

Responsible Innovation in Industry

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Responsible Innovation Management

 Springer

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Creating new knowledge sustainably will be a pre-requisite to meet the future dynamic competitive environment. Innovation, as a core competency in a country's drive to develop modern industry, plays a significant role in self-reliance in science and technology as the strategic support for future development. In recent years, however, innovation embraces more specific responsibility as individuals and companies have increasingly encountered sustainability and responsibility issues. Responsible innovation is a process that seeks to promote creativity and opportunities for science and innovation that are socially desirable and undertaken in the public interest. Specifically, responsible innovation acknowledges that innovation can raise questions and dilemmas, but it is often ambiguous in terms of purposes and motivations and unpredictable in terms of impacts, beneficial or otherwise. Responsible innovation creates spaces and processes to explore these aspects of innovation in an open, inclusive and timely way. This is a collective responsibility, where funders, researchers, stakeholders and the public all have an important role to play. It includes, but goes beyond, considerations of risk and regulation, important though these are. Responsible innovation associates with different levels of analysis, including individuals, systems, organizations and societies, and is a multi-disciplinary research topic. Therefore, there is a need to work in-depth towards the practical applications of responsible innovation and to develop an academic series of monographs on emerging issues regarding responsible innovation.

The series will provide an opportunity to explore in-depth and rigorous themes that are particularly relevant to responsible innovation. Examples of themes to be featured in the series are digital innovation, international business strategy, production and operations management, science and engineering applications, innovation and entrepreneurship, etc. The main objectives of the book series are to promote cross-disciplinary studies in Responsible innovation, and to encourage core research expertise to produce high-quality outcomes to influence the socio-economic systems.

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Responsive Innovation of Blockchain Technology in Traditional Supply Chains



Jiayu Hu  and Zhen Tan 

Abstract As a form of distributed ledger technology, blockchain is being increasingly studied for renovating traditional supply chains both theoretically and practically with a few real-world applications. However, the adoption of this technology may also lead to socioeconomic and environmental side-effects that could deviate it from the goal of being a responsive innovation. The recognition and understanding of the potential negative impact and risks of blockchain technology is a relatively recent development, especially for applications to operations and supply chain domain. In this chapter, we will scan a few recent studies by focusing on several potential challenges and disruptions for responsive integration of the technology into supply chain systems. Though few new suggestions are given, we highlight a need for careful considerations of these challenges and disruptions as well as creative and proactive system and policy design. Instead of giving a comprehensive literature review or discussion of this broad research topic, the main purpose of this chapter is to extract a few good examples and points from representative recent literature, so as to trigger timely investigations and explorations into the subject.

Keywords Blockchain technology · Supply chain management · Responsive innovation

1 Introduction

After the first recommendation in Nakamoto (2008)'s research, the public interest in blockchain technology has experienced several years of gradual evolvement and then reached a peak at the end of 2017 (Google Trends, 2021). Although the development

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of blockchain technology is still in its infancy, Treiblmaier (2018) predicts that the disruptive power of blockchain will spread through the field of supply chain management, shake the basis of current supply chain activities, combined with consumption on society (Queiroz et al., 2019). To some extent, this transformation process may be similar to the adoption of the Internet 20 years ago, as e-commerce has had a profound impact on the supply chain (Treiblmaier, 2018). In the past few years, the industry has actively explored the possibility of supply chain and blockchain integration. Several forward-looking companies have developed global supply chain platforms based on blockchain technology, such as the TradeLens, a logistic platform collaborated by IBM and MAERSK (Park & Li, 2021).

Similar with other disruptive technologies, when entering the traditional supply chain domain, blockchain comes with technical challenges that need to be tackled using multidisciplinary knowledge as well as social issues such as moral acceptability. Facing with these complexities and difficulties, industries and enterprises can participate in responsive innovation during the process of adopting blockchain, a representative technology of the fourth industrial revolution (Industry 4.0). Different from traditional linear and sequential innovation models, responsive innovation is more suitable for the highly competitive environment of Industry 4.0 (Lubis et al., 2019). According to Von Schomberg (2011), responsive innovation refers to a more adaptable, inclusive and incorporated management of innovative procedure with the involvement of stakeholders and several interested parties. Under the guidance of specific market preferences and perceived needs (Lubis et al., 2019), technological innovators will respond to social requirements, while social actors share responsibilities for the innovative procedure through constructive investments in defining socially desirable products (Von Schomberg, 2011).

In order to understand how responsiveness is blockchain technology when integrated to supply chains, it would be useful to first investigate the potential socio-economic problems it may lead to. However, systematic analysis of the possible negative implications of blockchain technology for the operations and supply chain domain is only a relatively recent endeavor. Therefore, this chapter will discuss some main problems caused by the adoption of blockchain in traditional supply chain management processes based on examples and points from some recent literature. Specifically, we will summarize the following four aspects of disruptions and challenges as a result of integration of blockchain-based innovation into traditional supply chains: (1) Loss of governance and control; (2) Change of the traditional information sharing structure and mechanism; (3) Threatening the occupations of intermediary and trust agency; and (4) Waste of resources.

We position this chapter as a timely narrative discussion about a few aspects of the potential problems of blockchain technology for responsive considerations, guided by achieving the desired goals of the innovation process (Lubis et al., 2019), namely *moral acceptability, sustainability and social desirability*.

The rest of this chapter is organized as follows. Sect. 2 will mainly present a brief literature reviews of theoretical background. Then, the following section will address those abovementioned challenges and resultant responsive innovations in

the traditional supply chain domain. Sect. 4 will conclude with a few comments for future research.

2 Brief Literature Review of Theoretical Foundation

2.1 Supply Chain Management: Objectives and Drawbacks

Supply chain management is the management process filled with complexity and diversity (Fernandez Campos et al., 2019), which is the movement of material, information, and resources through and among a network of upstream and downstream entities (Greasley, 2013). This process involves the coordination and integration of all supply activities within an organization, with the objectives of reducing inventory lot size and customer lead time, as well as minimizing the transportation costs (ibid). However, traditional supply chain has a number of potential shortcomings, including low mutual trust, information asymmetry, high transaction cost and low-quality level (Xue et al., 2021).

2.2 Blockchain: Definition and Applications

Blockchain is a peer-to-peer electronic transaction infrastructure (Nakamoto, 2008) with the application of decentralized and tamper-proof digital ledger (Wang et al., 2019a). A blockchain consists of nodes that store a copy of each block, and unless most nodes have validated the new block and reached a consensus, this transaction block will not be accepted (Wang et al., 2019b). The interconnect approach to blockchain is based on the analysis of cryptographic hash function, which become immutable when blocks are chained together (ibid). Numerous industries have adopted blockchain technology, including supply chain finance, smart contracts, and cryptocurrency (Babich & Hilary, 2020; Wang et al., 2019b).

2.3 Responsive Innovation: Definition, Advantages, and Trade-Off

Responsiveness and flexibility are key measurements on the superiority of organizational performance and the effectiveness of supply chain (Wu et al., 2006) in interpreting market signals. Furthermore, with a significant attribute of diversity (Stirling, 2007), responsive innovation is an effort of enterprises or stakeholders to propose resolutions from specific challenges, with the aim of instructing more concrete plans in accordance with the specific needs of the market (Lubis et al., 2019). In contrast

to the traditional innovation, this type of innovation typically contains lower risk and fewer investment (ibid). Kilubi and Rogers (2018) stated that organisational, technological and creative skills, learning and investigation, supplementary, network and collaboration capabilities at the enterprise level positively influence the association of supply chain risk management and flexibility/responsiveness. Specifically, on triggering an organization's responsive innovation capacity, the severity of disruptive technology may possess an advantageous impact, as innovative companies are prepared to respond and change in a quickly and sufficiently way (Craighead et al., 2007).

The information availability to all economic entities and the resultant quicker responses of markets could be viewed as one dramatic difference nowadays, leading to more responsive innovation by upstream organizations and even accelerating changes in customer preferences and market trends (Clemons et al., 2017). On the plus side, though, reductions on inefficient information asymmetries such as product lifespan and repair costs could be created by more responsiveness, it can also lead to reduced information privacy and deliberate maneuvering of information (Boucher et al., 2017; Dellarocas, 2006). Nevertheless, there is an ineradicable trade-off between responsiveness and efficiency (Chopra & Meindl, 2016). Moreover, according to Brandt and Neumann (2015), several observers stated that an unreasonable and overwhelming over-responsiveness towards the false signal of value altercations could cause adverse price fluctuations and market effects.

2.4 Integration: Causes, Examples and Potential Harms

According to Ebinger and Omondi (2020), as enterprises become increasingly interdependent on a global scale, there is growing awareness on supply chain ethics and sustainability. To better investigate and audit the behaviors of both suppliers and subcontractors, it is significant to achieve traceability, transparency, and standardization through supply chain activities (ibid). As stated in Sect. 2.2, since blockchain holds the characteristics of decentralization, temper proof and immutability, this technology could be applied to improve global supply chain evaluation and monitoring (ibid). Additionally, blockchain-based information systems are appealing to enhance the level of coordination (Lefroy, 2018), responsiveness and resilience (Calatayud, 2017) throughout the whole supply chain since transaction records are distributed under an unanimity mechanism in real-time.

At present, there are a few representative examples of supply chain and blockchain integration in the industry. TradeLens is a logistic platform collaborated by IBM and MAERSK to support information sharing and transparency, with the aim of improving the efficiency and safety of international trade (Park & Li, 2021). In addition, the world's third largest shipping company CFI is also collaborating with Accenture, AB InBev and European Customers Association to develop a blockchain-based international trading platform (Tu & Liu, 2018). Furthermore, in August 2017,

14 Japanese companies, including Mitsui, Nihon Yusen and Kawasaki Steamboat, formed a business alliance of blockchain-based trade data sharing platform (ibid).

