims.

Supply network costs can be lowered in a number of important ways which include:

- Improving forecasting of customer demand, sharing information with supply chain partners to improve scheduling and inventory management.
- Implementing electronic data interchange (EDI) between supply chain partners facilitating more effective communication and removing errors through single source data entry, reducing purchasing time and paperwork.
- Improving transportation possibly through outsourcing to reduce cycle times.
- Improving inventory management by implementing JiT philosophy.
- Improving business processes that are reliable, responsive, improve quality and are efficient.
- Better capital and revenue budgeting.
- Improving levels of customer service by being responsive and efficient. Listen and remove any blockages.

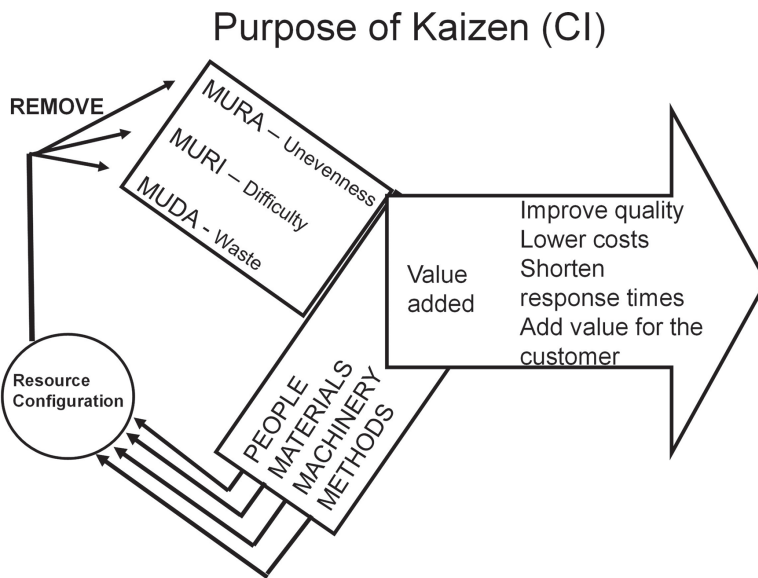


Figure 9.11 Kaizen – continuous improvement

- Improve supplier selection finding appropriate sources of supply that lower TCO.
- Establish better supply chain relationships (transactional, co-operative, collaborative, co-competitive or strategic partnership and/or alliances). Need to focus on lowering cost and achieving other objectives such as quality, reliability, dependability and responsiveness
- Establish global sourcing strategies to lower cost, improve quality and take advantage of low-cost EDI and low-cost transport.

*Post-ownership costs*

Historically, post-ownership cost has been easier to identify in capital purchases. This is because salvage value or disposal costs could be more clearly identified and established markets were available in which price was determined. Today there is less certainty and more risk involved and the world is a more litigious place with armies of “ambulance chasing lawyers” waiting for the opportunity to scavenge a deal by winning cases for customers based upon environmental disasters, product liability, failed warranties or simply customer dissatisfaction.

Finally, it is possible to provide an equation for determining the total cost of ownership (TCO) as follows:

$$TCO = A + PV \sum_{i=1}^n (T_i + O_i + M_i - R_n)$$

Where:

TCO = Total Cost of Ownership

A = Acquisition cost

PV = Present Value

T<sub>i</sub> = Training costs in year *i*

O<sub>i</sub> = Operating costs in year *i*

$M_i$  = Maintenance cost in year  $i$   
 $R_n$  = Residual value in year  $i$

This formula can be adapted for different TCO requirements. The formula is very similar to that required for investment appraisal decisions in capital budgeting and adopts the same discounted cash-flow principles.

Finally, it is worth noting that TCO is a philosophy and an analytical tool that organizations may use to support management decisions in the supply chain.

### Supply chain financials

It is worth taking a little time to explain the financial variables that can be affected by supply chain decisions. We begin examining the profit and loss (P&L) statement and the balance sheet (BS). A P and L comprises revenue, costs and expenses incurred to arrive at a profit or loss that is added or deducted to or from capital in the BS. The figures are cumulative representations of decisions taken during the financial period being reported. Let us now look at an example of how supply chain variables affect the profit and loss statement (Table 9.5) and the balance sheet (Table 9.6).

Table 9.5 Financial variables that can be affected by supply chain decisions

SC variable	Profit and loss statement		SC variable
	\$ Dr	\$ Cr	
		Revenue	Demand volatility
		X	Order response time
			Fulfilment speed
			Repeat orders
			Returns handling
Direct costs of:	Cost of Goods		Sourcing
Sourcing	Sold		Purchasing materials
Purchasing	X		Holding costs of inventories
Manufacturing or service process cost			(storage, movement, handling and distribution), costs directly related to get goods to a saleable condition
Inventory holding (policies and practices affect this cost)			
Returns			
Wastage			
Efficiencies vis-à-vis Inefficiencies in all aspects of product or service delivery			
Gross margin (revenue less COGS)	Gross profit or (loss)	X	
All other expenses (overheads) examples are	Expenses		Indirect costs – overheads – shared costs not directly traceable to each item sold; nevertheless, costs that are incurred doing business
warehousing and distribution	X		
lighting and heating	X		
administration	X		
buying trips	X		
marketing and sales	X		
Total cost		(X)	
Profit is added to capital on the balance sheet and losses reduce capital	Net profit or (loss) to c/f to BS	X	

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Table 9.6 Considers how the balance sheet may be affected by these supply chain decisions

<i>Balance sheet category</i>	<i>Supply chain activity</i>	<i>+/- Impact on value</i>
Fixed assets	Investment in plant and machinery, handling equipment, storage facilities and transport vehicles	+ Increase value
Current assets	Increase inventories	+ Increase value but also – increase in risk of holding inventories: obsolescence, redundant stock, deterioration whilst in possession, scrap, write-off when values fall below cost price
	Increase debtors when throughput increases and sales are achieved	+ Increase in bills receivable as a result of increased production and sales
	Cash movements	+ As bills receivable are paid cash flow will increase. – As creditors are paid for material purchases or for investments in fixed assets cash will fall and reduce value
Current liabilities	Creditors (bills payable)	Reduces value as you purchase materials on credit.
Working capital	Current assets – current liabilities	Working capital needs to increase as production quantities rise to meet growing demand (sales); working capital may reduce if you incur bad debts (customers do not pay or become insolvent).

The 7Vs all impact profitability and can do so in either direction having either a positive or negative impact. That is to say they can increase or reduce revenue or cost/expenses. Table 9.7 illustrates possibilities.

Organizations can take a number of supply chain actions to improve working capital which include:

- Negotiating price discounts or concessions.
- Extending payment terms with suppliers.
- Giving customers discounts for prompt payment.
- Having better information on key data in respect of working capital.
- Implement inventory management systems to improve the stock to cash cycle within the organization and across the total supply chain.
- Share information better between supply chain partners to reduce cycle times.

Figure 9.12 shows the key supply chain financial measures and how they affect profit (P&L) and balance sheet values. It also illustrates how they link to return on investment (ROI). The ROI is an important measure to justify investment decisions.

**Performance measurement an introduction**

*Supply chain metrics*

Supply chain metrics are used to establish comparisons between time periods, activities in the same organization or across competing organizations. They will usually involve measures of

Table 9.7 Hines 7V framework potential impact on supply chains

<i>7Vs</i>	<i>Negative impact</i>	<i>Positive impact</i>
Volume volatility	Lower than planned demand reduces forecast revenue	Higher than planned demand increases forecast revenue
Velocity	Speed (quick response or efficient consumer response) could increase costs; for example, air freight rather than sea freight to meet customer demand	Speed of response may result in higher turnover through repeat orders because of the increased sales times
Visibility/virtuality	Cost of improving systems transparency, for example, tracking costs	Improved visibility is likely to result in fewer stock losses, faster and more accurate delivery (achieving on time/complete orders); virtuality may offer digital systems delivery of products and services, for example, music downloads, magazines, books, reports, software
Variety	More variety may increase costs of purchasing, production, distribution and warehousing	Less variety and more standardization may reduce these costs of purchasing, production, distribution and warehousing
Variability	Lose customers by not delivering consistent service (products); incur higher costs to remedy mistakes/quality issues	Reducing variability likely to improve revenues and reduce costs; TQM
Volatility of wider system	Environmental factors cause increased costs. (PESTEEL); drive demand for your product or service downward; “gas guzzling cars”	Environmental factors may reduce costs or drive demand for your product or service upwards; “hybrid energy efficient; low-carbon emission cars”
Value	Competitor actions may reduce value; value reduced for supply chain partners and customers as a consequence of changes in other Vs also	Co-operative and co-opetition strategies may increase value for SC partners including customers

efficiency such as on time deliveries, complete orders, throughput times, lead times (production, time to market) and a range of financial measures such as asset utilization, capacity, inventories and inventory turnovers, profitability and return on investment.

Measuring performance is critical to the success of organizational strategy. Once an organization has set its course it is important to know how far away it is from meeting its strategic objectives. In measuring strategic supply chain performance there are two critical focal points: the customer and the competition. It is important for the organization to know how it is performing against its competitors in the market place and how it is performing in the eyes of its customers.

For the purpose of illustration five key performance areas are chosen: cost, speed, quality, reliability and flexibility. Performance objective and some typical measures are listed in Table 9.8.

Performance measures may be measured in terms of historical standards, target standards, competitor standards or absolute standards. Historical standards compare current performance against a previous performance. It is useful to measure performance through time to judge how well an organization performs over time. A target standard is set by the organization based on

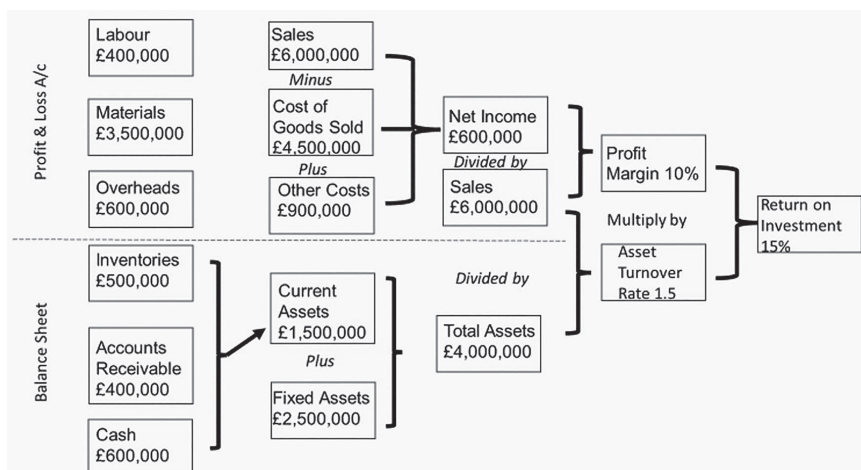


Figure 9.12 Supply chain profitability and return on investment (ROI)

Table 9.8 Five key performance areas

Performance objective	Measure
Cost	Delivery times (min, max, average)
	Budget variance
	Resource utilization
	Productivity
	Cost per hour
	Efficiency
Speed	Value added
	Enquiry to order lead time
	Throughput time
	Production lead time
	Cycle times
Quality	Actual V standard times
	Delivery lead times (min, max, average)
	Time to market (various cycles, e.g., new product, replenishment)
	Percentage of defects per unit
	Number of customer complaints
	Customer satisfaction scores
	Warranty claims
Reliability	Average time between failures
	Level of scrap
	Percentage of rework
	Percentage of orders on time
Flexibility	Percentage of orders complete
	Percentage of orders on time and complete
	Percentage of stock availability
	Average delivery time versus promised delivery time
	Time it takes to develop new products/services
	Set up/change over times
	Time to change capacity
	Time to change schedules
Average batch sizes	
Time it takes to increase activity rates	
Range of products/services offered	



judgement of what is deemed appropriate or reasonable. Competitor standards are those set by one or more of the organizations immediate competitors. For example, a common customer may declare that a competitor is able to deliver in two weeks. This may set the standard for your organization. Absolute standards are those that may be set at the theoretical limit, for example, zero defects or zero inventories.

A useful strategic improvement tool is the importance-performance matrix. This measures what customers’ value in terms of what wins business and how the organization shapes up against competition. The customer may consider some aspects essential to do business and these are order qualifiers. However, some factors may strongly influence buying decisions and these are order winners. Table 9.9 lists an example.

A similar table (Table 9.10) can be considered for organizational performance against competition.

The appropriate zone above the lower bound of acceptability is where an organization wants to be situated to satisfy customers and to be achieving appropriate performance in the competitive market place. The improvement zone below the lower boundary of acceptability indicates areas for improvement. The urgent action zone indicates that these are factors valued by customers and the organizations performance is worse than the competition. The excess area demonstrates that the organization is beating competitors in these areas but that the customer does not value them. The strategic question is whether or not resources should be applied in this area or would they be better used elsewhere where the customer places value.

Figure 9.13 shows the importance performance matrix to highlight customer order qualifiers and order winners. Figure 9.14 maps. Five competitive dimensions that the organization has identified are valued by customers: cost, flexibility, speed, responsiveness and dependability. For each of the dimensions a measure of how well the organization is able to compete

*Table 9.9* What the customers’ value

<i>What the customers value</i>			
Order winner	Strong	1	Critical advantage
	Medium	2	Important advantage
	Weak	3	Useful advantage
Order qualifier	Strong	4	High industry standard
	Medium	5	Average industry standard
	Weak	6	Approaching industry standard
Less important	Strong	7	Not usually important but may be in future
	Medium	8	Very rare that customers value this
	Weak	9	Never considered by the customer

*Table 9.10* Evaluating performance against competition

<i>Evaluating performance against competition</i>			
Better than competition	Strong	1	Much better
	Medium	2	Better
	Weak	3	Marginally better
Same as competition	Strong	4	Sometimes marginally better
	Medium	5	Nearly always the same
	Weak	6	Slightly lower than average
Worse than competition	Strong	7	Usually marginally worse
	Medium	8	Usually worse most times
	Weak	9	Always worse

Importance - performance matrix

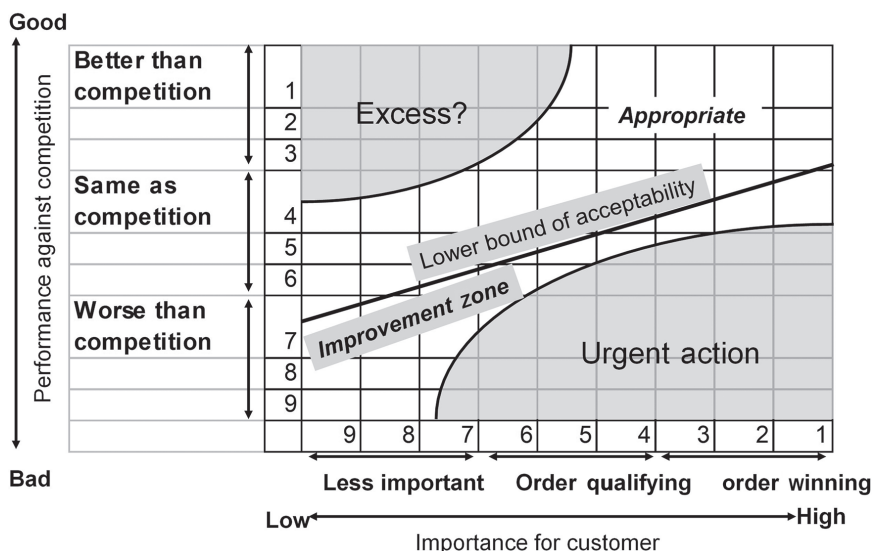


Figure 9.13 Importance – performance matrix

is required. In addition, a measure of how well competitors do along each dimension is also required. The best way to do this would be to ask your customers although this may not always be appropriate. It may not always be in the customer’s interest to reveal this information. Nevertheless, if accurate measures could be taken an organization would have a clearer picture about where it is able to compete more effectively and the strategies needed to do so. In the example, a Likert scale has been used to obtain the measures with five being the best performance measure. Competitors beat the organization on cost but lose on every other dimension. If customers are still buying competitor offerings it means they value cost above all other factors. In these circumstances you are probably supplying in what essentially is a commodity market and, more importantly perhaps, you should recognize that you are incurring costs unnecessarily in areas your customers do not value since they are not prepared to pay you any more for the services you offer in excess of your competition. Figure 9.14 maps how the organization is performing against competitors along the five dimensions to identify improvement areas.

*A material example (performance standards versus actual)*

One important financial measure in any supply chain is material cost and material usage. This is often analyzed using a budgeted standard cost figure and drawing comparisons between that figure and the actual price paid for materials. Usage variances can also arise in production processes for a variety of reasons. Let’s take a look at an example to illustrate how the budgeted standard cost and actual figures are compared.

**Material price variance**

$$\text{Price Variance} = (\text{Standard Price} - \text{Actual Price}) \times \text{Actual Quantity}$$

$$(\text{SP} - \text{AP}) \times \text{AQ}$$

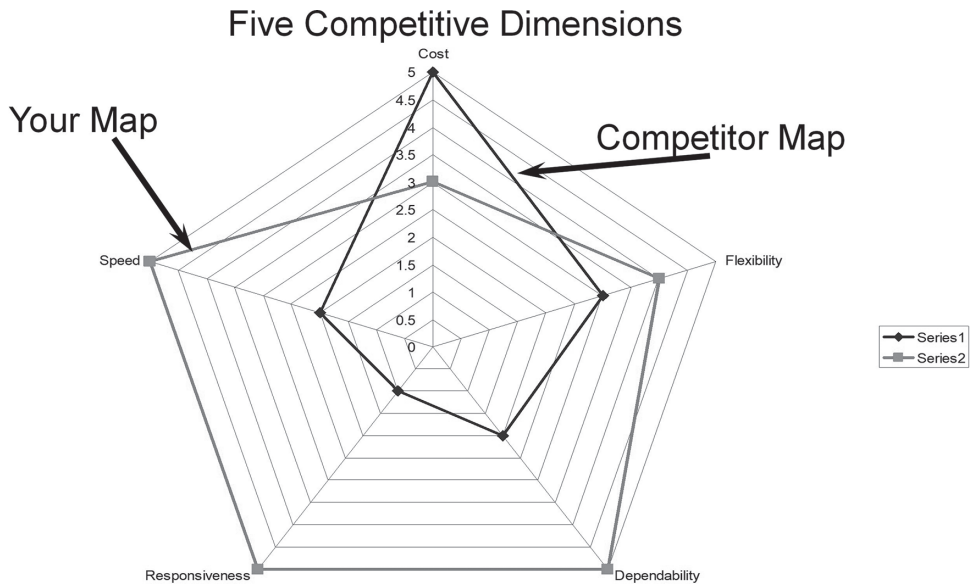


Figure 9.14 Five competitive dimensions

### Material usage variance

$$\text{Usage variance} = (\text{Standard Quantity} - \text{Actual Quantity}) \times \text{Standard Price}$$

$$(\text{SQ} - \text{AQ}) \times \text{SP}$$

The standard cost information for the production of one unit of product X is as follows:

Direct materials – five kilograms of material Y at £60 per kilogram.

During a certain cost period, 4,000 units of X were manufactured and the material used in production was 20,200 kilograms of Y at a total cost of £11,716. If we calculate the material cost variance and separate the results into a price and usage variance, we will get the following figures:

	£
STD direct materials (4000 x £3)	12,000
Actual cost	11,716
	Favourable variance 284

The question is, was it a price or material usage variance?

### Price variance

$$= (\text{SP} - \text{AP}) \times \text{AQ}$$

$$= (£0.60 - £0.58) \times 20,200$$

$$= £404 \text{ (favourable price variance)}$$

Price variance £404 (F)

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**Material usage variance**

$$(SQ - AQ) \times SP \\ (20,000 - 20,200) \times \text{£}0.60 = \text{£}120 \text{ (adverse material variance)}$$

Note the standard quantity was obtained from the original data where it stated that 5 kgs of material was required to make one unit of product therefore (4,000 units  $\times$  5kgs).

Taking the two constituent variances together we have a net favourable material cost volume of £284 (F).

**Reasons for material price variance**

1. Efficient or inefficient buying of materials.
2. A reduction in production may mean smaller amounts purchased, therefore a loss of quantity discount. The reverse may also be true, that is, an increase in the amounts of material bought leading to increasing discounts.
3. The need to acquire emergency supplies may lead to higher prices. For example, when a *just -in-time* system of stock replenishment fails.
4. Changing quality of the material purchased.
5. The loss of a source of supply which was inexpensive.
6. External factors, for example, if you buy from abroad, exchange rates. Other factors – inflation.

**Reasons for usage variance**

1. Inefficiency by an operator using the material (if not watching a machine and a fault occurs, e.g., in printing – operative may fail to turn off machine in time to minimize quantity of paper spoiled).
2. Spoilages – due to insufficient maintenance of machinery.
3. Substitution of poor-quality material resulting in lost production.
4. Change in the methods of production which makes the standard being used obsolete.
5. Inadequate storage, causing damage.
6. If the actual mix of materials in the product changes, then the usage variance would change also.

Having metrics that help identify and establish causes for variances from the plan are important especially when material costs form a high proportion of the total cost for the organization. From the analysis the organization is able to identify management actions to improve the situation.

**Benchmarking**

The term comes from surveying whereby a mark would be cut into rock as a reference point for land surveys. Xerox were the first company to use the term “Competitive Benchmarking” in 1976. Since that time benchmarking has been used to describe various aspects of measuring performance and the meaning has been extended considerably. It is no longer restricted to manufacturing but has been extended to include other areas such as marketing and purchasing. It has been used in service organizations such as banks and public sector organizations such as social services, health service, etc. It is no longer the domain of external consultants alone and may involve all staff working in the organization. Competitive benchmarking has been widened in meaning to include not just direct competitors but other organizations regarded as the best in their class.

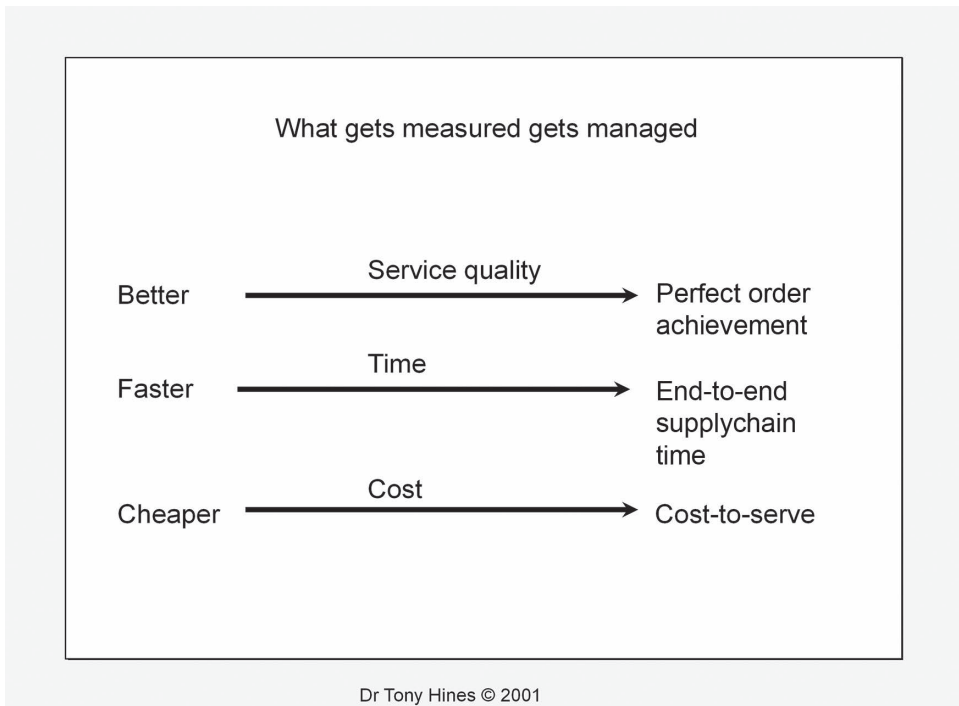


Figure 9.15 Better, faster, cheaper – what gets measured gets managed

Macneil et al. (1994), suggest that benchmarking “is a method for continuous improvement that involves the systematic evaluation and incorporation of external products, services and processes recognized as best practice.” A management method or tool used alongside other performance enhancement tools or philosophies such as total quality management TQM or competitive analysis. Continuous improvement is an integral part of benchmarking. It is a systematic search for “best practice.”

Benchmarking = Evaluation

Benchmarking supply chain activities usually focuses on operational improvements identified in Figure 9.15.

Supply chain competition is predicated on a notion of measuring performance to identify strengths and weaknesses against competition. Establishing appropriate measures is essential if you want to improve performance.

### Targets in public health service

Governance by targets and measured performance indicators is a form of indirect control necessary for the governance of any complex system (Beer, 1966). The form of control that target systems represent is a version of homeostatic control in which: (1) Desired results are specified in advance in measurable form; (2) some system of

monitoring measures performance against that specification, and (3) feedback mechanisms are linked to measured performance. Ironically perhaps, just as the targets system was collapsing in the USSR, the same basic approach came to be much advocated for public services in the West by those who believed in “results-driven government” from the 1980s.

Bevan and Hood (2006)

It is argued that targets can lead to a form of gaming by participants in the metrics game to ensure that they improve scores without necessarily improving practices. Managers become skilled in playing a game that give an outward appearance of improvement without necessarily tackling the issues and solving the problems that underlie such measures. For example, in health services waiting lists are manipulated so that only after a consultant sees a patient to accept them into a treatment programme does the waiting begin. All prior contact with the service is not included in the measure. The critical measures have rules to determine when measurement can begin and when it ends. If a patient has an operation and later suffers a relapse this may be counted as a new condition and not tied to the original service failure. Game playing is visible in all sorts of measurement.

Under the Soviet system of five-year plans targets were set and outcomes measured against the plan. If a steel plant was given target measures based on tonnage, then it encouraged production of very large items. If it was measured on units, it encouraged the production of very small items. Those people being measured manipulate or subvert the measures to improve performance. In highly politicised environments this may be highly problematic for those with intent to make things better (Nove, 1993).

*Supply chains need to ensure that appropriate measures are identified to achieve the strategic aims.*

Performing better, faster and cheaper than your competitors establishes supply chain excellence. Quality, time and cost are often the measures employed (Kaplan & Norton, 1996). We cannot assume, however, that what cannot be measured is not worth managing. Sometimes it is easy to measure those activities that we have collected data on and we assume that they are the only things we need to manage. But this is wrong headed. We need to ask a different question what we need to know that would give us a better understanding of what we need to do. We do not simply want to benchmark all the measures that are easy that others measure because they can. There is no virtue in that. We need to apply management wisdom and know what it is we ought to be measuring and set about gathering data to do so.

Simon Caulkin makes a very important point in relation to the “what gets measured gets managed” statement. He says that too often managers measure things that are easy to measure and ignore the difficult things to be measured that may be more important for managers to understand. He warns against the management tendency to reduce matters to numbers that may mislead. “Just because you can measure it does not mean you should.”

*Source: Caulkin (2008)*

**Different types of benchmarking**

The focus for benchmarking may be internal or external. Internal benchmarking is used to compare performance between different parts of the same organization, for example, different car plant efficiencies in the same automobile manufacturer. External benchmarking is used for comparing similar activities in different organizations. Competitive benchmarking is used to achieve a number of outcomes, which are summarized in Table 9.11.

Customer service benchmarks are particularly important in supply chain management. These benchmarks are designed to measure:

- Order cycle times.
- Delivery reliability.
- Frequency of delivery.
- Stock availability.
- Documentation quality.
- Order completeness.
- Technical support.

For example, if a supplier delivers on time 95 per cent of the time and the orders are complete 90 per cent of the time combining the two measures gives a benchmark for suppliers who are both on time and complete.

$$95\% \times 90\% = 85.5\%$$

The supply chain council ([www.supply-chain.org](http://www.supply-chain.org)) identifies six major processes that organizations undertake and they are categorized as: plan, source, make, deliver, return and enable. In essence, this is a useful categorization for in-house manufacturing. However, for many contemporary organizations the dynamics may be somewhat different. For example, they may design, plan, source, collaborate, outsource and deliver. The focus of the SCOR model shown is very much operational and ignores the strategic options available to the organization. Operational benchmarking is conducted against each of the SCOR activity areas. Strategic areas in addition to those already used by SCOR are shown in Table 9.12 and explained.

*Table 9.11* Reasons for competitive benchmarking and process steps

---

Planning	<ul style="list-style-type: none"><li>• Identify benchmark outputs</li><li>• Identify best competitor</li></ul>
Analysis	<ul style="list-style-type: none"><li>• Determine data collection method</li><li>• Determine competitive gap</li><li>• Project future performance level</li><li>• Establish future goals</li></ul>
Integration	<ul style="list-style-type: none"><li>• Communication of data and acceptance of analysis</li><li>• Develop functional action plans</li></ul>
Action	<ul style="list-style-type: none"><li>• Implement specifications</li><li>• Monitor results/report progress</li><li>• Recalibrate benchmarks</li></ul>
Maturity	<ul style="list-style-type: none"><li>• Leadership position obtained</li><li>• Process integrated with practices</li></ul>

---



Table 9.12 SCOR operational focus and strategic activities/focus

<i>SCOR activities (operational focus)</i>	<i>Strategic activities (strategic focus)</i>
Plan	Design and innovate
Source	Plan
Make	Source
	Outsource
	Collaborate
Deliver	Make
	Deliver
	Obtain feedback from customers and re-plan
Return	Reverse logistics – dealing with returned goods
Enable	Enablers to support the five activities – plan, source, make, deliver, return

***Design and innovate***

This activity is wider than the task of design. It is rather a way of thinking, constructing and implementing design from concepts into practical customer focused product and service solutions. Innovations in design and design processes enable organizations to compete on a number of different strategic dimensions (time, cost and difference). It is the step before supply chain planning.

**SCOR – (APICS)**

The supply chain operations reference (SCOR) (APICS) model is a management tool used to address, improve and communicate supply chain management decisions within a company and with suppliers and customers of a company. The model is organized around six primary management processes: plan, source, make, deliver, return and enable. By implementing the SCOR model, companies can identify supply chain issues or inefficiencies, outline and recycle best practices to ensure repeated success, leverage capital investment, coordinate with suppliers, quantify operational and supply chain performance, reduce costs, improve the accuracy of data and make better decisions about how to market and sell their product or service.

***Plan***

Any operational plan balancing supply with demand to manage capacity must be aligned with the organizations strategic planning processes. For example, resource planning to acquire plant, machinery, storage and distribution facilities, people with appropriate skills and knowledge, capital to finance operations.

***Source***

Sourcing is both a strategic and operational decision that impacts an organization’s competitive advantage. Sourcing from remote parts of the world may bring cost benefits, but also carries higher risks such as possible disruptions to supplies. Sourcing further away may reduce an organization’s ability to be responsive, so it is important to keep a strategic focus on customer requirements. Sourcing can be costly and once established, sources may not be easily changed. Sourcing in one area may also involve local investment, which cannot easily be switched when cost/benefit variables shift.

### ***Make***

Producing the goods within the overall production system by executing operations to achieve the task of making the goods. This is a very “operations” driven focus. However, it is not simply about making unless you are the manufacturer. It is about meeting customer demand. Adopting a strategic focus would lead to other alternatives being considered such as *outsourcing* and *collaboration*.

### ***Deliver***

Delivery too, may need to be considered more widely in a strategic context. Traditional delivery modes have been chosen on the basis of time and cost. The key elements are managing demand, orders, storage and distribution. Delivery for some goods and services may be digital and it may be self-delivery. Deciding on how customer fulfilment will be achieved is critical to the success of the organization. In many respects, it is the most important but perhaps least understood aspect of managing market demand. Strategically organizations must consider means of fulfilment and organize resources appropriately. This may involve capital investment in facilities, technology and equipment to deliver.

### ***Return***

This process deals with returns. The SCOR Guide provides further details about what is examined in the process.

### ***Enable***

This process enables all other processes, that is, plan, source, make, deliver and return. SCOR identifies five performance attributes which are:

1. Reliability – ability to perform the task as expected.
2. Responsiveness – customer focused attribute on speed of fulfilment.
3. Agility – customer focused attribute focusing on ability to change, for example, to deal with a natural disaster or labour disruption (flexibility and adaptability).
4. Costs-internally focused on resources.
5. Assets – efficiency of assets utilized.

These performance attributes determine the strengths and weaknesses of a supply chain and may be matched against the opportunities and threats presented by the external environment beyond the immediate control of supply chain managers. In this sense these types of measure are useful to understand and act appropriately both operationally and strategically.

### ***Outsourcing***

Traditionally this has been viewed from a cost point of view and is often referred to as a “make or buy” decision. However, outsourcing may bring other strategic benefits apart from simply a cost advantage. For example, an organization may want to outsource part or all of its production or service activities because the customer can be served better by doing so. The organization may not have access to technology, skills and other competencies that it can buy-in through outsourcing. There are arguments that relate to “core activities” and “peripheral activities.” It is

sometimes argued that organizations should “stick to the knitting” in other words do what they do best and outsource everything else (Peters & Waterman, 1982).

**Collaboration**

Organizations strategically do not simply make but they may collaborate with other suppliers of goods and services to produce a superior customer offer than can competitors. Collaboration may bring benefits such as access to better technology, better know-how and better service standards. Collaboration in this context may not be with the customer but rather with other suppliers. Although one could think of some industries where the customer is given the tools to make their own products by the service provider and hence there is customer collaboration without making by the supplier. An example might be digital music collections.

**Feedback**

The final stage in strategic supply chain management is to obtain feedback from customers to learn and improve operations and to develop more effective strategies (see Table 9.13).

**Best practice defined**

Best practice is simply that identifying the best practice in the activities performed in the same industry, sector or in the wider definition best practice across all competitive environments. This latter definition is sometimes referred to as “world-class.” Best practices are not necessarily the best possible practices; they are simply the best in use at the time. Best practice is about:

- Doing things better, that is, more effectively.
- Focus on operations – usually inventory management or distribution management.
- Making comparisons with organizations who are acknowledged leaders in the particular area.
- Identifying similarities between your own organization and the “benchmark” company chosen.
- Staying focused on context.

*Table 9.13* What to benchmark

*Supply Chain Council – supply chain operations reference*

<i>Metric type</i>	<i>Outcome</i>	<i>Diagnostic</i>
Customer satisfaction/ quality	Perfect order fulfilment satisfaction	Customer Delivery to commit date Warranty costs, returns, allowances
Time	Product quality Order fulfilment lead time	Customer inquiry response time Source/make cycle time Supply chain response time Production plan achieved
Costs	Total supply chain costs	Value added productivity
Assets	Cash to cash cycle time Inventory days of supply asset performance	Forecast accuracy Inventory obsolescence Capacity utilization

Companies pursue “best practice” to:

- Achieve targets they set themselves.
- Become more effective.
- Become the best in their class at what they do.
- Become recognized as best in the world at what they do – REPUTATION.

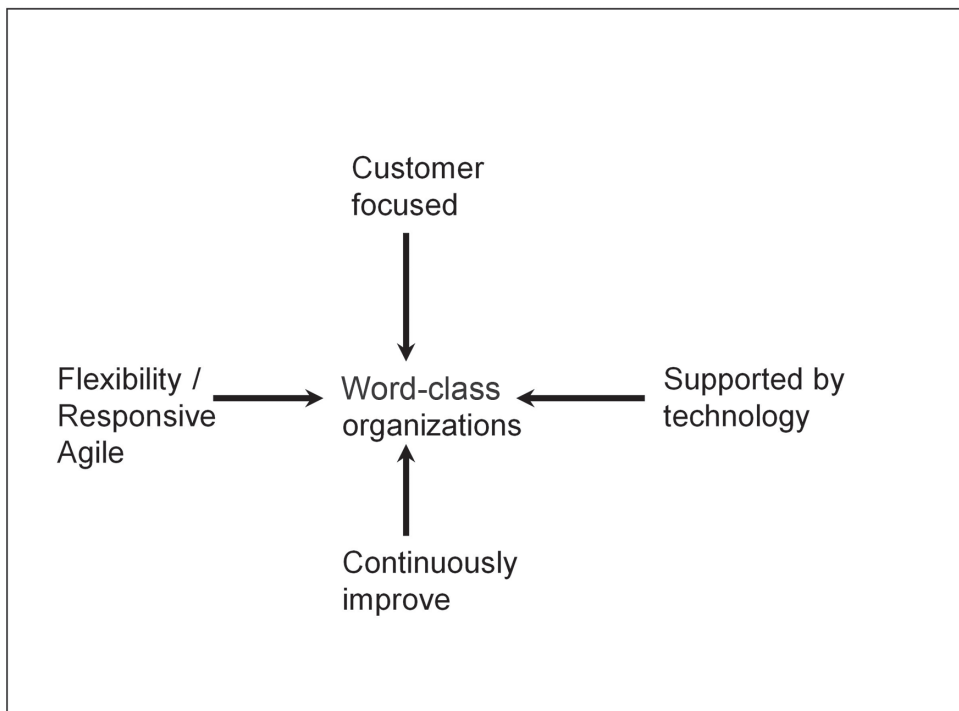
There are four critical elements to achieving “best practice” which are:

- Focus.
- Flexibility.
- Continuous improvement.
- Visibility achieved by effective use of ICT.

Customer focus is central to achieving best practice and requires that these four critical elements receive attention (Figure 9.16).

**World-class organizations**

World-class organizations combine these elements into their philosophy and set benchmarks that measure activities along each of these dimensions. In recent years it has become popular



Dr Tony Hines © 2001

Figure 9.16 World-class organizations are customer focused

in “management speak” to refer to “world-class” organizations. This essentially has developed from organizations wanting to achieve “excellence” or become “best in class.” Schonberger (1990) developed his world-class organization concept further and referred to building a chain of customers rather than a supply chain. This turned the focus away from supply and towards satisfying demand. It was an important conceptual focus switch.

### **Balanced score card (BSC)**

The BSC is a structured approach to performance measurement and performance management that links the organization’s strategic thinking to the activities necessary to achieve desired results. The BSC is a vehicle for communicating an organization’s strategic direction and for measuring achievements towards these predetermined objectives. The BSC clearly establishes linkage between strategic objectives, the measures for determining progress, the stretch targets established and the focused initiatives needed to move the organization forward to meet those organizational goals.

The BSC utilizes organization-wide measures plus individually tailored local measures (e.g., SBU or department) to achieve the strategic goals the organization has set itself.

Results of BSC measurements provide decision-makers with critical information on:

1. The efficiency with which resources are transformed into goods and services; and
2. The effectiveness of organizational activities and operations in terms of their specific contributions to strategic objectives.

It is a means of assigning accountability to individual staff by flowing down the BSC to individuals and teams.

Kaplan and Norton (1996) developed the BSC approach to develop a range of different performance measures to examine and control organizational performance at a strategic level to ensure that the organizational strategies were being controlled. The approach is important because it allows organizations to develop non-financial measures in addition to the traditional financial measures that most organizations adopt. The claimed benefits for the approach may be summarized as follows:

- Gives management strategic control.
- Communicates to everyone in the organization and provides a clear context for their work.
- Discusses how competencies will be developed to meet the challenges, examines customer relationships and how IT will pay off in future.
- Creates an opportunity for learning by more systematically measuring factors important to success and uses the data to involve people in discussions about what the critical success factors might be.
- Takes a longer-term perspective by explaining measures that have no immediate effect on “bottom line profit” or revenue streams.
- Adds to the financial picture already available in the financial annual reports.

Figure 9.17 illustrates the BSC approach with four dimensions centred on the organizational strategy. Financial, customer, internal business processes and learning and growth are the four dimensions measured. To the left of the BSC you can read the perspectives that are being highlighted yesterday, today and tomorrow. Financial measures tell us what happened yesterday, business processes and customer measures tell us what is happening currently and the learning and growth

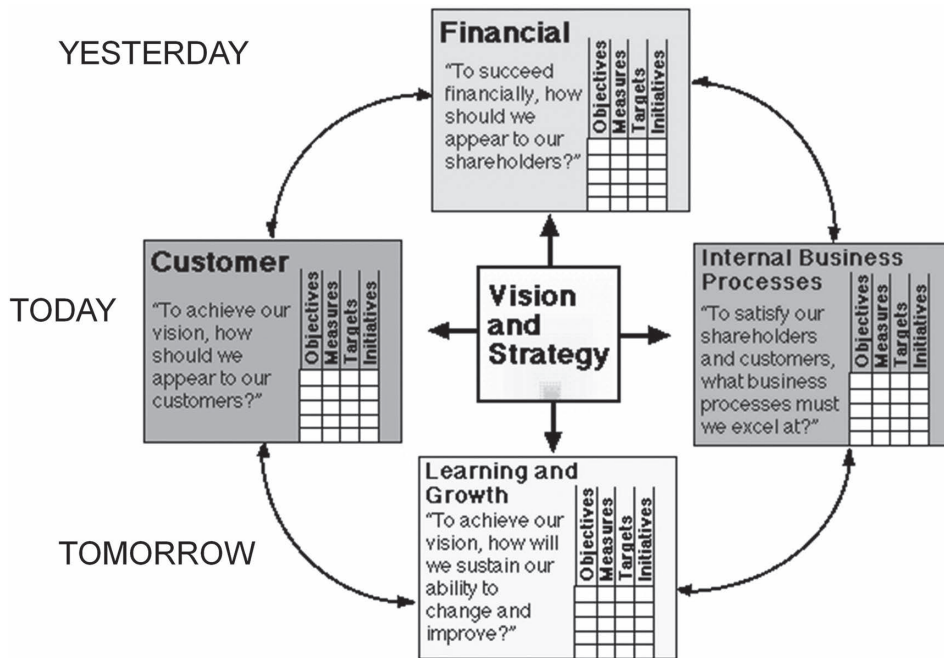


Figure 9.17 The balanced scorecard

measures indicate what could happen tomorrow. This past, present and future perspectives are essential for successful supply chain strategy development. It also shows how these perspectives are linked to each other reflecting two-way loops between past and present; and present and future all centred on the vision and strategic direction for the organization. How an organization chooses to design, manage and control its supply chain is an important strategic and operational matter.

According to Olve et al. (2000), BSC approaches have gained popularity with many organizations examining their strategic performance using the approach. It can be used to drive strategy forward. The BSC approach shifts focus from purely financial measures towards measurement of how the organization appears to its customers and measuring business processes that deliver or fulfil the customer promise.