Although more enterprises are willing to invest and experiment blockchain technology in the supply chain management, blockchain is a disruptive technology by nature and may even revolutionize (Treiblmaier, 2018) the supply chain. As stated by Holden and Moar (2017), 51% Participants perceive that there will be heavy disruptions on their business partners or downstream customers due to the blockchain application. To make such blockchain investments in the traditional supply chain field ethically acceptable and socially desirable, as well as sustainable, industry should consider responding to this innovation in a proper, adaptive, and inclusive manner (Von Schomberg, 2011). Babich and Hilary (2020) envisioned a few important research needs ranging from classical inventory management, to new areas of ethical operations management, and to questions of industrial organization, for the effective, efficient and sustainable application of blockchain in supply chains.

3 Discussion of Responsiveness to Main Challenges and Disruptions

3.1 Loss of Governance and Control vs. Increased Transparency

According to Wang et al. (2019a), the starting point for the disruptive impact of blockchain will be in the governance of the organization because the distribution of traditional information flow is based on a decentralized mechanism. Ebinger and Omondi (2020) also stated that the access to data records is restricted and authorized among stakeholders because of shared ledgers. There is a dilemma between information transparency and the degree of control.

Decreasing controls may cause discomfort among some supply chain participants but may be acceptable to others. To be specific, traditional economically dominant players such as banks tend to be reluctant to share valuable information due to the anxiousness of losing control over revenue gain under the traditional business model (Michelman, 2017). Additionally, downstream customers may be unwilling to accept total transparency for the consideration of personal information privacy (Boucher et al., 2017; Holden & Moar, 2017). In contrast, upstream suppliers, such as food farmers, are more willing to share information because the traceability that transparency brings is more helpful for their marketing and reputation building (Wang et al., 2019a). On account of the level of governance control are correlated to the interests of each player in the supply chain, Patel et al. (2017) indicated that “*cultural resistance and existing business processes will be major obstacles to change.*”

One of the most representative industries suffering from such trade-off between information transparency and the degree of control is agriculture food (agri-food) industry. According to Zhao et al. (2019), in order to realize the quality, nutrition

and safety improvement of agricultural products, agri-food industry has introduced numerous measures, such as genetically modified seeds, supply chain traceability, hydroponic system and blockchain, in spite of these measures, they are still difficult to achieve due to the distinctive features of agricultural products such as perishability and seasonal production. Nowadays, a number of non-government organizations, laws and policies have put pressure on agri-food supply chain about sustainability (Allaoui et al., 2018). In addition, agri-food supply chain system (AFAS) is occupied with complexity, with a number of materials, information, technology, finance and decision flows from upstream to downstream (Greasley, 2013).

It is essential and competitive for AFAS to be responsive to today's quality and safety expectations of agricultural product, under the background of urbanization, supply chain globalization, diet diversification and sustainable development (Zhao et al., 2020). Kamble et al. (2020) presents a representative chart (Fig. 1) of blockchain network in agricultural supply chain with the goal of real-time track through the network, which allowed by all parties and entities. Zhao et al. (2020) also argued that information access and knowledge sharing such as customer preference and waste reduction among different organizations are critical for in-house decision conducting and supply chain effectiveness (Chen et al., 2018). Therefore, a systematic framework to create, access, share and apply knowledge—knowledge governance mechanisms (KGMs) should be formulated, for the sake of improving supply chain performance and achieve organizational competitive advantage (Zhao et al., 2020), since KGMs could be regard as the lifeblood (Wadhwa & Saxena, 2005) of supply chains. As a response to agri-food traceability and transparency, it is verified by Zhao et al. (2020) that a KGMs (Fig. 2) consisting of elements of mutual recognition, integrity, market, and agreement could promote knowledge deployment in the AFSC, hence improving AFSC performance on the dimensions of product quality, efficiency, flexibility, process quality, and responsiveness.

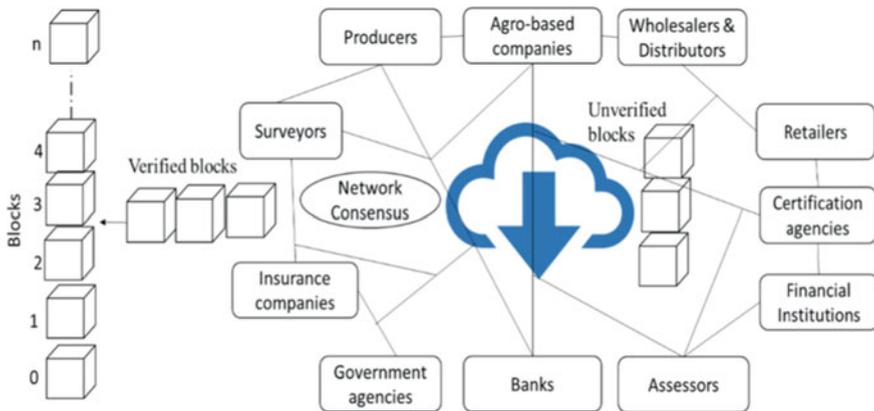


Fig. 1 Blockchain network of agricultural supply chain (Kamble et al., 2020)

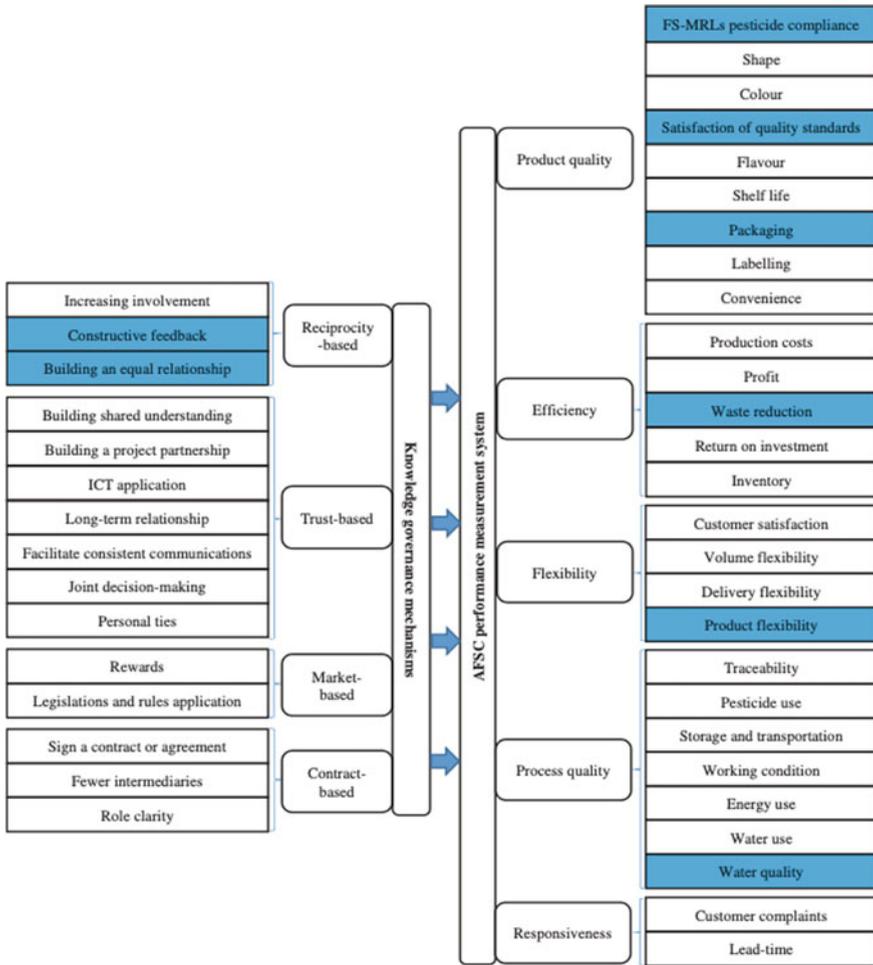


Fig. 2 Theoretical framework of KGMs (Zhao et al., 2020)

3.2 Changes of Information Sharing Structure and Mechanism

The dynamics of supply chain structure hold the natures of complexity, uncertainty and stochastics (Ivanov et al., 2019). These instincts can create more challenges in the supply chain management. Loose supply chain is faced by customized and prompt responses due to the intensified marketing competition and variation in customer requirements (Xue et al., 2021). As a result, traditional supply chain is unable to acclimatize itself to the new circumstance with its low capability in information

sharing (ibid). Sheffi (2015) revealed that real-time information sharing and feedback are crucial for distributing scarce resources through the supply chain and the coordination between different participants to secure the stability and sustainability of process (Ivanov et al., 2019). While blockchain-based information system is capable of realizing synchronized data transformation and thus reducing inefficiency (ibid).

In the traditional business structure, customers are the center of the enterprise rather than the whole supply chain (Xue et al., 2021). Specifically, traditional upstream suppliers collect information from the downstream enterprise instead of the final consumers (ibid). The traditional mode of information sharing is mainly in the type of point to point and if downstream nodes transfer excessive demand to the upstream enterprises, the upstream production will be distorted, which is the bullwhip effect (Devika et al., 2016). Reliable information sharing is critical to weaken or even effectively eliminate the bullwhip effect. As a response, Xue et al. (2021) proposed the basic idea of a decentralized management operational model (Fig. 3) based on blockchain technology (specifically, the consortium chain), which locates customers as core of the supply chain, rather than the downstream enterprise. Alongside the radical shift from the traditional hierarchical structure, the authors seek to stimulate the coordination among all points (ibid). However, with the future adoption of decentralized management model, the relationships among different participants will be changed from relationship management to contract management.

With blockchain in place, more sophisticated mechanisms for data sharing will be made possible to support the contract management. For example, Wang et al. (2021) proposed a blockchain enabled information sharing mechanism within a retailer-supplier partnership (RSP), with an unique usage-based data assessment and pricing

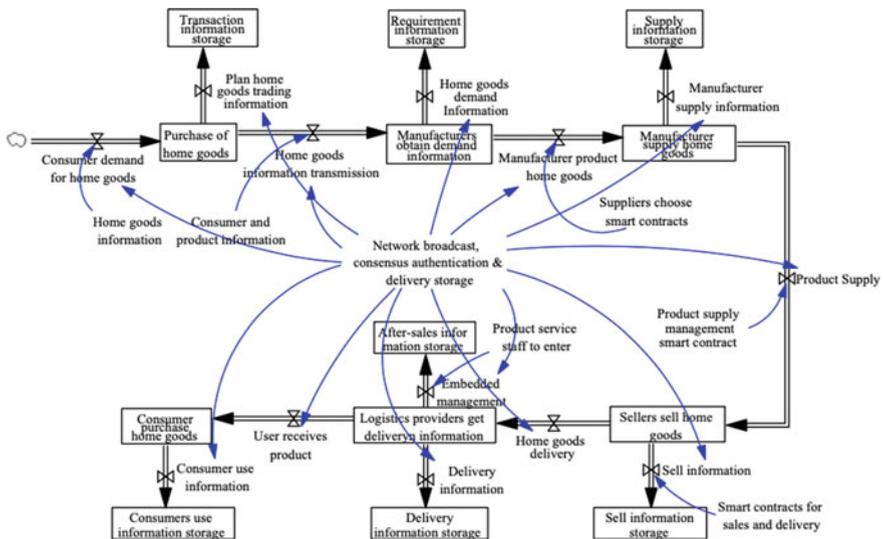


Fig. 3 Example of decentralized management model (Xue et al., 2021)

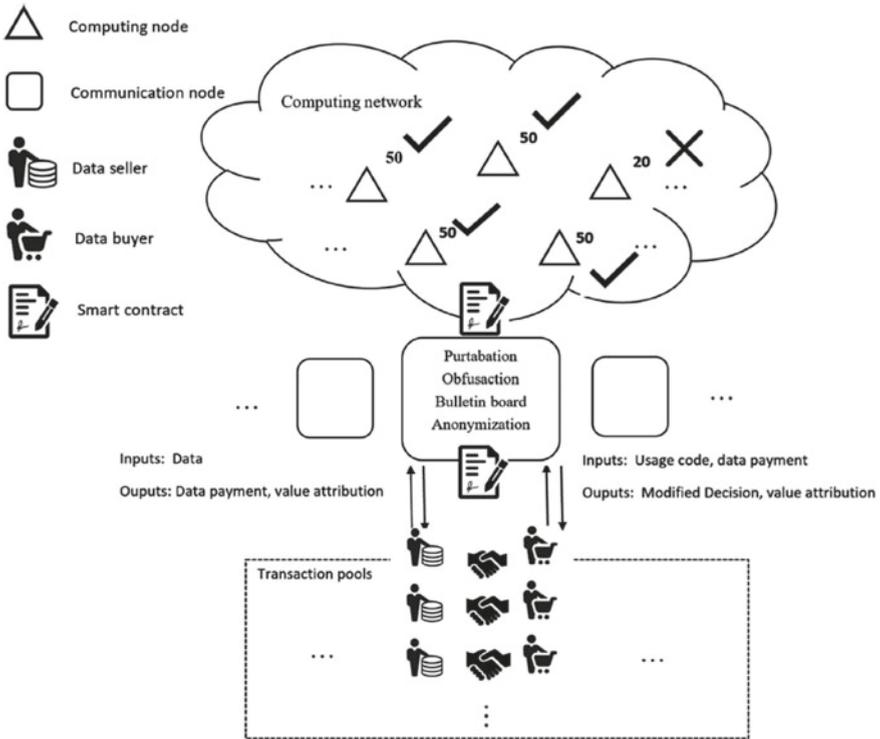


Fig. 4 Example of the architecture of the data exchange (Wang et al., 2021)

system to encourage data transfer (Fig. 4). This model seems to be a promising example of a transparent, credible, and equitable supply chain information distribution system, which is traditionally hard to achieve by only mutual trust. However, new problems have to be addressed for managing these blockchain-enabled data sharing mechanisms, such as the risk of off-chain computation needs and strategic behaviors of data sellers and buyers (Wang et al., 2021).

3.3 Threatening the Occupations of Intermediary and Trust Agency

As mentioned in Sect. 3.2, with the changes of information sharing structure, the transformation of intermediary occupations is a prominent issue that should be considered carefully. The adoption of blockchain will threaten the role of intermediaries in the traditional supply chain through their distributed consensus intrinsic quality, which indicates that some type of intermediaries may be eliminated from the

market to find space for other new intermediary occupations providing blockchain-related services, such as data analytics and integration (Wang et al., 2019b). Similarly, Wang et al. (2019a) specified that if the costs of existing supply chain intermediaries surpass their added value, disintermediation will occur, and new types of intermediaries may emerge to grasp opportunities in the supply chain and foster more benefits on economics, environment and society. Additionally, the consensus algorithm and mechanism are constructed through cryptography, trust agency and relational investment are unnecessary for supply chain management (ibid).

One of the significant applications of blockchain technology is smart contract (Fig. 5), with several objectives including reduction on intermediary, arbitration, fraud and executive cost (Bekrar et al., 2021). Bekrar et al. (2021) also suggested to combine the adoption of blockchain technology and reverse logistics, for the sake of avoiding violations, promoting visibility reliability and accountability for both parties. Under the premise of smart contracting, Choi et al. (2021) discussed the value of blockchain technology in buffer stock sharing schemes as a form of partnership between manufacturers. The model mentioned in Sect. 3.2 designed by Wang et al. (2021) is essentially a form of data-sharing smart contract in RSP. Based on the operation of smart contract, trust can be generally programmed with the eradication of trust building process (Wang et al., 2019b); therefore, trust agency could be phased out.

Traditional travel and booking industry have responses to smart contract innovation. For example, according to Dong et al. (2020), traditional centralized reservation agencies have low service efficiency and high charges, while blockchain can be applied to the booking service industry to provide trustworthiness and efficiency. Moreover, Dong et al. (2020) proposed a decentralized hotel booking system (Fig. 6)

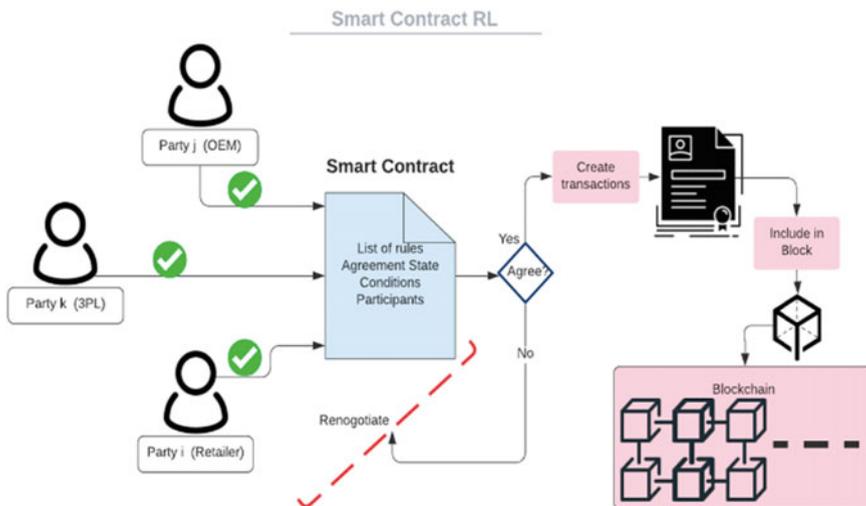


Fig. 5 Example of smart contract (Bekrar et al., 2021)

A blockchain-based decentralized booking system

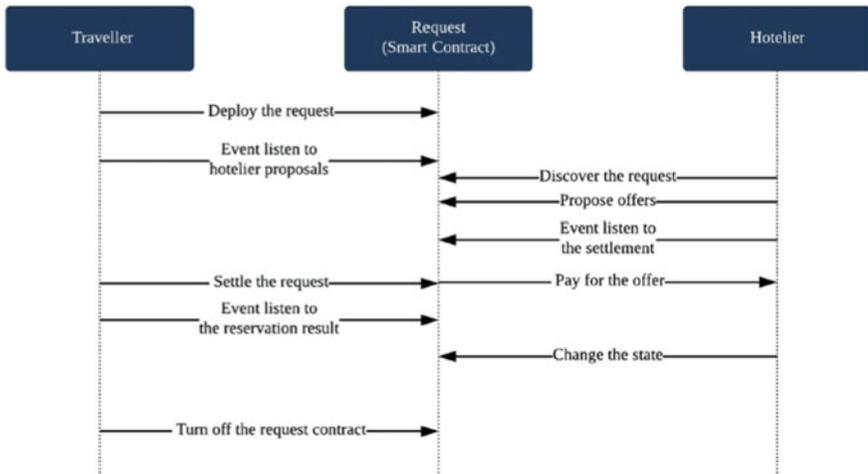


Fig. 6 Overview of system design (Dong et al., 2020)

with the intermediary of smart contract between travelers and hostellers, on the basis of booking request of customers and domain-specific language. Different from other blockchain-based reservation systems which are based on their own mechanisms and currencies, this system is operated in the Ethereum ecosystem with simplified system design and only comprises of three parts: *user*, *miner* and the *smart contract* (ibid).

3.4 Waste of Resources

It is an indisputable fact that the exploitation of blockchain technology could promote the efficiency and effectiveness on traditional supply chain through real-time transaction and thus reducing the waste of energy and expenditure (Tan et al., 2020). However, on the other hand, another vital consideration that should be taken into account seriously is the waste of computational resource caused by the adoption of blockchain technology. Zhao et al. (2016) stated that the establishment of a new transaction record entails a comprehensive validation process, associated with approximately 10 min of verification time and thousands of nodes, which is viewed as a waste on computerized resources.

Moreover, according to Tan et al. (2020), the design of blockchain technology contradicts with the intention of green logistics as it involves redundance issues such as the wasteful data storage and excessive electricity consumption. In particular, blockchains are designed to operate in an untrusted environment where records of information transactions need to be stored repeatedly at each node, resulting in a large amount of data storage space and consuming more electrical power (ibid). Babich

and Hilary (2020) pointed out that blockchain network suffers from the problem of inefficiency by design and is not clear whether it is superior to a centralized database or a mobile phone app. In addition, the system may have the problem of ‘garbage-in-garbage-out’ at the first place (ibid), i.e., discrepancies between the physical state and information recorded in the distributed ledger. While the solutions to this problem may need significant additional resources such as advanced sensor networks (ibid).