### New measures are always required as contexts change

The idea of circular supply chains and the circular economy has gained traction as a result of growing interest in sustainable supply chains. Many of the costs associated with environmental, sustainability and governance (ESG) are a result of activities that happen in supply chains. Performance measurements related to circular supply chains apply existing measures, which are adapted to the new context. For example, modified balanced scorecard measures or benchmarking adaptations (Lahane et al., 2023). A different research study also makes use of adapting the balanced scorecard to develop performance measures for lean supply chain management (Garcia-Buendia et al., 2022). A further study examined the predictive value of supply chain sustainability using ESG measures across the extended supply chain (Das, 2023).

Value stream mapping too, is used to trace costs and measure performance in supply chains. One such example is to measure lead times or lead-time reductions in various settings such

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as production operations, distribution and warehousing. The study here looked at reducing warehouse lead times for pharmaceutical inventory (Abideen & Mohamad, 2020). Another interesting paper measuring supply chain visibility and economic performance, environmental performance and social performance used covariance based – structural equation modelling with confirmatory factor analysis to evaluate the relationships listed and how Industry 4.0 was influencing these factors and found a positive result (Al-Khatib, 2023).

### Summary

The chapter started by examining the concepts of cost and value in relation to the supply chain. Value added, value chains and the value system were explained before assessing the role of forecasts and budgeting as part of the supply chain planning processes. Different aspects of performance measurement were discussed from simple variance analysis to benchmarking and balanced scorecard approaches. The BSC approach was deemed particularly appropriate for measuring supply chain performance because it offered three different perspectives using different types of measure. Financial measures generally examined the past, and current measures focused upon customers and internal business processes while future perspectives addressed the organizations capabilities to improve through continuous learning. Best practice models and the concept of developing world-class organizations were also discussed.

#### Discussion topics

1. Explain the importance of supply chain metrics and identify three used by your chosen organization. Discuss how these measures improve competitive supply chain performance, potential shortcomings and their importance to strategic and operational decision making.
2. Provide examples to illustrate your discussion. For an organization of your choice select one supply chain process or activity and identify and analyze costs involved in the process or activity in terms of material, labour and overhead or activity costs. Explain how value is created for the customer through the process identified.
3. Explain the terms cost and value in relation to supply chains.
4. There are three cost perspectives that need to be considered in relation to ownership, list them and explain the importance of identifying these costs in relation to managing supply chain costs.
5. Explain the term risk cost.
6. “Budgeting is important to managing supply chain costs.” Explain why budgeting within organizations needs to be extended to the whole supply chain if supply chain strategies are to be evaluated.
7. Material price variances are just one aspect of managing supply chain costs but why do you think managing material cost might be critical to supply chain efficiency?
8. Explain the term “benchmarking” and discuss the importance of benchmarking supply chain performance.
9. “Balanced scorecard approaches have been viewed by many organizations as an essential performance measurement tool.” Discuss.
10. Explain the concept of “world-class” in relation to organizational supply chains.



## Notes

- 1 “Opportunity cost” is the cost of the alternative foregone a term used in economics.
- 2 Some of these ideas were articulated by Leroy Zimdars, former director of supply chain management at Harley-Davidson, quoted in John Yuva, Reducing costs through the supply chain, *Purchasing Today*, June 2000.

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## 10 Service levels, synchronization of business processes and inventories

### Introduction

Service levels are an important strategic choice for organizations attempting to meet the twin aims of a customer focused strategy, which are: (a) to meet demand effectively and (b) apply resources efficiently. Being effective means getting the right service, to the right place, at the right time and at the right price. Being efficient means lowering costs while remaining effective in meeting customer demand. Synchronicity, integration of systems, efficient processes and supply chain flows are the keys to achieving these twin aims. For many organizations, particularly those engaged in manufacturing, a large part of achieving the aims rests on managing inventories. These inventories have to be managed at unit level, organizational level and across the supply chain system. Managing relationships with partners becomes important and the use of appropriate technologies to provide transparent information to all parties is essential. Many organizations attempt to achieve the latter by introducing enterprise-wide systems (ERP) that use a common platform such as SAP.

### Inventory management

#### When things go wrong

Falling Sales, running out of cash, your best employees leaving, a warehouse full of unsold inventory and the only calls are from creditors and the bank.

*Source: Consuming Future (2023).*

“More than 80% of hospitals surveyed by the American Hospital Association reported they had to delay treatment, and nearly 70% said patients received less effective substitute drugs.”

*Source: Dooran (2011, July 12).*

Inventory management or stock management are terms used interchangeably. It is an essential part of managing supply chain activities. The management challenge is to minimize the stock-holding costs whilst simultaneously satisfying customer demand. In other words, there is a trade-off between customer service levels achieved and inventories held. Business processes often need to be redesigned to accommodate improvements to service level, to lower inventories throughout the supply chain and to develop strategies to maintain efficiency whilst simultaneously meeting demand effectively.

There are a number of tools and techniques that enable managers to manage the trade-offs involved in managing inventories and balancing customer service levels. These include ABC, EOQ, JiT, MRP, DRP, CRP, ERP each of which will be explained in turn.

### ABC analysis applying Pareto's concept

ABC analysis is a simple but very important technique to identify different categories of stock. It is sometimes referred to as the Pareto concept because it applies Pareto's 80/20 rule. In other words, 80 per cent of the value is accounted for by 20 per cent of the volumes. These are, in effect, the "A" items of inventory. "B" items represent ten per cent of the value and 30 per cent of the volume, while the remaining "C" items represent the remaining ten per cent of value but constitute 50 per cent of the volume.

This is a useful concept to apply to any inventory. It will help the managers focus on what is important in terms of allocating their time and effort. A simple example will illustrate the concept. Consider an automobile manufacturer they will need to have many different parts that make up the car. The analysis of the bill of materials (BoM) for the vehicles will reveal a hierarchy of parts. Figure 10.1 demonstrates an abbreviated summary of car parts that make-up the vehicle. Higher value items would be categorized as "A", medium value as "B" and low-value as "C." The rule can be applied to any inventory. The majority of inventory items will always be low-value high-volume and the smallest category will always be high-value low-volume. In the example, finished goods items (the vehicle itself, engines and the immediate sub-assemblies that make the final vehicle would probably constitute the "A" category. "B" category items would be those items that feed into the sub-assemblies. The 'C' category would be all the nuts, bolts, rivets, plates, wiring, etc. that there is lots of but the unit cost is relatively low. Table 10.1 illustrates ABC analysis.

Figure 10.1 provides a summary for this concept.

### Bill of Materials in summary form

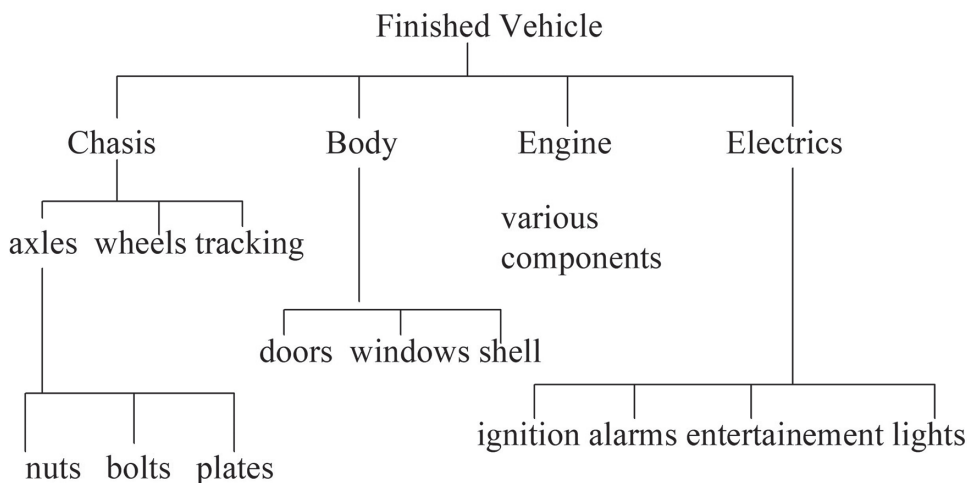


Figure 10.1 Bill of materials in summary form

These values may vary somewhat from organization to organization. The representation is a “rule of thumb” approximation. Some organizations may decide to use more than three categories but the principle is always the same. It is used to allow managers to concentrate their attention and efforts on those areas that promise the highest “pay-off.” An example for a manufacturing organization may look as shown in Table 10.2.

The example in Table 10.2 demonstrates how the actual percentage values and volumes may vary in reality. This type of analysis can also be applied to customers and to suppliers. For example, it is highly likely that an organization will earn a high proportion of revenues from a small number of customers. It is also highly likely that an organization will acquire a high proportion of total value for supplies from a relatively small number of suppliers. In any of these situations it will reap rewards for managers who focus their attention and interventions on these high-value items A and B categories rather than on C items.

Figure 10.2 illustrates the ABC categories identified by recognizing the percentage of stock value represented by percentage of stock volumes. Data from the table has been plotted to produce a cumulative frequency curve to create this graphical representation.

Recent trends for many organizations have concentrated their time and effort into managing relationships with fewer suppliers, getting agreements right, working on quality issues, stockless buying agreements or systems contracting and by placing transaction responsibility with the end user. These techniques reduce administration time and effort but maintain high service levels.

Figure 10.3 illustrates a trade-off between customer service and cost. The determining service level is what the organization is aiming to achieve. The qualifying service level is what it must achieve. This illustrates the computation of a trade-off between cost of service and possible increased revenue streams from a service improvement. If the difference between two revenue streams  $r_2-r_1$  is greater than the incremental cost of service improvement, the difference between  $c_2-c_1$  is worth pursuing a higher service level on cost vis-à-vis revenue improvement grounds.

Figure 10.4 re-visits the “Pareto” concept or ABC type analysis which can be applied to a number of different supply chain issues. It is often perceived as an inventory management tool as in the inventory chapter example in this text. However, it may be applied in different contexts. In this example 80 per cent of sales achieved are attributed to just 20 per cent of customers. These are identified as A items. It also shows that a further 15 per cent of sales are attributed to 50 per cent of customers (B items) and the remainder, five per cent, to 30 per cent of

*Table 10.1* ABC Pareto analysis

<i>Class</i>	<i>Percentage of total items purchased</i>	<i>Percentage of value of total purchases</i>
A	20	80
B	30	10
C	50	10

*Table 10.2* ABC analysis example

<i>No. of items</i>	<i>Percentage of items</i>	<i>Annual purchase value</i>	<i>Annual volume percentage</i>	<i>Class</i>
2325	18.78%	£28,500,000	79.61%	A
3232	26.10%	£4,100,000	11.45%	B
6825	55.12%	£3,200,000	8.94%	C
12382	100.00%	£35,800,000	100.00%	

### 80/20 Rule – Pareto Concept (Stock)

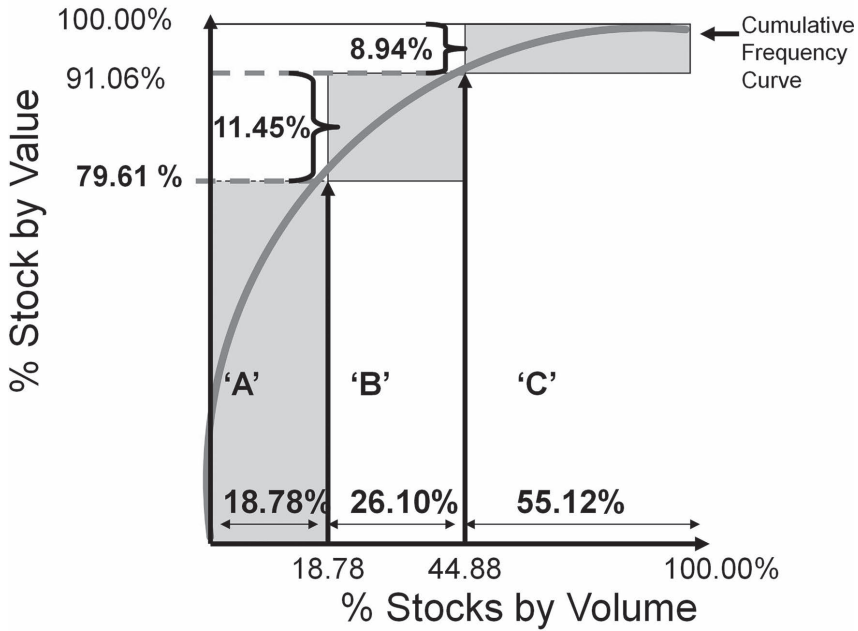


Figure 10.2 Pareto concept applied to customer service and inventory management

### CUSTOMER SERVICE AND COST

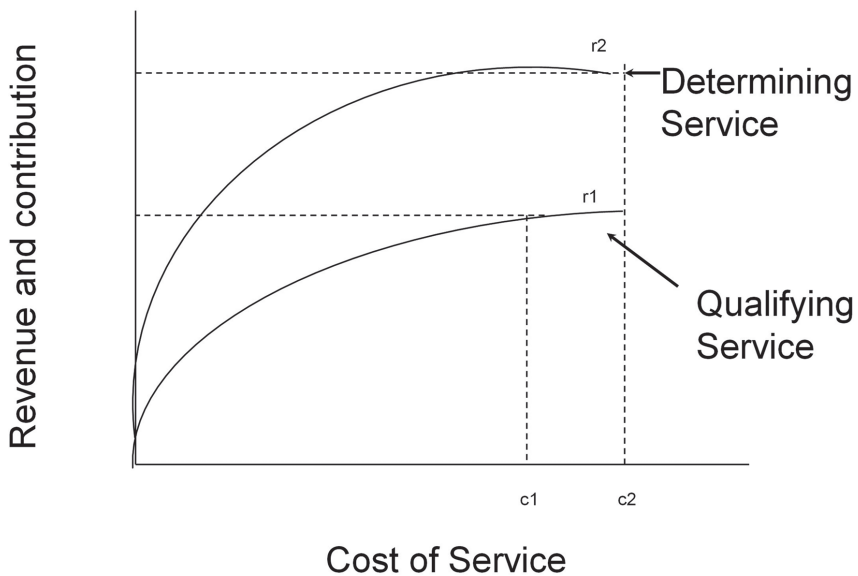


Figure 10.3 Customer service level cost

## 80/20 Rule – Pareto concept

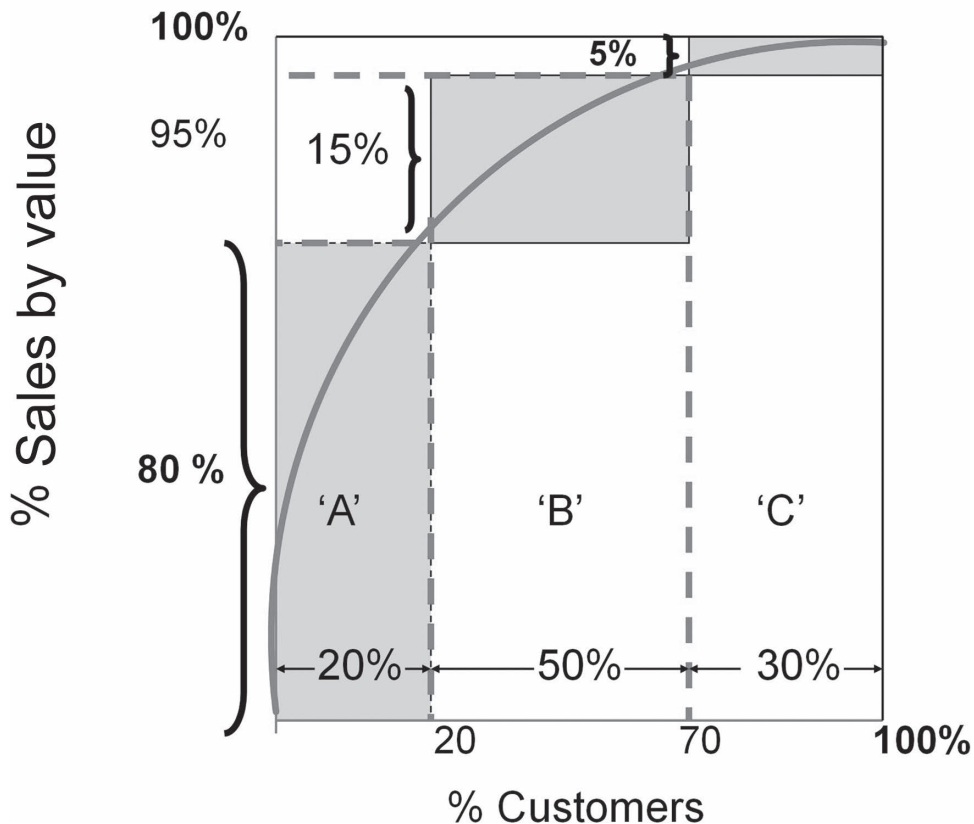


Figure 10.4 ABC analysis

customers that are labelled C items. ABC analysis is a means of prioritising management attention. It is obviously very important for the managers in this scenario to pay particular attention to satisfying the needs of the 20 per cent of customers identified in the A category since they represent such a high proportion of sales value, 80 per cent.

### Stockless buying or systems contracting

Sometimes organizations buy large quantities of relatively low-value items from a specific supplier. Although it is worth stating that systems contracting has been extended by some organizations to include higher priced items. The purchaser simply stores the items at the supplier until they are required, thus avoiding costs until there is demand. The arrangement is that goods are replaced using a computer generated order.

It works as follows:

1. The buyer places the order at firm prices.
2. The supplier delivers a pre-determined quantity to the buyer. The supplier may still own items at this point.
3. Buyer inspects items when delivered.

4. Computer system directs storage to designated bin or space.
5. Buyer places purchase order (PO) through computer system, which then updates supplier records.
6. Pick sheets are computer prepared. Buyer physically removes items from supplier's inventory.
7. Supplier submits a single monthly invoice for all items picked.
8. Buyer's accounting department makes a single monthly payment for all items picked.
9. Computer system generates summary reports monthly or when required showing items and quantities used. These records are used for future planning by both buyer and supplier.

Systems contracting is popular because it shortens the time from requisition to delivery and lowers inventory holding costs. The user is also usually able to give a good forecast to the supplier and that in turn reduces the risk of holding stock nobody wants. Often the purchaser will compensate the supplier for inaccuracy in the forecast but this depends on the initial purchase contract and negotiations. These types of relationship are often more information rich and less risky than the traditional "arm's length" purchasing approaches.

#### ***Outsourcing stockless stores***

Many large organizations have entered into outsourcing arrangements with contractors who are responsible for managing this type of operation on their behalf. This is often an efficient means of lowering inventories of large quantities of smaller value items. It allows the organization to focus its management towards the higher value elements of the business. For example, outsourcing consumable stores or the maintenance tools stores may release management time and indeed may remove costs of stores operation for a contractual price that is lower than doing it themselves. If costs are not lower, the benefit of allowing managers to focus on parts of the business that require more attention may be important.

#### **Economic order quantities (EOQ)**

This particular technique is used to determine economic order quantities, lot or batch sizes. The model in Figure 10.5 illustrates the trade-offs that occur between ordering inventories and holding inventories. The objective is to order quantities that minimize the cost of ordering and the cost of holding stocks.

The mathematical formula for calculating the economic order quantity is:

#### **Economic Order Quantity (EOQ)**

$$EOQ = \sqrt{\frac{2Co D}{Ch}}$$

Where: Co = Cost of placing an order

D = Demand in a period

Ch = Cost of holding one unit of stock

Table 10.3 provides you with an illustration of the concept in use. The data is available regarding a SKU. Intuitively what do you think is the EOQ and explain why.

Therefore, from the data provided, bearing in mind that the EOQ is a point at which total costs for ordering and stockholding are minimized, you might guess that this occurs at an order



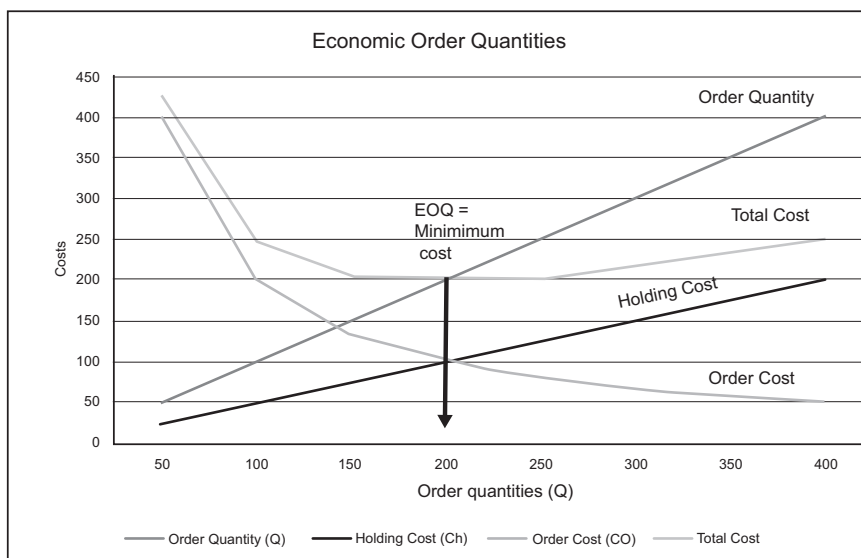


Figure 10.5 Economic order quantities (EOQ)

quantity of 200 from reading the table. You would be right. This is the point at which all costs are minimized. In mathematical terms it is the turning point. You can compute the same result by applying the formula previously given.

$$EOQ = \sqrt{\frac{Co D}{Ch}}$$

The calculation is as follows:

$2 \times 20$  (Cost of Order)  $\times 1000$  (Annual Demand) =  $40,000/1$  (Cost of Holding Stock) and then take the square root of  $40,000 = 200$  units

The Following Data is available regarding a SKU:

Table 10.3 EOQ data for a SKU

Order quantity (Q)	Holding cost (Ch)	+	Order cost	=	Total cost
	$0.5Q \times Ch$		$(D/Q) \times CO$		
50	25		400		425
100	50		200		250
150	75		133		208
200	100		100		200
250	125		80		205
300	150		67		217
350	175		57		232
400	200		50		250

Source: Demand (D) = 1000 units per year Holding Costs (Ch) = £1 per item Order Cost (Co) = £20 per order

Graphically you can see the trade-off for this data in Figure 10.5.

You can see that the turning point for the total cost curve is shown at 200 units. This is the point at which total costs are minimized and where the order cost crosses the holding cost, that is, the trade-off point.

A number of assumptions apply in the EOQ model, which may be summarized as:

1. Demand is constant.
2. Re-orders when made can be delivered without any time delay.
3. Prices do not fluctuate between order periods.
4. No small order surcharges apply (or discounts for higher quantities).

These restrictions are quite limiting but the model can be adapted to take account of variations.

The simple fixed quantity model can be illustrated as in Figure 10.6 which shows a situation where 1,000 units are ordered regularly. Demand is constant at 250 units per week. There is no lead-time and inventories are replaced immediately when required. In this example the average stockholding in any four-week period is simply  $1/2 \times 1,000$  units (the total stock for the period). At any point in time the organization will hold average stock of 500 units.

Figure 10.7 shows the average stockholding graphically.

Figure 10.8 shows the effect of introducing a one-week order lead-time into the situation.

The re-order point is therefore at the end of week three. When this point is reached, the organization would need to place an order to replenish the stock. A further complication can be introduced which is “buffer stock.” Organizations sometimes anticipate the effect of being out of stock (stock-outs). In order to avoid this position and maintain supplies it is essential to hold

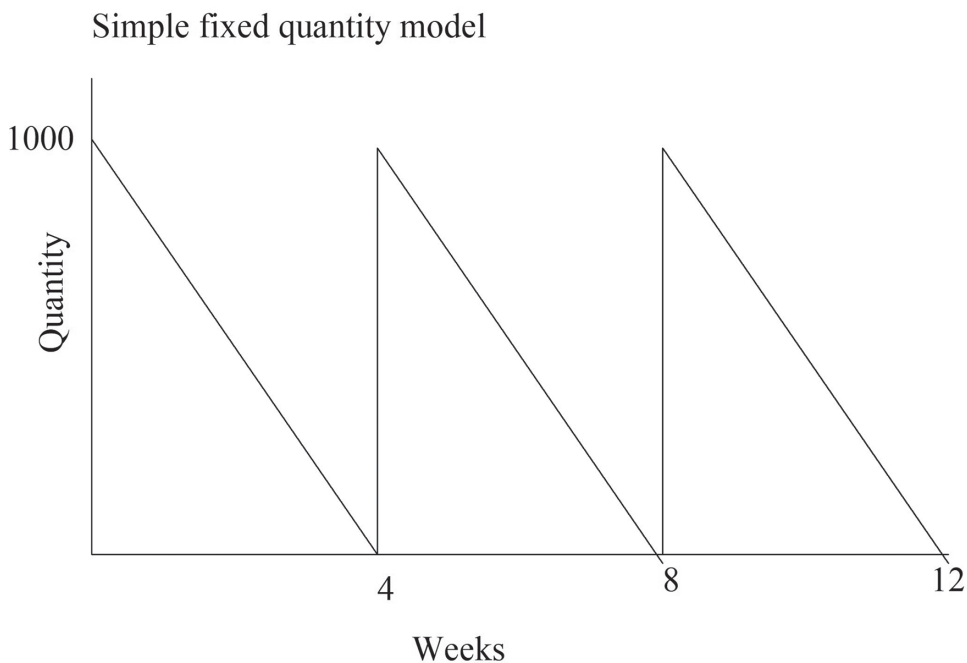


Figure 10.6 Inventory modelling-simple fixed quantity call off

### Simple fixed quantity model

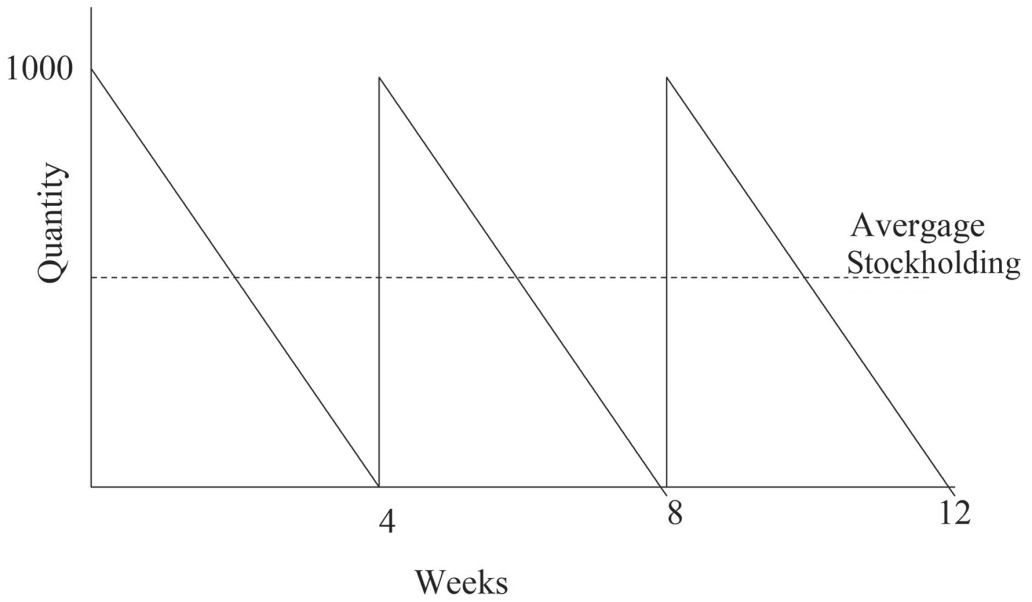


Figure 10.7 Inventory modelling showing average stock holding

### Simple fixed quantity model

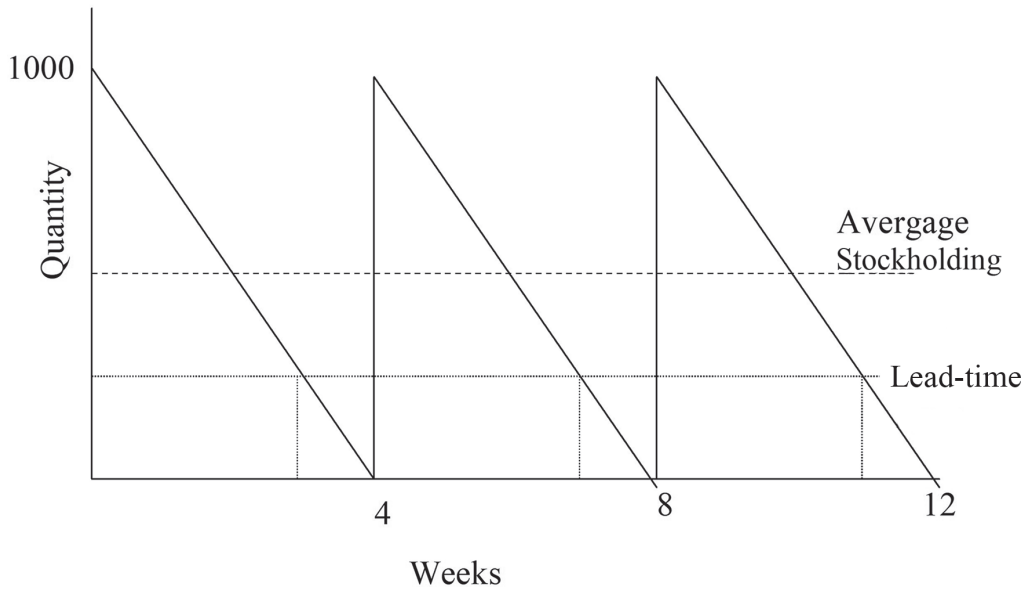


Figure 10.8 Inventory modelling showing lead times

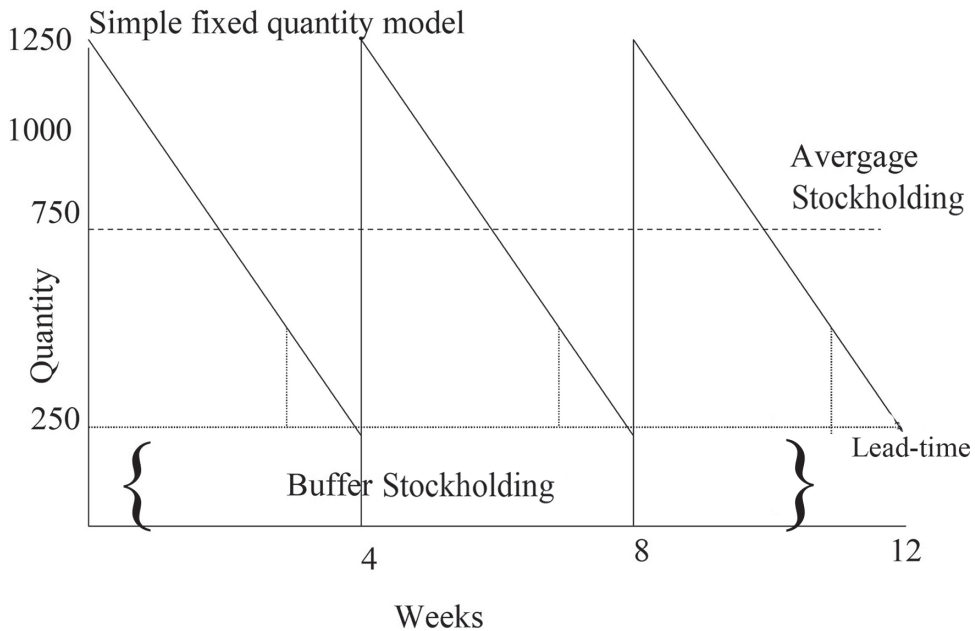


Figure 10.9 Inventory modelling showing buffer stock

a “buffer.” This is stock to cover a stock-out position. Stock-outs occur when demand exceeds forecast, supplies are disrupted by some unforeseen event (e.g., war, natural disaster, pandemic, strikes, accidents, closure of supplying firm).

Figure 10.9 shows the effect of holding buffer stock equivalent to one week’s demand. Note how the average stockholding has increased as a consequence.

### Demand led management

Recent focus on managing the supply chain has switched from simply organising supplies of materials towards managing customer demand. In order to achieve this “synchronization” of materials movement is required throughout the chain triggered by customer demand. Managing demand requires information to be shared across the supply chain in order to achieve synchronization. The accuracy and timeliness of this information is of paramount importance to reduce risks from demand amplification. Demand amplification and its consequences have long been recognized as having a “bullwhip” effect on the supply chain. This simply means that distortions can occur causing excess inventories at a number of links in the chain. It is often the retail store that receives signals of demand from customers at the end of a supply chain. This demand then triggers further supplies along the chain. However, if that information is inaccurate, it may cause inefficiencies in the rest of the chain by signalling to increase production and order components to make end products in excess of the quantities demanded.

Jay Forrester was the first to recognise and study the effect of inaccurate demand forecasting upon the supply chain (Forrester, 1961). Forrester examined channel interrelationships to demonstrate how demand forecasting could amplify positions within the channel such that oscillations occurred to correct the pattern of over and under demand from the market. The “bullwhip”

is depicted in Figure 10.10 using a retail example. Demand from the end consumer is relayed to the retailer who relays it to their supplier at each stage demand may be amplified. Initially there may be an over enthusiastic forecast which is later re-balanced may be by an under forecast. A bullwhip effect is experienced within the supply chain as it oscillates around “real demand,” that is, market demand by the end consumer.

Proctor and Gamble explored this effect after a series of erratic shifts up and down a supply chain for one of its most popular products (baby disposable nappies – Pampers). They identified the cause of excessive swings in demand not to be increasing quantities of baby waste at certain times but simply that the retail stores failed to update demand forecasts, batched orders, changed prices (causing rationing by the customer). These three elements linked together caused the bullwhip in the supply chain.

The Forrester effect is illustrated in Figure 10.11. In this example, demand from the customer is transmitted to the retailer and then passed upstream to first tier and from first tier to second tier suppliers. At each stage the demand is amplified causing increased inventory to be held at each stage in the supply chain.

Similarities exist in a number of different supply chains. It is a known fact in the grocery trade that promotional activities such as “buy one get one free” (BOGOF) or three for two or simple discounting may cause problems within the supply chain. Forecasting with accuracy the effect of the promotional offer on likely customer demand then becomes crucial. Forecast accuracy however may be problematical because other conditions outside the forecasting equation may have changed, for example, environmental conditions (taxes, stability, consumer attitudes; to name but three).

With the development of appropriate information, communication and technologies (ICT) it has become possible to forecast demand more accurately. Personal computers and forecasting software make this possible. However, inaccurate demand forecasts are still a problem. One major challenge facing supply chain managers is how to work across organizational boundaries

## Forrester Effect (The Bullwhip)

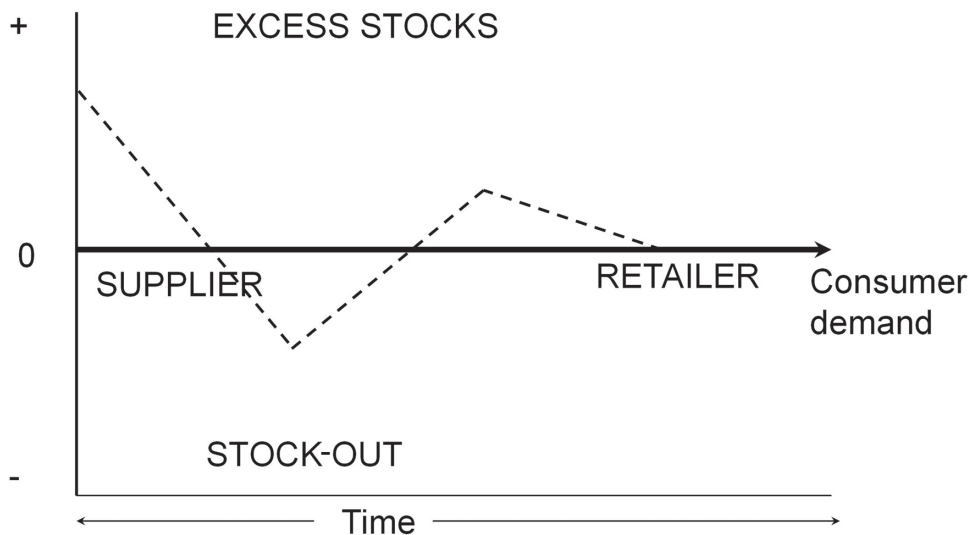


Figure 10.10 Forrester effect – the bullwhip

Forrester effect

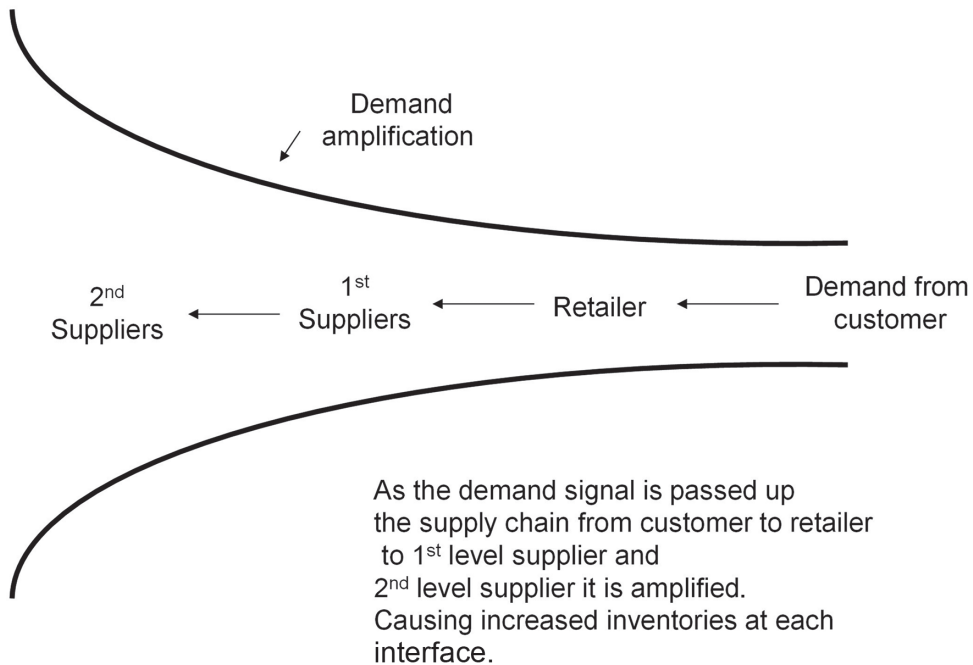


Figure 10.11 Demand amplification – demonstrating the Forrester effect

effectively to share responsibility for the accuracy of the market demand forecast. Collaboration across functions within the firms involved within a supply chain and collaboration throughout the chain involving both customers and suppliers is needed to achieve this. Large organizations working with large suppliers have been able to respond by employing enterprise resource planning systems (ERPs) such as SAP and ORACLE.

**Collaborative planning**

Collaborative supply chain strategies are important for organizations that recognise that to deliver customer focused products and services the means cannot always be achieved independently by a single organization. To serve customers better may require different types of collaborative strategies: outsourcing, comakership, cooperation agreements in, for example, technical knowledge transfer, strategic alliances, partnerships of various kinds and joint venture arrangements.

Some firms produce many products, with different customers, suppliers and delivery methods, the challenge for them is how to deal with the complexity of the different supply chains they manage. In the United States textile and apparel supply chain work was conducted by TC<sup>2</sup> a solutions consultancy firm under the lead consultant Jim Lovejoy. The DAMA (Demand Activated Manufacturing Architecture) Project decided to pick a specific product, for example, a man's nylon parka and trace all the steps in the process for the product from raw materials to its final purchase by a retail customer (DAMA, 2012). The team comprised the retailer, an apparel manufacturer, two textile mills and two fibre suppliers involved in the production.

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In this supply chain, the total time from the nylon fibre to the retail customer buying the jacket was 45 weeks. Nine weeks was process time but the actual assembly (cutting and sewing) of the parka took only 55 minutes. So why did it take so long for the raw materials to reach the end customer? The primary reason discovered in the project were due to uncertainty in the retail forecast. As Lovejoy stated, “there was a lot of ‘just in case inventory’ in the supply pipeline.” This was because no one wanted to disappoint their immediate customer. In addition, there were 15 inspections, ten transportation steps and the goods spent 24 days in trucks. The total supply was not synchronized and only a small number of business processes were integrated between organizations making up the supply chain.

***Transparency or visibility within the supply chain***

Many large retailers have shared information with their large suppliers using state of the art information systems that allows point of sale information to be viewed by the supplier. This releases resources and management time within the retail organization and enables their suppliers to manage demand for their own product supplies with the retailer. This doesn’t just happen in retail but it is happening within other industries too. The demand for automobiles and the complexity of managing their supply networks may be achieved better through sharing information to create transparency throughout the supply chain.

***Vendor managed inventory (VMI)***

One approach to the demand management problem has been for organizations to shift the responsibility for inventory management to their supplying organization. Walmart has worked with its major suppliers for several years to allow them access to customer demand information and then organize their own operations to ensure they can meet the customer demand. For example, the VF Corporation is the largest clothing manufacturer in the world and they have major brands such as Wrangler jeans. VF are able to manage and co-ordinate the flows of materials (denim, zips, cotton, buttons, studs) to their production units worldwide to ensure that they supply jeans (finished goods) on time to their retail customer. VF develop ranges and fill the store space and are paid when the products are sold out of store (Hines, 2004). This has a number of benefits for consumers, retailer customers and suppliers. These may be listed as:

- Consumers get what they want when they require it.
- The retailer does not have to manage the inventory nor do they pay for it until it is sold.
- The supplier only produces what is required (assuming the demands are accurate from the retail information systems and they should at least be more accurate because they are now based on real-time information rather than forecast data).
- The supplier has an added benefit because they are allowed to manage store space, they can introduce new products and try them on customers before committing to large production quantities.
- The benefits to the whole supply chain are to remove waste and inefficiencies.

There are also some potential problems that could occur:

- Unwillingness of the retailer to share data.
- Seasonal products or fashionable products may make it difficult to predict the demand.



- The cost of restructuring systems and the investment required in appropriate information systems.
- The effective “outsourcing” of supplies to the supplier may make the retail customer vulnerable if the supplier fails to deliver.