The exploitation of blockchain technology will lead to reduction on energies such as production and transportation because of real-time information transfer but will also lead to computational resources and electricity waste simultaneously. This possible two-sided effect may represent one of the key trade-offs of the wider application of the technology. It will be helpful if future researchers could build a quantitative model to examine which proportion of waste is larger. Based on this result, practitioners and researchers are allowed to further response to the innovation of blockchain technique under the guidance of green logistics and sustainability.

4 Limitations for Future Discussion

We have touched upon a few aspects regarding the economic and environmental implications of blockchain adoptions in supply chains. Clearly, there are many other essential aspects that need to be discussed. Firstly, typical responsive innovation requires smaller investment, as it contains the contributions from stakeholders and social entities such as initiative customer feedback and passionate employees, comparing to traditional linear and sequential innovation model (Lubis et al., 2019). However, when involving with blockchain technology adoption, the responsiveness may need higher cost such as excessive electricity consumption (Tan et al., 2020) and computation resources (Zhao et al., 2016). This chapter does not include an investigation of the investment resulting from the adoption of blockchain in the supply chain, which could be improve by future study.

Another limitation is in respect of the occupations of middleman. As discussed in Sect. 3.3, the response to inefficiency issues brought from traditional intermediary provided by Zhao et al. (2020) is to develop a block-chain based ecosystem in the Ethereum ecosystem. It is possible that this response could generate new occupations such as information system developer and data analyst, however, it will not solve future unemployment problem of traditional agencies. This paper does not explore the possibility of changing careers in traditional agencies considering *moral acceptability* and *social desirability*. For example, it could be meaningful to investigate whether they could do low-technical capability required occupations or been trained to master new tools in the context of blockchain technology.

Last but not least, blockchain technology may help promote ethical, sustainable and responsible operations besides the ethical and environmental implications of its own application. But again, the problems of garbage-in-garbage-out and state-zero pose fundamental challengers for ensuring credible and verifiable certificate for

the green practices in operations. Although these issues were not discussed in this chapter, we refer interested readers to Babich and Hilary (2020) for a nice discussion.

5 Summary

Based on a narrative review of the recent literature, this chapter firstly addresses the definition of responsive innovation, as well as the relationship and integration between blockchain technology and supply chain management. Then, responsiveness to major challenges faced by traditional supply chain is listed, involving examples in agricultural supply chain systems and reservation systems. Finally, a few limitations of this chapter are analyzed. We conclude that blockchain technology is still a disruptive technology to the traditional supply chain management model, with the parallel existence of undeniable opportunities. In the context of sustainable development and operations efficiency, practitioners and researchers need careful considerations and comprehensive analyses to better prepare for and response to this disruptive innovation.

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Money Talks: How Crowdfunding Facilitates the Growth of Micro, Small and Medium-Sized Enterprises (MSMEs)?



Han Yan  and Lina Zhang

Abstract MSMEs are not always the most favourable customers for conventional banks, and their financing difficulties have impeded their development. As an innovative financing method driven by advanced information technology, crowdfunding has bestowed on these MSMEs great opportunities to prosper with mitigated financial struggles. This chapter aims to explain the development of crowdfunding, its main operation models, and its wide applications in different sectors in the context of the Chinese economy, in doing so highlighting the impact of such an innovative financing method on nurturing MSMEs. Two short cases in the filming and gaming industries (U17 and Thunderobot, respectively) have been presented to illustrate the specific processes and benefits of crowdfunding for MSMEs. Finally, discussions on how to best leverage crowdfunding to obtain success have been presented to provide insights for both businesses and policy makers.

Keywords Innovative finance · Crowdfunding · Micro · Small and medium enterprises (MSMEs)

1 Introduction

China has reformed and opened its market for more than 20 years, and the development of micro, small and medium enterprises (MSMEs) has made a significant contribution to China's sustained and rapid economic growth. According to the China Economic Census Yearbook 2018, the number of SMEs in China skyrocketed 115% from 2013 to over 18 million by the end of 2018, representing 99.8% of all legal entities in the country (National Bureau of Statistics, 2020). Further, these SMEs

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contribute to more than 79.4% of labour force employment and over 68.2% of total annual operating revenue from all companies in China (National Bureau of Statistics, 2020). It is clear that MSMEs play a critical role in driving the growth of the Chinese economy by creating more jobs for higher employment rates, by empowering the economic development especially in under-privileged areas in China, and by spearheading technological innovations.

With China's in-depth economic system reform, especially the state-owned enterprise reform, a large number of laid-off workers need to be resettled every year. Though both large enterprises and MSMEs can resettle the surplus workers, MSMEs have unique advantages. Firstly, the required skills (e.g., technical proficiency) for the employees in MSMEs are relatively low. Therefore, MSMEs can employ a large number of less-skilled and/or older workers who are less likely to be accommodated by large enterprises with more demanding requirements for employees, which contributes to abating the unemployment problems. Secondly, the sheer number of MSMEs implies massive job opportunities for the labour force nationwide. In particular, the presence and the number of township SMEs are particularly valuable for rural workers. In China, large enterprises are generally located in major cities with more appealing economic conditions, such as being in proximity to the target market, better access to skilled talents, utility and infrastructure, taxation and incentives, etc. The rise and development of SMEs in rural areas, therefore, have become an important lever to promote local economies in those backward areas.

Apart from their significance in employment creation and economic growth, MSMEs are crucial in driving technological innovation. In China, MSMEs account for more than 70% of technological innovations (National Bureau of Statistics, 2020). Since, in most cases, high-tech industries are often associated with high risk, large enterprises tend to focus on conventional production instead of taking risks. Many product inventions are tested in the MSMEs first before being expanded to large enterprises. Thus, MSMEs are often considered the "experimental field" to transform technology innovation into productive forces. In 2020, the number of technology-based small and medium-sized enterprises and high-tech enterprises exceeded 200,000, and the added value of high-tech manufacturing increased by 7.1% throughout the year (Ma, 2021). The research development and innovation performance of MSMEs are outstanding.

However, despite the importance and potential of MSMEs for the Chinese national economy, they have been ill-supported by the traditional financing market where commercial banks prefer high-profile businesses over MSMEs and start-ups for issuing loans (see Fig. 1). The reasons for such lack of support lie primarily in the financial repression and the credit rationing from banks. Xu and Faure (2019) suggest that the financial system in China is repressed as it conforms to the stereotype described by the financial repression theory (Natke, 1999), which holds that the government has excessively intervened in the financial system for its economic development in developing countries. The banking industry in China is dominated by state ownership and interest rates are controlled by the government, implying that political factors rather than commercial motives greatly influence credit allocation. With financial repression, banks tend to allocate limited resources to safer projects of

more established enterprises and decline loan requests from the perceived high-risk projects of MSMEs. Such discrimination in issuing loans means that many MSMEs are blocked by the financial system and cannot obtain sufficient financial support. As the theory of financial repression indicates, all these characteristics will lead to a less efficient allocation of capital through the banking system and to a substantial underground financial market (Goldstein et al., 2008).

Additionally, credit rationing can occur when the market demand for bank loans often exceeds the loan limit that banks can supply, given a fixed loan interest from banks (Modigliani & Sutch, 1969). Taking the perspective of information asymmetry between banks and enterprises, Stiglitz and Weiss (1981) underscored that banks do not fully understand the information and risks of enterprises and therefore will implement credit rationing for some customers, especially MSMEs and other startups. In this case, banks are reluctant to issue loans to MSMEs, regardless of the potential and the willingness to pay for the interest of these MSMEs. Therefore, SMEs are more likely to be eliminated than large enterprises in China due to the practice of credit rationing (Jing and Zhang, 2019).

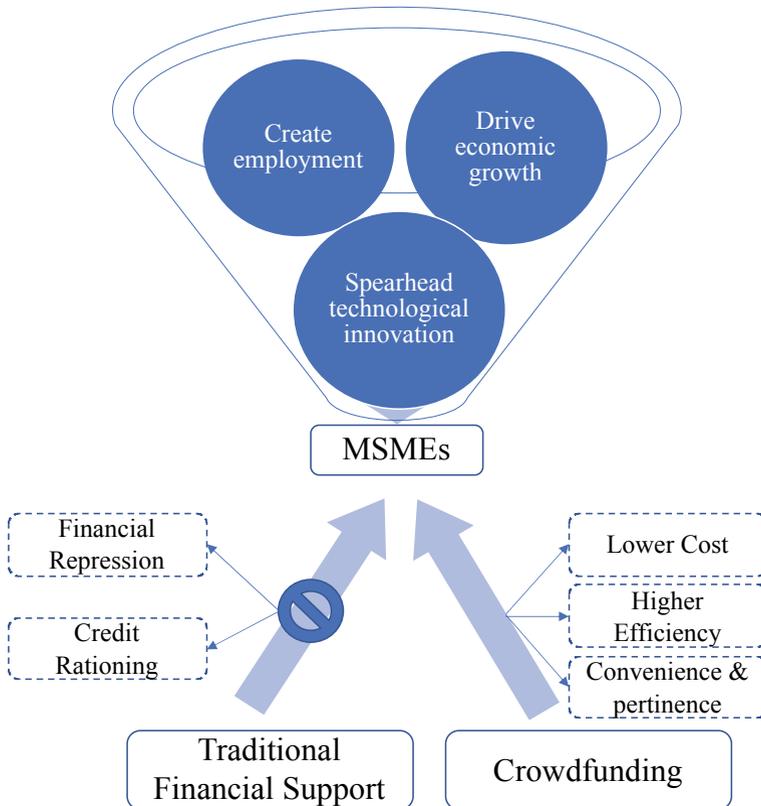


Fig. 1 The value of crowdfunding in providing financial support for MSMEs

Combining internet technology with traditional financing features, crowdfunding lends itself as a novel internet finance method and a strong weapon to unlock access to finance for MSMEs (see Fig. 1). Using the internet, crowdfunding allows MSMEs to seek and obtain external financing from many individuals without standard financial intermediaries (Mollick, 2014). Compared with the indirect financing method in the traditional commercial bank and direct financing mode in the capital market, this novel financing model of crowdfunding has universality, convenience, and pertinence (Xu et al., 2014). Also, crowdfunding is considered to be more cost-effective with an enhanced level of operating and risk management (Gong, 2013). Other studies have shown that crowdfunding increases financing sources, lowers financing costs, increases financing speed, and lowers financing barriers, which significantly helped MSEMs to resolve financing difficulties (Ahler et al., 2015; Allison et al., 2017; Barbi & Bigelli, 2017; Xie & Zou, 2013). Acknowledging the value of crowdfunding in helping MSMEs secure financing with lower costs, the Chinese government has been actively promoting the development of crowdfunding. For example, in April 2013, the state council published nineteen key financial research topics, where “The Development and Regulation of Internet Finance” are included. In August 2013, the state council proposed support for internet finance innovation and internet finance regulation. According to the state council’s “383 Reform Plan” issued in October 2013, internet finance institutions are highly encouraged to leverage their unique advantages in the field of small and microfinance.

Motivated by the novelty and significance of crowdfunding, this chapter provides an overview of the development and wide application of crowdfunding in the Chinese economy. Specifically, we first delineate the typical parties involved in crowdfunding and the major types of crowdfunding. We then discuss two short cases (U17 and Thunderobot) to demonstrate the application of crowdfunding in the filming and gaming industries. Based on the case analysis, we derive key insights into the critical factors that affect the success of crowdfunding projects and therefore provide guidance on how MSMEs could better adopt crowdfunding to secure external financing.

2 Crowdfunding: The Main Types and the Development in China

2.1 The Main Types of Crowdfunding

As crowdfunding represents a novel method of raising small amounts of money from the public for a particular project or enterprise through the internet, it involves principally three participants: the project sponsor (fundraiser), a crowdfunding platform, and project investors (Allison et al., 2015).

Crowdfunding fundraiser refers to enterprises, individuals, and other groups that want to use the crowdfunding platform to obtain financial support from the public. A crowdfunding fundraiser is the initiator of the project, and its purpose is to

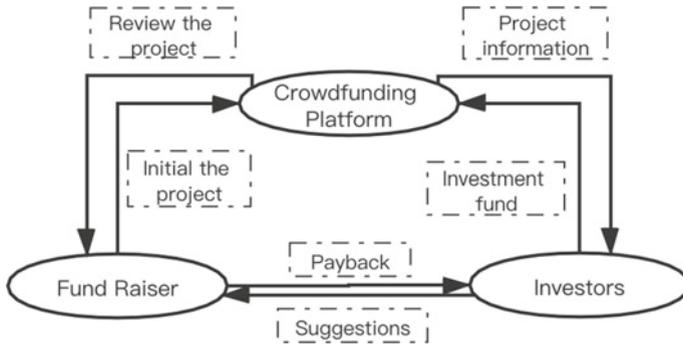


Fig. 2 The three principal participants in crowdfunding

obtain financial support for its entrepreneurship and management and, at the same time, provide a return on investment to the supporters. Crowdfunding investors are investors from the public. This is a massive group with unlimited and inestimable resources but also with lots of uncertainties. Choosing the public for financing is the most critical feature of crowdfunding. Crowdfunding investors can not only get their returns after investing and sometimes can even get involved with the project development and production process. Serving as an intermediary, the crowdfunding platform links the needs of crowdfunding fundraisers with project supporters and receives commissions from successful projects in return (e.g., 4–5% of the total funding amount as suggested in Agrawal, Catalini and Goldfarb [2015]). It allows crowdfunding fundraisers to release information and provides a channel for investors to support their projects. Figure 2 illustrates the relationship between the three parties of crowdfunding.

Based on the different types of crowdfunding payback made by the fundraiser to the investors, Meyskens and Bird (2015) classified crowdfunding into four categories: donation-based crowdfunding, lending-based crowdfunding, equity-based crowdfunding, and reward-based crowdfunding (see Fig. 3).

Donation-based crowdfunding is also called public welfare crowdfunding where investors provide capital voluntarily for the project and receive nothing in return. It is more of ethical consumption. Supporters give donations for an individual or community cause, such as after a natural disaster or other emergencies.

Debt-based crowdfunding provides a platform for lenders and borrowers to share and match their financing or investing needs. Borrowers list their financing goal, interest rate, and payback time after the platform verifies their personal information. Investors could then choose desired projects on the platform, invest specific amounts of money in the borrower, and get principal and interest from the borrower in the future. Peer-to-peer platforms, such as Lending Club in the US and Renren Dai in China, are the most used method for debt-based crowdfunding (Miao & Yan, 2016).

Reward-based crowdfunding is a more common crowdfunding type in the market. Investors invest a certain amount of money for a company’s project and get its product or service in return. Equity-based crowdfunding is another popular way that

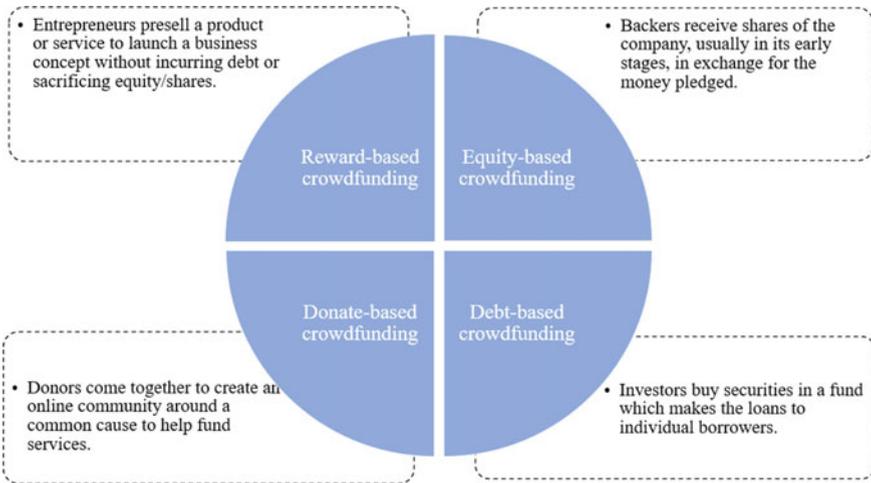


Fig. 3 Main types of crowdfunding

companies use to raise capital. Investors get a certain amount of equity after investing in one’s crowdfunding project. If the company’s value goes up, investors’ share of the equity value goes upward as well.

2.2 The Development of Crowdfunding in China

China witnessed the launch of the first crowdfunding platform in 2011 and then a period of the tremendous growth of Crowdfunding platforms from 2014. Figure 4 illustrates the three stages of the development of crowdfunding in China. The first stage is the initial stage of budding, followed by the second stage with explosive growth. From 2016 to date, the crowdfunding industry remains in the third stage of industry reconsolidation.

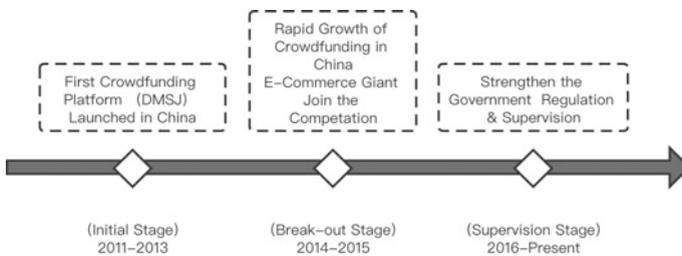


Fig. 4 The timeline of the development of crowdfunding in China

Figure 5 illustrates the number of different types of crowdfunding platforms in China from 2016 to 2019. It can be seen from Fig. 5, the total number of crowdfunding platforms (2898) was the highest in 2016, among which debt-based crowdfunding platforms (2448) make up the largest share, followed by reward-based crowdfunding platforms (304) and equity-based crowdfunding platforms (133). With the takeoff of crowdfunding, many issues and risks such as financial fraud, liquidity problems, and lack of coordination in regulation have also emerged. To this end, the Chinese government has strengthened crowdfunding platform supervision and regulation since 2016. As a result, many of the non-compliant crowdfunding platforms are gradually shutting down and knocked out of the market during the last six years, signifying a nosedive in the number of crowdfunding platforms. As of the end of 2019, there were only 435 crowdfunding platforms left in the business.

Considering that donate-based and debt-based crowdfunding are often applied to individual financing instead of financing of businesses, we focus our attention on reward-based crowdfunding and equity-based crowdfunding in this chapter. The next section discusses two short cases that exemplify the application of reward-based and equity-based crowdfunding respectively.

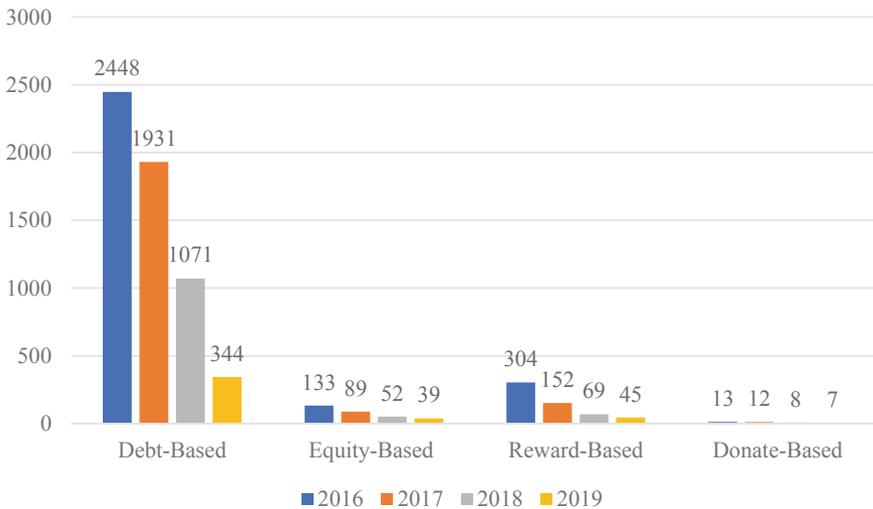


Fig. 5 The number of different types of crowdfunding platforms in China from 2016 to 2019 (The Crowdfunding Industry Development Report 2019, Renchuang Consulting)

3 Reward-Based and Equity-Based Crowdfunding Projects

Here we present two cases of a reward-based crowdfunding project and an equity-based crowdfunding project, respectively. For each case, we first outline the project background and then discuss the crowdfunding process and results and finally analyse the critical success factors for the case project.