**Just-in-time (JiT)**

JiT is one of the many management principles that have been known about for years but prior to the 1970s and 1980s; it was simply too difficult to apply consistently and across all categories of stocks. The main reason was the mathematical algorithms involved required many complex calculations to be performed. It was not until the development of high-power business computers in the 1970s that these computations could be easily facilitated. Toyota, the Japanese automobile manufacturer, was keen to pioneer a number of innovative management practices as part of its “Kaizen” philosophy. JiT became closely associated with this approach.

The basic principle is simple. Order stock items when required. This avoids the need to hold any stock and as a consequence avoids risks of obsolescent, redundant or waste in inventories. The practice requires the co-ordination processes to be managed efficiently. It places a great deal of responsibility with suppliers who must be able to respond quickly when supplies are ordered. Components and raw materials must arrive at the production centre exactly when they are needed. This eliminates the need to hold stock and reduces queues in the work-in-process inventory. Effectively peaks and troughs are ironed out of the system. The right goods, in the right place, at the right time.

Think about what would happen to our inventory in a system where this happened. Figure 10.12 illustrates the effect of JiT on traditional purchase ordering approaches

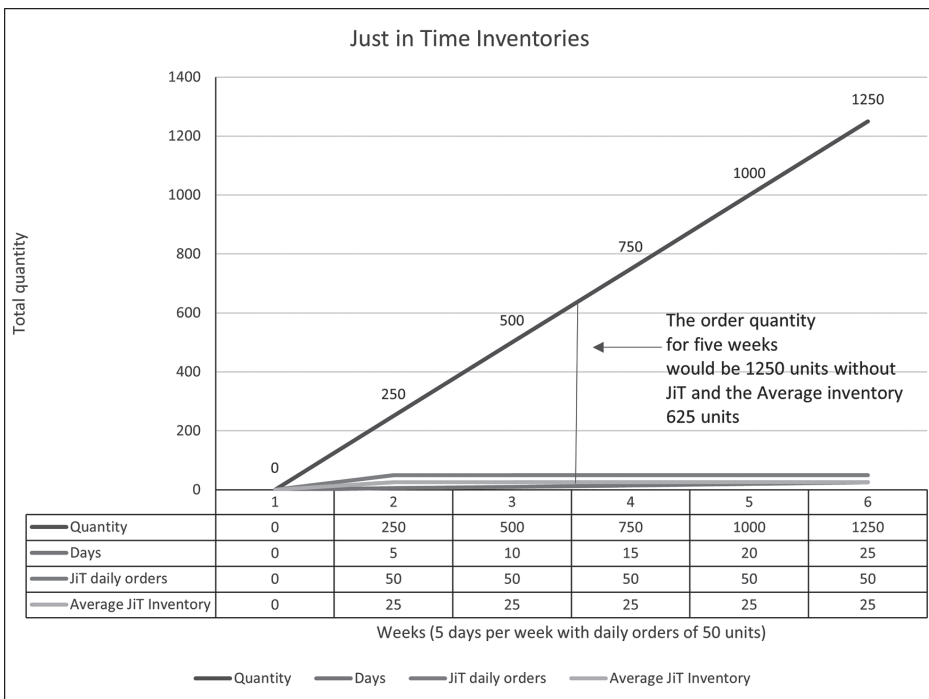


Figure 10.12 Just-in-time inventories – significantly lower average inventories

represented by the EOQ examples earlier. In this example, daily orders of 50 units are placed. Assuming a five-day week, the effect is to deliver 250 units per week at a rate of 50 per day as required. Inventory costs have fallen substantially. In this example, at any point in time the organization only hold an average of half a day's stock (opening stock + closing stock/2) or 25 units. This is a substantial saving in inventory holding costs from the previous example. Another very important issue in considering JiT systems is the effect on storage space. In the example where traditional EOQ was applied, the average storage space needed to store 500 units ignoring the buffer. Under the JiT system with an average of 25 units, this has fallen to 1/20th.

Demand and supply are balanced in a JiT system. Processes need to be designed to co-ordinate the supplies required as customer demand triggers orders. This process of balancing inputs to the system, processes and outputs to meet customer demand smoothes production flows and inventories are only held for very short periods of time when production is taking place. JiT treats set-up and order costs as variable rather than fixed costs implied by the EOQ model.

Three key total quality management (TQM) concepts underpin the JiT approach. They are:

1. The maker is responsible for quality or as buyers sometimes say, "quality is a given."
2. The quality is built in rather than inspected in. This means that each production operative is responsible for quality and not simply a quality control inspector.
3. Compliance is required with the quality standards set by the buyer.

These are important principles in the JiT system. The small lot sizes and the reduction in inventory substantially lowers risk for the purchaser. There can be no build-up of defective parts or problem parts. Smoothing the inventory flows avoids any "bullwhip" effect in the system. Manufacturing plants are not stressed by producing large quantities. This allows planned maintenance to occur. Thus, future problems are not simply stored but eradicated. Machines and working areas are kept clean. Maintenance, cleaning and tidying areas can take place in a planned working environment. Problem solving too can often take place when problems are identified by quality control checks. Ishikawa (why, why – cause and effect, fishbone diagrams) can be used as an analytical tool along with statistical quality control techniques.

JiT systems are essentially demand driven. It is a "pull system" (market driven) as opposed to a "push system" (production driven).

### ***Kanban system***

The kanban is a simple effective control system. It is essential to JiT as a visible tool that makes the JiT system operate effectively. Kanban is simply Japanese for card. The kanban is most useful for small lot sizes, high volumes and low-value items that are regularly used, for example, C items in ABC terminology. Kanbans are either single or double card systems. In the double card system, there are two types of cards, conveyance (C) and production (P). In the single card system only the (C) card is used.

Rules of the double card system are as follows: no parts may be made unless there is a P-kanban authorizing production. Workers may do maintenance, cleaning or work-improvement projects until P-kanban arrives rather than making parts that are not required. Similarly, C-kanban controls the transport of parts between departments.

1. Only standard containers are used and they are always filled.
2. Only one P and one C-kanban per container.

The essence of this visual control system is that it prevents an unwanted inventory build-up.

Inventory build-up's often disguise more serious problems. It is essential to systematically reduce inventory. Not only to reduce cost but to identify problems. For example, an organization may simply be holding a buffer stock to accommodate inefficiencies of a supplying organization.

### ***Implications of JiT systems for supply management***

Transport logistics need to be carefully organized to accommodate JiT systems where routing may be critical to the organization of pick-ups and deliveries. Deliveries may also need to be re-organized away from a central depot to the place at which the items are required. This avoids double-handling. Many organizations have organized their transportation and warehousing capabilities to operate effectively with JiT. For example, many retailers who operate JiT replenishment systems have organized “cross-docking.” This is a system whereby the delivery arrives at a transport storage depot not to be stored for any length of time but to be “cross-docked,” that is, switched between delivery vehicles that take goods to their final destination using standardized containers to facilitate ease of handling. Many of these transportation adjustments are important to manage the system effectively.

McLachin and Piper (1990) identified 11 benefits of JiT systems. They are:

1. Set-up time reduction
2. Small-lot production possible
3. Small-lot transportation possible
4. Multi-process handling through automation
5. Zero defect quality control
6. Equipment maintenance
7. Smoother and mixing of production flows
8. Withdrawal by subsequent processes
9. In-house modification and production of equipment
10. JiT supply arrangements
11. Employee involvement in continuous improvement

### ***Buyer-supplier relationships in JiT systems***

One of the biggest adjustments required when adopting JiT systems is the close level of co-operation needed between a buyer and a supplier. Organizations operating JiT systems often have fewer suppliers but they must work very closely with them to co-ordinate the different parts of the supply chain. It was Demming who first suggested that organizations needed to develop closer relationships with fewer suppliers in his list of 14 principles of TQM.

### ***Lean production (LP) or the “big JiT”***

Lean production is sometimes called the “Big JiT” and was pioneered by Toyota. It focuses upon Kaizen and in particular the elimination of waste. Lean production systems are flexible and responsive to customer needs. Organizations implementing these LP systems can lower costs in production. These principles were developed in the automobile industry and have since been transferred into a number of manufacturing and service sector organizations. In many of the case studies reported focusing on LP a key principle seems to be for the suppliers to understand the

key manufacturing processes in the buying organization. As a consequence, these organizations often need to work closely together and the automobile manufacturers often went into supplier companies to explain why they needed supplies presented in a particular way at a particular time. In these exchanges they help suppliers to identify waste and inefficiencies in their own systems that they aim to remove. This type of involvement is often based on another approach known as “business process re-engineering.” In these exchanges often suppliers engage in “open book” accounting revealing their cost structures to the buyer. This is essential if costs are to be reduced. This is a radical departure from adversarial purchasing negotiations (win-lose). In the LP approach purchasing behaviour is a win-win situation for all parties. By lowering the whole supply chain cost between the two or more organizations involved in these processes each can gain. For a fuller account of the benefits of LP see Womack and Jones (1996).

The acronym “WISDOM TO” is useful to recall the steps in lean thinking following a Kaizen TQM approach. Attention needs to be paid to:

- **W**aiting times (eliminate).
- **I**nventory levels (low without affecting service level).
- **S**ources of waste and issues (identify and remove).
- **D**efects (zero, Six Sigma).
- **O**verproduction (build to order not for inventory buffers).
- **M**ovement that is not necessary (no double handling, redesign processes as necessary).
- **T**ransportation routings (efficient, save the environment).
- **O**ver processing (do not over process).

### **Lean and agile strategies**

It is not simply lean manufacturing systems that are important but agility is important too and this has been recognized in the phrase “leagility” coined to denote the concept (Naylor et al., 1999). Suppliers need to be responsive to variable customer demand by being agile enough to deal with shifts in volume while keeping inventories to a minimum. Replenishment lead times and information flows become critical to managing leagility. In lean strategies the emphasis is on manufacturing to a forecast, keeping inventory holding low and seeking economies of scale in production. Agility relies on making to order acting on actual demand signals from the market, postponing production until that demand is known and being capable of adjusting capacity quickly (van Hoek, 1998). Decoupling points become central to the concept of leagility. An organization is able to postpone production if it is able to hold strategic inventories which can be used across different products. For example, generic and modular parts and components that can be interchanged between different finished products would be classified as strategic inventories. In apparel manufacture greige cloth is held for the purpose of postponing colour dyeing processes until demand is known with greater accuracy than a forecast. Dell computers are manufactured in a similar way using shared components between different model specifications.

Both lean and agile strategies require organizations to manage their inventories carefully to lower cost whilst simultaneously delivering customer service. Value stream mapping has been an important way for organizations to identify issues that could be improved and it has been applied to manufacturing and services (Hines et al., 2000). Organizations in different sectors of the economy have been keen to explore ways of introducing lean or agile strategies and in most cases, this requires policies, processes and relational arrangements with suppliers to be reconsidered. Interdependence between the different linkages in the supply chain have to be carefully managed to lower overall supply chain inventories removing the waste and inefficiencies

(Bruce et al., 2004). Accounting for these supply chain strategies also has to be rethought (Stenzel, 2007). Removing unnecessary inventories from processes and across the supply chain is not an easy task. It requires all partners within a supply chain working together to lower inventory levels and by so doing lower total supply chain cost (Anderson, 2008).

### **Resilient strategies**

Disruptions caused by the Covid-19 pandemic, and in the United Kingdom the added problem from leaving the European Union, without proper considerations to the disruptions it would cause to trading arrangements and supply chains resilient strategies have come to the foreground. US supply chains experienced their own pandemic problems, which prompted President Biden to introduce resilient supply chain strategies to protect critical industries which are discussed elsewhere in this book.

Resilient supply chain strategies are methods and approaches that businesses use to ensure their supply chains can adapt to disruptions, recover quickly and maintain operational continuity. These strategies are necessary because disruptions to supply chain operations have become more frequent and intense in recent years due to factors such as trade disputes, natural disasters, pandemics and economic uncertainty. By implementing resilient supply chain strategies, businesses can improve their financial performance, meet customer expectations and gain a competitive advantage in today's volatile and uncertain business environment.

Key strategies adopted include raising inventory buffers, which incurs cost but lower risk. Diversifying sourcing to spread risk, that is, a portfolio management approach. Multiple sourcing removes the risk of single failure nodes in any supply chain. Some firms have brought sources closer to home too, where it is possible, to avoid or mitigate disruption risk due to distance. Strategies that lower the cost of transport and maintain appropriate stock levels to deliver to customers at the agreed service levels are what are required.

Recent research on resilience has looked at vaccine supply chains suggesting 20 strategies to make vaccine supply resilient in Bangladesh (Mahmud et al., 2023), agribusiness examining long supply lead times, seasonality and perishability (Behzadi et al., 2017). Others looked at multiple sourcing and information sharing as a means of making supply chains resilient (Mehrjerdi & Shafiee, 2021).

### **Materials requirement planning (MRP)**

Demand for the final finished goods triggers a number of other purchase orders in a hierarchical structure. For example, the order for a single automobile creates demand for all the sub-assemblies and components that comprise the vehicle. Demand for these lower level items is dependent on final demand for the vehicle. A master schedule is needed. These schedules are created in a tree form with the principal item at the head and all the sub-assemblies and branches shown as branches. The BoM shown earlier is similar to a master schedule in structure. The difference between the BoM and the master schedule is that the BoM is for a single item whereas the master schedule would incorporate orders for several different products within the production period. At each subsequent level (and there may be many levels) the required materials are identified. The aim of MRP systems is to minimize cost of inventories and maintain customer service levels. These aims are often in conflict under other systems, for example, JiT but under an MRP system they are achievable simultaneously. MRP benefits include the ability to rapidly re-plan and re-schedule in response to changes in a dynamic environment. For example, supposing a company wants to change some key components in a

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computer build, say an Intel processor rather than an equivalent AMD processor to enhance the build quality. MRP would quickly facilitate this change. When the next order is placed the build specification and hence the BoM can be altered to implement the required change. It is flexible and responsive to the customer needs.

There are three principles of MRP. They are:

1. Dependence of demand on demand for the final product
2. Netting of inventory with expected deliveries and open orders to give a balance on hand
3. Time phasing by using information on lead times and needs

There are three basic MRP inputs to the system which are:

1. Master production schedule (MPS).
2. The structured BoM for the MPS.
3. Information on inventories, open orders and lead times.

Within the MRP system a number of rules need to be specified. They include:

1. Acceptable lot sizes.
2. Safety stocks.
3. Reject allowances.

***MRP II systems and capacity requirements planning (CRP)***

Manufacturing resource planning involves the merger of data sets from the firm's planning systems and the firm's financial systems. When MRP systems were introduced, it was not possible to easily merge these different data sets because each system maintained its own integrity. Furthermore, each system had its own inputs, process routines and outputs. The development of modern computer systems that are more powerful has enabled these data sets to merge and from a single point of entry the data can be manipulated and addressed to answer different sets of questions.

This has led to the development of CRP which is essentially planning various resources to achieve capacity in rather similar fashion to MRP systems for materials. CRP translates people and machine requirements and creates a match between what is needed and what is available. If there is insufficient capacity the manager must either adjust capacity or the master production schedule. This feedback loop to the MPS allows the organization to produce iterative solutions to the production problem. It is often referred to as "closed loop MRP." The CRP module links to MRP and allows managers to manage the whole production process not simply the materials element. These systems are only as good as the quality of information that is input to the system. Consistent, complete, accurate and timely data are required. Many contemporary MRP II systems integrate cost accounting data and are used in conjunction with budgetary control and product costing systems.

These systems provide managers with performance measures, planned order releases and the ability to simulate a master production schedule in response to proposed changes in production. They can be expensive to introduce and require careful management. Training, organizational change, computer hardware and software and different procedures may all be required to implement these systems successfully. In a large organization the benefits can be immense and far outweigh the cost of introduction, for example, reduce inventory, shorten lead times, split orders, increase delivery efficiency and allow production flexibility.

# Distribution Requirement Planning (DRP)

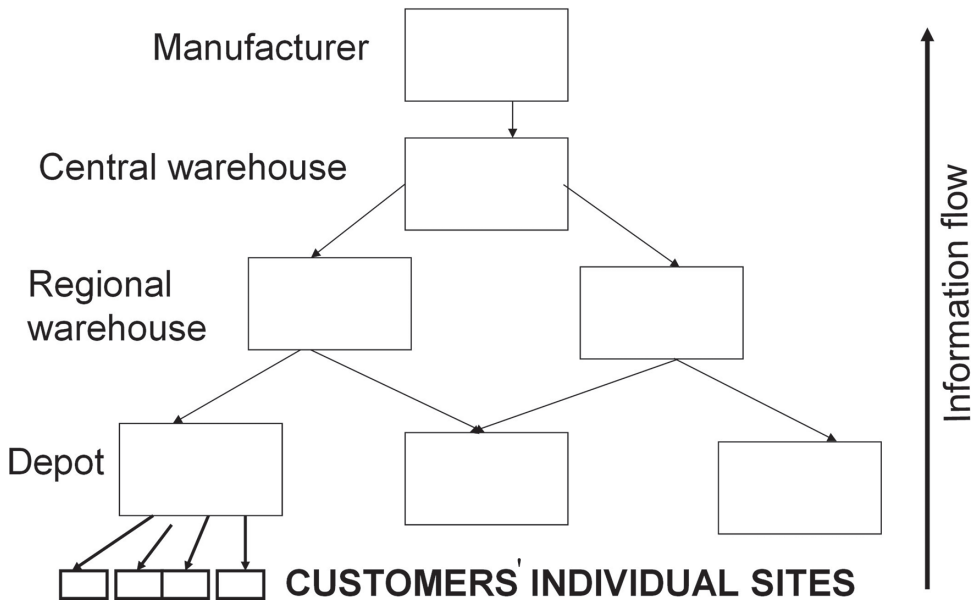


Figure 10.13 Distribution requirements planning (DRP)

## Distribution requirements planning (DRP)

DRP and DRP II are applications of time-phasing logic of MRP to the distribution function. DRP forecasts demand by distribution centre and aims to plan deliveries accordingly. Figure 10.13 illustrates DRP with a manufacturer delivering to a central warehouse which moves goods to local depots which move goods onto individual sites as and when required. DRP is an essential part of efficient MRP systems.

## Enterprise resource planning (ERP) systems

Enterprise resource planning (ERP) systems view the whole organization as an information system, different parts of an organization's management information is integrated. The big advantage of such systems is that data should be entered once only and people should be able to access the data to inform any other parts of the system. It is an enabling technology. Large suppliers of these systems include: SAP, Oracle, PeopleSoft and i2 Technologies. ERP should allow an organization to develop an integrated management information system that not only links all parts of the internal organization but also links with customer and supplier information systems to share data and improve the quality of management decision-making.

ERP systems are used to integrate business processes throughout the organization. Manufacturing, marketing, finance, human resources and purchasing information may be combined and analyzed in different ways depending on the questions the organization wants to answer. For example, when the company receives a sales order it allows purchasing to be aware that the demand has been registered. Production to be aware of the capacity needed (materials, manpower, machinery). Sales to be aware of lead times involved and finance to address cash flow



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planning, budgetary control, profitability and other financial commitments involved. Integration is a major benefit of these systems and although expensive they can remove costs through efficiency and standardization of systems and procedures.

Web-enabled systems allow supply chain partners to exchange information (orders, forecasts, production schedules, inventories and fill rates) via the Internet. Real-time accurate, consistent data can be exchanged between buyer and seller.

### **Business process design (BPD)**

Designing efficient and effective business processes is the essence of operations management. During the 1970s many firms began to introduce computer systems to help them manage operations. Many of these investments began in piecemeal fashion often the computer system would be purchased to process financial and accounting records, followed by sales and order management systems and to pay personnel. As the organization extended its computer operations it would purchase additional capacity and probably had a team of programmers employed to develop the necessary bespoke software or purchased some standard software that was adjusted to accommodate the need. The added modules were often a bad fit with existing systems and often different software worked on different assumptions or in a different programming language and glitches occurred when the organization tried to integrate the different modules. A consequence of this piecemeal approach was a series of “legacy” systems. Data storage and data processing was very expensive. Developers used complex programming algorithms to reduce data storage and data processing times but in so doing they often designed problems into the systems. One example of this is the Millenium Bug or Y2K where to save storage space only the last two digits were used in the year recognition of a date. This along with the falling price of computer technology in the 1990s drove many firms to re-invest in new technology in the 1990s to eradicate the problem that was in store when they hit the year 2000. For example, many organizations invested in ERP systems to achieve consistency, economies of scale and integration. In developing these systems an organization may have to re-design business processes to achieve consistency in the processes and to ensure effective integration between different areas. Internal integration may only be one aspect within a supply chain context. It may also be important to establish external integration also with suppliers and customers business processes and systems. Figure 10.14 provides an illustration of how an organization may decide to structure its key processes to interface with external customers and suppliers and to integrate internal systems to support business operations. In effect, the internal supply chain and the upstream (supplier) and downstream (customer) networks.

### **Business process re-engineering (BPR)**

Business process re-engineering was the term assigned to explain “fundamental re-thinking and radical re-design of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as quality, cost, service and speed” (Hammer & Champy, 1993, p. 30). Hammer and Champy provide seven key principles for re-engineering:

- Organize around outcomes not tasks.
- Have those who use the outputs of a process perform the process.
- Have people who collect information process it.
- Treat geographically dispersed resources as though they were centralized.

ERP architecture

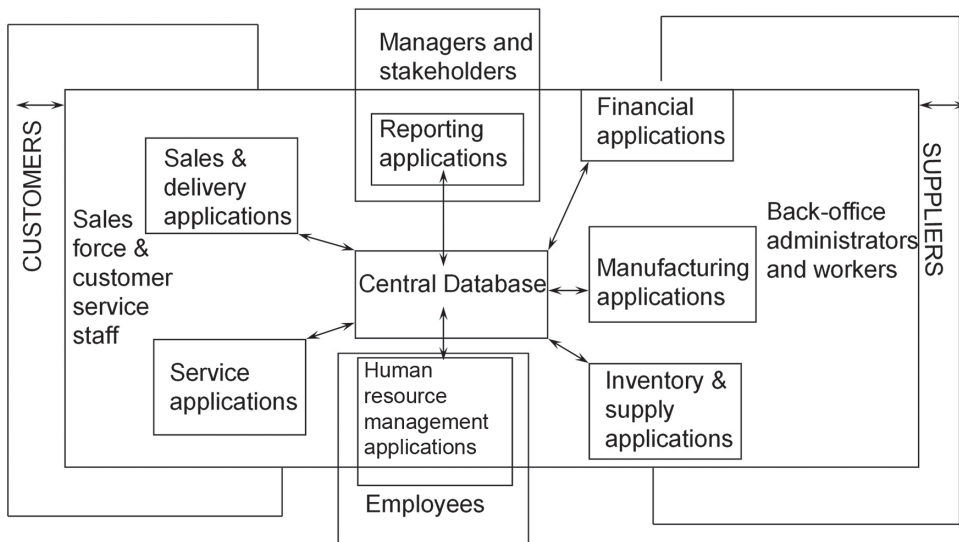


Figure 10.14 Enterprise resource planning system (ERP)

Source: Adapted from Davenport (1998)

- Link parallel activities instead of integrating their results.
- Put the decision point at the point work is performed and build in controls to the process.
- Capture information once at source.

**Service levels**

When we discuss all the necessary back office functions and transformation processes carried out in the operations that all organizations perform it is important not to lose sight of the purpose of all these activities, which is to satisfy customers. Organizations invest much time and energy into redesigning business processes, finding ways to lower inventories across the whole supply chain through collaborative strategies with partners, building relationships and trust to do so. These efforts have one purpose to satisfy the customer. There is now a new energy inside leading organizations to find ways to achieve efficiencies and to meet effective demand by being responsive to the needs of customers. To maintain a lead in satisfying customers all organizations need to be innovative. A detailed study of innovations in enhancing service levels has been published providing insights into how leading organizations are conceptualizing the new agenda of innovation with successful strategies (IfM & IBM, 2008).

The new agenda views customers not as separate but rather as active participants in this process of redesigning service strategies. Co-creating unique value with customers (Prahalad & Ramaswamy, 2004). Supply chain managers need a good understanding of what service means within their sphere of operation and they need to see operations from the point of view of the customer. This switch of focus is essential if organizations want to meet customer demand effectively as well as efficiently. A market orientation is necessary but it is not a sufficient condition

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from which to achieve the twin aims because managers also need to understand and act to make operations more efficient too (Krepapa et al., 2003). A key element of the strategic decision process is not simply to redesign service but to consider which services to retain to meet present customer demand (Lemon et al., 2002).

***Service dominant logic (SDL)***

When the first article by Vargo and Lusch (2004) was published on this topic (SDL), George S. Day refers to emergence and convergence of ideas drawn from across the discipline leading to a “tipping point” (Bolton, 2004). A “tipping point,” as the name suggests, being a point where small pieces of evidence converge such that the weight on the scales of argument become overwhelming whereby a particular trend reaches social contagion (Gladwell, 2000). This convergence has been articulated as service dominant logic [SDL] and the underlying premises on which the approach is based were articulated as follows:

This [SDL] paradigm begins to unify disparate literature streams in major areas such as customer and market orientation, services marketing, relationship marketing, quality management, value and supply chain management, resource management, and network analysis. The foundational premises of the emerging paradigm are (1) skills and knowledge are the fundamental unit of exchange, (2) indirect exchange masks the fundamental unit of exchange, (3) goods are distribution mechanisms for service provision, (4) knowledge is the fundamental source of competitive advantage, (5) all economies are services economies, (6) the customer is always a coproducer, (7) the enterprise can only make value propositions, and (8) a service-centered view is inherently customer oriented and relational.

Vargo and Lusch (2004, p. 3)

The notion of co-producer later changed to co-creator recognizing service as pre-eminent and not wishing to associate the notion with goods dominant logic.

**Summary**

A number of key supply chain strategies focus on lowering inventory to minimize cost and simultaneously satisfy customer demand. Achieving the twin aims of effective customer service and efficient delivery of service is a key focus for supply chain strategies that are customer focused. Re-designing business processes, using appropriate technologies to support the aims and synchronizing systems internally and externally with partners are important elements of the process. This chapter has discussed a number of inventory management tools used by organizations to manage inventory. Japanese lean production techniques pioneered these approaches in practice during the 1980s and 1990s. Since their development in the automobile industry lean production systems have transferred to and been adopted by a number of other industrial sectors. Principles of lean manufacture have played a part in supply chain management concepts introduced to manufacturing and service industries including: textiles, apparel, aerospace, electronics and retailing sectors in an acknowledgement that to carefully plan and manage inventories is to minimize cost without necessarily affecting adversely customer service levels. These lean principles are now also finding their way into other service industries; health and education to name but two (Wright et al., 2012). Chapter 11 will explore further some key supply chain levers for improving profitability, quality and revisit the concept of world-class.

### Discussion questions

1. Explain why ABC analysis is an important concept for managing inventories.
2. Explain the term “bill of materials” and discuss its function in managing production inventories.
3. The “trade-off” concept is important for managers trying to balance customer service and profitability. Discuss.
4. Explain what is meant by a stockless purchasing system.
5. What is a kanban and why is it used?
6. Explain the differences between MRP and JiT.
7. Why is continuous improvement critical to JiT systems?
8. For your own organization or any organization with which you are familiar identify categories of stock applying ABC analysis. Explain and evaluate why it is important for the organization to do this and demonstrate how managing inventories can improve overall performance.
9. Inventory management is both a strategic planning activity and an operational issue. Discuss.
10. ERP systems are often developed to integrate different organizational sub-systems. The big advantage is not simply internal integration but linking externally with customers and suppliers who have similar systems. However, many commentators have said that organizations buying ERP technologies need to be careful that they are not buying legacy systems. Discuss.
11. Resilient supply chain strategies can be costly. Discuss
12. Agility has replaced lean as the go to strategy choice – do you agree? Why?

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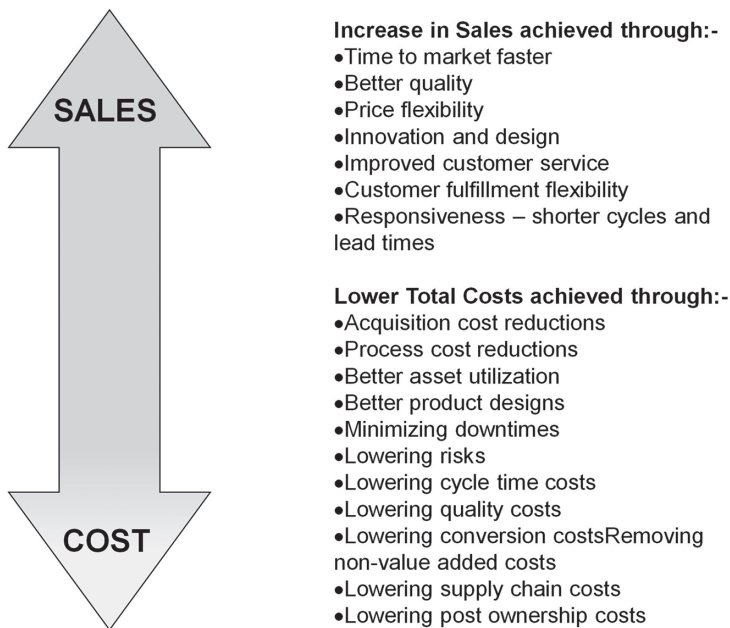
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## 11 Supply chain profitability, quality and world-class organizations

### Supply chain management and profitability

Managing the supply chain is a core competence that the organization must possess to deliver profit and return on investment (ROI). It has a major impact on organizational objectives and effectiveness in achieving those objectives. According to Dyer (2000, p. 27) maximizing supply network effectiveness is the key to individual and supply chain profitability. Virtual integration is achieved by firms collaborating in partnership (alliance), which is also referred to in the literature as the extended enterprise, strategic network or virtual corporation. Figure 11.1 illustrates supply chain strategies to increase revenue and lower cost which increases profit and ROI.

### How supply chain management impacts the 'bottom line'



**Bottom Line Profit = SALES REVENUE – TOTAL COSTS**

*Figure 11.1* How supply chain management improves profit and performance

The principle of “world-class management” is focused upon maximizing profitability by driving revenue up and lowering cost or eliminating completely non-value added costs. Schonberger (1986) introduced the notion of world-class manufacturing and principles to achieving world-class performance. Data, analytics and achieving world-class manufacturing are inexorably leveraged to achieve quality products that are profitable and satisfy customers. The world economic forum talk about unlocking value through data sharing to create world-class organizations (World Economic Forum, 2022). Data sharing has potential to reduce carbon footprints across supply chains. The data driven revolution that is unfolding relies on collaboration to enhance the customer experience and to have a positive impact on society and the environment (World Economic Forum, 2021).

The next section explains in more detail how “world-class” management principles may be applied.

## **World-class supply chain management principles**

### *Time to market*

Time to market has important implications for lifetime profitability (Stalk & Hout, 1990). Research has shown that being faster to market with new products is important and 40 per cent or more of the market may be gained at entry with a new product if it is timely. Conversely, being late will definitely cost the firm introducing new products late. Often late entry may result in the loss of a market or it may simply be that the late entrant firm withdraws because it cannot get hold of enough market share to make persistence worthwhile. Buzzell and Gale (1987) demonstrated that being first with a new product could earn profit margins that were twice as high as their competitors. Developing appropriate partnering strategies is one way to achieve this (Buzzell & Ortmeyer, 1996). Reducing product development cycles has been a prime focus for “world-class” organizations and many have reduced these cycle times by as much as 30 per cent. Often cross-functional teams are used to examine the different processes and times taken. Time compression is a strategic objective and can enhance competitive advantage (Towill, 1996). One important development has been the introduction of “concurrent engineering” principles (O’Neal, 1993). Put simply, this means that processes that hitherto would have been performed in sequence are now rescheduled and done in parallel thus removing time from the total process.

Developing responsive supply chains has also been important for organizations to respond to peak demand. Responsive organizations are able to shift resources (material, labour and overheads) quickly to manufacture products or provide services that have higher demand than expected. Responsive organizations are able to save cost and achieve additional revenue by “catching these waves of unexpected demand.”

World-class organizations draw comparisons with the best in the world when it comes to measuring their responsiveness. Measures include various cycle times and costs (e.g., time-to-market, time from receipt of order to delivery of order). Inevitably such measures translate easily into cost. The more difficult measures that are often overlooked are those that sometimes remain hidden such as “opportunity cost” measures (e.g., sales that would have been lost if the firm had not been responsive).

Consistent on-time deliveries, high fill rates, complete orders and quick response are essential for efficient customer response (ECR). Striving to improve customer satisfaction is essential in “world-class” organizations. The customer is the key focal point and the *raison d’être*.

Supplier choice is an extremely important aspect of any decision regarding sourcing. Sourcing and purchasing decisions can influence cycle times greatly. In making supplier choices an



organization will need to consider the many trade-offs involved in order to achieve the right combination of quality, service and price.

### ***Quality improvements***

There are numerous examples of organizations where quality improvements manifest themselves by translating quality into profitability. Doyle (2002) provides an example of the Prism, a Toyota manufactured under license at the GM factory in the United States. This particular product earned 50 per cent more in “lifetime” profits than its GM near competitor. The premium price charged was achieved simply through reputation of the brand despite the fact that the car was virtually same as the GM substitute, made with the same components and in the same factory. This provides one episode of consumer confidence being achieved through reputation of Toyota product quality. Interestingly it was not always so, back in the 1950s when Toyota first introduced its cars to the United States it had a disastrous launch with numerous manufacturing faults identified. However, within a short period of time Toyota did decide to withdraw completely from the US market to minimize damage to their reputation. They did not re-enter the US market for ten years but when they did, they spoke the language of quality with “zero defects.” The damage limitation exercise had paid dividends and Toyota maintained and enhanced its reputation as a quality automobile manufacturer.

It has been estimated that as much as 75 per cent of many manufacturing problems is attributable to defects in purchased materials (Burt et al., 2003). The principle of zero defects and Six Sigma have been adopted by world-class organizations with the specific aim of eliminating such problems. Collaboration with suppliers during product development cycles is of paramount importance if such costs are to be fully eradicated. The problem has been identified in service environments too and although lower it is still thought to be a significant cost. Japanese automobile manufacturers have been pioneers in working closely with suppliers and their supplier’s supplier to identify problems and lower total product cost through quality improvements. Indeed, this is the “Kaizen” principle in practice.

### ***Innovation***

Many successful new product innovations have come from technologies, designs and prototypes developed by suppliers. It has been estimated that as much as 35 per cent of all new product innovation may be attributable to supplier firms. Leveraging supplier technology or other specific competences in design may be an important difference between those organizations with longevity and those with shorter corporate lives. Business history is cluttered with examples of organizations that started out in one industry and moved to another industry not simply once in their corporate lifetime but may be more times. These businesses also provide evidence of being able to work collaboratively with suppliers for mutual benefit. Toyota themselves provide one example, 3M, Pearson, P and O and Ocean provide other examples of successful re-invention. For the many who did evolve there are equally many who did not. Some of these once household names no longer exist. Collector catalogues and antique showroom sales are littered with examples of this genre of business history, for example, Dinky, Matchbox, Hornby, Triang, Raleigh, Sinclair, BSA.

### ***Lowering total ownership costs***

The other part of the equation to improve the competitive position of an organization’s supply chain is to examine total costs of ownership (TCO). There are only two ways in which financial

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improvements can be made one is to raise revenue and the other to reduce costs. This section is about how to lower costs, more specifically TCO. Costs are incurred acquiring, converting, holding and even after ownership (i.e., post-ownership). Acquisition and conversion costs are easily understood. Post-ownership costs may include dealing with hazardous waste materials, manufacturing waste or the cost of lost sales as a consequence of poor product/service quality. The latter may have been a consequence of purchasing defective materials and incorporating them in the manufactured product. It is important that manufacturing organizations engage in effective supply chain management to prevent this happening. It is not only manufacturing companies at risk. Service providers can just as easily damage their reputation by purchasing defective materials consumed in the service. For example, a training provider that provides support materials for a management training course may purchase folders to hold materials and papers that subsequently fall apart. It will not be the company providing the folders but the training provider that will receive the criticism and loss of reputation. Poor catering, poor accommodation and poor organization of a conference could similarly damage reputation and all these activities may have been outsourced to supplier firms whose reputations remain intact while the conference reputation is damaged.

There are four key stages involved in managing supplies:

- Requirement identification.
- Sourcing supplies and suppliers.
- Pricing.
- Post-award activities.

Generating the initial requirements is critical to the success of any product or service. It requires that materials and services to purchase be optimized. Simultaneously, specifications need to be developed and statements of work describing the requirements. Whitney (1988) stated that approximately 85 per cent of cost in terms of materials, services and equipment was “designed in” during this key stage. It is essential at this stage to examine cost, availability and substitutes carefully and to search for ways that these costs may be lowered without sacrificing quality.

Sourcing supplies and suppliers takes considerable time and may involve hours of research in searching, visiting, negotiating, inspecting and ensuring compliance issues are resolved. Cost, quality, technology, timeliness, dependability, responsiveness and service are all issues that require thorough investigation. It is true that electronic searches using Internet technologies can now save time and cost but they are no substitute for thorough investigation and the thinking processes that must be engaged in to select appropriate products, services and suppliers.

Prices negotiated and conditions and terms attached to the purchase must be fair to the supplier firm if you expect them to deal fairly with you. If the supplier firm receives appropriate and just rewards for their effort, they are more likely to search for ways to lower cost that bring benefits to both parties – purchaser and vendor.

Post-award activities refer to ensuring that the product or service ordered is received on time, complete, at the agreed price and agreed quality meeting fully the specifications outline in the requirements stage.

*So how can TCO be lowered?*

There are a number of ways in which these costs can be lowered which are:

- Better product design – supplier involvement at an early stage can search for ways to work collaboratively and lower costs

- Acquisition cost – identification of appropriate suppliers, products, services that meet specifications without sacrificing quality and at lower cost. Negotiating hard but fair deals that provide appropriate rewards
- Processing cost – meticulous planning and implementation to increase efficiencies
- Better asset utilization – collaborative and alliance relationships often remove obstacles, enable sharing of knowledge, resources and equipment and provide better scheduling to minimize wastage and idle time. These combined activities result in better asset utilization
- Quality cost – working with carefully selected suppliers and continuously improving quality can lower costs of quality by removing inspection costs. Statistical process controls can be applied and other conformance measures to ensure that quality enhancement takes place
- Downtime cost – removing costly downtime through planned maintenance programmes and by re-engineering processes that ensure efficiency without placing undue strain on processes
- Risk cost – working more closely with chosen suppliers who meet the supply standards set by the purchasing organization may lower risk cost. Recent trends have witnessed many firms lowering risk cost by working more effectively with fewer suppliers who meet their requirements
- Cycle time cost – shorter cycle times for sourcing and selecting suppliers, bringing new products to market, for production processes all lower cost, as “time is money”
- Conversion cost – reducing time, increasing productivity through better asset utilization, better use of labour and materials can all lower the conversion cost. These costs are every bit as real and important as the purchase cost itself
- Non-value added cost – Womack and Jones (1996), identified that the average time taken for cola to reach the consumer’s refrigerator is 11 months. The actual time taken in conversion processes is three hours
- Supply chain cost – developing and managing the supply chain network requires considerable investment, primarily in people. Proper recruitment, selection, training and education are essential as is the investment in appropriate software systems and the design of appropriate systems, policies and procedures to manage these activities

## **Quality management**

Quality management is about competitive capability, reputation and profitability. It is widely acknowledged that there are many different pathways to achieving quality. A number of individual pioneers stressed the importance of quality improvements for many years but much of this prescription was ignored by large businesses that failed to see the link between quality and competitive performance. Today this is unthinkable since every aspect of competition depends on quality of product, quality of service and quality reputation in the congested marketplace. It is well-documented that many large automobile companies like GM only acknowledged the importance of quality when their very survival was threatened. Those companies, like the American Motors Corporation, that did not simply go out of business.

The visionaries whose underlying philosophy of business was built on quality are often referred to as “quality gurus.” There is not the space to discuss all their contributions in detail. However, it is appropriate to identify some of the key highlights that have impacted supply chain practice. In the early days of quality management, it was difficult to prove the link between quality and performance and measures, tools and methods were underdeveloped. The link between performance, cost and quality came much later. The early pioneers like Deming, Crosby and Juran often found it difficult to justify their hunches.

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Most of the focus of the quality evolution was focused upon improving internal processes, organizational systems, methods and tools. For today's supply chain managers, the focus has shifted to managing across organizational boundaries. In the following sections, a brief summary of the contribution of acknowledged quality gurus is given before summarizing the importance of total quality management (TQM) within the context of supply chain management (SCM).

***W. Edwards Deming***

Deming is widely acknowledged as the original pioneer of quality management in the twentieth century. However, it was not until the 1980s that Deming's work was acknowledged in the United States and Europe. He had spent most of his career in Japan as a consultant helping the Japanese rebuild their economy after the Second World War. Deming is best known for his 14-point plan, which is general enough to apply to most organizations and still have relevance for the modern supply chain manager. Perhaps the most important of his 14 points for the modern supply chain manager is the fourth one, which states: "end the practice of awarding business on the basis of the price tag. Instead minimize total cost. Move towards a single supplier for any one item, on a long-term relationship of loyalty and trust" (Deming, 1982).

Deming's quality framework focused on plan, do, check, action (PDCA) cycles ensuring that equal attention was paid to all elements in the cycle.

1. Plan – decide team purpose, decide changes that are needed, decide what data are needed, available and plan how they might be employed.
2. Do – carry out small scale study and observe change.
3. Check – change is as desired.
4. Action – study results, what did we learn, what can we predict and act on.

Deming was a keen advocate of statistical method in order to identify when a process is becoming unstable or unpredictable with the purpose of preventing defects occurring. The modern manager would recognize this in terms of what we now refer to as Statistical Process Control (SPC). Deming recognized that a major cause of defects in production processes were actually bought-in being directly traceable to poor quality materials, parts and components.

***Philip Crosby***

Crosby is another US quality guru who spent his formative years in manufacturing and management consulting. Crosby is best known for championing the concept of "Zero Defects" and "Do it right first time" (Crosby, 1983).

Zero defects are about focusing upon the customer's perspective and defining quality from that angle. The product needs to conform to requirements and processes need to be improved to prevent defects occurring and ensure quality. He promoted the idea of costing quality. Unfortunately for Crosby many organizations latched on to the motivational aspects of the slogans without recognizing the importance of the substance that underpinned the approach. As a consequence, these organizations became somewhat disenchanting with the approach and eventually gave up the programme. Zero defects were meant to be a management performance standard not a motivational programme. Deming believes that striving for perfection caused anxiety in organizations along with fear, distrust of management and frustration when the concept was used without the actual performance measurement to support the ideas.

### ***Kaoru Ishikawa***

Ishikawa was the first to introduce the concept of quality control circles. Perhaps his most important contribution to the continuous improvement movement is his “fishbone” cause and effect diagrammatic representation used by consultants and managers world-wide. Ishikawa argued that 90—95 per cent of all quality problems could be addressed by simple statistical techniques that do not require specialist technical knowledge (Ishikawa, 1985). Ishikawa’s approach was to simplify complexities to identify the elements where action is required to make improvements.

### ***Masaaki Imai***

Imai is often referred to as the father of “Lean.” Imai’s trajectory was similar to Deming and Crosby in that he too was a management consultant who introduced the world to continuous improvement through his “Kaizen” philosophy (Imai, 1986). The Kaizen approach is one of continuous improvement with constant and small incremental change in every process leading to improvements. Processes stretch across supply chains so in this context it is important for those involved to be able to work together to improve the whole supply chain. Kaizen is perhaps one of the most useful management tools and philosophies in improving supply chain performance. Each improvement is secured by making the improvement level a standard rather like a mountaineer anchors a position before climbing onwards and upwards to reach new heights of achievement. Kaizen is for long-term, long-lasting improvements resulting from team efforts focusing upon process improvements. Because it uses internal teams it requires less initial investment but requires great effort to sustain the approach.

Kaizen with its focus on continuous improvement removing waste, delays and inefficiencies is the foundation of lean thinking. Lean production is built around Imai’s conception of quality improvement. He set out the principles for Lean in his first book examining Japan’s competitive success and he founded the Kaizen Institute a consultancy for promoting lean practices.

### ***Genichi Taguchi***

Taguchi was an engineer and statistician. Taguchi served as director of the Japanese Academy of Quality and has received the Deming Prize for Quality four times. Taguchi defines the quality of a product as the loss imparted by the product to the society from the time the product is shipped. The loss may include customer complaints, additional warranty costs, damage to company reputation, loss of markets and so on (Taguchi, 1986). Statistical techniques in addition to SPC are used to enable engineers and designers to identify those variables, which if uncontrolled, can affect product manufacture and performance.

Taguchi’s statistical approach built on the work of others particularly Fisher and Gauss, and Markov. He was keen to focus his statistical analysis on the problems of industrial production and realized that target measures were important if people were to understand the nature of the problem. His work suggested that industrial production was a different problem, and he drew comparison with agricultural yield measurements where large numbers were important, carbon emissions where low numbers were important and the need to assess on target minimum variation measures in manufacturing and assembly of parts to achieve standards. Measuring variation around the mean is the basis of the method for statistical process control and it is around his ideas, along with those of Shewhart, Deming, Juran, Crosby and Ishikawa, that Six Sigma is built.

The squared-error loss function is widely used in statistics, following Gauss’s use of the squared-error loss function in justifying the method of least squares. It is this measure that Taguchi adopted to examine target measures rather than monotonic loss functions more suited

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to yield and carbon emission variation. As an engineer he realized the opportunities that his approach presented to design in quality through focusing attention on three issues:

1. System design
2. Parameter (measure) design – reducing variation in manufacture
3. Tolerance design following the Pareto principle that few issue take most time and effort to resolve

***Joseph Juran***

Juran is probably best known for his handbook on quality control published in 1951. This book is updated and still has relevance for the modern supply chain manager. Similar to Deming and Crosby, Juran is a management consultant with an international reputation who also worked in post-World War II Japan. Juran’s main contribution is focused upon “breakthrough” through planning and examining organizational issues and in preventing adverse change through control. He has a four-point plan to achieve his aims:

1. **Establish goals to be reached** – identify what needs to be done, the specific project that needs to be tackled.
2. **Establish plans to reach the goals** – to give structure to the process.
3. **Assign clear responsibility** – make it explicitly clear who is responsible for achieving these goals.
4. **Base the rewards on the results achieved** – feed the results back into the plan to keep it on track – hence control it.

Juran refers to the “quality trilogy” as quality planning, quality control and quality improvement. Objectives must be clearly set annually to increase performance and reduce costs. Development of these goals, plans and structures are the responsibility of top management. Juran took issue with Crosby’s approach claiming it to be simplistic with slogans that do not provide structure, which is important. “There are no shortcuts to quality” according to Juran (1988). Juran’s approach has received wider acceptance than perhaps both Crosby and to some extent Deming, probably because he set clear lines of responsibility and the focus was on detailed planning. This is appealing to practical managers who consider some of the alternative approaches to be more vague.

***Armand V. Feigenbaum***

Feigenbaum’s major contribution was to draw attention to designing quality into processes rather than inspecting quality at the end of the process. This way quality becomes an ingredient rather than a product of manufacturing or service. His conception led to the emergence of total quality control (TQC). He emphasized the role of the customer in the process and stressed that quality did not mean making the best possible item but rather it meant making the best thing at a given price that would satisfy the customer.

In his book, Feigenbaum lists ten essential elements of his approach to TQC which are:

1. Quality is a company-wide process.
2. Quality is what the customer says it is.
3. Quality and cost are a sum, not a difference.
4. Quality requires both individual and team zealotry.
5. Quality is a way of managing.



6. Quality and innovation are mutually dependent.
7. Quality is an ethic.
8. Quality requires continuous improvement.
9. Quality is the most cost-effective, least capital-intensive route to productivity.
10. Quality is implemented with a total system connected with customers and suppliers.

In defining quality Feigenbaum is keen to emphasize the importance of designing quality to meet the customer requirements such that they remain satisfied.

There are quality costs that can be identified as:

- Prevention costs including quality planning
- Appraisal costs including inspection
- Internal failure costs including scrap and rework
- External failure costs including warranty costs and complaints.

A lack of customer focus will result in increased costs related to quality according to Feigenbaum and incurring cost to prevent failure early will lead to sevenfold reduction in total quality cost (Feigenbaum, 1956).

#### ***Walter A. Shewhart***

Shewhart was a statistician who worked for the Western Electric Company at their Hawthorne plant in Michigan in the early part of the twentieth century. Shewhart framed the problem in production processes as arising from two causes, which he labelled assignable cause and chance cause. This was an important distinction and allowed him to develop a simple control chart. Every process displays variation the issue is to understand the root cause of the variation and bring it into control. Shewhart's statistical and mathematical background enabled him to develop a statistical method of process control. Shewhart's two most important rules were to note that:

1. Data have no meaning apart from their context.
2. Data contain both signal and noise. To be able to extract information, one must separate the signal from the noise within the data.

His ideas are applied to operation analysis today through statistical process control to identify controlled and uncontrolled variation within processes (Shewhart, 1931).

#### **Management approaches to achieving quality**

Six Sigma, total quality management, Kaizen – continuous improvement, zero defects, quality management systems (QMS) and just-in-time (JiT) are management systems that continue to make large contributions to the improvement, maintenance and performance of quality across supply chains and within individual organizations. Six Sigma and statistical process control charts are examined in the next section.

#### ***Statistical process control charts (SPC) and Six Sigma***

The most commonly used statistical process control charts are  $\bar{X}$  and R for control variables. They are typically used for situations in which the quality variable to be controlled is



a dimension, a weight or other measurable characteristic. In practice the two charts are used together with the  $\bar{X}$  to monitor absolute value or the location of process average and the R chart to measure dispersion (the range) of the output distribution. ==

In most applications the  $\bar{X}$  control chart limits are set at  $\bar{X} \pm 3$  standard deviations of the  $\bar{X}$  value (i.e., 3 sigma limits). The frequency distribution of measures used in constructing control charts are distributions of averages, not measures of individual values produced by the process. This fact ensures that the distribution is statistically normal when the process is in control. Six Sigma is the range ( $\pm 3$  sigma limits) of the chart and accounts for 99.9 per cent of the  $\bar{X}$  values that result from the process operation as long as only natural random variables occur. An example of such control charts is shown later in this section.

In the example the  $\bar{X}$  control chart shows five frequencies with an upper control limit (UCL) = 1004.3 and a lower control limit (LCL) = 995.36. The average around which the measures occur is 1000. The data comprises individual sample measures taken for 32 sub-groups. The readings were taken at 15-minute intervals over an eight-hour shift. They measure pipe diameters. The measures for the sub-groups are then summed and the average  $\bar{X}$  is computed. It is the average of the averages for each sub-groups sample. An average of the subgroup range values is then taken  $\bar{R}$ . The  $\bar{X}$  value 1000 is used as the process average on the chart. The  $\bar{R}$  value represents the mean value of the range of diameter sizes found in each sub-group and is the average range value used on the chart. Ninety-nine point nine per cent of the data falls within these ranges and are normally distributed. The interpretation of the chart is relatively simple any points outside the control limits are usually explained as a non-random variation. *If this process were in control, it would only happen three times in any sub-group inspection.* The appearance of other non-random patterns may also be observed. An unusually large number of points in sequence on the same side of the average line provide an indication that a process is out of control. Clear-cut trends of points in one direction may indicate an adjustment problem or a problem with wear on a tool. In either of these cases the process should be stopped, and the problem investigated (Figures 11.2 and 11.3).

Six Sigma is both a measure ( $\pm 3$  standard deviations from the mean) and a set of techniques and tools for process improvement. Six Sigma was developed by Bill Smith back in 1986 when he worked for Motorola along with Mikel Harry they were brought in as quality consultants. The aim is to remove defects in the production system to improve quality. Designed to minimize variability. When Six Sigma is reached 99.9997 per cent of production achieves the standard. Normal production is within  $\pm 3$  standard deviations of the mean. It is a point also referred to as zero defects as the chance of being defective is almost zero 0.01. DMAIC is an acronym of steps involved to achieve Six Sigma: Define, Measure, Analyse, Improve and Control. You can see other measures indicating higher levels of defects below.

**Six Sigma = 3.4 defects per million or put another way 99.99971 per cent perfect.  
Other measures are:**

- 5 sigma = 230 defects per million
- 4 sigma = 6210 defects per million
- 3 sigma = 66800 defects per million
- 2 sigma = 308000 defects per million
- 1 sigma = 690000 defects per million

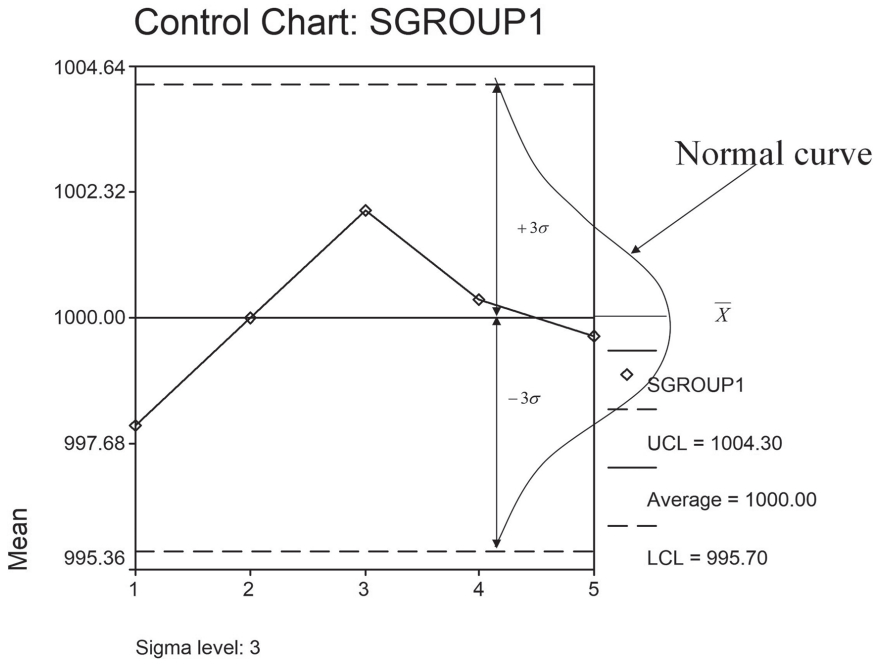


Figure 11.2 Statistical process control chart (a)

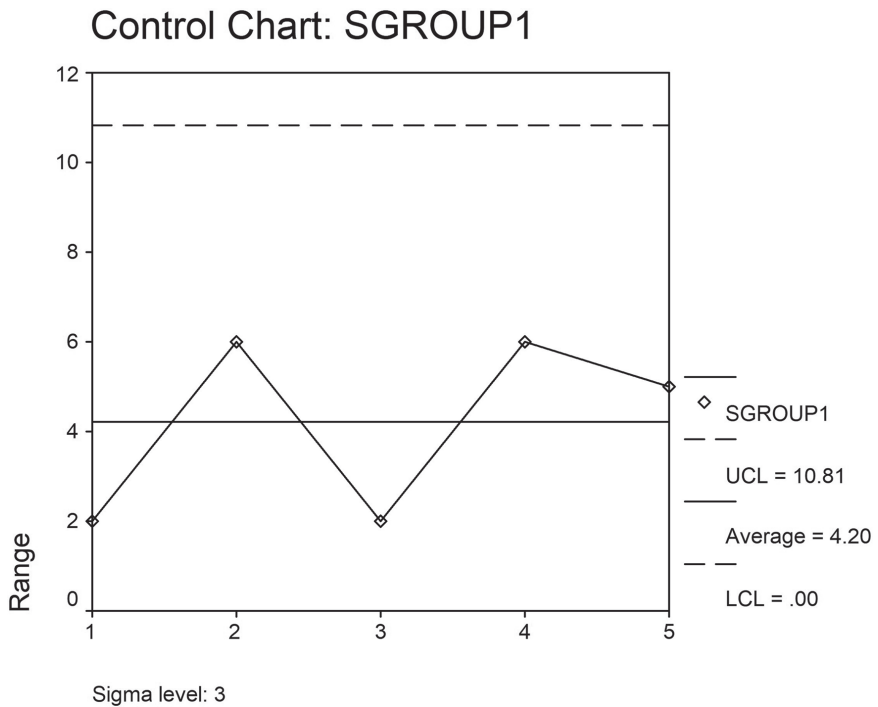


Figure 11.3 Statistical process control chart (b)

*Error chain analysis (ECA)*

When it comes to keeping product quality free from defects another interesting prospect is to examine multistage manufacturing processes examining existing control measures. The purpose is to identify where stricter controls may be needed to ensure quality is free from defects in manufacturing processes (Dockree et al., 2021).

***Standards***

The International Standards Organization (ISO) was set up in 1947 and is based in Geneva.

ISO has a membership of 162 national standards bodies from large, small, developed and developing nations. It is now the international standard setting body recognized by all member organizations that have achieved ISO certification around the world. Organizations are required to document processes and demonstrate compliance. There has to be an audit trail of evidence.

The quality movement has gained support from organizations reaping the benefit of implementing these tools and techniques to achieve quality improvements. A number of awards have been made, such as the European Quality Awards and Best Practice Awards both of which take place annually. A number of standards have been set for quality that are both national and international in nature. For example, BS5750 was the British Standard for quality, which was superseded by the European Standards ISO9000 in 1987. ISO9000 has been revised a number of times. ISO9000:2000 quality management systems requirements merged the old standards 9001, 9002 and 9003 and addresses the ability of the organization to meet customer and regulatory requirements, and thereby customer satisfaction. It is now referred to as the ISO9000 family. ISO9001 is the actual standard to which an organization's quality management system can be certified. ISO9001:2015 is the current standard. This is probably the most important standard for supply chain managers.

ISO has several standards that are relevant for supply chain management, including ISO22301 for business continuity management, ISO27001 for information security management, ISO14001 for environmental management and ISO9001 for quality management. These standards help organizations prepare for disruptions, secure information, minimize their environmental impact and proactively manage their supply chain. The ISO has published more than 24,500 standards during its lifetime. For complete details of standards see *www.iso.org*.

***Quality function deployment (QFD)***

QFD is a disciplined approach to problem solving. It is also called house of quality (HOQ). Japanese shipyard workers at Mitsubishi's Kobe site developed the technique. Many organizations have since used the technique including Toyota, Ford, GM, AT&T and Procter & Gamble. The strength of approach is its ability to draw together different views (knowledge and experience) from across the organization in addressing the needs of the customer.

***House of quality example – mobile phones***

HOQ measures how well the organization can match customer requirements by building a house of quality. Firstly, customer requirements have to be established from market research. The rank importance of each requirement is obtained through survey data using a Likert scale one to five or one to nine. In the example, one to five is used with one being low importance and five being high importance. Product attributes are identified and then measured against the customer requirements. In the example this has been done using a better, same worse scaling where high relationships equal five and low relationships equal one. Importance ratings can then be calculated by multiplying the

two values for each attribute. The organization may have pre-established target values it wanted to achieve and these are shown too (in the basement of the house). In the example, the keypad and VDU are slightly lower than the target. The correlation matrix in the roof of the house identifies potentially difficult trade-offs. For example, the handset is highly correlated with the keypad and the VDU meaning that changes to the handset will impact on both the keypad and VDU design. Similarly, the keypad is correlated with the VDU meaning a change to one will affect the other.

The stages are:

- Identify what the customer wants.
- Identify how the good/service will satisfy customer wants.
- Relate customer wants to product how's (in the example, handset, keypad, VDU).
- Identify relationships between the firm's how's.
- Develop importance ratings.
- Evaluate competing products – this can be done by identifying competitor offerings and adding a column for each one at the right end of the house and scaling them against the criteria set by the customer.

An example is given in Figure 11.4 that defines customer requirements for a mobile telephone. The ratings are developed from an average of all customer survey data. The rank order of importance in this example is:

1. Functionality = 5
2. Convenience = 4

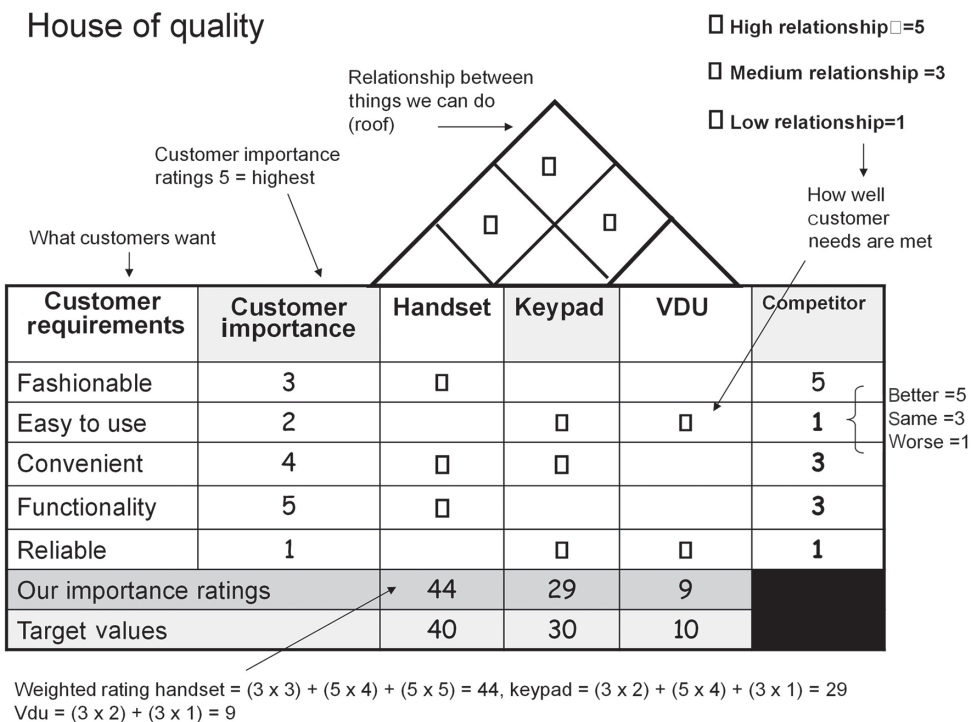


Figure 11.4 QFD house of quality

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3. Fashionable = 3
4. Easy to use = 2
5. Reliability = 1

Symbols have been used but we could equally have simply used the numbers throughout. Sometimes the roof is used to identify correlation distinguishing between positive and negative correlation using (p) or (n) to do so.

The technique is particularly useful in designing goods and services that meet customer expectations.

### Summary

This chapter has introduced a number of important supply chain concepts linked to quality and performance. It began by examining how supply chain profitability can be achieved. Time to market, quality and innovation were identified as key influencing factors. These are often major influencing factors to increase sales revenue. Total cost of ownership was then discussed in the context of how organizations can take supply chain action to lower total cost. Quality management is inexorably linked to competitive performance and a number of key practitioners who have made major contributions in the field were identified before explaining management approaches to quality. Finally, statistical process control and the concept of Six Sigma were explained, as was the technique of quality function deployment (QFD) or the house of quality as it has also become known.

### Discussion questions

1. For an organization of choice select a process and discuss issues relating to quality improvements that could be implemented and explain how the quality improvements identified would impact upon supply chain profitability.
2. Supply chain profitability is relatively a straightforward matter. Organizations may either lower cost and/or increase revenues. Discuss.
3. World-class organizations focus on time, quality, innovation and cost. Discuss.
4. How can organizations lower their total cost of ownership?
5. What impact will lowering the TCO have on profitability in:
  - (a) The supply chain?
  - (b) The customer?
  - (c) Supplier behaviours?
6. Quality management is sometimes over engineered. Discuss.
7. Why is it important to have quality standards and what are the implications of standards for supplying organizations?
8. Explain why statistical process control is an important concept for managing quality.
9. Designing quality in and cost out is essential in competitive markets. Discuss.
10. Explain what you understand by the term “Zero Defects.”

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## 12 Logistics and fulfilment strategies

### Introduction

Goods must be moved and stored at different stages in supply chains be those raw materials, components, sub-assemblies and finished goods. For example, some manufactured products might employ extracted metals which are transported to another part of the world where they are transformed into usable raw materials and then transported again to many different locations where they are turned into inputs for the next manufacturing process before becoming components or sub-assemblies and shipped again to where they are required. At each of the stages materials cross borders incurring tariffs, documentation is required and costs are mounting. Not until the products are sold at an intermediate or final stage in a supply chain do they add value and earn a return on investment.

From a strategic point of view several key decisions need to be taken by organizations when it comes to investment in logistics and fulfilment facilities. There are decisions relating to who should do it (the company or a third-party), where to locate facilities in relation to markets and operations and how to plan for increasing or reducing capacities. Issues relating to stores centralization and decentralization, types of building, layout, storage methods and handling equipment are also important considerations. This is a very important part of the organization's strategic decision-making and an area that can make the difference between satisfied customers or disgruntled customers, affect profit and loss, responsiveness, flexibility, quality of service and capabilities to meet market demand effectively.

Logistics and fulfilment are essential operational activities performed by all organizations delivering customer service. Benefits have occurred through the application of better communication systems including use of bar codes and RFID tracking together with voice technology. Initially, voice technology was used to guide pickers in the warehouse to specific locations (Kaplan, 2002). It is now an essential part of the logistics function inside the warehouse and on the road.

An important part of the process is warehousing which has been described as that part of an organization's transport system where goods are travelling at zero miles per hour. It is part of a total logistics system that stores raw materials, work-in-progress and finished goods at and between points of origin and point of consumption (Murphy & Wood, 2004, p. 299). Storage can take place at warehouses or distribution centres, the latter being for rapid movement of inventory to where they are in demand to maximize throughput. Faster throughput time means faster stock-turnover, lowering holding cost for inventories. Warehousing allows regrouping in a supply chain and can take four forms: accumulation (bulk-making), allocation (bulk-breaking), assorting and sorting.



### A retail example

Deliveries from several suppliers of clothing arrive at a central warehouse (*accumulation*), where they are divided into store order quantities for delivery (*allocation*) but first they need to be sorted by style, size and colour (*sorting and assortment*).

Stock and Lambert (2001, p. 391) comment that warehousing is required for the following reasons:

- To achieve economies of transport.
- To achieve economies of production.
- To take benefit from economies of purchase.
- To maintain supplies.
- To support customer service policies.
- To meet changing market conditions (e.g., disruptions to supplies through war, strikes, natural disasters and accidents; fluctuations in demand, seasonality and competition).
- To overcome time and space differentials existing between consumers and producers.
- To achieve lowest total logistics cost by balancing trade-offs to deliver the agreed level of customer service.
- To support JiT systems.

### Trucks, trains, ships and planes

Modes of transport are important decision to moving goods through supply chains. Logistics was worth over \$8.4 trillion in 2020 according to Statista. This includes freight movement and storage. It represents 10.7 per cent of global GDP. Those involved in the industry range from small firms, including one person businesses to multinational companies. The Asia Pacific Region is worth half of this (\$3.9 trillion) followed by the United States (\$2.1 trillion) with about one quarter and Europe just under that at (\$1.6 trillion). Africa (\$345 billion), South America (\$343 billion) and CIS (\$328 billion) (Statista, 2021). In the United Kingdom 77 per cent of freight is moved by road, 14 per cent by water (canals, rivers, sea) and just 3.9 per cent by rail. Air freight is very low within the United Kingdom. Sea freight brings 95 per cent of the UK's imported goods. The largest container port in the United Kingdom is Felixstowe. More than 85,200 vessels delivered goods to UK ports in 2021. Annual statistics provided by the US, UK and EU governments provide detailed breakdowns by category of goods. They also provide estimates of the contribution of CO<sub>2</sub> emissions for each too. So you can identify which are the most polluting.

Liquid bulk makes up 37 per cent of shipments such as oil products and gas. Liquefied natural gas (LNG) is shipped in tanks cooled to -160 degrees Celsius. This changes the gas to liquid form for transportation which lowers the volume of cargo increasing the quantities that can be shipped. Milford Haven handles 53 per cent of LNG imports. There is also direct pipeline gas.

The growth in container traffic and the rise in the size of vessels has been phenomenal in the past decade. Twenty-foot equivalent units (TEU) is the standard box size which all statistics use. The largest ports and largest volumes are in China. Felixstowe is 55th in a world league table; all British ports are small in relation to the top 50. Table 12.1 shows the leading ports in each of the regions listed.

Table 12.1 Ranking of world container ports by TEU

*Leading container ports in the world in 2022*

Port	2022 (TEU)	2021 (TEU) change	Percentage change
<b>EUROPE</b>			
Rotterdam	14455000	15299970	-5.52
Antwerp	13500000	14200000	-4.93
Hamburg	8300000	8700000	-4.60
Valencia	5052272	5604478	-9.85
Algeciras	4762808	4799497	-0.76
<b>UNITED STATES</b>			
Los Angeles CA	9911159	10677610	-7.18
New York/New Jersey	9493664	8985931	5.65
Long Beach CA	9133657	9384468	-2.67
Savannah GA	5892131	5613163	4.97
Houston TX	3974901	3482375	14.14
<b>CHINA</b>			
Shanghai	47300000	47030000	0.57
Ningbo-Zhoushan	33350000	31080000	7.30
Shenzhen	30040000	28770000	4.41
Qingdao	25670000	23710000	8.27
Guangzhou	24500000	24180000	1.32
Tianjing	21020000	20270000	3.70
<b>UNITED KINGDOM</b>			
Felixstowe	3700000	3500000	5.71

Sources: Adapted from worldshipping.org, uppy.com, consumingfuture.com, supplychainadvantage.com

**How much global trade travels by sea?**

About 80 per cent of global trade by volume and 70 per cent by value travels by sea freight and 60 per cent travels from Asia with one-third of maritime trade travelling through the Straits of Malacca and through the South China Sea (Cordesman et al., 2019). Figure 12.1 summarizes global sea trade. Trade passing through the South China Sea is valued at \$3.71 trillion. Europe and the United States are heavily reliant on these trade routes. Sea freight is one of the biggest disrupters when it goes wrong the impact is high and the interconnected supply networks feel the full effect with many businesses and consumers detrimentally affected. Fifty-two per cent of dead weight tonnage (DWT) is under control of just five nations: Greece 18 per cent, China 11 per cent, Japan 11 per cent, Singapore seven per cent and Hong Kong China five per cent. Sixteen per cent of all merchant ships are registered in Panama. The beneficial ownership will of course be located elsewhere.

**Pandemic disruptions to trade**

Even prior to the recent disruptions some signals were already emerging from the noise. The sharp increase in the cost of hiring 20 ft. and 40 ft. sea containers had risen with 40 ft. boxes rising from around \$4,000 to \$10,000—\$12,000 moving freight from China to the United States. Moving goods in a 40 ft. container from Shanghai to Rotterdam is costing in the region of \$10,000—\$11,000 up by 350—400 per cent on prices last year. This will feed into business costs and consumer prices in the months ahead. Price inflation is likely

to increase as the shortage of boxes intensifies. Most of the world's sea containers are manufactured in – you've guessed it – China. Many boxes are tied up in the supply chain as they remain at ports, on ships and elsewhere because it is taking much longer to complete shipments than it did prior to the pandemic. This extra time is adding to the pressure on the existing container stocks. Three in four containers returning from Los Angeles to China do so empty. Maersk estimate it costs them \$1 billion to ship and reposition empty containers annually. Most shippers want their empty containers in Asia for the next pick up. There is also a mismatch of increased demand to shrinking supply for transport.

Source: Tony Hines blog, Hines (2021)

**Facts about the boxes**

It is estimated that there are 93,161 maritime vessels (Hines, 2021), 5,222 of these are container ships. Figure 12.2 provides a summary picture. This number is expected to rise significantly with investment in new capacity underway. The capacity of container boxes in use is estimated at 38.5 million dead weight tonnage (DWT). This is the weight of everything on board a vessel including cargo, people, water, ballast, fuel, food and crew. Around 1,400 containers are lost at sea annually on average. Sometimes, but not often, a whole ship sinks which pushes averages upwards. In a normal year up to six million containers are manufactured usually in China where they make 97 per cent of all containers. There are two standard boxes known as the 20 ft. and 40 ft. container with a height of 8' 6" (high cubes are 9' 6"). While the 40 ft. box is exactly that the 20 ft. box is 19' 10". In addition, there are six million high cubes which are 9' 6". These containers make about 200 million trips p.a. equivalent to 811 million 20foot equivalent units (TEU) carrying \$4 trillion in container cargo value. They travel to 150 ports in over 80 countries.



Figure 12.1 Summary of global sea trade

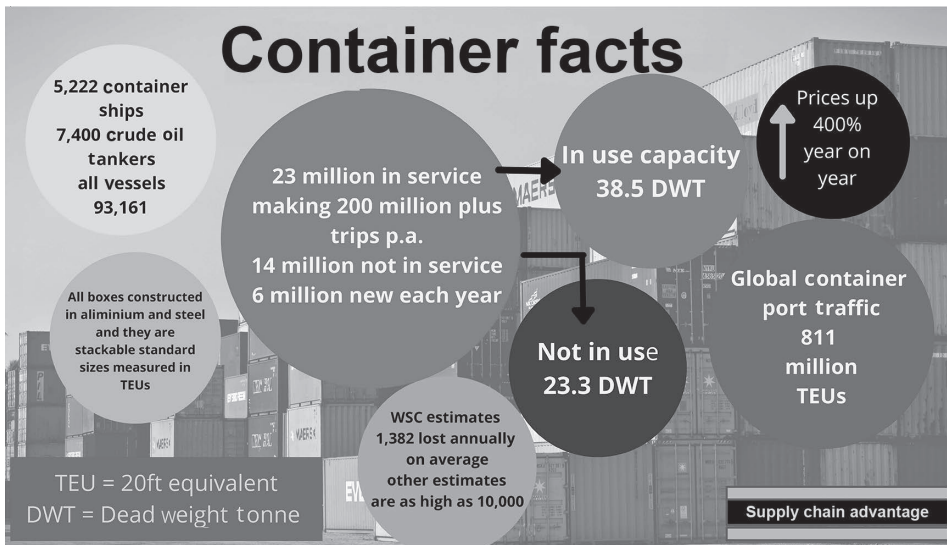


Figure 12.2 Container box facts

There is no complete register of containers but best estimates suggest that there are:

- Twenty-three million shipping “in service” containers or 38.5 million TEU (of these about 67 per cent are 40 ft. and 33 per cent are 20 ft.).
- Fourteen million not in service shipping containers or 23.3 million TEU.
- Six million new shipping containers or ten million TEU added annually.

Total 43 million shipping containers or around 72 million TEU.

So, if there are 23 million containers in use, 14 million not in service and six million new boxes added each year it appears that there are close to double the number of boxes available than are currently in use. This suggests that the efficiency level in container utilization is exceptionally low compared to other parts of the supply chain. So where is my box? There have obviously been disruptions due to Covid-19, but is this sector doing enough to remedy the situation? In normal times, pre-pandemic demand was obviously more predictable and less volatile than it is today. Inefficiency is disguised when you can operate at lower volumes. So, it maybe that there has been no urgency to improve customer service until now.

The standard shipping container was introduced in 1956 by American entrepreneur Malcolm McLean. He created the standard cargo container, which is basically still the standard today. McLean was driving trucks and thought the loading and unloading could be improved by using a standard box which he worked to develop. McLean set about designing a standard box that could be transported by truck, train and ship. It changed all three modes of transportation forever. It was the beginning of what we now call multimodal transportation. In April 1996 McLean refitted an old oil tanker to carry his boxes, 58 of them from Newark to Houston. One person’s experiment “made the world smaller and the world economy larger.” It reduced transport costs and economies of scale were achieved by building bigger and bigger container ships that drove many traditional shippers slowly out of business. It also changed dock work and dock labour practices as much of the handing was later done by machines rather than people, which

the container boxes facilitated. The box facilitated the global supply chains we observe today (Levinson, 2006).

### ***Reverse logistics***

Reverse logistics is the big issue to be tackled in shipping. It doesn't make sense to move empty containers on large ships halfway round the globe in large quantities. Maersk alone moved four million boxes empty to get them to where they were needed. Maersk has 16 per cent of the market in shipping containers. Improvements were made in road haulage transport when attention was paid to backhauling rather than returning empty so perhaps this is one area that needs attention if bottlenecks are to be avoided to make the supply chain more resilient. One suggestion has been for shippers to co-operate by sharing containers so that the empty box is reused at the destination port by other shippers to improve efficiencies. It cannot be that difficult in the digital age to set up a digital register of containers so that shippers have visibility to allocate, reuse and return boxes to ports of origin or somewhere else where it is needed. This simple step would make a significant contribution to reducing the carbon footprint of shippers.

### ***When ships are delayed***

When shipping lines carry containers to a port of discharge where cargo is unloaded, they request permission to enter and dock at an unloading berth where the containers are lifted off the ship. Usually, they are loaded either directly on to waiting transport where they are either moved directly to their onward destination or to a storage facility. If cargo gets stuck at a port for longer than the permitted berth time, it incurs charges known as demurrage. These fees are expensive. They are an incentive to get things moving. Excessive delays can incur costs greater than the value of the container cargo. Containers are often provided by shippers and they expect them to be returned to use as soon as possible after discharging cargo. Customers return them to the allocated port where they are picked up and put back in use. The shipper may have to move them to a pickup port.

*Detention Charge:* The customer picks up the container from the shipper and loads the cargo in the box wherever they have the goods stored. The container is then delivered to the embarkation port. There is a time allowance for doing this part of the operation. If the customer keeps the container longer than that time they incur a detention charge. If customers exceed the free day allowances that shippers give they have to pay detention charges until they are returned to use. Ten years ago it was rare to have detention charges. Nowadays such charges can be \$100 per day so you can soon run up a large bill.

*Demurrage Charge:* Once the container is inside the port again there is a time allowance for any loading or unloading. If this is exceeded, then demurrage charges apply.

### **Third-party logistics (3PL) – outsourcing the logistics function**

Dragan (2002) estimated that contract warehousing expenditure in the United States was worth \$20 billion and expected to grow by as much as 25 per cent in the next few years. Knemeyer and Murphy (2004, p. 35) estimate that users of third-party logistics services may be spending an average of one-third of their total logistics budget by 2005 compared to one-fifth today on 3PL. This demonstrates just how important outsourcing has become and illustrates the rising trend in practice. However, some commentators have argued that the supply of 3PL warehousing and

transportation have become commoditized to some extent and that suppliers need to enhance service provision particularly those associated with mass-customization and postponement (R.I. van Hoek, 2000). Security might be an important decision variable for organizations making choices whether or not to outsource warehousing (Labetti, 2002; Morton, 1999). Hazardous waste materials may be another consideration (Graham, 2002).

In recent years there has been a further development referred to as fourth-party logistics (4PL) which essentially involves one lead logistics supplier in coordinating a number of 3PL suppliers for the contracting organization. Essentially the 4PL source manages the logistics service on behalf of the contracting customer. The main benefits argued for 3PL and 4PL outsourcing is similar to that for most outsourcing decisions and includes:

- Cost uncertainty reduced since the contract specifies pre-determined costs.
- Risk is lowered.
- Maintenance costs are lowered.
- Specialist knowledge and skills bought-in from supplier (do not have to develop them yourself associated training and personnel costs lowered).
- Specialist carriers invest in state-of-the-art equipment and supporting technologies from which the customer can benefit without incurring capital costs.

### **Trade-off concept**

The trade-off concept is very important in the effective management of supply chains. No more so than in logistics and fulfilment strategies. It usually involves an algorithm of cost decisions between two or more variables that can be offset against some benefit of achieving an objective. For example, holding inventories (stock) involves the organization incurring costs (stock, warehouse and facility costs, labour, insurance and so on). To lower cost the organization may decide to put more resource into carefully planning just-in-time (JIT) deliveries. If the organization has selected reliable suppliers and agreed service standards, then it should be able to remove some of its fixed costs (overheads) in relation to warehousing that it would have previously incurred. You don't need a large warehouse if you can get stock just in time.

The classic trade-off is between the number of warehouse facilities required and transport cost is illustrated in Figure 12.3.

### **Definition of warehousing**

Storage is the physical holding of inventories awaiting transport to customers. There are a number of types of inventory that are held by organizations which include:

- Goods and other assets purchased for resale.
- Consumable stores.
- Raw materials and components purchased for incorporation into products for sale.
- Work-in-progress, which includes all sub-assemblies and partly finished goods.
- Long-term contract balances.
- Finished goods.

Storage of these items is an important "trade-off" decision. Should an organization incur the cost of storing items to deliver customer service levels or should it design systems, policies and procedures that ensure rapid delivery avoiding storage? This is a key question facing supply



### The classic trade-off in logistics fulfilment

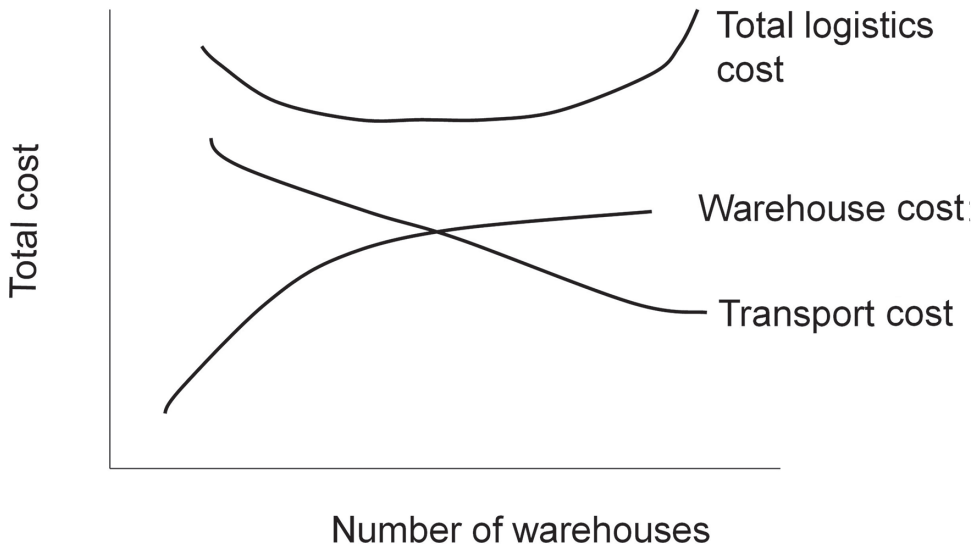


Figure 12.3 Logistics fulfilment trade-off

chain managers. There are no easy answers to this question and it will be a decision that is made considering the effect of various trade-offs.

#### *Size may be an important dimension*

Size of organization may be an important influencing factor in the decision and the bargaining power that an organization is able to apply. Large organizations are often able to exert influence over their smaller supplier organizations to store and supply as and when required operating JiT systems. Smaller suppliers may have little choice but to incur the storage costs and to design their supply facilities and systems to deliver effective customer service to these larger customers. Failure would simply result in the supplier being replaced by another supply source that could meet the requirements.

#### *Storage, inventories, working capital and customer service*

Historically the emphasis on storage and warehousing was a means of holding inventories to meet internal and external customer needs and a means of avoiding loss through wastage, deterioration, theft and obsolescence. The current emphasis is on the movement of inventories. According to Lysons (2000, p. 360) there are a number of important issues to be considered:

- Acknowledgement that reducing warehousing and storage costs is essential.
- Automated stores and computerised systems make it possible to better manage these facilities.
- Trade-offs between higher customer service levels, low inventory and low operating costs need to be balanced.



320 *Logistics and fulfilment strategies*

- Changes in business practices through the implementation of JiT and kanban concepts.
- Better logistics systems.
- “Time compression” reducing time consumed in business processes. Elimination of non-value-added time.

Figure 12.4 illustrates the trade-offs involved in achieving conflicting objectives of high customer service levels and low inventories and operating costs. In the operating cycle shown, the cycle begins with procurement, inbound logistics and conversion operations, goods are then sold and distributed to the customer. The organization has a number of conflicting objectives which are:

- Keep inventories low.
- Meet customer demand by being responsive to their needs.
- Minimize operating costs by being efficient.
- Minimize funds tied up in working capital.

The tensions and possible trade-offs between these objectives is indicated by the arrow lines.