3.1 The “100,000 Ways to LMAO” Crowdfunding Case: Reward-Based

3.1.1 Background

Launched in October 2009 by Beijing April Star Network Technology Co., Ltd., “U17 Original Comics Dream Factory” (hereafter U17) is an online comic platform offering original Chinese comics and animations. According to the producer of U17, Chinese cartoons are mostly designed for children, and comics that are designed for adults are very rare. To fill in this gap and achieve their long-term goal, U17 designed the comic “100,000 Ways to LMAO” (hereafter LMAO). LMAO was originally serialized in DreamWorks and later reproduced into a series of animated short films with a duration of ten minutes for an episode. After it went live in 2012, the series of animated short films caused a strong response from the Chinese audience. It went so viral on the internet that even the famous pop star Jay Chou participated in the dubbing. Given the success of the short film, the U17 producer aspired to move LMAO comics to the big screen by making an original animated film of 90-min length, which enables the team to tell a more complete and intriguing story while retaining the characteristics of the animation.

However, as a small-sized start-up company, U17 lacks fixed assets as collateral and therefore struggles for obtaining high loans from banks. Meanwhile, the lack of reputation in the film and television industry makes it difficult for the company to obtain capital investment from advertisers and other investors. The chance of gaining financing from IPO is even slimmer. After evaluating its internal retention, U17 decided to use crowdfunding to obtain part of the funds for film production to alleviate the plight of financing.

3.1.2 The LMAO Crowdfunding Project

In 2013, LMAO launched the challenge of “becoming the first crowdfunding movie in history” on the “Demohour” (China’s largest crowdfunding website at the time). The project’s crowdfunding goal is to successfully crowdfund 1 million in 150 days (5 months). “Demohour” has entered the field of crowdfunding in 2012 and has become the earliest crowdfunding platform in China. To initiate this project on

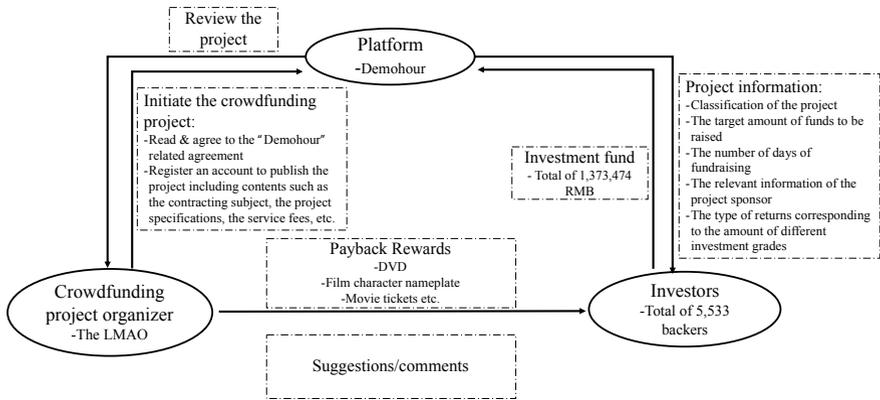


Fig. 6 The three parties in the U17 crowdfunding project

“Demohour”, U17 (as the fundraiser or project sponsor) followed a specific procedure as required by “Demohour” and publicized detailed information on the project, such as the project specification, clear information on the film production team (e.g., director and screenwriter), the target amount of funds to be raised, etc. (see Fig. 6).

Netizens can become micro-investors of the film by investing in the LMAO crowdfunding project. Such project exemplifies reward-based crowdfunding and the reward for crowdfunding investors includes DVD, film character nameplate, “LMAO” births comics, film character dolls, “LMAO” mobile game card, school bag, movie ticket, production team signature card, and some other mystery rewards. According to the amount of support provided to the project, investors will have chances to get film opening nominations, participate in the film script discussions, and participate in the film dubbing. In August 2013, the LMAO film crowdfunding project was successfully funded, attracted more than 5,533 investors, and raised 1,373,474 yuan in investment. As a result, the film “100,000 Ways to LMAO” was released in Mainland China on December 31, 2014, as the first crowdfunded movie in China. The film was a resounding success and generated a total of 76.6 million yuan in three days and grossed nearly 120 million yuan at the box office in the end.

3.1.3 The Critical Success Factors of the LMAO Crowdfunding Project

The success of the LMAO crowdfunding project by U17 provides insights into some critical factors that influence the success rate of a crowdfunding project. The first factor to be noted is the clearly specified and well-designed funding goals, which are widely acknowledged in previous studies (e.g., Barbi & Bigelli, 2017; Mollick, 2014). A low target may not provide sufficient financial support needed, whilst an excessively high financing target may cause discrepancies with investors’ expectations and thereby affecting investors’ willingness to invest. Based on the popularity of the animation accumulated in the early years, the project promoters carefully set its

crowdfunding target amount at 1 million yuan, even though the highest target amount of film crowdfunding projects was only 0.5 million yuan. The well-contemplated goal meets the expectation of the animation fans and investors and the project received approximately 0.37 million more than targeted when the crowdfunding period is over.

Another factor attributed to the success of the LMAO crowdfunding project is the provision of detailed information on the project to potential investors. As noted in Bernstein et al. (2017), information about the founders significantly impacts how investors make investment decisions, and the background of entrepreneurs matters the most to attract early-stage investors. By publicizing the use of the original team of animation directors, screenwriters, and dubbers¹ who are familiar and experienced to the audiences, the audiences and potential investors were more assured of the quality of the film and therefore have more faith in it.

Furthermore, the quality of publicity also plays an important role in reward-based crowdfunding. The quality of publicity can reflect how detailed the project description is and how many potential investors could learn from the description. By using short videos and pictures, investors could be more attracted and more likely to make the investment. LMAO has excelled on the project information disclosure by using short videos and pictures to attract and entice more investors. It has created a very LMAO-styled introduction video to describe this crowdfunding project. The production team, loyal fans, film demo, and project rewards were all shown in the introduction video deploying an LMAO style sense of humour. Apart from using the introduction video to get potential investors attached and interested in the final film, the project team also facilitates the interaction with supporters and potential investors who can leave comments under the crowdfunding page and then will receive feedback from the team shortly. A continuously updated timeline signifying the status of the crowdfunding process and relevant notifications will be released to the public so that the investors could be kept informed of the project's progress.

3.2 The Thunderobot Technologies Crowdfunding Case: Equity-Based

3.2.1 Background

Thunderobot Technologies is a reputable Chinese company that specializes in esports hardware and software. Popular apparatus and instruments provided by Thunderobot include esports notebooks, esports desktops, and other esports peripherals. The mission of the company is to "Allow every player to have an extreme game experience." In 2014, Thunderobot Technology secured its A round funding of 5 million

¹ The directors and screenwriters of network animation "100,000 Ways to LMAO" are Henry Lu and Jill Lee. Screenwriter Han Wu, the original author of the "100,000 Ways to LMAO" comic, also participated in the screenwriting of this film version.

RMB on JD Dongjia equity-based crowdfunding platform. B round of financing of 35 million RMB was secured in 2016 and C round of financing of 65 million RMB took place in 2017. In Sep 2017, Thunderobot Technology was listed on the New OTC Market (new over-the-counter market) in China. It was the first gaming stock in China, and the market value of Thunderobot Technology has increased from 135 million RMB to 1 billion RMB after its issuing. On the 26th of March 2019, Thunderobot Technology went public in the New OTC Market with 1.2111 million shares of stock, and 45 RMB per share were offered to the public. Although Thunderobot Technology has exhibited many successful financing outcomes year after year, its first successful financing by equity-based crowdfunding warrants the most attention since it helped the company start the business and attracted many following investors in the esports market.

All business activities will require capital investment, and traditional financing for businesses at the early stages is especially hard. Along with the rapid growth of equity-based crowdfunding in China in 2014, Thunderobot Technology was put on the way of equity-based crowdfunding for its financing at the time. Thunderobot Technology's long-term online sales partner JD.com planned to launch its equity crowdfunding platform JD Dongjia and invited Thunderobot to become the first batch of JD Dongjia's occupancy projects. Thunderobot accepted the offer and explored the application of equity-based crowdfunding to its business.

3.2.2 Thunderobot Technology's Crowdfunding Process

In March 2015, Thunderobot Technology's equity crowdfunding project went live. Under the leadership of JD Dongjia, Thunderobot received attention from the venture capital institution Zihui Venture Capital. Zihui Venture Capital has invested in multiple projects such as Hammer Technology, Momo, and Yingke. As a lead investor, Zihui Venture Capital invested 10 million RMB in Thunderobot, which accounted for 6.63% of Thunderobot's total shares. According to the level of contribution (i.e., the amount of investment made), investors for the project were divided into two types, namely the Dongjia investors (with an investment amount of 200,000 RMB or above) and the little Dongjia investors (with an investment amount of 5,000 to 200,000 RMB). Figure 7 depicts the three parties involved in the Thunderobot Technology crowdfunding project.