Store operations are an important aspect of all businesses and the processes involved include:

- Receiving goods inwards or from other departments in the same organization.
- Inspection of these inventories.
- Recording the receipts manually or using computer systems.
- Security – (avoiding stock-loss, e.g., theft or misplacement).

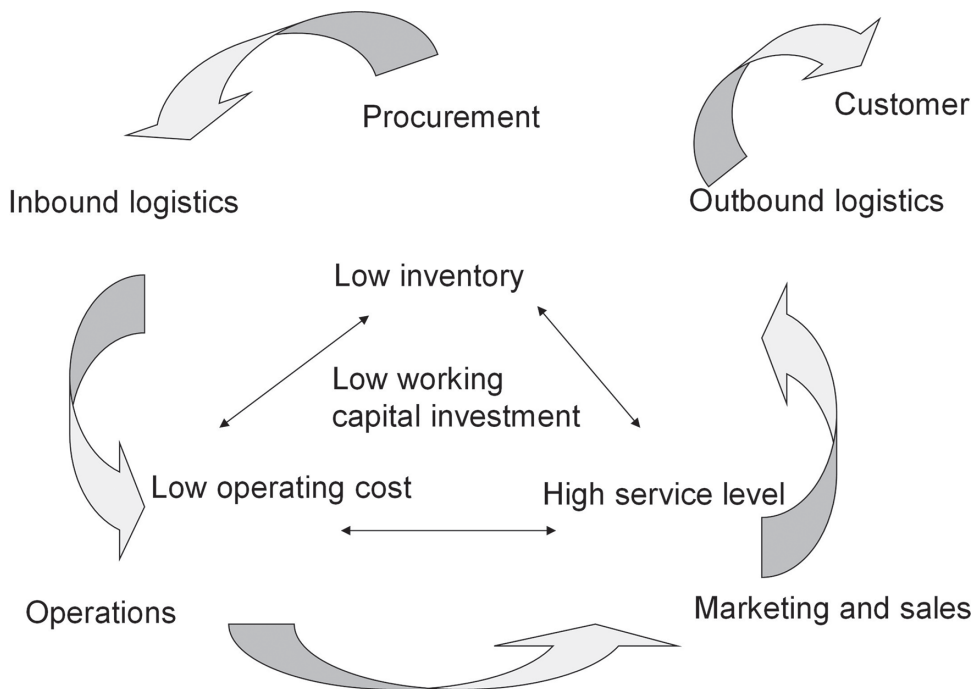


Figure 12.4 Supply chain strategies employed to manage trade-offs

- Maintenance – protecting the inventories against loss through deterioration (e.g., by fire, water, vermin).
- Stock control – determining ranges, quantity, and quality. Dealing with receipt and issues.
- Stock-taking – verification of stock records by reconciling paper/computer record with physical stock. These inventory counts can be done at regular intervals (weekly, monthly, quarterly, six monthly or annually) – that is, cyclically or they may be done continuously.
- Disposal of surplus stocks (*scrap* – salvageable, re-usable has a value, *redundant* – no value to the organization but may have a value in another organization and is saleable or *obsolete* items which need to be disposed of but have no value to anyone).
- Retail organizations may simply have store stock and stocks held in RDCs that they want to push through their retail organization as quickly as possible to generate cash and to avoid the various costs indicated. In these circumstances they will “mark-down,” that is, discount the retail price in the hope of moving stock quickly through the system.
- Compliance matters including the implementation of personnel policies in relation to stores staff. Legal compliance issues such as Health and Safety regulations are also important.

### Location of storage facilities

Decisions relating to where to locate facilities to achieve efficiency, economy and customer responsiveness are strategic supply chain decisions in relation to logistics fulfilment. Murphy and Wood (2004, p. 256) identify two commonly used approaches to finding the lowest cost location, which are the “centre of gravity” and the “grid system.” The two approaches are illustrated in Figure 12.5. In the illustration of the centre of gravity approach, a map is used to identify a location which minimizes distance between distribution centres, stores and the central warehouse. A grid system could be overlaid on the map to ensure that the distances are optimized. In the illustration of the grid system, it shows that the best location for a central warehouse

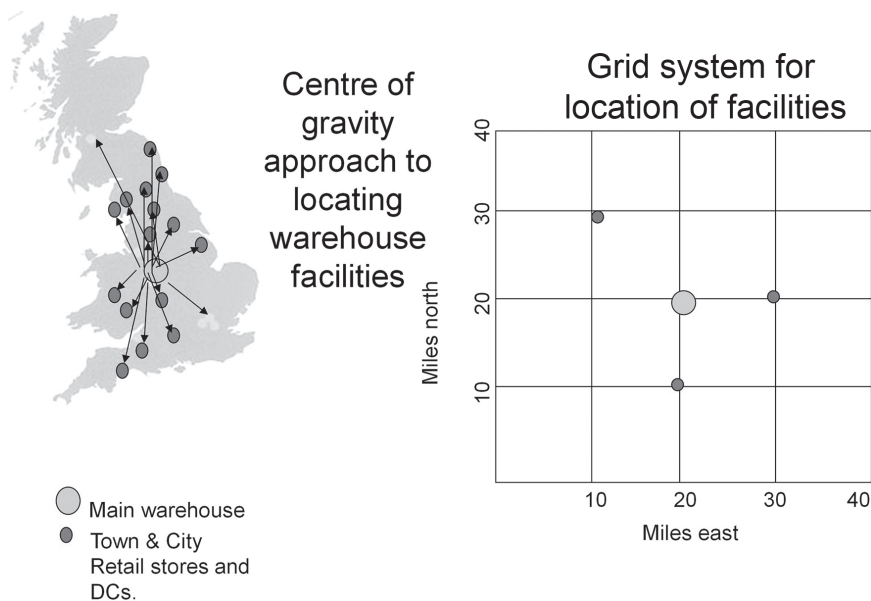


Figure 12.5 Locational choice of storage facilities

Table 12.2 Locational decision data

Store	North	East	Monthly volume tonnes	North x volume	East x volume
1	30	10	5	150	50
2	10	20	6	60	120
3	20	30	4	80	120
Totals			15	290	290
	Weighted average			19.33	19.33

Table 12.3 Weighted average from locational decision data

Store	North	East	Monthly volume tonnes	North x volume	East x volume
1	30	10	10	300	100
2	10	20	6	60	120
3	20	30	4	80	120
Totals			20	440	340
	Weighted average			22.00	17.00

between three stores plotted on the grid is at grid location 20 miles north and 20 miles east. Each store is ten miles from the facility.

Supposing additional data such as the monthly delivery volumes were obtained, and a table constructed to compute the weighted average centre of gravity for the facility warehouse in the grid system.

The three stores and monthly volumes are used to compute the weighted average centre of gravity as shown Table 12.2. The result is that the optimum location for the warehouse in the example is 19.33 miles north and 19.33 miles east. Monthly volumes have influenced the small shift in location. The danger in adopting this approach is obvious. If volumes are accurate and likely to remain stable, there is little problem in making the location decision as explained. However, should volumes be volatile then the decision may not be optimum in the longer term. In the example, it would not matter too much because the weighted average centre of gravity has not shifted greatly. However, supposing the store volumes remained the same for stores two and three and doubled for store one. The decision would change to 22 miles north and 17 miles east owing to the higher volumes. This is shown in Table 12.3.

Equations to calculate the centre of gravity location point using grid coordinates on x and y scales.

$$C_x = \frac{\sum_i d_{ix}W_i}{\sum_i W_i} \qquad C_y = \frac{\sum_i d_{iy}W_i}{\sum_i W_i}$$

$d_{ix}$  = x coordinate of location  $i$

$W_i$  = Volume of goods moved to or from location  $i$

$d_{iy}$  = y coordinate of location  $i$

n.b. Examples in the tables have used this method using an Excel spreadsheet.

**Location decisions applying cost-volume analysis**

Another possible analytical tool in deciding location based upon cost and volumes is the break-even tool.

Table 12.4 shows the decision costs of locating a warehouse at three locations. The costs are identified as fixed costs that do not vary with volumes at each location, for example, building costs; and variable costs, that is, costs that are associated with each unit handled at that location and vary with volume. The volume handled in a period is forecast to be 5,000 units. It is now possible to compute a total cost of operating the facility for the period. Results are shown in Table 12.5.

The lowest cost location is Liverpool, Manchester is second and Warrington third in the example. A break-even chart for the data showing crossover points is illustrated in Figure 12.6. The cost volume analysis indicates that Warrington would be the lowest cost for very small volumes up to 667 units, Manchester would then become lowest cost up to volumes of 2667 units and after that Liverpool is lowest cost location.

**Geographical Information Systems (GIS)**

GIS systems such as Mosaic and Microsoft MapPoint use geodemographic data to optimize locational decisions. Combining data from different sources: census, road maps, maps locating rivers, mountains, lakes, forests, utilities, airports, universities, colleges, schools and hospitals; it is possible to optimize locational choices according to different objective criteria. Geographical information systems are used by retail organizations to make location decisions for retail stores. Commercial property organizations may use GIS to site commercial property, entertainment centres, shopping centres, hospitals and other facilities. Businesses may use GIS to determine their head office location considering criteria such as quality of life, quality of personnel, transport links, other facilities and costs.

Table 12.4 Fixed cost, variable cost and volume data

<i>Data</i>			
	Liverpool	Manchester	Warrington
Fixed cost	£70,000	£90,000	£50,000
Variable cost	£30	£45	£60
Volume	5000	Units per period	

Table 12.5 Locational break-even points

<i>Results</i>			
<i>Breakeven points</i>	<i>Units</i>	<i>STG pounds</i>	
Liverpool vs. Manchester	-1333.333333	30000	
Liverpool vs. Warrington	666.666667	90000	
Manchester vs. Warrington	2666.666667	210000	
Volume analysis @ 5000 units			
Total cost	Liverpool £220,000.00	Manchester £315,000.00	Warrington £350,000.00

**Rating scales and location decisions**

Finally, a commonly used method of making locational decisions is to use a rating scale against specific criteria determined to be important to the decision maker. An example is given in Table 12.6. Several criteria are identified and then weighted in order of importance to the decision. Each criterion is marked using a scale, which in the example is 1–10 but 1–100 or another appropriate scale could be chosen. The key is to choose a scale large enough to discriminate between criteria.

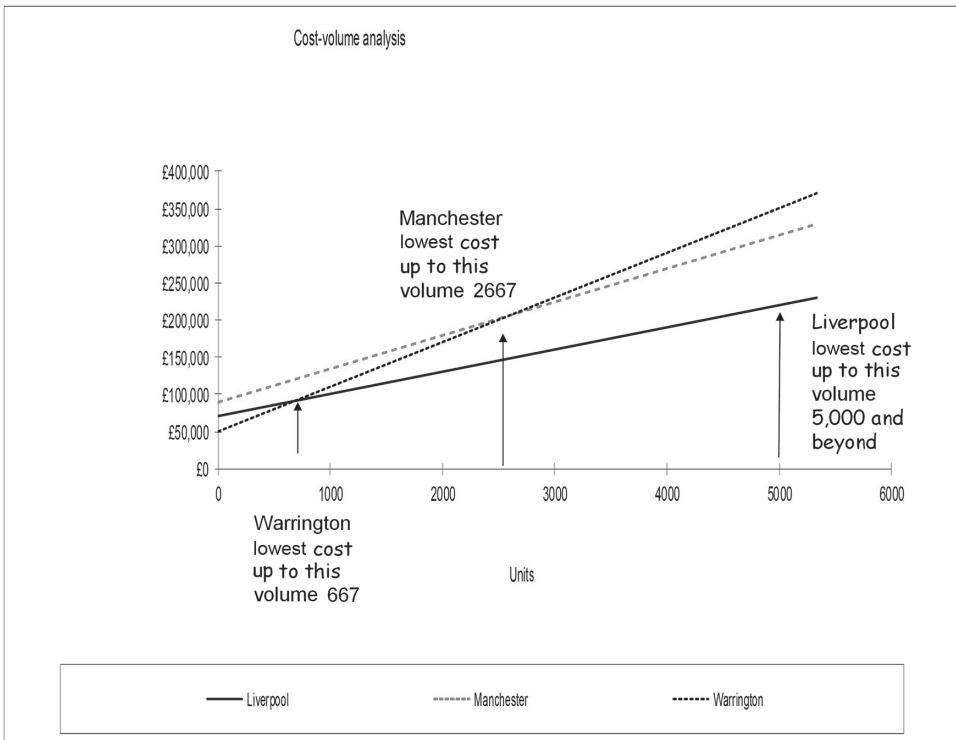


Figure 12.6 Cost-volume analysis applied to facility choice

Table 12.6 Rating scales and locational decisions

<i>Data</i>	<i>Weight</i>	<i>Chester</i>	<i>Manchester</i>
Labour availability and attitude	0.25	6	5
People-to-car ratio	0.05	5	5
Per capita income	0.1	5	7
Housing quality	0.05	7	6
Cost of labour	0.4	7	5
Education and health	0.15	7	5
Results			
Total	1		
Weighted sum		6.45	5.25
Weighted average		6.45	5.25

## **Types of storage facility**

Warehousing operations can range from traditional, manual methods to advanced automation technologies. Mechanical warehousing refers to traditional methods of managing inventory and moving goods within a warehouse using manual labour. Semi-automated warehousing involves a combination of manual labour and automation technologies to improve efficiency and accuracy. Technologies might include conveyor systems, automated storage and retrieval systems (AS/RS) and robotic picking systems. Fully automated warehousing involves the use of advanced automation technologies to manage all aspects of inventory storage, movement and tracking with minimal human intervention.

Semi-automated warehousing can offer several advantages such as reduced errors, increased productivity and added value. It can also be retrofitted to an existing facility and is less costly than full automation. Fully automated warehousing can deliver significant benefits by eliminating hidden costs and providing a high-return on investment. However, implementing automation technologies requires a significant upfront investment. The benefits of warehouse automation include increased throughput, better resource utilization and reduced labour and operational costs.

There are several types of warehousing facilities available to businesses. The type of facility chosen depends on various factors such as the characteristics of the products being stored, proximity to transportation hubs, type of equipment available to store and move goods, space needed for storage, ability to store goods sensitive to environmental conditions, security and fire-resistant facilities, processes to provide timely service, proactive customer support, alignment with different transport modes and licenses/certifications to address trade permits and other legalities.

By choosing the right type of warehousing facility, businesses can benefit from efficient use of space and volume, easy access to goods, control over changes in reserves, ease of maintenance, automated control and reduced operating/maintenance costs. The type of warehouse chosen can also have a strong impact on order fulfilment operations and customer relations.

Cold storage warehousing is a type of facility designed to store perishable or temperature-sensitive goods such as food, medicine and artwork. These warehouses maintain a specific temperature range to preserve the integrity, shelf-life and quality of the stored goods. Cold storage warehouses can be privately owned or operated by third-party logistics companies as public facilities.

Storage facilities fall into different categories depending on location, purpose, operation and stock characteristics as illustrated in Table 12.7.

### ***Location***

Location maybe outdoor (stockyard) as is the case with steel stockholding, tubes, larger castings, timber, bricks aggregates and some finished goods, that is, cars. The decision to store these items outdoors is taken because they are items which in general terms will not deteriorate from external exposure to the elements. It is also cheaper to simply store items outdoors. The organization does not need to incur costs of building facilities.

Indoor stores may be single or multistorey buildings that have been specially built for the purpose or they have been adapted from existing premises.

Single storey buildings have the following advantages:

- Building costs per cubic metre are lower.
- Extensions are easier and cheaper to build.
- Store layouts are flexible.

Table 12.7 Types of storage facilities

<i>Location</i>	<i>Purpose</i>	<i>Operations</i>	<i>Characteristics of stock</i>
Outdoor, for example, stock-yard	Quarantine stores, for example, livestock	Discrete – each operation separately performed	Raw materials
Indoor – single storey or multistorey	Bonded stores, for example, whiskey and other spirits – where customs duties are payable	Integrated – automated	Production supplies
Centralized or decentralized	Reserved stocks		Jigs and tools
	Hazardous stores – chemicals		Patterns Lifting equipment Scrap Salvage Work-run progress Finished goods Consumables Stationery Computer supplies

- Handling costs and handling equipment costs are generally lower (except where upper floors perform the function of a gravity feed e.g. grain storage silos).
- Fire risks are reduced.

Multi-storey buildings have the following advantages:

- Storage capacity on the site “footprint” is greater.
- Restricted space can be maximized.
- Reduced heat loss as upper floors provide insulation.
- Gravity can be used to deliver goods to lower levels where appropriate.

**Centralized stores**

One important choice for an organization in designing its storage facilities and systems is to decide how the organization will access stores. This is either done through a centralized store which comprises one large facility (DC) that all units of the organization draw their stocks from, or stores are decentralized. For example, W.H. Smith has a centralized storage facility that supplies all its retail stores located in Swindon. Suppliers must follow instructions given on the WHS website. Deliveries have a 30-minute timeslot to deliver. There are penalties for missing the time slot, for example, long delays or risk of rejection. WHS also provides delivery services for suppliers. Local deliveries are also made direct to store from suppliers who are given orders and instructions on how to supply.

**Decentralized stores**

Many retailers need to have decentralized storage facilities from which to deliver their supplies regularly. For example, regular replenishment of food and grocery lines is an important issue for food retailers especially for their perishable lines. Sainsbury’s and Tesco amongst others have a number of regional distribution centres (RDCs) from which they replenish stores regularly.



### Cross-docking terminals

In recent years there has been increasing management attention focused upon improving throughput times in supply systems. Time pressures have forced organizations to improve the way they receive, store and distribute goods. Automated handling systems, the use of bar code and RFID tracking systems (illustrated in Figure 12.7) and a reassessment of facilities required. Cross-docking allows deliveries to enter temporary storage until the loads can be married with other loads being sent to the same destination. The aim is to move goods on to their final destination in as short a time as possible. Often in FMCG this is measured in hours rather than days. Cross-docking has been an important logistics development enabling a faster supply chain. Cooke (2000) noted the pressures from virtual sales in a digital economy. Often organizations were able to accept orders but had difficulties in fulfilling them. Figure 12.8 illustrates a cross-docking operation.

### From “push” to “pull” the changing face of retail

In the 1950s and 1960s it was usual for manufacturers operating on a nationwide basis to carry out national distribution to retail outlets. Control of these supplies was firmly in the hands of the manufacturers. Today the control has switched to the retail organizations who aim to respond to their customer demand. Goods are now pulled through the system rather than pushed by the manufacturer.

There is an increasing active involvement by retail organizations and a diminishing involvement of manufacturers in the supply of groceries according to the Institute of Grocery Distribution – United Kingdom (IGD, 2003). Direct to store was the order of the day until the 1970s. In the

**Warehouse scanning devices are often mobile devices like this one nowadays. Used to scan bar codes and QR codes on the product. Data are transferred using cloud technology. The inventory records are updated.**

**Sometimes scanners are attached to the warehouse operatives like the one shown in this photograph. The reader is linked to software to scan data from Radio Frequency Tags, bar codes and QR codes located on SKUs.**

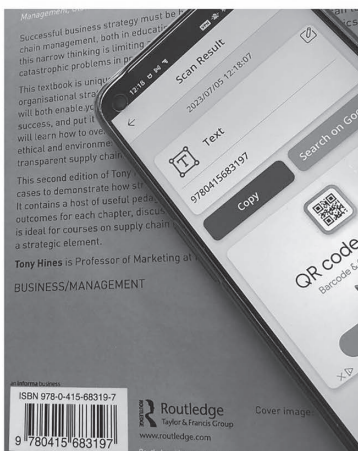
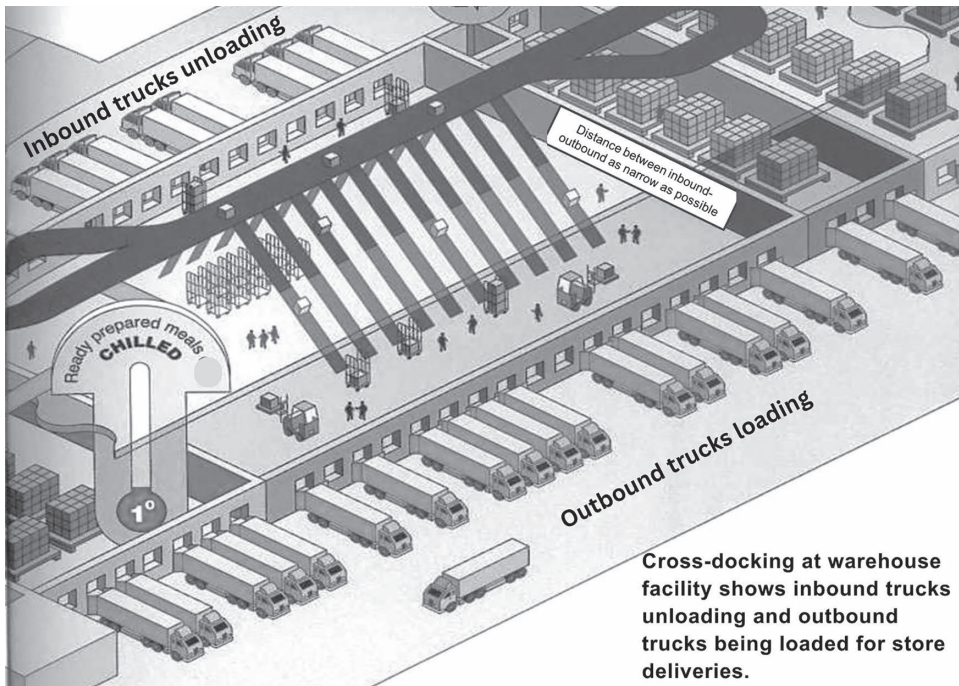


Figure 12.7 Scanners used by warehouse operatives



**Cross-docking at warehouse facility shows inbound trucks unloading and outbound trucks being loaded for store deliveries.**

*Figure 12.8* Cross-docking facility

1980s suppliers delivered to retail depots, which then organized supplies for particular retail outlets. In the 1990s suppliers delivered to a consolidation point where the retailer then took charge delivering to retail depots and on to store from the depots. The next moves may see retailers organize the suppliers' supplies and take charge and control of the entire supply chain. This has already happened in some non-food lines. Today only a very small part of the supply chain that between the raw material suppliers and the food manufacturer is outside the direct control of retailers.

The advent of factory gate pricing and increasing “backhauling” has diminished the suppliers roles further. Backhauling ensures that trucks are filled both ways to ensure the economies of scale. As more of these operations are done by retail logistics or their third-party suppliers, the supplier fleets are left with little to do in this part of the supply chain. As a consequence their economies of scale are reduced.

### *Automated warehousing facilities*

Automated warehousing facilities have become increasingly important reducing handling and speeding up movements through warehouses using integrated information systems to track goods. Amazon is a company that has moved more towards semi-automated warehousing with ambitions to become fully automated. They have invested heavily in automating facilities and in developing technologies in their warehouses that may be rolled out elsewhere as they integrate their warehouse management systems with those of their suppliers.

Robots are used in Amazon's automated warehousing systems, but robotic arms find it difficult to read bar codes. Bar codes are sometimes difficult to locate on goods and they are in unusual places especially on non-standard shaped products. Amazon has developed their own identification

system to overcome this problem. They use photographs of items passing along conveyors in their warehouses and set about training an AI system to recognize the goods. Amazon's AI and robotics teams need to integrate this system with the robots to pick up items without any need to use the bar code. It is hoped this will speed up operations and accuracy. Products in Amazon warehouses still need bar codes if outside companies that make and ship them rely on the technology to identify, trace and track SKUs. Amazon's new system is currently in use in facilities in Barcelona, Spain, and Hamburg, Germany. Amazon's AI experts began building up a library of images of products with data about the products dimensions to produce algorithms that were used to train the AI system. Initially the algorithm's accuracy rate was between 75 per cent and 80 per cent. It is now claimed to be at 99 per cent. Once fully adopted this technology could replace human handling.

Asda's fully automated warehouse (97 per cent) at Burtonwood, Warrington cost £100 million. It still employs 600 people working alongside robots with 4.5 km of conveyor belts. It is designed to handle 4.9 million cases and 8,000 lines fulfilling the needs of 18 million customers in the Northwest with 100 per cent accuracy. It has nine robotic cranes; each one controls 27,000 pallets and they can extend higher than any forklift truck up to 27 metres high. The automated storage and retrieval systems (AS/RS), and robotic picking systems are integrated with the company's existing warehouse management system (WMS) to provide real-time inventory tracking and order fulfilment.

#### ***Importance of consolidation – a retail example***

Some of the largest retail distribution depots operated by large retailing organizations deal with over 2,000 suppliers and provide over 14,000 SKUs (stock-keeping units). Key consolidation sites dotted around the United Kingdom will hold and sort goods into full vehicles before they are despatched to the depots. Depots are often operated by third-party logistics providers on behalf of the retailers. Tibbett and Britten, Exel Logistics and Christian Salvesen are some of the largest third-party suppliers operating in the United Kingdom. A single depot may handle over 300,000 cases on a single day. A typical depot may supply 100–150 stores in a defined geographic area. Once a delivery is made the trucks will either return to the consolidation point or they will return items to depots from the stores (backhauling – pallets, ex-promotional stock, crates or waste).

Optimization of vehicle fill enables small suppliers to deliver on a daily basis. It reduces the inbound traffic at depots. One of the biggest problems at depots when many different suppliers delivered directly to the depots was delays. Consolidation avoids delays and enables daily replenishment from large numbers of smaller suppliers.

#### **Size and structure of leading retail warehouse facilities**

If we compare the size and structure of the distribution networks for some of the UK's largest retailers, that according to Statista Amazon have 22 DCs, which is the same as the number in Germany, France has just nine. The largest facility is over one million square feet in Dunfermline. Morrisons have six DCs and its largest DC is in Sittingbourne which is around 920,000 sq. ft. Tesco has its largest DC in Dublin which is 753,473 sq. ft. Aldi has 13 DCs in the United Kingdom (11) and Ireland (2). Their largest DC is in Sawley, Derbyshire at 600,000 sq. ft. Lidl has 13 DCs in the United Kingdom with the largest located in Luton at 1.2 million sq. ft. Sainsbury, too, have 13 DCs in the United Kingdom. Two are dedicated to slow moving SKUs and two frozen food facilities. The Co-op has nine regional distribution centres and three local DCs. Biggleswade is the largest facility at 660,000 sq. ft. Table 12.8 gives some indication of the size and shape of the distribution networks for major UK retail organizations.

Table 12.8 Distribution and store summary UK retail stores

<i>Retailers</i>	<i>No. of stores 2023</i>	<i>No. of stores 2003</i>	<i>Annual case throughput</i>	<i>No. of DCs</i>	<i>No. of DCs</i>	<i>Area (sq. ft.)</i>	<i>Area (sq. ft.)</i>	<i>Product SKUs</i>	<i>No. of suppliers</i>
			<i>2003 Data</i>	<i>2023</i>	<i>2003</i>	<i>Largest facility</i>	<i>2003 Data</i>	<i>2023</i>	<i>2023</i>
<i>2023</i>									
Amazon	6 Fresh Stores and 1 general store	0	Not known	20	Not known	1,000,000	Not known	12 million	281,257 UK
Aldi	1000	278	Not known	13	Not known	600,000	Not known	2000	5,000
Asda	633	256	728,000,000	15	21	1,000,000	5,543,000	21,810	2,000
Co-op	2500	2,386	237,100,000	9	18	660,000	2,081,000	15,000	2,500
Iceland	653	758	111,000,000	5	4	Not known	815,000	2,500	300
Lidl	960	Not known	Not known	13	Not known	1,200,000	Not known	2,000	650
M&S	1035	315	104,500,000	6	6	900,000	691,000	7,500	1,000
Morrisons	1136	Not known	Not known	6	Not known	900,000	Not known	26000	2700
Sainsburys	1428	468	812,710,000	17	21	900,000	5,400,000	25,000	2,200
Tesco	3712	729	1,270,000,000	20	25	832,965	7,327,000	90,000	2,500

Source: Consuming Future Research

<i>Retailers</i>	<i>No. of stores 2023</i>	<i>No. of stores 2003</i>	<i>Annual case throughput</i>	<i>No. of DCs</i>	<i>No. of DCs</i>	<i>Area (sq. ft.)</i>	<i>Area (sq. ft.)</i>	<i>Product SKUs</i>	<i>No. of suppliers</i>
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Source: Consuming Future Research

**Tesco case in point update**

**Key facts 2022–2023**

Tesco has UK sales of £57,656 million (i.e., £57.7 billion) with adjusted operating profit of £2,630 million (i.e., 2.63 billion). Its stores deliver to 12 million customers using the Clubcard app and 21 million households are active Clubcard users. It operates 3,712 stores in the United Kingdom with total sales space of 38.7 million sq. ft. The average store size is 25,789 sq. ft. It supplies 35,000 SKUs with own label products accounting for 35 per cent. Tesco publishes an annual listing of first tier suppliers which extends to 44 pages of A4. There are around 1,200 first tier suppliers listed in 2022 for food and groceries and non-food categories. The list also shows how many people are employed at each supplier listed. It is more difficult to gain visibility with regard to second and third tier suppliers.

Tesco has put its not too distant troubled past with suppliers behind it. The problem began as it attempted to improve reported profits by delaying payments to suppliers (Allen, 2016). Back in 2016 it breached a legally binding code of the grocery watchdog, which went back to 2014 when it overstated profits by £250 million. If it had continued for a full year, it would have meant a black hole in the balance sheet £600 million (Butler, 2016).

*UK sales by store size*

<i>Sq ft</i>	<i>No. of stores</i>	<i>Million sq ft</i>	<i>% of total sq ft</i>
0—3000	2605	5.6	14.6
3001—20000	276	2.9	7.6
20001—40000	286	8.2	21.2
40001—60000	182	8.8	22.8
60001—80000	119	8.4	21.6
80001—100000	45	3.7	9.6
Over!00000	8	1	2.6
<b>Total</b>	<b>3521</b>	<b>38.6</b>	<b>100</b>

Since then, Tesco has made significant improvements to its practices with suppliers and its financial reporting. It has faced criticism too, for a practice known as land banking, which is essentially sitting on land purchased to develop without activity. It has also been criticized for manipulating planning laws.

Tesco has four main formats: Express (up to 3,000 sq. ft.), Metro (seven to 15,000 sq. ft.), Superstore (20—50,000 sq. ft.), and Extra (60,000 sq. ft. and more). Express and Metro stores account for 22.2 per cent of floor space.

**Strategic priorities**

Tesco has four strategic priorities, which are to offer outstanding value, great quality and market-leading convenience and rewarding loyalty.

Tesco say they have six big key performance indicators aligned to their strategic priorities, which they list as:

1. Sales growth.
2. Profit growth.



3. Improving operating cash flow.
4. Customer focus – recommendations based on Net Promoter Scores (NPS).
5. Employee satisfaction – great place to work and shop.
6. Reducing carbon emissions.

Tesco has a distribution network which is one of the largest in the United Kingdom. More than two billion cases are moved through the network each year, 95 per cent of this is distributed centrally and five per cent is delivered directly to stores. To support these distribution centres there are teams at head office across different areas, which include global logistics, primary, fleet, grocery home shopping and fulfilment.

### **Fulfilment**

Tesco has 20 distribution centres (DC) in Britain including one in Scotland. The largest distribution centre in Europe is in Dublin, Ireland. The past few years has seen Tesco rationalize its DCs closing smaller DCs and concentrating on having larger sizes in the network, which are more efficient. Tesco's Dagenham site is the largest fresh food distribution centre in the company's UK network, with capacity to handle up to 3.5 million cases of fresh products. Tesco's largest DC facility is in Ireland employs 600 people and it handles 1.5 million cases a week with capacity to store 76,000 pallets.

During the pandemic Tesco asked suppliers to contribute to the increased cost due to supply chain disruptions, for example, shortages of HGV drivers according to CIPS. So too did other supermarkets. There were several key challenges faced by big supermarket retailers such as increased transport costs, disruptions in supply due to Covid and Brexit in the United Kingdom and the increasing cost for shipping containers. Tesco has plans to use rail more in future to mitigate risk.

Customer buying habits changed too as the frequency of purchases declined because customers could not access stores freely and many switched to online deliveries creating further challenges.

### ***Global logistics***

Transporting over 75,000 shipping containers, co-ordinating 25,000 trucks from Europe and over five million kilos of airfreighted cargo every year. Managing the safe movement of product flows from all sources into Tesco UK and CE distribution centres. It moves around 65,000 containers by rail and wants to increase this to 90,000 by 2028.

### ***Home deliveries***

Tesco makes more than 15,000 home deliveries daily. Cutting CO<sub>2</sub> emissions by more than 7,000 metric tonnes in just one year thanks to the introduction of Lightfoot driver improvement technology across its fleet. Tesco uses the technology to manage emissions as demand for home delivery services rocketed during the Covid-19 pandemic.

Tesco's commitment to be carbon neutral by 2035 is on track with 243 electric vans into their home delivery fleet, and in an industry first, Tesco introduced a zero-emissions electric HGV to trial deliveries across the 400 London stores served by the Dagenham

distribution centre. LED lighting has been installed in distribution centres and customer fulfilment centres too.

Telematics and Hive route planning systems are used in home delivery vans and distribution fleet. The continued use of telematics and improved planning systems assures best operational efficiencies by improving route plans, which reduce mileage and energy requirements. There are also plans to roll out refrigeration units using CO<sub>2</sub> as a refrigerant in 2024.

Order lead times into stores are generally faster across most categories than their competitors. It takes 18 hours on average for FMG lines, 12–24 on chilled, produce and fresh foods and 48 hours for non-food. In general, these lead times are between 25 per cent and 50 per cent better than their closest competitors. Lead times into depots for FMG lines are 48 hours. Beers, wines and spirits have some of the slowest lead times reported. This is similar to competitors.

Tesco packaging strategy introduced in 2019 claims it pursues 4Rs – remove, reduce, re-use, recycle. With 500 million pieces of unnecessary plastic removed. These include over 30 million yoghurt lids, 29 million pieces removed from limescale tablets, 24 million plastic windows in doughnut packaging and three million pieces in nappy packaging.

*Sources:* Data for Tesco PLC (Tesco, 2022, 2023). Consuming Future (2023).

### Case questions

1. Why has Tesco been so successful in the e-shopping home delivery sector?
2. Recycling packaging and storage materials is likely to become a bigger issue with consumers in future. Do you agree? Why?
3. Explain why Tesco is able to deliver good service to customers when its stock holding is relatively low.
4. Explain how warehousing and distribution operations enable Tesco to be competitive.
5. Do you think that using retail stores effectively as warehouse storage has helped home delivery services grow? Discuss.

### Factory gate pricing (FGP)

It is important to know the term “factory gate pricing.” It is the point at which the buyer takes control. It will vary according to circumstances and the details of the contract negotiated by parties agreeing the contract (buyer-seller). As it implies, the factory gate is the point at which the finished goods are in a complete state for the buyer. No further finishing, packaging or assembly is expected. Depending on what the contract says in practice the factory gate can be:

- Port of entry into United Kingdom.
- Manufacturer’s site.
- Manufacturer’s warehouse or consolidation point.

It is a point in the supply chain when ownership (and risks) for goods pass from supplier (seller) to the buyer (or their third-party agent, e.g., hauliers).



### ***Transport decisions***

When goods are purchased, there will be a number of complex transport decisions that will need to be taken. These decisions will be dependent on:

- Where the consignment is, for example, supplier location, factory gate in United Kingdom or abroad.
- Volumes and dimensions will determine cost and modes of transport.
- Special considerations, for example, value, fragility and temperatures.
- Modes of transport depend on lead times, delivery dates required and costs.
- Geographical coverage will determine selection of carrier as will the service levels required. Specialist product knowledge/experience may mean specialist carriers are needed with specialist equipment.
- Required receipt date will impact upon the choices available and there may be trade-offs between fill and cost efficiency and indeed the service level expected by the customer.

### ***Transparency and FGP***

One important benefit of FGP is that the buyer knows the cost of the product and the transport cost is separated. Under the alternative of delivered price, the cost of the product is not separated from the transport cost element. Knowing the transport cost element allows the buyer to make choices based on the issues listed under transport decisions with the aim of lowering total acquisition costs (TAC). This transparency is very important for buying organizations. It allows the purchaser to make valid comparisons between different suppliers of products and between different suppliers of transportation.

### **Storage and material handling equipment**

Storage equipment is required to store, handle and pick inventoried items. Depending on the type of facility this may include racking, cranes, pallet trucks, forklift truck of different sizes and heights, automated equipment and other items. Storage methods include those listed in Table 12.9.

### ***Storage methods***

Forms in which materials are moved and stored include those listed in Table 12.10.

### ***Two important types of storage equipment***

Pallets and racks are two of the most common types of storage equipment. Pallets are defined by BS2629 (BSISO6780) as:

A load board with two decks separated by bearers, blocks or feet or a single deck supported by bearers, blocks or feet constructed with a view to transport and stacking, and with overall height reduced to a minimum compatible with handling by fork lift trucks or pallet trucks.

Pallets are categorized by:

- Form of entry (i.e., one-way, two-way or four-way entry).

Table 12.9 Storage methods include the following:

<i>Method</i>	<i>Type of goods and equipment</i>
Free stacking	Bulk materials, stacks of units, bulk containers
Shelving and bins	Non-adjustable, semi-adjustable and cantilever
Pallet racking	Adjustable beam, tubular, cantilever
Drive in or drive through racking	Lorries, forklift trucks, cranes may be able to drive through the storage areas
Mobile racking	Mechanical, manual, or power operated mobile racks
Live racking	Gravity fed belts, hoppers, inclines or horizontal power operated conveyors
Automatic retrieval systems	Stacker crane, trucks, robotics are used to reduce human effort and for safety purposes where possible
Automatic flow through racks	Power driven with elevators and robot platform

Table 12.10 Materials moved and stored

<i>Type</i>	<i>Storage</i>
Bulk materials	Liquids (tanks and containers), solids (tanks and containers) pastes (tanks and containers)
Piece parts	Castings, forgings, components (shelving, bins, racking)
Package	Bag/sack (flour, powder), drum (oil, liquids), carton, cask, cylinder
Unit load supported	Pallets, stillages, post pallets, box pallets
Unit loads without support	Built in units, shrink wrapped, stretch wrapped and strapped (books, boxes)
Intermediate bulk container	Metal, plastic, other materials
Containers	End loading, side loading, top loading (mixed goods various types)

- Construction material (e.g., wood, corrugated metal, wire mesh, aluminium, expandable fibreboard).
- Shape – basket, box.

BS2629 specifies the standard sizes. The principal benefits of using pallets are as follows:

- Standardization of loads moved by standardized equipment in standardized vehicles.
- Optimizes use of storage space.
- Save time loading and unloading trucks.
- Reduces possibility of damage in transit.
- Minimizes handling allowing pallets to go straight into store.
- Promotes good housekeeping and clean areas by keeping goods off the floor.

Racks are frameworks designed to store loads in upright columns diagonally braced for strength. Racking is very flexible and can be used to store pallets, drums, containers, plates, sheets, bars, tubes, tyres, crates, etc.

Materials handling has three main aspects:

1. Physical movement, handling and storage through the enterprise.
2. Management through effective planning and control.
3. Technology – techniques to move, handle and store linked to information systems.

**Manual** systems are used for light loads and powered systems are used for heavy loads. **Semi-automated** systems will be part mechanical and require some human intervention. **Fully automated** systems are computer controlled and use robotics and AI.

Mechanical handling equipment includes hand trucks and forklift trucks with or without power. Loads in excess of 23 kgs require mechanical handling, when two or more people are needed, when travel time is greater than lifting or handling time and space above floor level can be used.

### Assessing storage requirements

Over assessing storage will result in unnecessary cost. Rent, rates, light, heat, water maintenance, labour and so on. Building and building service cost alone can be as high as 40 per cent of the annual cost of storage. An underassessment will result in cramped, inefficient and possibly dangerous conditions.

The objectives are to:

1. Utilise space efficiently within the building cube.
2. Create rapid and easy access to stock and stock movements.
3. Achieve efficient and balanced traffic flows.
4. Mechanise and automate stores operations.
5. Minimise distances and stock movement (e.g., avoid double handling).
6. Clearly identify stocks.
7. Group products with similar storage characteristics and according to frequency of receipts and issues.
8. Maintain adequate security.

Organizational factors to consider include:

1. Space required and costs for each category of stock.
2. Whether to centralize or decentralize the stores.
3. Physical characteristics of the stores at each location, for example, size, weight, shape, perishable, hazardous.
4. Flows of materials and handling equipment required.
5. Goods received into store: quantities, volumes, frequencies, packing, delivery vehicles, handling requirements, documentation and inspection.
6. Goods outwards – quantities, volumes, frequencies, packing, delivery vehicles, handling requirements, documentation, packaging.
7. Inventory policies, for example, JiT, buffer stocks, stockpiling.
8. Security and safety.
9. Administrative systems and personnel.

Illustrates the key reasons for fluctuating warehousing space requirements.

### Stores layout

Stores need to be laid out in an orderly fashion to achieve the objectives of (a) efficient materials flows and (b) clear identification and location of inventories and (c) efficient space utilization.

Four principle types of stores layout have been identified by the Chartered Institute of Logistics and Transport (Rowley et al., 2008):

1. The inverted “T” warehouse flow.
2. The crossflow warehouse.
3. The corner warehouse flow.
4. The throughflow warehouse.

Essentially these different designs shown in Figure 12.9 have different benefits. Efficiency, flexibility, distances, height, load bearing, equipment handling and time are all essential elements to consider for good warehouse design.

Goods inwards and outwards are located on the same side of the building in the inverted ‘T’ design. There are designated areas for a bulk store and for low-, medium- and high-usage items to minimize handling. This is achieved by placing low-usage furthest away from the exit point and the high-usage stocks near the exit. This also saves time and minimizes the distances travelled for fast moving stocks. Unified bay operation with goods inwards and outwards next to each other provides better security and surveillance. It is also easy to extend these facilities on one of three sides subject to site constraints. The main disadvantage is the central aisle may become congested in periods of high throughput.

The “crossflow” warehouse is a one-way system with goods inwards flowing to the left on entry and then into one of the three designated storage areas depending on high, medium or low storage items being identified. This design retains the main advantages of the T system with a unified goods inwards and goods outwards system side by side but removes the central aisle congestion problem. It is essentially a one-way system. Bulk storage and picking stocks are stored alongside each other. The main disadvantage of this system would be the situation where a high proportion of the stock was bulk may lead to the design being impractical.

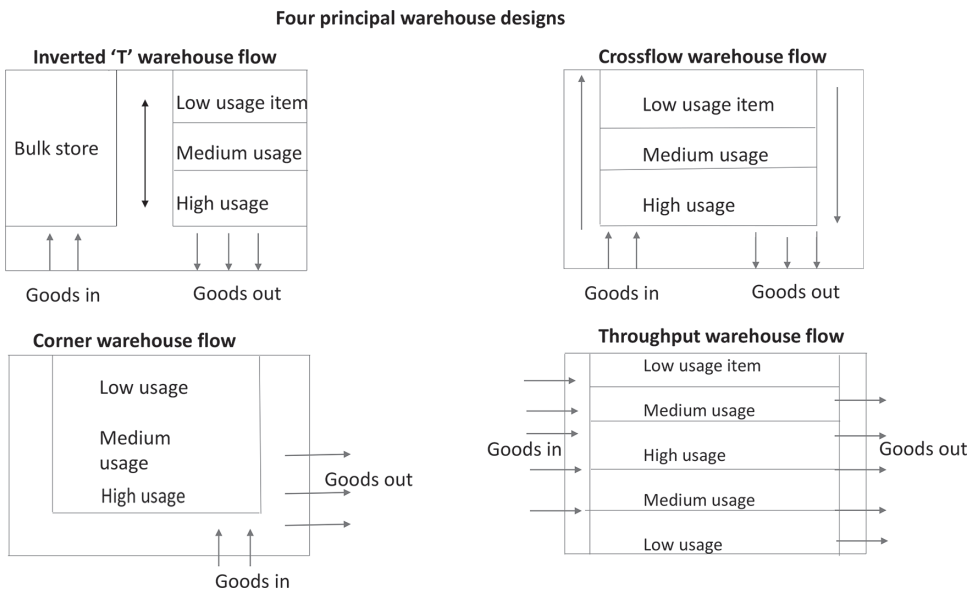


Figure 12.9 Four principal warehouse designs

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The corner warehouse has the goods inwards and outwards areas adjacent on two sides at the corner. This layout reduces aisle congestion in times of high throughput activity. One possible disadvantage is that any expansion can only be developed on two sides. There may also be potential security and surveillance problems with having to monitor two corner positions.

The final layout is the “throughput” design. This has the advantage of being a flow system with entry and exit points on two opposite sides of the building. It also achieves good aisle areas. There are three main disadvantages to this layout which are: all stocks will have to travel the full length of the building between receipt and despatch; goods in and goods out are on two different sides of the building increasing the security risks and surveillance; thirdly, if the warehouse is to be extended, it can only happen on two sides unless bays are moved. This layout may be particularly useful in situations where bays inwards and outwards have different handling requirements, for example, bay height differences.

***Importance of stock codes***

A code is a symbol or system of symbols used to easily identify and accurately classify stocks. The advantage of having codes may be remembered using the mnemonic SUPPLIER.

Simplicity

Unique

Promotion of standardization

Pricing and costing made simpler

Location is made easier in store

Implementation of computerized stock records is possible

Easier requisitioning using short simple codes

Re-ordering made simpler

Codes can be of three main types: alphabetical, numerical or alpha-numeric.

**Transport decisions and supply chain strategies**

The choice of appropriate transport modes is critical to determining performance. Table 12.11 provides an indication of how decision choices can affect several different aspects of supply chain performance.

In order to make appropriate transport choices a number of issues need to be considered that include:

- Customer requirements.
- Time taken in transportation.
- Cost (and benefits) of different transport modes.
- Security.
- Other risk factors.
- Storage requirements.
- Packing requirements (containers, pallets, crates, etc.).
- Labelling.
- Documentation including shipping, billing, export duties, etc.

Table 12.11 Supply chain areas affected by transportation decisions

<i>Planning</i>	<i>Procurement</i>	<i>Operations</i>	<i>Distribution</i>	<i>Customers</i>
Network and asset rationalization	Landed cost	Inter- and intra-organizational movements of inventory	Load plans	Availability and dependability – will goods be available when required
Lead times	Inbound in-transit inventory management	JiT systems	Pick lists	Responsiveness – how responsive is the supplier to customer requests
Vendor sourcing	Ability to lower inventories	Handling equipment required	Packaging and labelling	Cost – affects total cost incurred
EOQ/JiT inventories	Time	Inventory holding policies	Shipping documentation preparation	Lead times – effect on customer lead times
Facility locations	People – competencies required	People – competencies required	Dock scheduling	
Levels of technical support and management information systems	Levels of technical support and management information systems	Levels of technical support and management information systems	Outbound shipment management  Mode/carrier selection	Levels of technical support and management information systems

Choosing an appropriate transport supplier or partner involves several key stages.

*Strategic choice using Deming's PDCA cycle*

Plan	Set objectives Establish costs and benefits Stages in the plan Collaborative arrangements Agree quality standards	Define needs and establish criteria for selection Know the market Articulate needs Identify potential suppliers and partners Integrate systems, procedures and agree standards
Do	Choose and implement	Manage, co-operate and control
Check	Evaluate and control	Agree performance indicators and benchmark standards
Act	Revise the plan if necessary	Re-assess needs at regular intervals

**Summary**

This chapter has demonstrated the importance of organizational capabilities in fulfilling the customer promise. To achieve customer order fulfilment organizations must make strategic decisions in relation to supply chain logistics. Decisions whether to own or outsource logistics facilities are of strategic importance. Choices in relation to where to locate warehouses, how many and how big they should be are critical to successful fulfilment operations and strategies. Issues in relation to inventory holding policies and customer service are amongst the important trade-offs that have been considered. Types of storage facilities needed to satisfy customer

demand and how they are laid out demonstrate the fine line between operational and strategic decisions. This chapter has recognized the linkages between operational and strategic supply chain issues and how they are interrelated to serve customers more efficiently and effectively.

### **Research note**

Some researchers claim that the impact of e-commerce, mass customization, omni channel distribution along with just-in-time systems have driven automation in warehousing (Custodio & Machado, 2020). This is a fruitful area for further academic research to study how these new technologies are changing practices.

### **Discussion questions**

1. Discuss the general and specific factors to be considered by organizations reviewing their storage and transportation requirements. Explain how efficient management of these operations improves organizational profitability.
2. Discuss trade-offs that may occur because of changing space requirements for warehouse and distribution facilities.
3. Discuss the use of 3PL and 4PL suppliers and their relative merits.
4. Explain the arguments in favour of decentralising stores.
5. Explain the concept of factory gate pricing.
6. Discuss the strategic importance of consolidation in relation to storage and distribution.
7. Explain why materials handling is more than simply an operational concept and why it may be of strategic importance to organizational choices.
8. Assessing storage requirements is both an operational concern and of strategic importance. Discuss.
9. The location and layout of storage facilities is of strategic importance. Discuss.
10. Stock codes need to be designed following key principles. Discuss.

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## 13 Supply chain futures

### Challenges ahead

This chapter discusses creating supply chain advantage by developing strategies to meet challenges and innovate to tackle weaknesses while building strengths for the future. It examines how organizations respond to challenges, changing political, economic, social and technological trends and the need to enhance things that are already done well.

#### Different times require different roles

Skills are perishable they wear out over time as conditions in our environment shift. A *saga makers bottom knocker* may have no place in a world where automation takes over the function or where it is no longer a required role because the industry has ceased to exist. In the 1960s, if you worked in accountancy, you would no doubt have a number of people who were skilled at using comptometers; these were essentially mechanical adding machines and the people who used them had to be skilled to key in numbers and perform calculations at speed. The skill became redundant as electronic calculators and computers took over the job and so many people who worked on these machines either had to reskill or lose their jobs.

It is riskier today, there is increasing protectionism and governments want to legislate and regulate more than ever because they are nervous about their economic positions. There is an emerging trend of deglobalization, moving away from everything that has happened in the past 50 years, moving things offshore in remote parts of the globe where labour costs are lower and the cost of producing goods is lower, but it might cost more money to transport those goods to market, which is a trade-off. But significantly, transport costs have been relatively low compared to the other costs saved, such as labour and, of course, other production costs. There are more frequent disruptions in today's supply chain and we have witnessed that in the recent times with the pandemic in the United Kingdom, and with Brexit.

In various trade wars between countries, whether it is bilateral trade or multilateral trade, it has been more difficult to reach agreement through the World Trade Organization (WTO). And then there are the big issues that we are experiencing presently in relation to security. Defence of the realm, the security of food, security of water, security of energy and security is going to be a big part of any supply chain future. Then there is the impact of climate change. That is a major disrupter, with everybody going for net-zero by 2050 that is putting a lot of pressure on

businesses and governments to produce strategies and policies that can ensure that they lower their carbon footprint and minimize their impact on changes to the climate. Organizations are still flirting with the idea of mass customization too and today we have the technologies that can achieve mass customization more than ever before, and some of those technologies are industry four technologies like 3D printing, and I will discuss those in this chapter.

Then there is the idea of the greening of the whole supply chain. That is the end-to-end supply chain becoming a greener place. This is about reducing CO<sub>2</sub> emissions, pollution, nitric oxide, plastic pollution, chemical pollution of various kinds, fertilizer reductions, all kinds of impacts where pollutants make it difficult to green the supply chain. We are thinking of end-to-end cycles and circularity. So, we start, perhaps, with extraction of minerals, growth of crops and we procure those raw materials into our supply chain. They come with embedded pollution as we lift them out of the ground, as we lift oil out of the ground, as we lift coal out of the ground, as we lift any fossil fuel out of the ground. They come with the release of chemicals into the atmosphere and, of course, as we produce goods we incur more energy and more potential to pollute and contribute to emissions. So, we must think differently about the ways in which we decide to procure, produce and, of course, transport those goods around the globe. And we need to think not just about greening the supply chain but about sustainability.

Obviously, there is a relationship between climate change, greening the supply chain ethical concerns and human rights, the environment, governance and sustainability (ESG). New technologies make it possible to manage information in real-time, get that data immediately, to reduce waste and serve customers better, and this is all about having intelligent systems and having integrated systems which use artificial intelligence, machine learning and sensors. Managers will require different new skills than those they possessed when they came into the industry or the skills they currently have today. They will have to renew, relearn and develop. This will present opportunities to others to enter a career in supply chains from perhaps non-traditional areas, for example, data analysts.

Policymakers and governments need to be smarter in understanding how supply chains work and the damage they can do to frictionless supply chains. For example, Brexit caused damage to the UK economy by introducing frictions into supply chains. This is not a political argument, but rather about how governments manage these things. They often have a political agenda that happens to the exclusion of common sense, economic sense and supply chain sense.

### **Increasing uncertainty**

Managing complex global supply chains is difficult. Governments struggle to create policies that avoid friction and are fair to home producers, and policies and actions such as Britain leaving the European Union have simply made things worse. In this sense, to actually close the borders between your biggest trading partner and introduce a range of complex tariffs and added bureaucracy creates friction in the supply chain. These complexities become a source of risk, volatility and uncertainty, and this is one of the biggest challenges to modern supply chains. As countries become more protectionist, supply chains come under threat and the businesses that operate within those supply chains find it harder to deal with their suppliers in different countries. They find it slower, more bureaucratic and increasingly more costly, and this in turn changes the geographies of the supply chain as those companies search for ways to lower cost, reduce bureaucracy and reduce frictions. It is an adjustment that takes time. We live in an age of uncertainty, and uncertainty has certainly increased since the pandemic and the various supply chain disruptions caused by the pandemic and other factors, such as wars, political unrest and the geopolitical machinations taking place in the world. Today, increasing turbulence and

volatility is changing the complex global supply chain arrangements that have been built in the past 50 years or more, and we are beginning to see businesses move those supply chains nearer to shore, onshore, reshored and away from those far shores where they soared, cheaper labour costs and lower production costs. In total, when we consider the tariffs placed on goods moving between countries across borders, we ought to remember that when we manufacture goods in one country, the raw materials and the components may have moved through several borders before they arrive at assembly plants or manufacturing sites where those goods are assembled. Once they are put together, they have to be packaged, shipped and moved to the country where they are going to be sold and once again they can incur tariffs crossing borders back to the markets. And of course there are complex exchange rate arrangements that will exist as these imports and exports take place and there are trade-offs that businesses need to work out both with exchange rates, local taxes, tariffs and any quota restrictions to be legally compliant as they move goods around the globe.

In 2015, I was at Heathrow about to alight a plane for Boston and while waiting in the airport, my usual experience is to make my way to the bookshop, which I duly did, and on the shelf waiting for me in that bookshop was a book that changed the way I thought about the future of work, and it was a book by Martin Ford called *The Rise of the Robots* (Ford, 2016). It was a business book of the year in 2015, and it was about technology and the threat of mass unemployment. And, of course, you see change around you and you begin to think, and you read what is said in the book with your experience in the workplace and what others are writing in newspapers and talking about. As I looked at some of the comments on the back of that book one of them was a comment from a review in *The Observer*, and it said the elephant in the room of artificial intelligence is mass obsolescence of the human workforce, and so if robots can do your job faster, better and for no pay, you'd be unemployed, and of course, that's the premise of the book. If you take this further, of course robots do not take time off, they do not get sick and they are more consistent.

So if you think about automation in the workplace, because that is what we are talking about here, it has many advantages. There is a cost to it, of course, and that's capital investment, and there is a cost to society in lost jobs if those jobs are not replaced and people do not reskill to do other jobs elsewhere. One of the things that struck me about this whole change that was taking place is that jobs in all walks of life travel agents, data analysts, doctors, taxi drivers and even computer programmers, the people that write the programmes and the algorithms, the software for the robotic automation. And if you have a machine that learns, so you have machine learning taking place, they update themselves. So how is this all going to impact and change the economic and political landscape? That is the big question and it still is the big question. Organizations, businesses, governments, all need to grasp the challenge of automation. Automation can make our lives easier and, of course, it can improve efficiency and effectiveness and in supply chains there are great opportunities for automation, which we have talked about through the book. Now the question is should we be concerned about robots, robotic automation and technology replacing humans and causing mass unemployment? Is that likely to happen? Well the evidence from history suggests not, and the reason has been that in advancements in technology, although people have been replaced by machines, those people have always found other activities to pursue that earned them a living. With the consequence of advancement in technology, society has become more prosperous. We can think about the automation of agriculture, industrial processes and service industries, all of which have benefited from the technologies that have made processes more efficient and production output greater and created better incomes for people working in those industries, although the skills that they possess have had to be developed to the changing world around them.

## **Protectionism versus free trade**

Next, I want to turn attention to protectionism and how that impacts trade and of course, supply chains. Protectionism is on the rise. In addition to import and export tariffs, market access barriers include quota import restrictions, unnecessarily complicated technical standards, and subsidies. Protectionism is a threat to world trade. Resilience in supply chains has become a byword for protection to ensure that supply chains cope when stressed by disruptions. Some policies and actions to achieve this aim may also be interpreted as forms of protectionism. For example, moving supply chains back home (onshoring) is designed to reduce uncertainty and mitigate risk from the impact of global trade disruption. It sounds perfectly sensible until you dive deeper to investigate the implications of having such a strategy. Protectionist policies have a place in the mix as and when required but not every product, firm and nation state should see it as a panacea to stop disruptions.

Protectionism is best understood through government policies promoting a country's interest above all else, and those policies, such as America First or Buy British back in the 1960s, were attempts to both protect and promote home industries. The policy instruments used to do so are tariffs and quotas, and they make imported goods more expensive (tariffs), or they limit availability (quotas). When it comes to arguments in favour of adopting protectionist strategies, they include protecting infant industries, those industries at an early stage of development which may be of strategic importance. For example, if we wanted to develop a microchip semiconductor industry in the country, then we might decide to protect it against competition from established microchip exporting countries. And we do that to allow the infant industry to grow and so as not to lose that particular industry through competition.

It is also argued that tariffs and quotas can be used to persuade buyers to procure domestic purchases over-imported goods. The efficacy of the argument is dubious, given that tariffs may be placed on imported goods but not on those made in the home nation. This in turn might mean they support inefficiencies by making the goods produced locally at higher costs of production for an inferior product. It may deprive businesses and consumers from accessing the best quality of goods available on the world market, creating restrictions on economic growth. For example, if you employ cutting-edge technologies in sub-assemblies, you may not have the necessary expertise to be able to make these yourself at a reasonable cost/price ratio and at a comparable quality to imported goods. You may prefer to get the best available components from elsewhere in the globe. A tariff where it has the desired effect might choke off imports and increase orders for substandard products, which have been protected along with their inefficiencies. There is also a dubious argument that stability can be achieved through restricting foreign trade, but there's little evidence to support that argument. Dumping is another issue that has been raised. This is when countries with excess quantities of commodities decide that they love a very low price to get rid of excess inventory, and that's dumping, and that can harm local manufacture, local production, as those goods are dumped in the market which is temporary, and so protectionist tariffs and quotas may be necessary for a short period.

Then there are arguments to do with protecting the standard of living for people in the state by governments that want to implement protectionist policies. It was, of course, one of the big arguments put forward by Brexiters in the United Kingdom that they did not want migrant labour taking away British jobs. There are also arguments about self-sufficiency if a country wants to become self-sufficient, then a tariff might be employed to restrict imports of the goods that the country is trying to become self-sufficient in. And, of course, protectionism most of all is used as a bargaining chip, because if one country applies tariffs or quota restrictions to the country's export trade, then that country may retaliate by doing exactly the same with regard

to imports from that country, and that is why you get strange things happening, like banana wars, tomato wars, fishing wars all kinds of trade wars that break out. In 2018, President Trump imposed duties of \$200 billion on China, and that was the start of the trade war that was still going on in 2023.

Protectionist strategies, of course, were most successfully applied during the period of the Great Depression between 1929 and 1935. But some say that that was not really a success. It stopped the development of world trade, held things back. So, what is designed to protect can actually kill. The arguments against protectionism are far stronger. It restricts imports, which inevitably leads to restricting exports because of the retaliation involved. Once a duty is imposed, they very seldom get removed. They stay, making things more expensive forever, and tariffs raise costs. They act like any tax and push up the price, which is not good for consumers, not good for business, and it is not good for government, because tariffs drive price inflation. Interestingly, governments are intervening in trade.

In January 2021, the United Kingdom introduced the *National Investment and Security Act*, and that was passed into legislation and implemented in January 2022. And the act is a form of protectionism. It is designed to restrict foreign ownership of strategic assets. Now, whether you think that is right or wrong, it is protective. Many countries have similar protection in place the United States and Australia, for example, and this law is designed to secure those assets for the benefit of the home population. An acquisition can be called in for assessments if the Secretary of State deems that there is a risk to national security. There are currently 17 areas of the economy where it may happen, such as advanced materials, advanced robotics, artificial intelligence, civil nuclear communications, defence, data infrastructure, quantum technologies, transport, satellite and space technologies and energy. So, there are lots of areas that can be called under scrutiny. The government can act. It has powers to act intervene in the business transactions regarding takeovers, to protect national security.

Supply chains span the globe, interconnecting countries around the world with trade in goods and services passing between them. Protectionism arises because countries are concerned about whether they are dealing fairly in the trade of goods and services, so sometimes they want to protect home industries from competition, either because they deem it unfair or because it disrupts the home market. The WTO was set up after a meeting at Bretton Woods in 1944, and the WTO oversees world trade. It is an organization specifically set up to deal with arguments between countries when disputes occur between countries engaged in trade. The WTO will look at the detail of products and services supplied and any tariffs applied to a range of products.

Sometimes disagreements arise between the countries involved in trade, and often their first port of call is to approach the WTO for clarity and sometimes for sanctions against a country that they feel is dealing unfairly with trade. Often, when this happens, there may be trade wars that break out. Recently, we have seen the United States and China locked in a trade war, mainly about technologies and the transfer of those technologies between the countries. So, things like semiconductors and telecommunications equipment, amongst other things. The WTO intervenes if it thinks that one country is seeking advantage over another unfairly, by charging tariffs, placing them unnecessarily high to prevent the import of competitive goods and perhaps introducing quota systems, which they deem unfair. What happens when the WTO interferes? Well, you may be surprised to learn that gaming can take place as countries can still get around the imposition of instructions and penalties set by the WTO by simply, for example, being slow to unload ships or to pass goods into the country from the country from which it is importing. So, they can slow down the traffic and choke the flows of that trade, and that can disrupt the competition. So, it is not straightforward. When President Trump came to power in the United States, one of the first things he did was to tear up the Transatlantic Trade and Investment Partnership



agreement. It was part of his Make America Great Again-America First Project, in which he saw threats coming from Mexico and China and that threatened the New World Order.

As supply chains have become more complex and stretched around the globe, so the opaque world of trade, tariffs and quotas and protectionist policies have risen to the surface. Apple iPhones are designed in California, but they are made and assembled in China, with parts sourced from across the globe. Many other products, too, are designed in the place where the goods are marketed, but they are assembled and built in areas where the labour cost is lower and other advantages regarding production are in place. And you will often see products of major brands where it says designed in Zurich, or designed in Paris, designed in London, designed in Berlin, designed anywhere apart from where they are made. The products themselves could be made in Southeast Asia and shipped in through an arrangement of complex supply chains to get to the markets where the goods are sold, and they must cross borders to do that. Once products begin to cross borders, that's when other costs regarding trade tariffs and maybe quota limitations come into play, and so there's friction introduced into the market through protectionist policies.

### ***Have you heard of “de minimis?”***

When we consider tariffs and trade, we consider that to be the norm but have you heard of de minimis? As the name suggests, it sets a minimum limit on goods, which have to pay to duty when goods are landed at US ports. Leading Chinese importers such as Shein and Temu are able to import packages up to \$800 in value without incurring duty. It is a loophole (Rapoza, 2023). This allows them to avoid tax. De minimis allows these companies and others to ship products direct to consumers without paying duty. In the United States, de minimis imports topped \$1.8 billion in 2022. Bill Cassidy a Republican senator wants to introduce a bill that would change the law (Masters, 2023).

De minimis rules also apply in the United Kingdom but they are slightly more complicated. In the United Kingdom, customs duties are administered by HMRC, and non-excise goods worth up to £135 do not attract customs duties. There are staggered benefits for gifts above that value. Gifts that are valued at between £135 and £630 attract duties of two point five per cent, with some exceptions. To summarize Section 105 of the VAT Regulations 1995, allow imports up to £135 free of duty and above this up to £625 attract just two point five per cent duty according to the Gov UK website where you can find out more (Gov.uk, 2023).

### **De-globalizing or continued globalization of supply chains**

The World Economic Forum (WEF) puts it like this they say that deglobalization is gaining traction after a long period of globalization with the exception of 2008 they year of the financial crash that they refer to as slowbalization (World Economic Forum, 2023). They produced an interesting chart showing that between 1870 until 1913 there was an increase in trade and global integration which was interrupted by the First World War. The period from 1915 to 1945 they claim was a period of protectionism and war. That was a period of course in which the great Wall Street crash happened in 1929, and that caused a large downturn for a decade in the run up to the Second World War in 1939. It was not until 1946 that economies started to open up again but much of the 1950s saw slow growth and economic progress as countries were recovering from the war. Globalization increased steadily for the next 30 years from 1960 through to 1990 when the next gear change came and hyper globalization happened and continued through to 2005. When the global financial crash hit in 2008 globalization began to wane replaced by slowbalization until 2020 when the global pandemic saw decline in trade. The evidence in global economic



data shows that although there has been a slowdown the underlying trend is still towards globalization. Disruptions in supply chains and global trade throughout the pandemic years remain a threat to further globalization but perhaps the bigger threat is the rise of geopolitics and a move towards more protectionism.

***Metals are the new oil and China is dominant in this supply chain***

First, we had water, coal and steam to power industry. Next came oil and gas. Today we are moving to green energy with rare metals replacing fossil fuels to drive electric motors. As Henry Sanderson notes in his excellent book *Volt Rush* we are dependent on a few metals and rare earths to power our devices and vehicles (Sanderson, 2022). There are increasing tensions between China and the West as we transition to green energy. China holds a dominant position in the material supply chains that underpin the switch. China imports many of the metals such as lithium from Australia and cobalt from the Democratic Republic of Congo (DRC). It has spent the past two decades building these supply chains with an eye to dominating the future of this technological revolution ('China Supply Dependency', 2021).

Back in 1995, China had just three per cent of world trade. Today it is over 30 per cent. In 2020, China was the number two economy in the world in terms of gross domestic product. It was number one in total exports, number two in total imports and 68 in terms of GDP per capita. It is the 28th most complex economy according to the Economic Complexity Index. China exports are 20 per cent of GDP, up three per cent from 2020. It is the world's largest importer after the United States. More than 90 per cent of goods transported by sea. China ranks third in world shipping, with 6,896 ships and a total deadweight tonnage of 129 million in 2020. It lags behind Greece and Japan. According to the United Nations Trade and Development Statistics. UNCTAD, COSCO, the Chinese shipping company, is the world's biggest shipping company. They have 1,371 vessels with almost 114 deadweight tons and it is the biggest terminal operator in the world. China has over 400 ports along inland rivers and coastline. Shanghai is the largest container port and Ningbo has the highest cargo tonnage. China is the world's biggest shipbuilder, accounting for 45.6 per cent of the total ships delivered. China produces 96 per cent of all dry cargo containers and 100 per cent of temperature-controlled containers. China also has stakes in ports around the globe. Five in the United States, 100 ports in 63 countries, altogether ten European ports, and it has invested about 57 billion pounds in FTSE companies. In the 100 list, Chinese ports handle 242,020 equivalent units in a year. In fact, that was the last pre-Covid year 2019.

China has built a maritime silk road through its Belt and Road Initiative, so it has global economic and political influence. This has helped China connect with ports around the globe. The Belt and Road Initiative focuses on goods, investment and people. It covers 138 countries, ports, roads and information grids, and between 2013 to 2017 it was reasonably successful.

So, where's China headed today? China exported approximately \$3.36 trillion worth of goods in 2021. It is around 30 per cent of world trade, with the top exports from China telephones at 31 billion, computers 21 billion, integrated circuits 16.5 billion, semiconductor devices around five billion and light fixtures around 4.74 billion. The United States is the largest trading partner and they take about 17.2 per cent of China's total exports, which is about \$521 billion. This is closely followed by Hong Kong China, 313 billion, about ten point three per cent. Japan about five per cent, South Korea four point five per cent, Vietnam, four point two per cent, Germany three point four per cent, Netherlands three per cent, India two point nine per cent, the United Kingdom at two point six per cent, Taiwan two point three per cent, Malaysia two point three per cent, Thailand two point one per cent, Mexico two per cent, Australia and Russia two per cent.

The United States has an ongoing trade war with China about opening markets to United States businesses. This trade war does not do any good for anybody, because China needs the United States and the United States needs China. Lots of US jobs are tied up with Chinese companies and lots of Chinese business is tied up with the United States. There is a great deal of cross investment. Close to 66 per cent of trade was conducted with those top 15 countries I just mentioned. The United Kingdom, by the way, is worth \$78.8 billion to China. One of the most startling statistics is that Mexico increased its imports from China at the fastest rate. It was up 36.2 per cent from 2020 to 2021, and India was up 31.8 per cent. South Korea was up 20 per cent, Thailand 23 per cent, Malaysia 22 per cent, Germany 18 per cent and Taiwan up 17.7 per cent and the Russian Federation up 17.5 per cent. The most modest increases came from Japan at six per cent and the United Kingdom at eight point five per cent. In 2021, China was the United Kingdom's largest import partner. A year earlier it was number three. It is the sixth largest export partner for goods. The United Kingdom imported £63.6 billion worth of goods from China in 2021. That is 13.3 per cent of all goods imported to the United Kingdom, and exports accounted for £18.8 billion. That is five point eight per cent of all goods exported from the United Kingdom.

Since the start of the Industrial Revolution, Britain was always known as the workshop of the world, but that mantle has definitely passed to China. China is now responsible for many of the products that we see in our stores, in our businesses, in the factories. It also manufactures the majority of electronic goods. If you take a look at anything in your possession, from the Apple iPhone through to Hi Fi equipment or televisions. No doubt inside those products there will be Chinese manufactured components.

China dominates semiconductor markets and they dominate the extraction and mining of metals that go into all these products. During the past 20 years, China has slowly developed its resource base in Central Africa, in the Copperbelt, extracting all kinds of minerals. And, of course, China has built up extensive networks in Southeast Asia to support its operations. That is what competitive nations do. The world has basically allowed China to become the supplier of choice. Originally, a choice made down to cost. It was all to lower labour cost as many products moved offshore to achieve those lower costs and China became the preferred supplier. During that period, China, of course, developed its own skills, its own abilities in manufacturing and supply. It learned from Western companies how to do things in all kinds of industries where it had previously no expertise. Since China opened its economy in 1978 to world markets, 800 million people have been lifted out of poverty and it is also expanded health services and education to the wider population. So there have been some real benefits to China's population. China is now regarded by the World Bank as a middle- and upper-income country; no longer in poverty.

### **More frequent disruptions**

In 2020, as the pandemic took hold, there was a spike in demand for personal computers and communication devices, and that caused a supply shortage of basic microchips. The problem caused by factory closures and a trade war between the United States and China. The United States had decided to choke off supply of chip technologies to China. It began to have a big impact on people around the world and their everyday lives, according to Chris Miller, who wrote an interesting book called *Chip Wars* (Miller, 2022). He says that Huawei have been stockpiling chips since at least 2019. They were already preparing for the sanctions that the United States might take against China. There was also a growing demand for chips from the expanded data centres that were springing up around the world for cloud technologies. In the early part of

the pandemic, automobile manufacturers reduced demand for chips because they thought there was going to be a slump in the industry, but when demand quickly recovered, they found that the chipmakers had already reallocated the supplies of those chips to other customers. Big automobile manufacturers use around 3,000 microchips in a vehicle. During 2021, manufacturers struggled to get hold of those chips and they produced nearly eight million fewer cars in 2021 than they would have done if they had not faced the chip shortages. That is about \$210 billion of lost revenue, according to industry estimates.

Many people viewed this as a supply chain problem, and the Biden administration in the United States produced a 250-page report about supply chain vulnerabilities, and it focused attention on semiconductor shortages, rare earth metals, minerals and EV batteries. But it was not just semiconductors that were suffering. All types of products were disrupted from the Covid lockdowns. This type of disruption would have been considered a black swan, something that happens once in a lifetime. In 2021, 1.1 trillion semiconductor devices contained these microchips. It was a 13 per cent increase on 2020. And it is probably better to see the semiconductor shortages as a demand growth problem rather than the supply problem. It is driven, of course, by new technologies, more PCs, 5G phones and artificial-enabled data centres. Essentially, it is all about computer power. Chris Miller says that politicians around the world misinterpreted the semiconductor supply chain dilemma. The problem not the chip, but the industry's far-flung production processes dealt poorly with the pandemic and the lockdowns. So, could this happen again, or was it really a black swan?

In a briefing note from the White House, it was stated that:

While amplified by the public health and economic crisis, decades of underinvestment and public policy choices led to fragile supply chains across a range of sectors and products. Unfair trade practices by competitor nations and private sector and public policy prioritization of low-cost labor, just-in-time production, consolidation, and private sector focus on short-term returns over long-term investment have hollowed out the U.S. industrial base, siphoned innovation from the United States, and stifled wage and productivity growth.

The White House (2021b)

Funding to support the aims of this resilient supply chain policy will come from the public purse working with private industry and allies. Funds have also been set aside from the defence budget because this is about critical infrastructure to support defence policies.

The biggest challenge is the semiconductor vulnerabilities according to the US government (The White House, 2021a, pp. 67–68). This is what the report says about it:

The biggest challenge to increasing domestic semiconductor production is cost, both absolute and relative to other countries as discussed in the “Fabrication” and the “Competitor Actions” and “Ally/Partner Country Actions” sections. A large volume 300 mm fab anywhere in the world can cost billions of dollars, and tens of billions for a leading edge fab. The most critical factors for determining the best location to manufacture semiconductors include synergies with an existing semiconductor ecosystem/footprint, access to skilled talent, protection for intellectual property, labor costs, and government incentives. While the United States fares well on the first three factors, the costs of labor are higher and there have been significantly fewer government incentives. As a result, the 10-year cost of a new fab in the United States may be 30 per cent – \$6 billion on average – higher than building the same fab in Taiwan, South Korea or Singapore, and up to 50 percent higher than in China. Much of the cost differential (estimated 40–70 percent) is specifically due to government incentives.

The demand for semiconductors is forecast to grow, which in turn requires 50 per cent further productive capacity. This report was basically a call to arms to the US manufacturing sector and it was later backed up the Inflation Reduction Act giving tax incentives to technology firms able to contribute to the increase in output required.

### Security – defence, energy, food, water

In Chapter 2 we discussed risk and disruptions to supply. Security is the corollary of risk whereby to avoid or mitigate risk we need to secure supplies. Security has moved up the public consciousness since the pandemic and the disruptions experienced to supplies taken for granted, Russia's invasion of Ukraine brought turbulence to energy and food markets not to mention human rights violations and damage to critical infrastructure with scant regard for human life. Critical supplies are in defence, energy, food and water. I will now discuss each briefly in turn.

Supply chain security for defence involves identifying, analyzing and mitigating risks inherent in working with other organizations as part of a supply chain. In the previous section it becomes clear how interrelated supply chain security of critical assets is part of building defence infrastructure through the resilient supply chain initiative of the Biden-Harris Administration in the United States. There are two closely intertwined parts to defence security physical hardware and cybersecurity. Securing the global supply chain is essential to national security and economic prosperity and requires a multifaceted and functionally coordinated approach. The UK Ministry of Defence has published a *Defence Supply Chain Strategy* that outlines how defence plans to build resilience within its supply chains. The National Cyber Security Centre has also published guidance on supply chain security that proposes a series of 12 principles designed to help organizations establish effective control and oversight of their supply chains.

Supply chain security for energy involves ensuring that the supply chains for clean energy technologies are secure, resilient and sustainable. The resolve of governments around the world to achieve net-zero carbon emissions by 2050 has switched the focus to the supply of minerals, rare earth metals and manufacturing capacity to deliver clean energy. The International Energy Agency has published a report on *Securing Clean Energy Technology Supply Chains* that assesses current and future supply chain needs for key technologies and provides a framework for governments and industry to identify, assess and respond to emerging opportunities and vulnerabilities.

Supply chain security for food involves ensuring that the supply chain for food is consistently able to deliver adequate quantities of food, both through preparing for disruption and having the capacity and flexibility to respond effectively to unexpected problems. A resilient supply chain is robust and resilient, possessing an ability to recover from disruption and which can re-orientate to alternate outcomes when necessary. In the case of food, we are talking about the sustainability of human life and the environment is critical to food production (Lang, 2021). Biodiversity is reducing and the forests are already receding with carbon capture severely reduced. If we decide to turnover more arable land to forests to replace the depleted forests, the capacity to grow crops recedes. The opportunity to feed the world is severely impacted. The UK government has published a *Food Security Report* that looks at food security in terms of key infrastructure underlying the supply chain (Gov.uk, 2021). Three priorities for government are healthy food for healthy people, maintaining a healthy environment and ensuring sufficient food is grown for the population. Policies are needed to achieve these goals. We must not forget all those empty shelves during the pandemic. It is a lesson we do not want to relearn in future.

Food logistics includes transport, trucks, ships, planes and involves distribution hubs and ports. The United Kingdom imports 50 per cent of its food supply give or take and it exports

food and beverages such as whisky, fish, meat, cheese and other processed food and farm produce. Food logistics is important to food security. This goes beyond trucks, planes, ships and other transport and covers systems including sensors, satellites and cybersecurity to protect data and information systems managing the networks.

Supply chain security for water involves ensuring that the supply chain for water is consistently able to deliver adequate quantities of safe, clean water, both through preparing for disruption and having the capacity and flexibility to respond effectively to unexpected problems. A resilient supply chain is robust and resilient, possessing an ability to recover from disruption and which can re-orientate to alternate outcomes when necessary. Water companies in the United Kingdom have been heavily criticized and fined heavy penalties for discharging raw sewage into rivers and into the sea during the past few years. They have also been fined for contaminating the fresh water supplies to consumers. Standards and compliance with those standards must improve significantly if the problems are to diminish.

Additionally cyber security has become a priority with so many critical systems now dependent on cybertechnologies. This is likely to increase in the coming years.

### **Climate change impacts**

The problem, briefly, is human activity and its impact on the planet. There are frequent temperatures rising in excess of 40 degrees Celsius causing wildfires in Australia, Greece, California and Turkey. The combination of droughts and heatwaves for longer periods than normal is a common feature of regions where increasing wildfires occur. It is the fact that conditions are not following normal patterns which adds to the problem. These conditions, which deviate from historical norms, contribute to the drying out of vegetation and make landscapes more flammable. It is climate change rather than simply temperature rises that is making weather more unpredictable. Climate change affects a wide range of atmospheric variables, not just temperature. It can alter precipitation patterns, increase the frequency and intensity of heatwaves and exacerbate drought conditions. However, it's important to note that while climate change is a significant factor in increasing wildfire risks, other factors such as land management practices and human activities also play a crucial role. There is a growing inability of the earth to reflect the sun's rays to reduce ground and sea level temperatures. Deforestation and the imbalances that brings to capturing carbon emissions and excessive waste with chemical, plastic and other waste entering the seas and landfills. Biodiversity is reducing; animals impacted badly by human activity destroying their natural habitat. Ocean and river fish stocks will be depleted. Fresh water free from contamination is a problem in many parts of the world. Soil quality for growing crops is under threat due to the declining amount of arable land to grow food that is free from harmful fertilizers. Climate change is a source of major disruption.

Many governments have now committed to achieving a zero-carbon future by 2050, including the UK government. This is an ambitious target. Although many activists say it should be sooner. Doing nothing is not an option if we do not want to see average temperatures rise by 2.3 degrees Celsius by the end of this century. In a planned economy with a non-democratic government such a target might be easier to reach as dissenting voices and non-compliant behaviour of citizens could be punished and enforced. In a society that is democratic and individualistic in nature it is less clear how the target can be reached in practice. Statistics cited to promote the COP 26 event in Glasgow in November 2021 related to actions and measures already in the bag. In other words, it is not about the future but a record of past achievements to demonstrate the successes of the United Kingdom. While some of these achievements are not to be brushed



aside, we should now be focusing on the hard road ahead to meet the target of a zero-carbon economy by 2050. After all we have just a short time to reach it. Every tonne of carbon emitted into the atmosphere adds to the problem. Greenhouse gases and CO<sub>2</sub> is the enemy. It remains in the atmosphere for hundreds of years. Because of this all emissions are cumulative as they stick around unless removed.

Since 1880, carbon emissions have increased average temperatures by 1.23 degrees Celsius. Each decade is hotter than the previous. It is estimated that this will increase average temperatures by 1.5 degrees Celsius in just over 11 years. This is significant because at that figure scientists claim that we will have reached the point of no return. The IPCC Report published 9 August 2021 makes uncomfortable reading about what we already know. COP 26 hosted by the UK government in Glasgow discussed further what needs to be done and what policies governments in 166 countries members of IPCC should implement (IPCC, 2021).

Major industrial economies are contributing more than their fair share of greenhouse gases. At the IPCC conference in 2018 it was stated that to have a 67 per cent chance of success in achieving net-zero carbon we have to keep emissions below 420 gigatonnes of carbon and today it now needs to be below 350. This is a tough call with global emissions running at 40 gigatonnes each year. Remember carbon once released into the atmosphere is cumulative.

Countries with the largest repositories of carbon assets are possibly those that stand to lose out economically, and that includes the United States, China, Russia, Australia and India followed by Venezuela, Saudi Arabia, Qatar, Iraq and Germany. The Big Five have coal deposits along with Germany. The rest have mostly oil and gas. Countries with more sun have less to lose as they will be able to harness solar power. The Big Five have plenty of sun so there is some trade-off. Carbon is, of course, best left in the ground where it can do no harm to the planet. This is about existence itself and not about economics. Without the planet the rest is dust. As Mike Berners Lee says in his excellent book on this topic, *There Is No Planet B* (Berners-Lee, 2019).

Carbon of course is not just underground it is in the make-up of life itself. Carbon makes up 18.5 per cent of the human body. Eradicating carbon is not the issue rather it is reducing the amount released into the atmosphere through industrial processes. All human activity including mining, agriculture, manufacturing, construction, transport and travel, amongst other things, need to contribute to this reduction of greenhouse gas including carbon (CO<sub>2</sub>).

Chris Goodall offers some proposals of “what we need to do now for a zero carbon future” in his book of the same title (Goodall, 2020).

1. Increase renewable electricity, store any excess and convert it to hydrogen to use when required.
2. Improve insulation on buildings with government offering incentives for those that do such as low-cost capital. I would add tax incentives and grants for individual property owners to convert premises to meet the standards.
3. Electrify the transport system seek to replace fossil fuel with hydrogen where possible. Diesel heavy transport, shipping and hydrocarbon aircraft fuel needs to switch to more environment friendly energy. New cars after 2030 in the United Kingdom will have to be electric.
4. Rethink the food system moving away from meat production and reduce the use of artificial fertilizers.
5. Textiles and clothing supplies need to move away from polluting production processes (use of dyes, chemicals, fertilizers and water reduced). (My view is that the real answer here is to produce and consume less.)

6. Change technologies for production of steel, cement and fertilizers switching to hydrogen fuel (or other green energy sources).
7. Reduce de-forestation and increase woodland to mitigate CO<sub>2</sub> impact.
8. Improve carbon dioxide direct capture methods from the air. Use it to produce hydrogen or synthetic low-carbon chemicals, using hydrogen generated from surplus electricity.
9. Introduce carbon taxes.
10. Research and plan geoengineering techniques.

### **Mass customization**

Customizing brings benefits to both producer and customer. The customer gets what they want and can participate in the design and specification of a product, while the producer can postpone production until the customer demands it and deliver the customized product knowing that it will be accepted by the customer and payment will be made. This eliminates the need for forecasts, inventories and purchasing delays. Mass customization ensures that niche markets can be served effectively and efficiently.