As a result, Thunderobot has attracted 4 Dongjia investors with a total investment of 4.715 million RMB (accounting for 3.13% of the total shares) and ten little Dongjia investors with a total investment of 285,000 RMB (accounting for 0.19% of the total shares). After this equity-based crowdfunding financing, Thunderobot Technology successfully raised 15 million RMB and the company's value has increased from 135 million RMB to 150 million RMB. The success of this equity-based crowdfunding put Thunderobot Technology in a more competitive and advantageous position in the esports industry. To keep up with the continuous technological innovation in the industry and to sustain and excel in its customer service, Thunderobot Technology

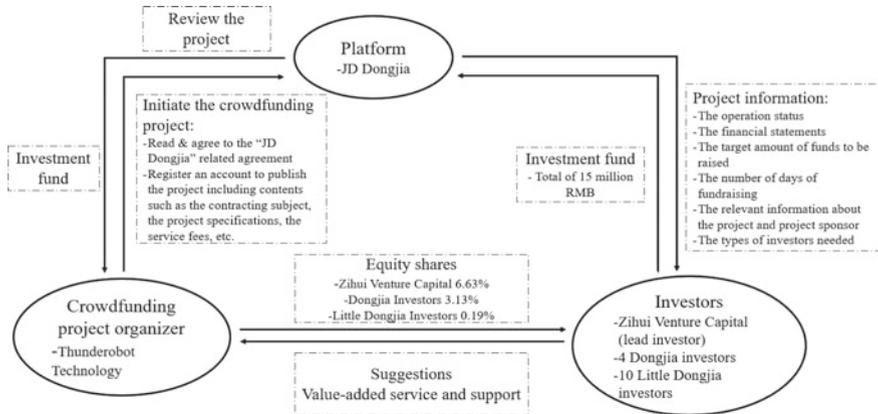


Fig. 7 The three parties in the Thunderobot Technology Crowdfunding Project

needed substantial resources, particularly for new product research and development and marketing. Through equity-based crowdfunding, Thunderobot Technology not only obtains more funds but also received many valuable resources from Zihui Venture Capital and other investors in the industry. The endorsement from Zihui as a lead investor also provided Thunderobot Technology with a good foundation for further financing.

3.2.3 The Critical Success Factors of the Thunderobot Technology Crowdfunding Project

The success of the Thunderobot Technology crowdfunding project provides insights into some critical factors including the project’s quality, lead investor, crowdfunding platform selection, and fund raiser’s education background, working experience, and social capital.

The first factor to be noted is the project quality. Ahlers et al. (2015) suggests that the quality of the product has a significant effect on the success of equity-based crowdfunding projects. In the description of Thunderobot Technology’s equity-based crowdfunding project, it demonstrated its ambition to become the No. 1 esports brand in China, released its sales data for 2014, and elaborated its future product planning and business planning. It can be seen that it has already obtained a certain profit and had a clear business plan and business model, this helps its equity-based crowdfunding project attract the investors easily when crowdfunding. Besides, the more focused companies on product development and technology promotion are more likely to get the attention of venture capital institutions in crowdfunding and are more likely to be successful in fundraising. For example, in the development process of Thunderobot Technology, we can see that the company continues to make iterations with its consumers and make product development based on users’ actual

feedback. By doing so, it has developed a series of new products and services and obtained certain loyal users. Those are some essential advantages for Thunderobot Technology since a company with those features is more likely to be favored by venture capital institutions when they are doing equity-based crowdfunding.

Moreover, the promoter's educational background, working experience, and social capital also play important role in equity-based crowdfunding projects' success. Lu Kailin, the founder of Thunderobot Technology, graduated from a top university (Xi'an Jiaotong University) in China and worked in the leading laptop division in Haier Groups. With the abundant industry working experience and rich supply chain resources, he and his group had generated a strong team with excellent management skills. This is in line with Bernstein's study in 2017, that in terms of equity-based crowdfunding fundraisers, potential investors will increase their confidence in projects when the fundraisers have a better education background and working experience. As evidenced in Thunderobot Technology's case, a team with a better portfolio could promote crowdfunding success.

According to Agrawal et al. (2015), the better the fundraisers' social capital, the more likely a crowdfunding project can be successfully funded. In terms of external social capital, Thunderobot Technology has more than 1.2 million fans on Post Bar, Forum, Weibo, and WeChat before they start crowdfunding. This number continues to increase as crowdfunding is in progress. Thunderobot Technology has followed 12 other projects on the platform in terms of social capital, including five non-spontaneous projects. Among these five other projects, two people supported or followed Thunderobot's projects back. Therefore, rich social capital is also essential for the success of Thunderobot's crowdfunding project (promotion and marketing to a wider user base).

The impact of crowdfunding investors on project success is also reflected in the quality and performance of the lead investors. Based on herd behaviour (Trueman, 1994), the crowd is likely to follow the movement of the leader. When an investor cannot access the complete information, before making investment decisions, they will refer to the decision that their predecessors made and reduce their dependence on current private information. In Thunderobot Technology's equity-based crowdfunding, a well-known investment firm (Zihui Venture Capital) make a lead investment in the project, and this created a creditable impression of the project to the other potential investors. With limited information, the other potential investors are more willing to follow the decision of professional investment institutions. In the case of Thunderobot Technology, the project has been successfully funded within one hour after its launch. The rapid increase of the funding amount on the crowdfunding platform proves the performance of Thunderobot is excellent and reduces the doubts of later investors, thus helping with the success of its equity-based crowdfunding.

Last but not least, the right choice of equity-based crowdfunding platform could also improve the success rate of crowdfunding (Mollick, 2014). Thunderobot Technology has chosen JD Dongjia as the equity-based crowdfunding platform to raise funds. JD Dongjia was founded in 2015 and ranked as the No. 1 crowdfunding platform. In 2015, the average completion rate of the project reached 127%. The platform has excellent word of mouth, it has the best equity-based crowdfunding projects on

the platform and thus attracted a group of high-quality investors, which is conducive to crowdfunding projects' success. The platform is adopting the "lead investment + follow-up" model for equity-based crowdfunding projects. The platform attracted many high-quality institutional investors, most of those institutional investors with great reputations become lead investors of crowdfunding projects eventually. With the lead investor's investment, it will encourage more follow-up investors to invest in the project and reduce the cost of follow-up investors, and as a result, increase the success rate of crowdfunding projects.

4 Discussions

In this section, we elaborate on the critical factors contributing to a successful crowdfunding project from the perspective of the fundraisers and the crowdfunding platforms. Additionally, we also explore the implications of the crowdfunding industry on policymakers in terms of regulation.

4.1 *Implications for the Crowdfunding Project Fundraisers*

Based on the insights from the above cases and the existing studies in the literature, it is critical for crowdfunding project fundraisers to strategically decide the fundraising target, project payback period, and project description to improve the rate of successful crowdfunding. The project funding target should be specified by the fundraiser, which is inversely proportional to the project's success. The lower the target amount the crowdfunding projects have, the more likely the projects will be successful. Moreover, crowdfunding projects could be most attractive to potential investors when they almost reach the fundraising target. Since the higher the project completion rate will increase the investment incentive of new supporters, fund raises' relatives and friends could make an appropriate investment to promote the crowdfunding project's completion rate in the early stage.

Secondly, the payback period has no significant relationship with the success of the product-based crowdfunding project but is significantly important for debt-based crowdfunding projects. That is to say, it depends on which method of crowdfunding is used, the length of the return time might have or have not directly affected the project's success. For reward-based crowdfunding, a longer financing period is a bad signal for investors. That is, if the crowdfunding project is a high-quality project, it should generate its target financing amount in a short period. Thus, a long financing period reflects that the project's quality is not good enough and requires more time to generate the fund. The issuance of this signal may reduce the credibility of some investors. In addition, the long financing period will lead to longer waiting times for investors to get their returns, but investors are more likely to obtain investment returns

as soon as possible. For equity-based crowdfunding, on the other hand, this study has shown that the longer maturity of the project, the higher return for the investors. At the same time, investors will bear more risks. Thus, setting a reasonable maturity date is also important, and different maturity times target different groups of investors.

Furthermore, studies have shown that there is a clear positive correlation between the quality signals of high-quality projects and the success of crowdfunding projects (ref). Project funders should focus their work on achieving project success by promoting the project and communicating more detailed project information with potential supporters. Fundraisers should appropriately add text describing the project and add videos to promote the advertisement effects. Also, sending signals of project information to investors through multiple channels such as text and pictures, videos, and giving investors a letter with detailed descriptions are key actions to demonstrate the funders' attitude toward the investors.

Project funders should also thoroughly consider the progress of crowdfunding projects when carrying out project publicity, and they need to pay more attention to the information publicized in the early stage of crowdfunding. Project funders need to update the project's progress in a timely manner and promptly answer supporters' questions and reply to their comments and feedback. Meanwhile, they need to display the project information as detailed as possible to give potential investors a chance to judge the quality of the project. More interaction with investors and followers in the later crowdfunding stage can also attract potential investors to make future investments. More information disclosure about the funders the better chance to be the success of crowdfunding projects.

Fundraisers should also choose platforms carefully. A good selection of crowdfunding platforms is essential for fundraisers. Before crowdfunding, fundraisers should pay attention to the news in advance, understand each mainstream crowdfunding platforms' advantages and disadvantages, do a comparative analysis of the platforms, and choose their desired platform wisely.

Last but not least, Fundraisers should take precautions against risks. First of all, fundraisers should deal with the infringement risk of intellectual property rights. They should also keep their trade secrets and patents protected. When publishing project information on an equity-based crowdfunding platform, the description should not be too comprehensive. Secondly, start-ups should apply for patents as soon as possible; the best timing will be sometime before initiating crowdfunding. Secondly, the fundraiser should keep their distance from the risk of illegal fundraising. The illegal cost of violators should be increased. When the fundraisers were setting the limit of crowdfunding investors, they need to keep the shareholders to less than 200 people. The fundraisers should also make investors aware of the potential risk for this investment, and they shall not guarantee the return of the investment.