Recent technological developments, such as 3D printing, have made customization easier to achieve. These printers are able to produce three-dimensional physical objects in units of one, enabling the printing of complex designs in many contexts. This overcomes one of the biggest problems in supplying mass customized products, which is waiting for an item to be made. Rapid prototyping is also available using this technology, saving time in product development.

If supply chains can integrate technologies and respond effectively to demand pull signals efficiently, mass customization is possible. In many settings, the cost of a mass-customized product is comparable to a mass-produced product. However, some critics argue that this overlooks the fact that extruding, printing and sintering are not the same as manufacturing and the materials that things are made of might actually be important too. For example, a Stradivarius not made of wood (willow, spruce and maple) or by the master crafter may not sound quite the same.

There are different ways to develop mass customization, which may be summarized as follows:

1. Modular customization – is when a supply chain is organized to have a variety of components that can be switched between different designs for a core product that has variation. For example, an automobile can be customized to have different specifications of trim, wheels, tyres, engine size, electronics, steering wheel and colours. Customers often participate in the process by choosing from a menu of possible variation allowing the manufacturer to build a car that they have customized. Modular manufacturing processes allow this to happen at the same time they could wait for standard mass-produced vehicle.
2. Adjustable customization – is often a way of allowing variation at a later stage of production or after completion of a standard unit. For example, if you buy a car at a local dealer they will often ask if you want a sunroof, specific wheel trims, interior fittings and other additions that can be made easily before delivery.
3. Dimensional customization – is when specific changes are made permanent before delivery such as cutting or machining metal to change shape, form or function. Once again choices are limited to a menu.

Choice must be limited in some way to accommodate the variation that could otherwise take place and incur high-costs of purchasing, inventories and processing or manufacture. Customer choice is balanced against cost (Anderson, 2008).



Staying focused on what the customer wants, removing complexity and simplifying supply chain flows and processes is key to achieving mass customization. This may be achieved through integration and synchronization that removes time from the supply chain and by combining other actions to reduce product variety and material variations staying focused on interchangeability between components used to deliver different configurations on the same platform. Outsourcing, integration and transparent shared information between supply chain partners is essential to achieve effective and efficient mass customization. Real-time customer data replaces forecasts and inventories. Customer demand pulls materials, components, labour and manufacturing processes together to assemble a mass customized product for the customer. These processes, as they are planned and designed, ensure lean thinking. Mass customization may involve concurrent engineering and le-agility to reduce costs and meet demand. Mass customization differs from mass production as follows:

1. Mass production builds products based on forecast data whereas mass customization builds based on real-time demand data.
2. Mass production requires higher inventories (i.e., build for stock rather than build for the customer). Whereas mass customization is based on real-time demand so long as the firm can adopt le-agility strategies to postpone production closer to the market demand period. This will also depend on how resilient the supply chain is.
3. Mass customization is vulnerable to inefficient supply chain integration and co-ordination because of (2) above. Organizations that pursue mass customization strategies need to ensure that they have reliable supply chain partners that can share information and ensure transparency within the total supply chain to know at any point in time where everything is.
4. Lean manufacturing processes save customers money and are an essential part of mass customization. In mass production the higher cost of inventories is passed on to customers through price and it is often the customer that covers the cost of supply chain inefficiency. As firms move to create resilient supply chains, this problem has the potential to increase risk.

### **Dell case study**

Dell Computers were one of the first companies to employ the “mass customization” concept. Dell delayed the final configuration of their product until a customer specified the components that they require. The company makes a standard offer at a standard price and then allows upgrades of additional components and services to be configured by the customer at additional price increments. This allows the organization flexibility to minimize inventory owing to the limited choices available from the standard product. Assembly then takes place with variations to the key components making up the required personal computer (PC). Limiting consumer choice within acceptable ranges is the key to effective inventory control. The variety of inventory held is then minimized and replenishment is simple. As advances in technology or changes to design occur it is possible to re-configure possible choices without too much trouble. New parts can replace older components and sub-assemblies as and when they become available. Since minimum inventories are held, there is not a major problem with obsolescent or redundant stock items. This innovation has been copied by several other suppliers of computing equipment. It has also been adopted in the automobile industry by brands such as BMW.

### **Example 1 – Self-cleaning fabric**

Not many readers will necessarily remember the film *The Man in the White Suit*, which captured my imagination many years ago. It was about a struggling textile mill in the north of England where Sir Alec Guinness played a textile scientist that developed self-cleaning cloth. I was very interested personally because if this could actually happen then no more wine stains or tomato stains on your shirts. Well, it is now possible, researchers at the Royal Melbourne Institute of Technology have developed textiles that are self-cleaning.

#### **How it works**

Nano threads were used to create a fabric which when exposed to sunlight can clean themselves within ten minutes. The nano threads contain silver and copper structures which when exposed to sunlight breaks up organic matter, which are then removed from the textile factors without a washing machine in sight. No water or chemicals are required so the benefits are immense when it comes to sustainability.

You can see too that the supply chain configuration also has to change as a result of the innovation, which requires a different material mix in the fabric makeup.

### **Example 2 – Smart clothing**

Innovations have combined technology to monitor wireless health monitoring through smart patches included in garments with internet connectivity. This has wide application and will have a profound and beneficial effect on world health. The potential to incorporate innovations and technology in smart clothing for mass customization is now a reality, and supply chains need to adapt and respond to these developments.

### **Example 3 – Redistributive manufacturing (RDM)**

Professor Wendy Phillips does research looking at RDM in healthcare. Imagine you need to get pharma products to a remote community quickly. If instead of waiting for those products to be produced in distant factories, sorted and assembled for shipping, you could get the ingredients and manufacture on site what you need. RDM has potential to engage local communities to become co-producers in providing products and services at the point of consumption and to customize them to meet the specific need of service users (Phillips et al., 2022).

### ***Music***

Thirty years ago, people visited their local music store sifted through racks of vinyl LPs and selected one or two to listen to in a sound booth or later through headphones in store. The rise of CDs, MP3 players and other digital systems allowed consumers to configure their own selections of music and to download them from Internet websites and streaming services. Initially, this was often without any payment. Shawn Fanning founded ‘Napster’ the free music exchange

service as a 20-year-old student writing file-swapping software at Northeastern University in the United States. When payment is made, it is often a fraction of the price that would be paid for in store music (vinyl records, CDs, DVDs, cassette tapes, etc.). Disintermediation has taken place in this market. Music and media companies publishing and distributing music built their asset base by developing or purchasing back catalogues often for vast sums of money. The back catalogues guaranteed licensing agreements with other suppliers to publish their material elsewhere for payment of a fee. Many music suppliers are rightly concerned that their long-established catalogues are no longer worth the sums of money invested in them. Without entering the legality or the ethical aspects of this customization it is easy to conceive how other markets could change significantly in future. Figure 13.1 illustrates the differently configured supply chain options. There are different channels to market that music can take with different costs and prices. What is salutary is that the digital route to market with its highly customized concept is probably lowest cost and lowest price. Apple iTunes held a dominant place in the market for digital music. Now there are other streaming services such as Spotify that compete in the space. Dominant market positions are difficult to maintain, and disruption is caused through innovation, which provides both opportunities and threats to those dominating particular market segments or a particular niche. Digital supply chains have reconfigured the ways in which consumers access music. Technologies have developed to support the growing demand for digital music downloads and wireless streaming throughout the home. Supply chain strategies need to be constantly reviewed and renewed to meet the challenges presented by innovation. Vinyl has had a renaissance in recent years and it had 46 per cent of total permanent music sales in 2021. Volumes are much lower than 30 years ago though.

### Music Industry Supply Chain Channel Configurations

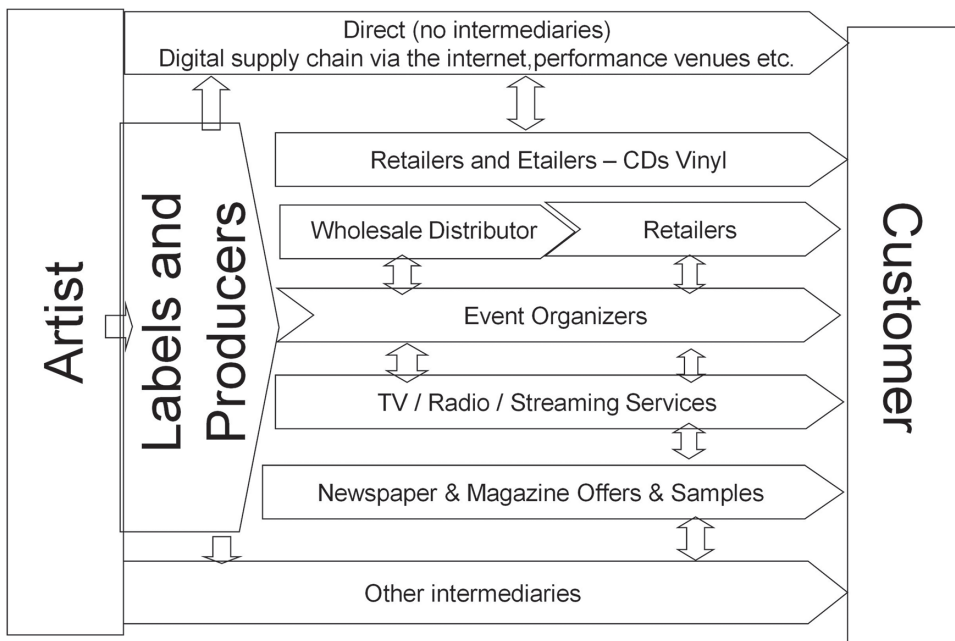


Figure 13.1 Music industry supply chain channels

***Conditions give rise to change***

The rise of the global economy and the impact of macro-environmental change have consequences for consumer behaviour. Socio-cultural shifts and demographic change have given rise to new market opportunities whilst simultaneously hastening the decline of long-established mature industries and products. Product life cycles are much shorter. The levels of risk have increased generally.

The rise in consumerism has brought more fickle buying behaviour. Consumers expect more for less. The long-term trend is falling prices in real terms despite the current inflationary spikes. Improvements in technology, design and other features have brought benefits for many without necessarily increasing prices. Consumers want instant or near instant availability. It is often said that today's working consumer is time poor and cash rich whilst the reverse is true of those who find themselves out of work. Demographic change causes shifts in consumer behaviour. For example, it is estimated that 38 per cent of the UK population is over the age of 50 while in the United States it is over 30 per cent. This has implications for demand, service, products, service locations and shifts in specific consumer requirements. Consumers with higher disposable income have more choice, are likely to be less loyal, are not prepared to accept second best. However, for some the switch to online only services has had a negative impact, for example, elderly and non-tech consumer groups.

Companies that want to achieve market dominance have developed global brands to transcend local domestic markets. These organizations need to satisfy their customers by understanding better their needs. They are developing powerful information systems that provide their owner(s) with vast databases that they can mine to identify market trends and utilize for targeted promotional activity. New product innovation and creativity to leverage both the brand and the vast arrays of information that these global brand owners have at their disposal requires them to think in new ways about their business and the competition they face. Owning assets is no longer as important a consideration as owning customers. This belief is evidenced in trends to restructure organizations and to outsource many of the functional and traditional activities previously regarded as essential to the well-being of the organization. Efficient and effective supply chains are required to manage customer demand and brand operations.

**Greening the supply chain**

We need to look at what it means to green the supply chain. Green supply chain management (GSCM) is a set of practices that integrate eco-friendly processes into the traditional supply chain to improve environmental sustainability. It involves integrating environmental considerations into the traditional supply chain management processes, including procurement, manufacturing, transportation and logistics.

Large organizations have supplier standards that their suppliers must comply with when it comes ESG. Having a first tier sign up is one thing but beyond that many have relied on a cascade effect further upstream where the first-tier supplier ensures compliance from the second and the second from the third and so on. The problem is that the further upstream you travel compliance with standards becomes more opaque. This is illustrated here:

The proverbial three Ps of sustainability, *planet, people and profit*. Profitability relies on lowering cost, improving quality, delivery times, and technologies. Whilst simultaneously improving the quality of people's lives and limiting damage to the planet. "Not surprisingly,

that can lead to situations in which preapproved lower-tier suppliers violate the sustainability requirements of the MNCs they work with.”

Villena and Gioia (2020)

In future supply chains, adopting smart technologies have more chance of making the opaque chain visible. We can expect increased supply chain governance to achieve compliance. Consumers and businesses are far more demanding in this respect than at any previous time and it will intensify.

Managing supply chains offers many opportunities to reduce pollution at every stage. This topic has become of paramount importance since the start of the twenty-first century. Many commentators think that the focus has been skewed to thinking about extraction and pollution, which are rewarded, and less about regeneration of natural systems. A clean economy is one that uses resources in harmony with natural systems by minimising waste and finding ways to replenish depleted resources (Figueres & Rivett-Carnac, 2020). Politicians need to think more about measures that can be used to do so rather than simply relying in economic measures such as gross domestic product (GDP). If we had daily statistics about how many plastic nurdles were in the oceans and rivers of the world and less focus on a single digit measure of GDP improvement or decrease that might change mindsets to focus on what matters to most people. The mood swing is changing and there are now certainly more meaningful measures that do get press and television coverage, but more is needed.

Green pressure groups have risen in prominence in the past few years. These groups are generally concerned with protecting the integrity of the environment. They have drawn attention to the fact that many aspects of daily life impact adversely. Many energy sources (e.g., fossil fuels) are not renewable and consumption is damaging the ozone layers in the atmosphere. Increasing distances travelled by goods reaching their market destination consume energy and damage the environment. Many have discussed this issue in reference to “food miles.”

### **The case for local stores and local supply to reduce food miles**

It is claimed that the increasing dominance of supermarkets has been particularly harmful to local economies. While supermarkets would claim more choice for consumers by having an extended range of goods on the shelves at lower prices it has come at a cost to high street shops, and traditional village and corner stores. Some argue that the supermarket takeover has in fact reduced choice by forcing people to travel further to buy standard goods, produced far away from the local communities who buy them, often at higher prices. Small local retail outlets can have a hugely beneficial impact on an area. Local shops provide essential community glue without which you get social isolation and a rise in crime and vandalism. Not everyone has private transport to get to supermarkets and for elderly and disabled consumers this is a disadvantage. Some of this is mitigated by the home delivery services now offered by large supermarkets and the introduction of convenient local stores. Nevertheless, home deliveries can be expensive and you do not see what you are buying before goods arrive. One solution is to establish European procurement rules to encourage public bodies to purchase goods and services locally wherever possible. Big food retailers must reduce food miles by sourcing more products locally.

There is also the issue of genetically modified foods (GMF) referred to elsewhere in this book. Thus far, large supermarket chains have adopted a consumer focused and customer driven approach to their policy towards GM foods with many keen to highlight the fact that they do not stock them.

In addition to energy consumption within supply chains and issues surrounding the disposal of waste materials there are issues relating to the design of products and supply chain delivery mechanisms. Products and services could be better designed to remove waste using reusable energy sources, reusable or recyclable materials and parts. Procurement policies, particularly those of public organizations where they serve the needs of local communities through democratic processes, should look after the wider interests of the community.

### **Ethical supply chains**

Back in 2013, at the Rana Plaza Garment factory in Bangladesh, there was a disaster which claimed 11,130 lives and injured thousands more people. This event was considered by many as avoidable. It sent shock waves across manufacturing industry, particularly in textiles, clothing and beyond. It was a historic failure of textile and garment manufacture, and people began to ask questions about the ethics of supply chain practices, not just in the textile and clothing industries, but in other industries too, where there are persistent human rights issues, corruption and environmental risks shifting the nature of the arrangements in those supply chains.

Modern slavery is a term used to describe situations where people are forced to work against their will, often in terrible conditions. It includes forced labour and forced marriage. According to a new UN report, some 50 million people were living in modern slavery: 28 million in forced labour and 22 million in forced marriages. It is now thought to be that ten million more people were in modern slavery in 2021 than when previous estimates were done in 2016. Women and children are disproportionately vulnerable. The hidden nature of modern slavery makes it difficult to get data about precise numbers. It is estimated that modern slavery has increased to 50 million people worldwide suffering inhuman conditions. Seventy-one per cent of these are said to be women and girls. It is not limited to any single country. Even in the developed world we find modern slavery. It can be hidden in plain sight (Stevenson, 2022). Sixty-three per cent of the modern slavery observed exists in the private economy. It is largely unseen which is why it is so difficult to be precise when it comes to numbers.

Within the broad definition of modern slavery, we observe trafficking, exploitation, forced labour and servitude with a blatant disregard for human rights. Greater increases in the reporting of these crimes account for part of the increased numbers each year. It is now in the public gaze much more than in the past. The United Nations has set sustainable development goals (SDG) one of which addresses this issue whereby the global community has committed to ending modern slavery among children by 2025, and universally by 2030. Many governments around the world subscribe to the UN SDG's and are taking the matter more seriously than in the past.

As supply chains become more complex, global and opaque it has been more difficult to get a handle on not just the legal aspects of supply chains but on the moral and ethical judgments that organizations make when they enter into supply chain arrangements. Consumers are also asking questions about their purchasing decisions when it comes to organizations they buy from. So, it is not just organizational procurement important as it is that is at the heart of this, but it is also about choices that consumers make at the final steps in supply chains. Many people believe moral judgements are important but often missing from management ethos, and they see management as simply rational decisions about the economics of business and not what is right or wrong in the process of doing business. So, is that the missing ingredient when it comes to those firms that build better reputations, better brands and have better connexions with supply chain partners? And indeed, with customers? Are the moral firms better at building relationships?

Angel Gurría secretary of the Organisation for Economic Cooperation and Development (OECD) said, "the business community has a responsibility to conduct business in a way that



takes into account both the bottom line and the impact of their activities on society.” The OECD due diligence guidance is a major milestone in ensuring that governments and businesses can work together to drive more inclusive and sustainable growth across the world through more responsible business conduct and due diligence across supply chains.

The OECD set up a national contact point for responsible business conduct in 48 countries who signed up to the OECD Guidelines. Anyone can submit grievances to the MCP concerning any business operating in or from the country, which is causing or linked to alleged corporate, social, labour or human rights issues, and there can be remedies for the victims which bring about significant change in corporate conduct, contributing to the prevention of future harm. There are thousands of companies involved in global supply chains, and it is difficult to know who is responsible for how those supply chains work and we have seen voluntary arrangements by organizations trying to do the right thing. But sometimes they are frustrated by a rogue partner, or even a rogue state. Since 2000, the national contact points have accepted more than 450 cases addressing impacts from business operating in 100 countries, territories and most submissions focus on employment and worker issues 54 per cent. Followed by general policies, which include expectations related to due diligence, 49 per cent human rights issues 32 per cent and environment 20 per cent. Knowing where to begin when we look at the ethical supply chain is an important consideration and we can think about the ethics of sourcing, procurement operations, labour practices, market arrangements, partnership arrangements, the buyer, seller arrangements and the transportation and distribution of goods and services in any supply chain.

Rana Plaza illustrates what can happen when the powerful and the powerless in supply chain relationships coexist and depend on each for their income and wealth. At one end of the supply chain there are big brands, often the retailers making profit from the production of low-cost supplies in low-cost countries. Those big brands dictate prices, payment terms, supply chain arrangements and everything else. They determine either directly or indirectly the wage rates of those making the goods and they put pressure on suppliers to ensure they comply with the guidelines and production specifications supplied by the powerful brand. Retrospective discounting is common in the textile and clothing industries that adds to the pressure. Cancelling orders is a regular occurrence, delaying payments and refusing to accept completed orders if markets are not working well in the home destination for those goods.

The garment industry comprises mainly female labour (70 per cent), and those females that work in the garment industry comprise many young girls and women trying to make a living in the difficult workplace situation. There is often sexual harassment and workplace abuses. And of course, there might also be corruption and that is what has come to light from the Rana Plaza example. It was an eight-storey factory building that collapsed and it was found in the investigations that followed that it was built on unsuitable land. Construction regulations were bypassed, shortcut payments were made to people to get things passed that should not have been and the building materials might have not been to the appropriate specifications. Officials allegedly took bribes, which produced a perfect storm.

### **Information, integration and intelligent systems (AI, sensors, machine learning)**

When it comes to trade and global supply chains digital transformations make a big difference and will continue to do so. Data not documents should be the way that global trade and supply chains are administered and smarten up processes. This could save trillions of dollars and create synergies and efficiencies. Technology will play a big part in assisting businesses and governments to achieve their decarbonization targets in various ways. For example, the development of efficiencies in choosing modes of transport, routing vehicles, using vehicles operating clean energy such



as EVs and using autonomous trucks, that is, trucks without drivers integrating sensor technologies, AI, machine learning and data systems for loading, unloading and moving goods around.

### **Driverless trucks with AI technology are moving container boxes at Felixstowe**

What if your port could increase efficiency, operational consistency and significantly contribute to decarbonizing operations with just one innovative solution?

Well, that is what the Port of Felixstowe in the United Kingdom is doing with the help of AI autonomous trucks supplied by Westwell of Shanghai. Westwell's Q-Trucks already operate at terminal D in Thailand and Lam Chabang port. In 2020, 15 Q-Trucks that operated in mixed mode were run alongside other traffic separate from any other traffic. They handled 334,020 twenty-foot equivalent unit (TEU) containers since their introduction. Clemence Cheng, Chief Executive Officer of the Port of Felixstowe and Executive Director of Hutchison Ports, said:

We are really excited to be working in partnership with Westwell to bring their groundbreaking and AI-driven technology to the Port of Felixstowe. Following the positive introduction of autonomous trucks at our terminal in Thailand and after thorough and successful testing in Felixstowe, we are rolling the system out in the U.K. The new trucks will increase the efficiency and operational consistency of our container handling as well as making a significant contribution to decarbonising operations at the port.

*Source:* Port of Felixstowe (2023)

Chapter 8 examined supply chain technologies. The ability to integrate systems and information to gain better control over supply chain activities through collaboration, co-ordination and synchronization were discussed. Intelligent systems take many forms detailed in discussions of Industry 4.0 from intelligent fridges with blue tooth technology, manufacturing systems, logistics traffic management systems (TMS) with sensor technologies to track and trace inventory movements in real-time as well as the condition of goods in transit and retailing organizations using bar codes, QR codes and RFID technology. The availability of, and access to these new technologies has allowed organizations to capture vast amounts of data that can be analyzed and used to understand better customer requirements. ICT systems have created the opportunities to develop new ways of approaching customers to attract business, new ways of making sure customers do not migrate and stay loyal to provide lifetime value for the organization and new ways to deliver products to market. Some of the latter have been discussed in this chapter, for example, Napster. The IESA case below is a further illustration of the benefits of having intelligent, integrated information systems.

### **IESA dispensing supply chain aspirins for blue chip clients**

IESA is a supply chain solutions company based in Warrington, United Kingdom. The company has developed a groundbreaking way of managing and monitoring the dispensing of tools and components with their automated tool dispenser (ATD). It combines proven vending technology, mobile telephony and Internet based management systems

to deliver operational benefits including cost efficiencies. The ATD has a touch screen for user authentication and product selection, which presents users with product images and technical information to enable accurate selection. The ATD records information on each item dispensed (who requested it and when), as well as monitoring the inventory level for each product line and triggering automatic replenishment orders when appropriate. Transaction data is linked to existing ERP systems for consolidated monthly invoicing. The integrated GSM engine provides 24-hour remote access to the ATD product information database allowing changes to product images and descriptions from central control offices. Remote access to inventory data means that “out of stock” is a thing of the past. Usage trends and tracking data keep close control of inventory. The ATD presents an optimum solution to maintenance, repair and operating (MRO) goods. The system only requires 240 volts of power and can be located anywhere convenient where there is a socket.

*Source:* Author

### **Implications for managers, organizations and policy makers**

Consumer challenges presented to suppliers in the twenty-first century will be many. Consumers want to buy products and services when they want them, at an affordable price, representing value for money, from sources that are reliable and this might mean that the supplier is ethical, environmentally conscientious and engaged with local communities being served by its products and services. There are a number of important policy implications for governments, organizations and managers engaged in supply chain strategies. Governments will need to establish regulatory frameworks that acknowledge consumer interests and the interests of the wider communities they serve. They cannot afford to continue to simply put these concerns lower down the priority list than business interests. Businesses need to recognize the realities of this situation and take steps to ensure that they can meet the challenges presented by designing green, sustainable, lean, agile, resilient and ethical supply chain strategies that deliver products and services efficiently and effectively adding value for customers. Balanced supply chain strategies must take account of markets served and sources of supply.

It is unacceptable ethically to source lowest cost supplies to serve high-value markets if it causes environmental damage or causes social injustice to the indigenous source country and population. Organizations have a social responsibility in designing supply chain strategies that minimize environmental costs and cannot simply ignore them. Globalization revealed many challenges and many paradoxical situations. For example, how do you explain to families who consume products in England that they lost their jobs manufacturing goods locally because it was cheaper to buy them from overseas sources so they could buy them in their local retail store cheaper? It is unsustainable for governments and organizations to allow local sources of supply to completely evaporate. It is “short-termism” and a high-risk strategy in the longer term for many industrial and commercial sectors. For example, quick response strategies need to have reliable, responsive and refigure suppliers to be effective in meeting customer demand. For governments, the impact of local organizations moving their manufacturing and sourcing operations overseas upon the balance of payments and employment will give cause for concern. Many organizations have had to reconfigure their European supply chains after the United Kingdom left the European Union. This will have meant moving operations into the European Union to reduce supply chain frictions where those organizations did a lot of trade with EU countries.

AI has many potential benefits and risks, and discussions about how to manage its development are a priority. Mustafa Suleyman is one of three cofounders of *Deepmind* which was a startup in 2010 and sold to Google in 2014. It is now part of Google Brain in 2023. The technologies employed by *Deepmind* are machine learning and AI. Suleyman (2023) warns that there is a need to contain AI so that it is not used by ‘bad actors’ to disrupt society and cause harm. AI has the potential to do so much that is good. It can improve productivity, efficiencies in production of all kinds of goods and services vital to human existence and the human condition but it also has potential to do quite the opposite if it is not managed properly. Fear is pushing governments around the globe to think about how they might regulate the technology to protect their citizens. Imagine bad actors with the ability to reengineer the human genome sequence, generate or replicate deadly viruses, to manipulate voting behaviour and even what we do and what we buy. This is why so many are concerned about development without safeguards. Ethics and morality are at the heart of ensuring it does good. Many are also concerned it will lead to all types of job losses across many industries at every level, which could change how we organize the material world. So many questions and so far, not too many answers to give confidence that it will improve our lives more than disrupt them. Perhaps we need to ask future Chat GPT for answers to the conundrum.

## Conclusions

Several important themes have been examined in this chapter. The themes selected are my interpretation of important developments that have brought us to where we are today. From roots firmly located in purchasing, supply and operations the concept of “supply chain management” as we now understand owes much to developments in other disciplines: strategy, economics, marketing, management, organizational behaviour and information technology. It is the integration of these disciplines in terms of thinking and applications in terms of practice throughout the management process that is important in helping to understand the current issues and the future directions that research can take.

### Discussion questions

1. What emphasis should organizations place on ethical practice within the supply chain?
2. Explain why greening the supply chain is viewed as important and what it means to have green supply chains.
3. One aspect of globalization is it has helped many countries have access to uninterrupted supplies of fresh food all year round, but what is the impact of this on local suppliers?
4. Local farmers complain that supermarkets will not take their produce because it does not conform to their quality standards (size, shape and colour). They say supermarkets would rather source standard tasteless goods from halfway round the world and local people are being denied local produce. Discuss.
5. Global supply chains are complex to manage and owing to geographical distance they are costly and risky too. Discuss.
6. Local communities losing manufacturing jobs may rightly ask questions about the moral-ethical dimension of the decision to source overseas supplies. How

do organizations ensure that the backlash from consumers does not threaten their market offering?

7. Intelligent information systems offer organizations new ways of developing supply chain strategies that improve customer service. Discuss.
8. Mass customization is an oxymoron. Discuss, how organizations that need to produce large quantities to keep costs low could offer customized products.
9. Discuss, the challenges facing government policy makers when it comes to ensuring organizations develop sustainable and environmentally friendly supply chain strategies.
10. Choose and discuss one possible research topic and explain how you might tackle the project to deliver the research objectives you have set yourself.

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## 14 The big transition

### Realigning global supply chains

In this book we began by looking at the external environment and how it shapes global supply chains. Then we looked at the details of different aspects of managing supply chains, which are demand driven and customer focused with a view to developing supply chain strategies. The road ahead is troubled. Steering a path to the future is what strategies must do. The biggest challenges faced by organizations come from external factors (e.g., geopolitics, environment, societal change and technology) and competitor strategies, it is to those we now return at the close of the book. As a major transition is underway with energy, due to climate change, decarbonization and sustainability driving change that will realign world trade and with it global supply chains.

In this closing chapter I want to look at the biggest transition impacting supply chains, the move towards green energy supply. The speed and scale of this change is immense. It is changing the balance of global trade. Despite all the talk about resilience in western economies achieving it is problematic creating geopolitical tensions that are likely to continue. We are living through a pivotal moment in how supply chains are being reconfigured for the twenty-first century. These changes will create winners and losers in the global economy. The story is best understood by looking at critical resources that will determine the outcome.

#### **Is hydrogen the fuel of the future?**

Hydrogen fuel has the potential to be a clean and sustainable energy source for the future. It can be produced from a variety of sources, including natural gas, nuclear power, biomass and renewable energy sources like solar and wind power. Hydrogen produces only water as a byproduct. There are several types of hydrogen, including white, green, blue, grey, black and brown hydrogen, which are produced using different methods. Green hydrogen, which is produced using renewable energy sources, has been hailed as a clean energy source for the future. It is the only type of hydrogen that is produced without emitting greenhouse gases. Grey hydrogen is produced using gas or methane and it releases CO<sub>2</sub> which is not captured. Blue hydrogen uses the same steam reforming process but the CO<sub>2</sub> is captured making it cleaner.

#### **Carbon capture explained**

Captured carbon dioxide (CO<sub>2</sub>) emissions from industrial processes and power plants before they are released into the atmosphere is a technique commonly referred to as **carbon capture**. The captured CO<sub>2</sub> can then be reused or stored underground. This technology has the potential to significantly reduce greenhouse gas emissions and help mitigate the effects of climate change.

The shift towards renewables sources of energy is a deliberate move away from fossil fuels to power the world economy. It is a permanent change with the aim of reducing greenhouse gas emissions. Decarbonization comes at a cost as we transition to avoid a bigger cost of destroying the planet. Continuing with oil, natural gas and coal is no longer an option. Investment in fossil fuel resources is in decline as investors prioritize environmental, social and governance (ESG) factors in their decisions. Table 14.1 shows energy input sources in the global economy are still dominated by fossil fuels (84 per cent) despite efforts to transition away to renewables (16 per cent). Biomass fuels which are used in low-income countries are not included in this table because they are difficult to quantify. This needs to change quickly if countries are to meet their net-zero targets agreed with the Intergovernmental Panel on Climate Change (IPCC). The IPCC is a United Nations body that assesses the science related to climate change, its impacts and future risks and potential solutions. It provides scientific information to policymakers but does not set targets itself. Net-zero targets are goals to balance greenhouse gas emissions and removals by a certain date, usually around 2050, to limit global warming to 1.5°C. They require deep reductions in emissions, with any remaining sources being removed by land-based or technology-based solutions. This was set in train by the Paris Agreement which is a legally binding international treaty on climate change that was adopted by the United Nations Framework Convention on Climate Change (UNFCCC) in 2015. Its goal is to limit global warming to 1.5°C, compared to pre-industrial levels. The Paris Agreement, adopted in 2015 by the United Nations Framework Convention on Climate Change (UNFCCC), is an international treaty that aims to address climate change. The agreement's objective is to keep the increase in global average temperature to well below 2°C above pre-industrial levels, with a goal of limiting the increase to 1.5°C. To achieve this, the agreement calls for countries to work towards peaking their greenhouse gas emissions as soon as possible and to achieve a balance between human-caused emissions and removals of greenhouse gases by natural sinks in the second half of this century.

Transitioning to green energy permeates every aspect of our lives. Whilst sustainability and climate change have been the initial drivers of change, the economic motivation will move it forward at warp speed. As velocity increases it will reshape and rebalance the global economy and it will reconfigure not simply the energy supply chains but every other supply chain too. The adjustments may not be smooth. The turbulence that is created by the shift will create opportunities for some and existential threats to others. Steering a pathway through the turbulence will require strategic skills.

*Table 14.1* Energy input sources globally in 2020

<i>Energy source inputs</i>	<i>Percentage</i>	
Oil	31.50	
Coal	27.60	
Gas	25.00	
Total Fossil Fuels		84.10
Hydropower	7.00	
Nuclear	4.40	
Wind	2.60	
Solar	1.40	
Other renewables	0.50	
Non-fossil fuels		15.90



There will be unprecedented growing demand for minerals and metals used to produce, store and distribute electricity. According to the World Bank:

Metals which could see a growing market include aluminum (including its key constituent, bauxite), cobalt, copper, iron ore, lead, lithium, nickel, manganese, the platinum group of metals, rare earth metals including cadmium, molybdenum, neodymium, and indium – silver, steel, titanium and zinc.

World Bank (2017)

Wind, solar and energy batteries will be a key focus for transition.

The trilemma facing nation states is energy security, energy sustainability and affordability of energy. A key challenge for energy suppliers is how to match supply with demand. Most energy is produced at times when demand is low, which means it has to be stored. For example, if you produce solar energy from sunlight in daytime that energy may not be in demand until later in the day when it is dark. If there is insufficient storage it is wasted. Dynamic pricing could offer customers more choice and better prices when demand is low to avoid waste. During the pandemic it was noticeable that those charging EVs did so less frequently and at different times. For example, whereas prior to the pandemic people tended to charge EVs in the evening and overnight they were now switching to daytime charging. If consumption patterns could be adjusted to time shift energy usage avoiding peak times that would smooth supply which would improve matters for customers and suppliers.

The Inflation Reduction Act 2022 in the United States is a catalyst encouraging change and creating a possible tipping point for building capacity in sustainable renewable energy. This is likely to change pricing and investment by means of tax incentives shifting resources. Increasing green energy sources and lowering prices are two of the key challenges. Lowering the cost of production requires economies of scale. Many of the skills to achieve the latter reside in extant fossil fuel businesses – they have the know-how. It is essential that those businesses bring their expertise to renewable energies.

Electricity grids are coming under extreme pressure. Most energy grids were established and developed when demand for energy was lower. They were not built to sustain exponential growth and demand for energy. If every household switched to EVs, overnight the grid would not have capability to deliver. Energy supply has to build capacity to deliver electricity that is clean and dependable at affordable prices.

## **Race to the future**

Let us now turn to the evidence for the claims. At the end of the nineteenth century, Thomas Edison created three electric battery vehicles that he hoped would drive the automobile of the future. Edison developed a nickel iron battery for his vehicles. The problem he faced was to develop batteries that would not be too heavy and would have the capacity to travel distances without recharge sufficient to make consumers buy the vehicles. Edison and Ford set up a venture to bring these early EVs to market in 1912. In 1914, Ford and Edison had disagreements over the battery technology to power vehicles. There were more electric vehicles in New York and London at the start of the twentieth century than those fitted with combustion engines. Circumstance quickly changed when Henry Ford introduced the Model T a vehicle with a combustion engine that was more affordable for most customers. Although some vehicles continued to be fitted with batteries during the twentieth century, they tended to be short journey delivery vehicles that travelled at much slower speed than combustion engine vehicles, for example, milk

floats. It would be a century before the world would return to examine the potential of electric vehicles. The climate crisis became the catalyst for change.

There are 90 million freight vehicles on the roads of major cities in the world and almost all are diesel powered producing five per cent of global CO<sub>2</sub> emissions (Burgess, 2023). Medium class vans such as the Ford Transit make up the bulk of these vehicles with about 28 million sold world-wide. Traditional vehicle manufacturers have built cars, trucks and buses at scale for over a century to lower cost. The future requires a different business model according to the article by Burgess which is to build for demand.

*Source:* Hines (2021, November 12).

### Questions

1. How necessary is it to clean up supply chains by transitioning to electric vehicles (EV)?
2. How do you think that transitioning to EVs will clean up vehicle pollution?

Technological developments drive change and so it is in the battery technology needed to power many devices we use daily as well as the transition towards electric vehicles. Advanced battery technologies employ lithium-metal and silicon anodes, solid-state electrolytes, advanced Li-ion designs, lithium-sulfur (Li-S), sodium-ion (Na-ion), redox flow batteries (RFBs), Zn-ion, Zn-Br and Zn-air batteries. Battery technology has come a long way in recent years, paving the way to produce electric vehicles at scale. One of the most significant advancements has been in the field of lithium-ion batteries, which are now widely used in electric cars. In addition to this, researchers are exploring the potential of solid-state batteries, which could offer a safer and more cost-effective alternative to traditional lithium-ion batteries. Other emerging battery technologies that show promise for use in electric vehicles include graphene-based batteries, sodium sulfur (NAS) batteries, sodium-ion batteries, rechargeable zinc-manganese dioxide batteries and organosilicon electrolyte batteries (OSEB). Graphene batteries can be either lithium-ion (Li-ion) batteries with graphene plates or coatings, or lithium-sulfur (LiS) batteries with graphene-carbon materials. These batteries charge faster and are safer. One of the problems with some types of battery has been the fire hazard they create.

There are five critical minerals used in the production of Li-ion batteries, which are: cobalt, graphite, lithium, manganese and nickel. China is dominant in the supply of products using these metals even though it does not have an abundance of raw materials. Its strength comes from processing 80 per cent of raw materials from deposits located elsewhere in the world. China and Chinese companies have secured control of mining these products for the past ten years or more. China is also the largest producer of graphite, which is used in anodes in the batteries. According to Mining.Com Australia is the second most important nation as it has great capacity to produce lithium and it also has large deposits of nickel. Brazil comes next in order of importance because it has deposits of four of the five metals listed. The only one it does not have is cobalt (Bhutada, 2021).

The switch to clean energy means that there will be a 50 per cent increase in the use of minerals and metals used in automobiles compared to a fossil fuel combustion engine equivalent. The

International Energy Agency (IEA) says this will have far reaching consequences for mining and metals industries.

Building solar photovoltaic (PV) plants, wind farms and electric vehicles (EVs) generally requires more minerals than their fossil fuelbased counterparts. A typical electric car requires six times the mineral inputs of a conventional car, and an onshore wind plant requires nine times more mineral resources than a gas-fired power plant. Since 2010, the average amount of minerals needed for a new unit of power generation capacity has increased by 50% as the share of renewables has risen.

International Energy Agency (2022)

In 2018, CATL (China) became the world's largest battery manufacturer taking over the mantle from Panasonic. In the same year, EV sales reached two million units. In 2020, Tesla built the biggest mega factory in Shanghai to provide batteries for their cars. In that same year Japan commissioned the first battery driven submarine. Innovations are also under way to power ships and aircraft using battery power; in 2021, CATL won a \$1 billion contract to exploit Bolivia's lithium reserves. The thirst for lithium is reminiscent of the gold rushes of the nineteenth century. Bolivia has huge reserves estimated to be in the region of 21 million tonnes, in the Potosi and Oruro salt flats. According to the BBC "Argentina, Bolivia and Chile share an expanse of salt flats, or salars, called the "lithium triangle," holding more than 75 per cent of the world's lithium deposits." Companies from China, Russia and the United States are competing for these resources. By 2030, the global demand for lithium is expected to exceed two million metric tons of lithium carbonate equivalent. This is more than double the demand forecast for 2025 and nearly four times the figure for 2022. The increases in demand for electric vehicles is driving the derivative demand for batteries as firms approach net-zero target deadlines.

### **Sourcing lithium**

Lithium is not found in its pure form in nature. Instead, it is commonly found in pegmatitic minerals and can also be obtained from brines. It is present in ocean water as well. To isolate lithium metal, a mixture of lithium chloride and potassium chloride is electrolyzed. While lithium is usually found in trace amounts and can be difficult to locate, there are high concentrations of it in the aquifers beneath salt deserts in South America. Additionally, seawater and various types of rock contain lithium.

The countries that produce the most lithium are Australia, Chile, China and Argentina. In 2019, Australia produced 52.9 per cent of global lithium production and had 55,000 tonnes of mined lithium content in 2021. Chile produced 21.5 per cent of global lithium production in 2019 and had 26,000 tonnes of mined lithium content in 2021. Chile also has the largest lithium reserves in the world, with 9.2 million metric tons. China produced 9.7 per cent of global lithium production in 2019 and had 14,000 tonnes of mined lithium content in 2021. According to Forbes, "Argentina produced 8.3% of global lithium production in 2019 and had 6,200 tonnes of mined lithium content in 2021."

### **Geopolitics in action**

Novak Djokovic is a Serbian professional tennis player, when he was refused entry into Australia because he had not been vaccinated against Covid-19, Serbia withdrew permission for Australian companies to mine for lithium in what was allegedly thought to be

some form of retaliation. This is significant because Rio Tinto Zinc (RTZ) was expecting to harvest significant lithium for battery production. The RTZ share price fell by 123 pence on the London Stock Exchange as a consequence of this decision.

Lithium mining has significant environmental impacts on soil, water and air. The mining process consumes enormous amounts of water, which could lead to droughts during summer months and floods during rainy seasons. Further consequences of lithium mining are water pollution, diversion of water sources away from fertile land, reduction of the water table and air pollution. Lithium has many applications. Originally it was used to treat bipolar conditions and manic depression to reduce anxiety, sleep deprivation and anger. It is also used to clean other metals removing impurities in iron, copper and zinc. It can remove oxygen, nitrogen, hydrogen and carbon. It can also improve melting of aluminium. Lithium is also used to strengthen other metals, for example, magnesium and aluminium. Metals used to produce aircraft, trains and bicycles use lithium as a strengthener when alloyed with other materials.

Lithium is traditionally extracted from brine water using the evaporation method. This involves pumping the brine water from the salar (salt flat) into large ponds where evaporation can take place resulting in piles of salt from which lithium is then extracted using a series of treatments and processing. Brine is carbonated using sodium carbonate heated to 80–90 degrees Celsius to extract the lithium. Lithium can also be extracted from hard rock lithium ores such as spodumene, lepidolite, zinnwaldite and petalite using various methods. These methods include acid leaching, alkali roasting, salt roasting and chlorination.

Mining for lithium, like most metals, can have negative environmental impacts. However, the metal extracted may be used for sustainable initiatives. It is used for EV battery production, wind turbines and electric (smart) grids all of which produce energy that reduces CO<sub>2</sub> emissions. The advantage of lithium is that it is a very light metal, which is attractive to reduce weight in EVs. Accelerating demand for lithium has pushed prices up. In March 2022, the lithium carbonate price had passed \$75,000 per metric ton and lithium hydroxide prices had exceeded \$65,000 per metric ton.

As prices rise it stimulates activity and further exploration to find pockets of scarce materials such as lithium. In *Volt Rush* Henry Sanderson talks about Cornish mines being developed to excavate lithium. Cornwall is one of the most deprived counties in the United Kingdom with a history of tin mining captured in imaginative fictionalized characters such as Poldark but it may now be about to share the spoils of the twenty-first century big transition to clean energy. We could argue that demand creates supply after Keynes (Keynes, 1936).

### **Supply chain accountability – ESG investments, lithium markets and mineral nationalism**

Sustainable finance is required to make investment decisions in lithium markets. This means that finance is given to those firms that persuade lenders that they will achieve ESG goals. It is assumed that this leads to green investments for long-term projects. Banks, private equity companies and investment companies have all raised the stakes when it comes to making investments that are seen as green, clean and sustainable. Those companies that demonstrate they have credible carbon strategies are being rewarded with funding and they get better fiscal terms too. This makes it difficult for firms with high carbon assets

to attract funding. One of the big problems though is that there is no globally accepted definition of low-carbon. Different organizations are using different measures to make their claims. Measurement standards are variable and not clearly defined which makes it easy to be imaginative with claims of being low-carbon and net-zero carbon. When companies report emissions, they will not necessarily report on the whole supply chain. Some will focus on scope one or scope two emissions while others may focus on scope three. Measurement difficulties mean there are differences in the ways that companies account for carbon emissions. For example, total carbon emissions, carbon intensity of emissions, carbon intensity of emissions per unit of finance, means that there is no standard measurement. Therefore, how can we know if the company is low-carbon or net-zero carbon? Similarly, the omission of any standard for sustainable finance means that it is difficult to evaluate if finance is being given to those who are green and clean rather than those who are greenwashing to get capital investment for their projects.

Lithium resources are highly concentrated in what is known as the lithium triangle of Argentina, Bolivia and Chile. Physical disruptions due to climate, natural disasters, political events and geopolitical unrest will have an impact on supply and pricing as will other factors affecting these countries. These three countries have talked about creating a cartel similar to OPEC to manipulate lithium prices. Each has also seen a revival in resource nationalism to control supplies and protect their assets. For example, Bolivia has seized tin, copper and zinc assets and brought those back into nationalized control.

### Questions

1. Discuss how availability of investment capital is shaping the market for lithium?
2. Do you think lithium itself is a green product or does it contribute to environmental damage?
3. US and EU government policy has placed restrictions on trade to protect nascent industries; is there a case for this to be applied to green energy products?
4. Resilience has become a focal point for governments reducing risk and dependence on supplies from single nation states, particularly China. Is this a sensible policy?
5. What impact will transitioning to green energy have on global supply chains?
6. What impact do you think that countries endowed with minerals would have on markets and supply chains if they form cartels similar to OPEC?
7. Do discuss if you think the impact will go further than being limited to just energy supply chains?

### Three levels of scoping emissions defined by the National Grid

Scope 1 covers emissions from sources that an organization owns or controls directly – for example, from burning fuel in our fleet of vehicles (if they're not electrically-powered).

Scope 2 are emissions that a company causes indirectly and come from where the energy it purchases and uses is produced. For example, the emissions caused when generating the electricity that we use in our buildings would fall into this category.

Scope 3 encompasses emissions that are not produced by the company itself and are not the result of activities from assets owned or controlled by them, but by those that it's indirectly responsible for up and down its value chain. An example of this is when we buy, use and

dispose of products from suppliers. Scope 3 emissions include all sources not within the scope 1 and 2 boundaries.

*Source:* National Grid (n.d.)

### Sourcing cobalt

Cobalt is a critical raw material, another metal that is necessary for the big transition to green energy. According to the Cobalt Institute, cobalt is a crucial element in the production of rechargeable batteries used in electric vehicles. They state that cobalt can be found in many everyday portable devices such as phones, tablets and laptops (Cobalt Institute). The Democratic Republic of Congo (DRC) has the largest cobalt reserves in the world, accounting for more than 50 per cent of the global total. Other countries with cobalt reserves include Australia, China, New Caledonia, Morocco, Brazil, Zambia and Cuba which has the world's third largest cobalt reserves. Australia has 15 per cent of world cobalt reserves. Cobalt is mined as a byproduct of copper mining in Australia.

Landscapes are devastated by mining activity resembling lunar landscapes. Damage to soil fertility, water pollution and crop contamination are problematic too. I read that a Canadian brewer used cobalt in the 1960s to put the froth on its beer until they realized it was possibly a health hazard. In low doses cobalt has been ingested by humans because of its beneficial effects. Cobalt is a component of Vitamin B12, which keeps the nervous system healthy and produces red blood cells. The metal is used in alloys, semiconductors and fertilizers as well as being an enamel for steel and a drying agent in varnish (Watts, 2019). The demand for cobalt has trebled in less than a decade and growth is likely to continue.

Katanga is the centre of the mining industry in the DRC. The largest cobalt mining companies in the world (Investingnews; Muroki, 2023), are shown in Table 14.2.

In 2021, Gécamines took control of artisan mining in the DRC by establishing a new company Enterprise Generale du Cobalt to regulate activities. The aim is to establish labour laws compliant with international standards reduce, child labour and improve working conditions. Artisan miners remain suspicious about these goals and think that it will simply reduce their earnings.

Cobalt is an expensive metal with approaching 60 per cent of supply coming from just one country the Democratic Republic of Congo (van den Brink et al., 2020). Cobalt mining is a very dirty business. It is linked to environmental damage and health risks of those who mine it being exposed to toxic gases that can result in heart and lung disease, eye and skin damage and risk of cancer (Watts, 2019). There is also the big question about what happens to all of these materials when the useful life of the batteries comes to an end. How will the electric vehicle

Table 14.2 Largest cobalt mining companies in the world

<i>World rank</i>	<i>Mining company</i>	<i>Value</i>
1	Glencore PLC (Anglo-Swiss Company – produces 16 per cent of the total cobalt – has wide mining interests in cobalt, nickel, coal, copper, zinc, oil and gas)	\$203.8 billion
2	Vale S.A. (Brazilian company that earns more mining other metals than it does from cobalt, for example, nickel, copper and iron ore)	\$54.5 billion
3	Gécamines (DRC – state owned number one in DRC has a near monopoly)	\$33.69 billion
4	Eurasian Resources Group – founded in Luxembourg in 2013	\$33 billion
5	China Molybdenum Co. Ltd (partner with Ford)	\$24.1 billion



manufacturers deal with waste? The demand for cobalt is set to quadruple in the run up to 2050. Demand is of course, tied once again to the production of EV's. Tesla source most of the cobalt they use from the DRC. Each of their vehicle batteries has about five per cent cobalt and they are actively trying to lower that.

Presently EVs produce more CO<sub>2</sub> in production than those with combustion engines because of the battery packs that power them. According to Jarod Cory Kelly, a principal energy systems analyst at Argonne, the production of electric vehicles generates more carbon emissions than traditional combustion engine cars. This is primarily due to the carbon footprint associated with extracting and processing minerals for EV batteries and manufacturing the power cells (Lienert, 2021).

### **The geography of change**

Global shifts move markets and centres of production, but they cannot move physical resources from where they reside without excavation. In simple terms we have markets where people are located, we have resources embedded in the earth's crust wherever they reside and we have production centres that move when cost equations and economics of production change.

China along with South East Asia is the largest production and processing centre for the transition materials. China is home to six of the ten top EV battery manufacturers in the world. They are also on path to have the biggest automobile industries along with a rapidly growing market for these goods. North America is playing catch up and the Inflation Investment Act will spark a change in the scale of change to do so. China is estimated to have 140 giga factories by 2030, in 2021 it had 93 but some think this may be an underestimate (Whalen, 2021). Europe is also playing catch up but is slightly further ahead of the United States. The latter three geographic areas are, of course, big markets for EVs and transportation. This resource rebalancing has happened very quickly in the past decade or more. Unless western economies wake up to the challenges ahead, they risk being left behind in the race for the future. This is not simply damaging for trade and commerce but it will also impair military capabilities, if the United States and Europe lag behind China and elsewhere.

### **From zero to Time Magazine top 100 influential company**

When Robert Zeng's company, CATL, got a contract to supply Mercedes-Benz, it was significant. Mercedes had been building cars in Germany for 130 years (Sanderson, 2022). Zeng was said to be worth \$51.6 billion in 2021, according to Bloomberg. The headquarters of the company are in Ningde, China. Back in 2000, it was Japan that had 90 per cent of the world's lithium-ion battery production, with about 500 million batteries. China at that time was just producing 35 million. China's government became serious about supporting the electric vehicle industry around 2009, and China was really playing catch-up at that time. It was way behind other countries in the development of this technology. By 2020, China imported more crude oil than any country in history averaging nearly 11 million barrels every day (Ceicdata) and it was very concerned about the dangers of climate change and air pollution from man-made emissions. So, it obviously needed to do something. So, around 2009, Beijing began paying people to buy electrics, using a mixture of subsidies and incentives. This was a major government intervention. When the global financial crisis hit in 2008, BYD was metamorphosing from a



battery maker like ATL into an electric vehicle producer. Even Warren Buffett bought a ten per cent stake in the company in 2008. At that time, hybrids (using a mix of fossil fuel and electric power transmission) for most people seemed a better option than a pure EV, but the Chinese were determined to press ahead with pure EVs and they saw it as a solution to public transport, with buses, too, subsidies for the development of EVs were generous. According to Sanderson, CATL has a Chinese name that means *the age of Ningde*, and it split off from ATL. With encouragement from the Chinese government, ATL remained a 15 per cent stakeholder in the business, which it sold in 2015. BMW was a major customer for CATL batteries. In 2016, CATL delivered more battery packs to a battery company, Yutong Bus, than Tesla used in all of its cars since it began. The state investment was beginning to pay, so CATL was on the rise from being non-existent in 2015 to becoming a leading manufacturer of batteries for electric vehicles. In 2023 CATL dominated the world battery market for EVs with 37 per cent followed by BYD with 13 per cent. In June 2023, Time Magazine recognized CATL as one of the World's Top 100 most influential companies. This remarkable rise was funded by Chinese public investment.

### Conclusions

As discussed earlier in this book, energy security, food and water security, cyber security and national security are major concerns for national governments. The pursuit of zero emissions will transform the way we think about energy security on a global scale. Instead of focusing on the supply of fossil fuels, the emphasis will shift towards ensuring the availability of minerals, materials and manufacturing capabilities required for clean energy technologies. This transition to electric transport and clean energy will have a significant impact on supply chain strategies. Security, resilience and sustainability are at the heart of these strategies according to the International Energy Agency (IEA). Rapid innovation continuously improving the development and use of different materials and material combinations to improve efficiencies of the product will be necessary. There are many risks on this path to the future, which include shortages due to resource nationalization, geopolitical tensions giving rise to volatility in supply, price volatility and quality of supplies. It is also uncertain how governments around the world will be able to argue that materials and material processes are scoped as compliant with definitions of green energy. Definitions are often ambiguous, and many organizations have been able to exploit ambiguities to “greenwash.” If we take the assigned regulatory definitions for emissions as an example, then some organizations have been able to interpret scope one, two and three emissions such that they have been able to persuade external bodies that they are compliant with the existing regulations, when in reality they are not. It also means that an investment community views them as investible in ESG terms. This has significant implications for the allocation of scarce resources.

### Discussion questions

1. Some supply chains have more strategic importance than others. Do you agree? Why?
2. Do you think global supply chains will diminish in importance as resilient policies are implemented? Why?
3. Will the big transition discussed in this chapter happen as explained or do you think it might be different, and if so, how?
4. Do you think the balance of economic power will move away from Western countries as China and South East Asia grow their economies? Why?

5. How will supply chain strategies change in the next five to ten years?
6. As we transition to a world where electric power sources will become more important will we have to reconfigure supply chains to reduce risk?
7. Do you think geopolitics will become more influential when thinking about supply chain strategies? Why?
8. Critical resources may need protection by national governments and this will cause significant changes including increasing intervention and regulation by governments that will impact supply chains – do you agree? Why?
9. Will any single nation or economic bloc dominate energy supply chains? Why?
10. Do you think we need better definitions to understand ESG – accounting and reporting standards and more importantly, will it change behaviour? Why?
11. Do you think green energy is a dirty business? Why? Discuss.

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## Glossary

**ABC analysis or Pareto analysis** This is a technique used to identify the percentage of highest value items by priority. For example, A items may be worth 80 per cent of the value but only 20 per cent of the volume, B items ten per cent value, 30 per cent volume and C items 50 per cent value from 50 per cent volume. Note the percentages vary from organizational context to context.

**Activity based cost (ABC)** This is a costing system based on identifying activities that cause cost. It differs significantly from traditional product costing by focusing on the activities causing cost. For example, it may be customer activities and therefore customer account profitability may be determined. It is not simply a different way to cost products as is sometimes suggested by commentators.

**Activity based management (ABM)** ABM develops from activity based costing and is a tool for managers to intervene based on the activities undertaken. Activity cost and revenue streams will be identified in ABM systems and ways will be sought to do things better (more efficiently) and to do better things (change processes to be more effective).

**Artificial intelligence (AI)** Artificial intelligence (AI) is any non-human form of intelligence. AI has the capability to process large quantities of data relatively fast. AI interprets data to take action. Two types: Generative which can generate text, images, media (such as voice, audio, sounds). Non-generative which is predetermined following mathematical rules in the algorithm.

**Average cost (AVCO)** A system of valuing inventories based on the average cost of bought in and distributed inventories. Sometimes the term WAVCO is used to indicate that the average is a weighted average.

**B2B** Business-to-business commercial activities such as buyer supplier dealings. It is usually used to define e-business activities through the Internet.

**B2B2C** A combination of business-to-business and business-to-consumer activities. For example, a retailer may conduct business with suppliers through a virtual private network (VPN) using the Internet. Simultaneously it may conduct sales transactions directly with consumers through its retail website.

**B2C** Business-to-consumer communications, which may be informational and/or transactional. Usually meant to convey Internet commerce.

**Backhauling** This is a return load taken after a delivery has been made. It ensures that wagons do not return empty and that resources are utilized effectively. For example, a delivery to a depot may be dropped and the truck loaded with goods to move on to a different depot.

**Backorder** Orders that cannot be fulfilled at the time most of the order is shipped. Orders are recorded and filled for shipment when available.

**Barcodes** contain machine readable lines representing data about the item they are attached to. When these bars are passed over scanners the data in the code is captured and rendered

to the scanning device. They are used to track products and usually printed on the outer packaging.

**Bill of lading** A contract stating a carrier has received goods and has taken responsibility for delivery.

**Bill of material** A detailed schedule for materials required in manufacturing operations.

**Blockchain** Data within a block is distributed through the chain to members in a network. Data contains digital signature and is date stamped for authenticity. Blocks achieve authenticity through consensus in the network. Transactions occur once and cannot be duplicated. It is a method to ensure security of data transmission. It is used to transfer sensitive data that ensures encryption is maintained through a series of transfers. It is often used to make monetary and financial data transmission securely. Blockchain technology was originally developed to facilitate trust in cryptocurrencies and allowed Bitcoin to emerge as an alternative means of payment for exchange of value.

**Bonded store** A secure warehouse facility. Most commonly used for imported or exported goods involving the collection of customs duties and excise taxes where taxes are only paid on exit from the storage facility.

**Business process re-engineering (BPR)** Re-design processes to be more effective and/or more efficient to add value for the customer.

**Business processes** These are activities performed in sequence or parallel by an organization. Business processes will comprise a value chain for the customer. If business processes do not add value they incur cost. In such circumstances they should be identified and analyzed to see if they can be removed or redesigned to be more efficient or more effective.

**Buying groups** Independent organizations that may be wholesalers or retailers who join together to obtain better terms of trade from suppliers form these. For example, a buying group may be able to buy in bulk for its members and therefore obtain substantial discounts from prices they would pay individually. Buying groups are not the same as symbol groups since members retain their independence in trading names, etc.

**Category management** Categories are identifiable, measurable groups of products/services which are categorized to fit particular customer segment requirements. Traditionally products/services may have been identified by the nature of a product or service, for example, soap powder, cosmetics, clothing and so on. Categories, however, may, for example, be clustered as disposable nappies and carry out beer in six packs to reflect a particular customer demand pattern. They are grouped by category in the ways in which customers interrelate or substitute products/services. Category management teams may be organized as multifunctional personnel managing across traditional product areas for the benefit of the customer and to deliver better profits for the organization. Category managers will have responsibility for the strategy, operations tactics and performance for their categories.

**Category optimization** Systems designed to balance performance of all lines within a given product category thus reducing cannibalization resulting from price promotions on full margin lines.

**Central distribution centres and depots** Centralized distribution depots or centres may be used by an organization to bring all products to a specific location with a view to moving them on to their final sale destinations. The benefit of doing this is control and availability of stock. For example, the distribution depot can hold sufficient stock for stores it serves without delivering all items to specific stores and finding that they sell out in two and remain in the rest. CDC's can replenish stock to where the demand is.

**CIF** Cost, insurance and freight included in purchase price.

**Cloud technologies** Cloud technologies or cloud-based systems rely on servers which are actually based in a physical location but the data held can be accessed anywhere via internet

connections using smart devices including but not limited to computers, smart phones, tablets as well as other devices that can be connected, for example, sensors.

**Composite distribution centres** A multitemperature store facility where goods can be stored or distributed in combination (ambient, chilled and frozen products).

**Consolidation** May occur when groups of stock are delivered to a single distribution point to wait the arrival of other mixed items for delivery onwards to internal or external customers. Loads are consolidated until they become economic to deliver. For example, airfreight or sea containers are often filled by disparate goods and sometimes by different organizations until the container is full when it is shipped or air freighted to its destination.

**Consumer** A person who consumes products and/or services who may or may not be a customer. Often consumers are regarded as the end customer or the final customer in a supply chain.

**Continuous replenishment programme (CRP)** Essentially the same as vendor managed inventory (VMI). The vendor who shares sales information with the seller and thus knows when stock needs to be replenished replenishes inventories. Suppliers have a forward window on demand usually through sharing EDI. CRP or VMI systems have the benefits of lowering supply chain inventories through better demand planning and hence lowering costs.

**Cross-docking** This is a time reduction technique. It involves processes that marry products received in a facility from different suppliers or destinations with other products being distributed to the same onward destination. Goods are shipped at the earliest opportunity without going into long-term storage. Time in storage at a facility should be minimized as a consequence of cross-docking. Cross-docking terminals are often designed in rectangular shapes where trucks unload on one side and are loaded on the opposite side of the rectangle. Pallets or standardized containers are required if cross-docking is to be efficient.

**Customer** A person or organization that purchases products and/or services from a supplier.

**Cyber attack** An attack on IT systems conducted through malware designed to disrupt services. Serious attacks may result in a distributed denial of service known as a DDOS attack.

**Cycle time** Time it takes to complete one operational cycle. For example, in production operations if the cycle time for all operations can be reduced to equal *takt* time, products can be made in single flow.

**DDOS** Distributed denial of services – see *cyber attack*.

**Demand management** Is a system of developing a customer focused strategy rather than a supply strategy. For example, balancing promotions to optimize supply chain performance and thus avoiding the bullwhip effect caused by uncoordinated promotional activities within the supply chain.

**Demurrage** A charge assessed by a carrier for delays by a purchaser in failing to unload and return vehicles, vessels or containers promptly.

**Digital twin** A term to describe a replica of a physical supply chain in digital forms. Firms can test the resilience of their supply chains to changes introduced by creating this virtual supply chain, for example, the digital twin. Solutions to problems can be implemented before they occur in the real world.

**Direct product profitability (DPP)** DPP is an accounting technique to track those fixed costs attributable to specific products. This technique has the benefit of identifying all costs associated with the product when arriving at a profit figure. It can be difficult to do in practice. Costs vis-à-vis benefits need to be carefully assessed before implementing DPP.

**Dovetailing** Occurs when suppliers locate plants close to customer delivery points. JiT systems have encouraged this to occur.

**E-business** Any form of electronic business conducted between business partners.

- E-commerce** Any form of commercial transaction undertaken electronically. It has come to mean the conduct of commerce over the internet. However, there are many form of e-commerce (e.g. phone, fax, internet).
- Efficient consumer response (ECR)** Developed by KSA who also developed quick response for the apparel sector. ECR was developed for FMCG products in the US grocery supply chain. It takes a total supply chain view from a customer perspective and develops capabilities across the organization and the network of organizations working together within a supply chain to deliver products efficiently to the customer when they are demanded. The aim is to deliver superior customer value in faster times at lower cost. Better, faster, cheaper. ECR requires collaborative strategies supported by appropriate technologies.
- Electronic data interchange (EDI)** It is the exchange of electronic information between parties who trade within a supply chain. EDI usually requires specific standards and formats for the ease of transmission and validation of data.
- Electronic funds transfer at point of sale (EFTPoS)** Customer funds are transferred between parties at point of sale. For example, a consumer pays by Switch, Delta or credit card at a check out in a store and the funds are transferred at the point of sale from the purchaser to the vendor account using supporting financial technology (magnetic strips, chip and pin through electronic readers that record the transaction), software that exchanges funds is supplied from technology support organizations like GE Capital. Finally, the banking community manages funds and fund transfers on behalf of the trading parties.
- Electronic point of sale (EPoS)** A system that records sales by keying in data, scanning bar codes or using radio frequency tags at the till point to record a sale.
- E-markets** Any form of electronic market place. For example, the trade in stocks in and shares is an e-market. The traditional definition of a market is a place where buyers and sellers meet. An e-market is simply a space where buyers and sellers meet. It is used in contemporary language to mean digital space through the Internet.
- Enabling technologies** These are technologies that support supply chain activities. For example, EDI, RFT, bar codes, EFTPoS, EPoS, SAP, databases.
- ERP** Enterprise resource planning. These are enterprise wide systems such as SAP, Oracle and i2 Group that attempt to integrate businesswide systems and processes allowing different parts of the organization to access a common database.
- FMS** Flexible manufacturing systems. These are automated production systems which can adapt to changes for different products and quantities being manufactured. They use high-speed machinery and computerized controls that can be reconfigured to produce a variety of parts and accommodate different manufacturing processes.
- F.O.B.** Free on board. Purchase price does not cover freight or insurance after goods are placed on board a vessel for delivery. Originated as a shipping term.
- First-in, first-out (FIFO)** A type of inventory (stock) system that operates on a first-in-first-out basis. Cost accounting systems often adopt this basis for inventory (stock) valuations.
- Five S Japanese model** Five terms beginning with S in Japanese that indicate a workplace suited for visual control and lean production. Seiri = separate tools, parts and instructions are arranged and removed from unneeded ones. Seiton = identify each tool, part, etc., for use. Seiso = clean up the environment, Seiketsu = conduct seiri, seitin and seiso at frequent intervals to keep the workplace in perfect condition (usually daily). Shitsuke = means to make it a habit to do the other four Ss.
- Five why's** Ohno said that you should ask why five times when you encounter a problem in order to get to the root cause. Managers in organizations practising TQM often use five why's to generate Ishikawa diagrams to identify the root cause of problems.



**Food miles** The distance that food travels from source to consumer.

**4PL** Fourth party logistics. One lead logistics supplier coordinating a number of 3PL suppliers for a contracting organization. 4PL organizations offer end-to-end supply chain solutions covering global supply chain design and planning, logistics and distribution, customs brokerage and international trade services, managing cash cycles and information, as well as freight services via ocean, air or ground.

**Generative AI** This is AI that generates text, images and media. It is able to learn through interaction and experiences.

**GPS** Global positioning systems (GPS) have helped transport and logistics management track deliveries and identify the locations of vehicles carrying out the deliveries. For example, UPS and FedEx use satellite tracking to identify the precise location of parcels and vehicles. GPS systems can help planners change routings, timings and other variables that make up the transport management system.

**Hollow corporation** This term was coined in the 1980s to describe organizations that did not desire to own assets but instead built dynamic networks to respond quickly to demand. Flexibility and responsiveness required these organizations to adopt extensive outsourcing of suppliers to meet customer demand. The practice of pure brokering reflects the title “hollow corporation.”

**Horizontal integration** Acquisition of other organizations at the same stage in the chain of distribution as the acquirer. For example, a retailer purchasing another retail organization, a wholesaler buying another wholesaler, a producer buying other producers.

**Incoterms** International commercial terms define the duties of buyer and seller at each stage in the movement of goods. The terms define who does what (transport, export clearance, import clearance) and who absorbs cost and takes the risk. Commonly used terms include: Ex Works, a named place of delivery usually the seller’s dockside, Free Carrier (FCA) a named place where goods are cleared for export and lodged with a carrier specified by the buyer, Free Alongside Ship (FAS) goods cleared for export are delivered to named port and carrier when all risks are taken over by the buyer, Free on Board (FOB) risks and costs are passed to buyer when the goods are on board a named vessel at a named port, Carriage Paid to (CPT) named place and cleared for export at which point the buyer assumes responsibility for all risks and costs, Carriage Insurance Paid (CIP) similar to CPT but cargo insurance must be paid by the seller, Cost and Freight (CFR) seller agrees to pay transport costs but not insurance, Cost, Insurance and Freight (CIF) seller agrees to pay transport cost and insurance, Delivered at Frontier (DAF) to named place, Delivered Ex-ship (DES) goods made available to buyer on board ship, Delivered Ex Quay (DEQ) as above but at the quay-side, Delivered Duty Unpaid (DDU), Delivered Duty Paid (DDP).

**Industry 4.0** Industry 4.0 is a term that identifies industrial progression from Industry one through to four presently. It refers to the state of technology in the case of industry 4.0 it is driven by the Internet of Things (IoT). This term gained in popularity as it was promoted by Klaus Schwab and the World Economic Forum recognizing revolutionary forces changing the technological base of industries. It is a form of lifecycle model of industrial development. It recognizes the seismic shift to a digital economy. Industry 1.0 was the first industrial revolution (circa 1700—1850) driven by coal, steam and water power. Industry 2.0 (circa 1851—1914) was the second revolution developing transport and other infrastructures to support the move from domestic to factory production and the development of electric power. Industry 3.0 recognizes the rise of computing power at the end of the twentieth century. Industry 4.0 moves the digital transformation further to IoT with automation, cloud computing and cyber physical systems.



- Internet of things (IoT)** A recognition of how machines are linked together through digital technologies. Machines with the capability to make decentralized decisions. For example, a smart fridge placing an order as the inventory of milk is depleted. Automatic replenishment is enabled through IoT. Of course it is much broader and far reaching than this simple example.
- Just-in-time (JiT)** JiT systems move inventories to the next stage in a supply chain to meet demand. Delivery is made when the inventory is required and not before, hence just in time to perform operations or to be used by the final consumer. The major benefits of JiT are lower inventory cost in a supply chain, increased quality through waste avoidance, obsolescence or deterioration, reduced lead times and greater efficiency in operations.
- Kaizen** Continuous improvement to add value and remove cost by removing waste (Muda), smoothing flows by removing unevenness (Mura) and (Muri) removing difficulties.
- Kanban** Kanban is a visual card system of inventory control that operates a pull system of production so that inventories are only supplied when they are required. See the text for a full explanation of use in practice.
- Kieretsu** A network of Japanese firms with historical and/or equity linkages in a vertical or horizontal chain.
- Last-in, first-out (LIFO)** A type of inventory system based on last-in-first-out. Accounting systems sometimes adopt this system for valuing inventories.
- Lean production and lean thinking** Lean production systems search for ways to lower cost and add value to production processes. Lean production systems developed in the Japanese automobile industry at Toyota. The concept is simple based upon Kaizen philosophy removing waste (muda), smooth flows (mura) and removing difficulties (muri). Lean thinking is the antidote to muda developed by Ohno who identified seven types of waste. Womack and Jones (1996) added an eighth “goods and services that don’t meet the needs of the customer.” The key to lean thinking is “specify value, to line up all value creating activities for a product along a value stream and to make flow smoothly at the pull of the customer in pursuit of perfection.”
- Logistics** Movement, lodging and supplying goods.
- Machine learning** This is how machines learn through experience. Generative AI learns through interactions and experience, for example, drawn from large data samples.
- Manufacturing requirements planning (MRPII)** Expands MRP into a capacity-planning tool with financial interfaces that translate operational plans into cost with a simulation tool to facilitate “what if” decisions.
- Markdown optimization** Software systems designed to balance real-time supply and demand data in order to select poor performing lines that can be discounted to clear inventory. Better performing lines remain at full price.
- Materials requirement planning (MRP)** A computerized system of determining the quantity and timing requirements of materials used in production.
- Milk runs** A routing of supplies or delivery vehicles that make multiple pick-ups and drop-offs. Often these are short journeys between stores or places nearby stores without holding stock that can be delivered quickly to satisfy interim customer demand.
- M.R.O.** Maintenance, Repairs and Operations. These refers to the tasks and activities involved in maintaining and repairing the physical infrastructure of a facility, including its systems and equipment. Its crucial for the ongoing operation of any company, encompassing a range of tasks from asset maintenance to administrative duties.
- O.E.M.** Original Equipment Manufacturer. These produce parts and components that others including brands incorporate into their finished goods. An example is Intel manufacturing microchips for use by branded manufacturers of computers.

**Open book accounting** Financial information is shared between supply chain partners that is relevant to what they do.

**Operations and operational research** INFORMS define the term as follows: operations research (OR) is the application of scientific and mathematical methods to the study and analysis of problems involving complex systems. Analytics is defined as the scientific process of transforming data into insights for making better decisions. INFORMS was established in 1995 when The Institute of Management Sciences – TIMS (est. 1953) merged with the Operations Research Society of America – ORSA (est. 1952).

The OR Society – ORS, UK (est. 1947) definition is: “Operational research (OR) is a scientific approach to solving problems in the management of complex systems that enables decision-makers to make better decisions.”

**Outsourcing** The trend to move operations outside the supplier organization to take advantage of lower cost and/or better quality or efficiency offered by another supplier. Outsourcing as a concept can be traced back to “‘make or buy” decisions. Is it better to make an item yourself or buy it in from outside? Many organizations outsource operations. For example, publishers outsource typesetting and printing of books. In effect, they can be hollow corporations with capabilities to manage sourcing, production, marketing and distribution. The capabilities may be bought in from outside and simply co-ordinated by the organization’s management team. There are debates about which activities ought to be outsourced and many commentators say that non-core activities should be outsourced. However, there is a growing trend to outsource even core activities. One significant issue is that organizations need to know what is core and non-core before making decisions.

**Perfection** A term used in Lean production to indicate complete elimination of muda so that the value stream creates value and not cost.

**PESTEEL** Sometimes referred to as PEST or SLEPT. This enlarged form of the term reflects that analysis of the business environment should encompass, political, economic, socio-cultural, technological, ethical, ecological and legal issues. These influencing factors will give rise to opportunities or threats from the wider environment.

**Plan do check act (PDCA)** An operational improvement tool applied to each activity in a production cycle.

**Poka-yoke** A mistake proofing device or procedure to prevent defects during manufacture. For example, if any assembly is missing a component it cannot proceed to the next stage.

**Price optimization** Software systems designed to test elasticity of demand discriminating between goods that are price sensitive and non-price sensitive to improve total turnover and earn higher margins on non-price sensitive goods.

**Promotion optimization** Software designed to select lines for price promotion using algorithms that balance consumer demand patterns, stock availability and sales forecasts.

**Pull inventory systems** An inventory system that responds to “actual” customer demand rather than forecast demand.

**Purchase order (P.O.)** A firm commitment to buy.

**Push inventory system** An inventory system that supplies to forecast demand rather than actual customer demand.

**Quick response (QR)** It is a form of time-based competition. Organizations need to be responsive to the customer and fast in producing and delivering. QR was a technique developed by KSA for the US apparel and textile supply chain in the mid-1980s its purpose was to develop competitive capabilities to deliver faster to hold off lower priced foreign imports threatening the industry. QR is now practised in many sectors and by many nations including low-cost competitors. QR is about getting the right product to the right place at the right time.

**Radio-frequency identification (RFID)** is a technology that uses radio waves to automatically identify and track tags attached to objects. RFID systems consists of a tiny radio transponder, a radio receiver and transmitter. When triggered by an electromagnetic interrogation pulse from a nearby RFID reader device, the tag transmits digital data, usually an identifying inventory number, back to the reader. RFID tags track goods, inventory movements and container boxes amongst other things.

**Relationships in the supply chain** Relationships within a supply chain may be categorized by type from arm's length through to strategic alliances and partnerships. At each progressive stage of relationship the parties work more closely together and at the final stages may compete through collaborative strategies that integrate systems, policies, processes and procedures. Relationship approaches are often claimed to be "win-win" strategies for supply chain management, which have benefits of lowering cost or improving revenue streams for parties within a supply chain compared to transactional approaches, which tend to focus on "win-lose." "Relationship contract theory" recognizes that relationships are interdependent across supply chain organizations.

**Replenishment optimization** Software designed to maximize sales and minimize inventories taking account of real-time sales data, inventory holding and replenishment lead times.

**Resilience** The ability to bounce back from disruptions occurring in supply chains. Post-Covid-19 Many supply chains experienced severe disruption so they focused on strategies to make supply chains resilient. This often increased cost as organizations chose to hold higher inventories as part of implementing a resilience strategy. If just-in-time supply is disrupted there is little choice but to hold higher average levels of inventory. Strategies to improve resilience include stress testing supply chains looking for fragility, vulnerability and rigidity (FVR).

**Retail distribution centre (RDC)** A central distribution centre servicing a number of stores in geographically defined area.

**Reverse logistics** This is a term used to describe the process of moving products from customers back up the supply chain (e.g. returning goods for credit, returns for repair or re-works, warranty returns, re-usable containers, a trade-in, consignment agreed returns, product recall, recalibrations and not fit for purpose supplies).

**Reverse optimization** Software systems designed to maximize sales and profit through balancing price, promotions and mark-downs.

**RFP** Request for proposal. Buying firms issue a document detailing what work is required and request suppliers to make a proposal. Proposals will be evaluated according to pre-determined decision criteria and selected suppliers will be chosen after interview or further representations that clearly demonstrate their capabilities to supply.

**RFQ** Request for quotation. Similar to RFP processes but in this case a supplier is asked to quote for supplying goods and/or services. A quote is a firm price unlike proposals which are tentative and negotiable.

**Sales and operational planning (S&OP)** This terminology dates back to 1950 when the concept of aggregated production planning (APP) was developed. It came into wider use during the development of materials requirement planning, particularly MRP2 around 1985. APICS defines S&OP as the "function of setting the overall level of manufacturing output (production plan) and other activities to best satisfy the current planned levels of sales (sales plan and/or forecasts), while meeting general business objectives of profitability, productivity, competitive customer lead times, etc., as expressed in the overall business plan." The Institute for Supply Management defines it as "working cross-functionally with internal business units to forecast anticipated demand, inventory, supply and customer lead times based on the sales forecast, actual demand and capacity forecast." It is a means of

planning production to meet demand aligning data and plans (forecasts and real-time) to synchronize supply.

**Sales based ordering (SBO)** A system of store replenishment using EPoS sales data to restock the store. The data is used to forecast future demand patterns at the store.

**Shrinkage** Inventory losses that are difficult to explain and account for. For example, shrinkage may be a consequence of theft.

**Six Sigma, 6σ** A statistical term used in “world-class organizations” to represent zero defects. Statistically any processes in control (99.99 per cent) is said to have zero defects, which is defined as 0.01 per cent. Six sigma means that all processes fall within +/- 3 standard deviations of the mean. Organizations who pursue world-class status have “black belts” who are champions of Six Sigma. See text for further explanation. Six sigma = 3.4 defects per million or put another way is 99.99971 per cent perfect. Other measures are: Five sigma = 230 defects per million, four sigma = 6,210 defects per million, three sigma = 66,800 defects per million, two sigma = 308,000 defects per million, one sigma = 690,000 defects per million.

**Social network theory** This has been used to explain the nature of supply chain relationships and to move the discussion from a previously economic exchange focus towards a relationship explanation of supply networks. See *relationships in the supply chain*.

**Space optimization** Systems designed to match available selling space with appropriate product lines to maximize returns (profits and sales) given consumer demand patterns.

**Standard costing** Standard costing systems are developed to set cost around the planned cost for completing a task. Standard costs are planned costs usually set in advance of the budget period as the standard against which actual costs can be measured. Variances obtained by comparing actual and standard costs are then used as performance measures from which to take appropriate management actions to control budgets.

**Stock keeping units (SKUs)** An identifiable line held in store. For example, 500 ml own brand detergent. SKUs are identified by a unique stock keeping code, for example, a unique bar code that identifies the items.

**Strategic alliance** Strategic alliances are formed to compete through cooperating. Cooperation might be at any stage of operation within a value chain, purchasing, production, distribution, marketing and sales. Airlines, for example, have strategic alliances to try and cover complementary routes in order to attract customers to purchase an air ticket. The nature of a strategic alliance is cooperative to compete against other airlines not in the alliance. Thus taking customers from them. Without such strategic alliances the individual supplier airlines would be at a significant disadvantage against a competitor who could cover the routes themselves without cooperating.

**Supply chain** Covers all activities associated in acquiring and moving products/services from source to end user. Extraction (mining, quarrying, drilling for minerals), growing, producing through manufacture raw materials, components, work-in progress through to finished goods to be distributed and delivered to the customer and lastly to the consumer. Source, plan, make and deliver are often used to describe supply chain activities.

**Supply chain management (SCM)** SCM coordinates and integrates supply chain activities to deliver customer value. Efficiency and effectiveness are keys to managing supply chain processes. Integration is required to remove functional and organizational barriers that prevent better customer value being delivered.

**Supply chain strategy** Supply chain strategies need to focus on customer demand patterns to ensure capacity to plan, source, make and deliver superior performance compared with competitors. SC strategies may be designed to do existing things better (through more

efficiency in current operations) and/or to do better things (through designing more effective systems, processes, policies, facilities and modus operandi).

**Symbol group** These are voluntary associations formed when wholesale organizations reach agreement with independent small retail chains. For example, Spa, Londis. The retailer receives a group identity, better discounts technological support, national and local advertising/promotion in exchange for guaranteeing to purchase agreed volumes of goods.

**Takt time** Available production time divided by the rate of customer demand, for example, demand is 60 per day of a SKU and the time allowed to produce is 120 minutes the takt time is two minutes.

**Target cost** The design, development and production cost that cannot be exceeded.

**Third-party logistics (3PL)** Outsourcing logistics functions to a third-party supplier of services. Often specialist carriers such as Excel Logistics, DTP, Salvessen, Tibbet and Britten.

**Throughput time** Time taken from concept launch through to the end customer. It includes waiting or queuing times. A measure of time taken in a system.

**Total cost of ownership** TCO recognizes that costs are incurred pre-purchase, during the purchase transaction and post purchase. TCO is important because it involves costs other than simple transaction cost.

**Total quality management (TQM)** A system designed to continuously improve products and processes to deliver customer benefits.

**Toyota seven (muda) wastes defined by Ohno** Overproduction, waiting, unnecessary transport of materials, overprocessing, inventories, unnecessary movements and producing defective products.

**Transaction cost** Transaction cost is “friction in the physical exchange process” according to economists. Transaction cost economics recognizes all costs involved with a transaction, which may include: drafting a contract, negotiating costs, cost of any risks and social costs. Transaction costs do not include all pre-acquisition costs, relationship costs or post acquisition costs. The theory of transaction cost economics, does however recognize that many transaction costs have been reduced through collaboration.

**Value added** A measure of difference in a system between input cost and output cost. Value added is usually measured in monetary terms, for example, the cost of raw materials, labour and overhead incurred in a process = \$100 and the sales invoice for the finished item is \$150, therefore value added would be  $(\$150 - \$100) = \$50$ .

**Value stream** Specific activities needed to design, order and provide a specific product from concept launch into the customer’s hands.

**Vendor managed inventory (VMI)** VMI systems are managed by the supplier. For example, Wrangler’s parent corporation VF has an arrangement with Walmart to supply clothes to stores. Walmart EPoS sales data is shared with VF and they forecast forward demand and replenish in-store stock accordingly. Inventories are not paid for by the retailer until sold. Ownership of the goods does not transfer from vendor to buyer until the point of sale. The benefits to the retailer are clear: reduces risk of holding unwanted inventories, lowers stock-holding cost and improves cash flows. For the supplier the benefits are that they can see a forward demand window and build their capacities and production operations to meet demand. They avoid missed sales through not having inventory available in stores and they lower operating costs through better production planning and inventory control. The downside might be an initial worsening of cash flow when establishing a VMI system.

**Vertical integration** Vertical integration is a growth strategy based on acquiring organizations at different points in a distribution chain. For example, a retailer takes over a supplier, who has perhaps in turn already bought into farms or factories to ensure supplies. A fully

vertically integrated organization would own raw material suppliers, manufacturers, wholesalers and retail stores.

**Virtual supply chain** This is a supply chain in digital form. See also *Digital Twin*.

**Warehouse** Storage facility where goods remain for extended time periods.

**WAVCO** A weighted average cost valuation of inventory.

**Win-lose** This is a strategy based on adversarial negotiations with one winner and one loser.

**Win-win** This is a strategy based on collaboration to improve both parties position. Both win-lose and win-win were terms used in the development of “game theory.”

**Zero based budgets** These are budgets developed without reference to prior budgets. In other words you begin from a zero base and build the budget needed to achieve the result.

**Zero defects** Organizations that are striving to be considered “world-class” pursues a continuous improvement programme in their processes so that the possibility of defective production is eliminated. Crosby introduced the notion of zero defects and his mantra was “right first time.” See also *Six Sigma*.



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