4.2 *Implications for the Crowdfunding Platforms*

The crowdfunding platform should only be an intermediary. Crowdfunding platforms should position themselves as information intermediary platforms that only provide investors and crowdfunding fundraisers information. The platforms should not interfere with investors' decisions or participate in investment or intervene in capital transactions. The operation of the business should be more standardized so that the investors can invest more assuredly. Independent third-party funds custodian. In order to avoid the risk of misappropriating funds, third-party fund custodians should be improved. The financing amount raised by fundraisers on the crowdfunding platform needs to be put into the independent third-party fund custody, and the crowdfunding platform should not collect the fund and build a fund pool. Also, crowdfunding platforms are strictly prohibited to use raising funds for their platform-related economic activities.

It should also strengthen the supervision of crowdfunding platforms. The crowdfunding platform should improve the information disclosure system since most of the following investors invest based on the lead investors' investment decisions. The platform needs to emphasize the importance of supervision on lead investors and ensure sufficient information disclosure. This will help with the risk of illegal fundraising, where fundraisers seek private interests and damage investors' interests by using investors' herd behavior.

Enhancing the guidance for investors is also important. For reward-based crowdfunding projects, those kinds of projects have vital social attributes. Crowdfunding platforms should provide more convenient interfaces for investors and fundraisers to communicate better. On the other hand, for equity-based and debt-based crowdfunding platforms, investors pay attention to the return on investment. The crowdfunding platform can provide an intuitive and easy-to-understand investment return analysis of each project, for example. The platform could provide a histogram of investment return and help investors to choose their desired project.

Platforms should also strengthen the guidance for fundraisers. Crowdfunding platforms should help the fundraisers with their crowdfunding project settings based on their experience and increase the success rate of fundraising. For example, although a lower expected financing amount for crowdfunding projects can make the project easier to complete, it may raise the risk for product production in the later stage if the financing amount is too low. Therefore, the platform needs to check whether the fund raiser's target amount is reasonable, and if it is too low, it needs to be vigilant. For those crowdfunding projects that failed to raise funds on the platform, the crowdfunding platform needs to conduct a detailed one-to-one analysis to overcome those problems in the future. For example, the crowdfunding platform could provide them with some promotion methods to allow more exposure to the project on the platforms. The platform could also introduce some professional investors to make certain investments as lead investors to attract ordinary supporters to participate in this project.

4.3 Political Implication for Government Regulation

As discussed in Sect. 2.2, the Chinese government has reinforced its intervention in the crowdfunding industry since 2016 with heightened supervision and regulation. To ensure a healthy operating environment for the crowdfunding industry, the Chinese government should improve the relevant content of the supporting legal system of China's regulatory framework. First of all, the government should perfect the supportive measures of China's regulatory framework. According to the crowdfunding industry's developments, the current financial industry laws and regulations modify and supplement the content, improve the legislative level of quasi-financial institution supervision, and enhance legal validity by completing the legal and policy system hierarchically in stages. Secondly, the government should supplement the relevant content of China's crowdfunding supervision and legal policy system. Based on the current Securities Law, Banking Law, and Company Law, add amendment Ordinances suitable for crowdfunding.

Moreover, the government should establish a comprehensive crowdfunding consumer rights protection system. In the short term, list the laws and regulations on the protection of crowdfunding consumer rights protection laws and policy systems separately and clarify the responsibilities and business of crowdfunding institutions, based on the developments of the crowdfunding subdivision sectors. Revise certain parts of the "Consumer Rights Protection Law" gradually refine protection content and improve the crowdfunding consumer rights protection system. In the long run, first of all, a pre-intervention mechanism should be established which is capable of timely risk detection and management. Therefore, reducing systematic risk. Secondly, we must build an information security protection mechanism for the crowdfunding industry, protect consumer privacy, and raise the organization's information protection obligations to the legal level, improve the institution's capability to protect information security. Thirdly, a crowdfunding platform's nature should be implemented, and consumer property safety should be protected. Fourthly, we need to establish an information disclosure accountability system to increase the transparency of crowdfunding institutions, reduce unnecessary information disclosure incidents, and guarantee the orderly operation of the information disclosure system. Finally, we should polish the diversified dispute settlement mechanism, take maximum advantage of the Financial Consumer Protection Bureau, establish a mandatory mediation system, and properly handle the disputes between consumers and platforms.

The government should establish and improve relevant mechanisms. First of all, a small-scale crowdfunding exemption mechanism should be established. It is possible to draw on developed countries and establish a small-scale crowdfunding exemption mechanism while improving relevant policies and regulations. Under a specific limit, crowdfunding fundraisers could use crowdfunding platforms to raise funds. By acting the crowdfunding exemption mechanism, the transaction costs in administrative approvals and other aspects will be reduced. Secondly, a mandatory information disclosure mechanism should be established. While promoting the construction of

related mechanisms for crowdfunding, a mandatory information disclosure mechanism as a prerequisite for compliance with online crowdfunding should be established. Meanwhile, giving the entrusts party, for example followers and investors enough risk warnings to reduce the possibility of market fraud risk. Thirdly, the crowdfunding supervision mechanism should be improved. One is to improve regulatory legislation. The other is to specify the supervision content of crowdfunding platforms. Finally, is to implement investment and financing classification management system.

5 Conclusions

In this chapter, we provide a comprehensive overview of crowdfunding, including the strengths and the typology of crowdfunding and its practices in China. In particular, we examine how crowdfunding, as an innovative financial method, can drive the growth of Small and Medium-Sized Enterprises (MSMEs) by empowering them to obtain funding more efficiently. Two cases have been illustrated, namely the reward-based U17 LMAO crowdfunding project in the film production industry and the equity-based Thunderobot crowdfunding project in the gaming industry, to demonstrate how MSMEs can leverage crowdfunding to achieve success. Critical factors affecting the success of the crowdfunding projects have been highlighted via the discussions and illustrations of the two cases. In addition, we also discuss the implications of successfully deploying crowdfunding on the fundraisers, the crowdfunding platforms, and the relevant policymakers respectively.

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Mixed-Ownership Reform and Innovation Performance of Private-Owned Enterprises: Firm-Level Evidence Based on Difference-In-Difference Approach



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Abstract Transforming and upgrading the economy through innovation has been the strategic focus of China's contemporary economic development. Private-owned enterprises, as one of the key players in the economy, need to sustain their growth by strengthening the innovation capabilities. Grounded on the resource-based view of firm, this chapter argues that the mixed-ownership reform may improve the innovation performance of private-owned enterprises (POEs). Using a propensity score matching and difference-in-difference approach, we compare the innovation performance of MixPOE (i.e. the ownership structure of private-owned enterprises that includes non-controlling state-owned shareholders among their top ten shareholders) to POEs (i.e. fully private-owned enterprises) before and after the reform. Our finding confirms the hypothesis that the mixed-ownership reform significantly improves the innovation input, proxied by the R&D intensity of MixPOEs. Furthermore, we find that the strength of this positive relationship is contingent on the type of industries and regional factors. Theoretical and practical implications derived from our findings are discussed.

Keywords Mixed-ownership reform · Innovation · POEs · PSM-DID

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1 Introduction

Private economy contributes significantly to the economic growth in both developed and developing countries (Mead & Liedholm, 1998). China has witnessed an impressive economic catching-up over the past 40 years where the entry and rapid growth of private-owned enterprises (POEs) play an essential role in driving the economic growth, upgrading the economic structure and creating jobs (Wang et al., 2021). To achieve a sustained growth, it is crucial for POEs to build up their innovation capabilities and rely on technological advantages rather than the short-term cost advantages (Dosi et al., 2015). Despite the importance of innovation in building sustainable competitive advantages, it is a great challenge for POEs to make such a transition (Wei et al., 2017). Among all, one of the challenges that POEs are facing is the low credit availability and ownership discrimination in financing (Inderst & Müller, 2003). This is because China's current credit system is still dominated by the large state-owned banks. The financial constraints have been a major obstacle limiting the further growth of POEs (Berger & Udell, 2006).

To resolve this growth barrier (i.e. financial constraint) of POEs, the mixed-ownership reform may provide a remedy. China initiated the mixed-ownership reform of state-owned enterprises (SOEs) since 1990s, aiming to improve the efficiency of social capital by assimilating private capital to SOEs (Yang & Modell, 2015). After more than two decades since the inception of the mixed-ownership reform, the execution of the reform has been enriched based on trials and errors and the dynamic macroeconomic environment. While the strategy of mixed ownership reform originally only targeted SOEs and tried to improve their operational flexibility by increasing (reducing) the share of private (state) capital, numerous private-owned enterprises (POEs) have absorbed state-owned capital to gain tax benefits and easier access to credits (Zhang et al., 2020). Concerning the mixed-ownership reform targeting POEs, studies show that assimilating non-controlling state-owned equity effectively resolve the challenges of expensive financing for private-owned enterprises (Allen et al., 2003; Luo & Zhen, 2008). To what extent the mixed-ownership reform accelerates the accumulation of innovation capability and improves the innovation performance of the transformed POEs has not been investigated by the extant literature. This chapter aims to fill this gap by empirically examine the impact of mixed-ownership reform on *ex ante* POEs based on a propensity score matching and difference-in-difference (PSM-DID) identification strategy.

This chapter takes the A-share listed *private* companies in manufacturing industry from 2011 to 2017 as the research object. We manually collect the data of the top ten shareholders for each company and classify their types based on the nature of the equity. If the firm's top ten shareholders include one or more non-controlling state-owned ones, we classify the firm as mixed-ownership POEs. Therefore, we are able to divide the firms into a treatment group, including the *transformed* POEs (MixPOEs), and a control group, including the *untransformed* POEs (POEs), based on the structure of ownership. We then choose 2013 as the launch time of the reform policy, and the sample time span is divided into pre-reform and post-reform periods.

We adopt the DID approach to investigate the impact of mixed-ownership reform on the innovation capability of MixPOEs. To check the robustness of the results, we further employ PSM to select POEs that are similar to those in the treatment group (MixPOEs) to construct a new control group and then to perform the empirical analysis using DID. Furthermore, we investigate the heterogeneous impacts of mixed-ownership reform across two types of industries (i.e. monopoly and competitive) and across regions (i.e. eastern and non-eastern).

Our empirical results indicate that mixed-ownership reform (i.e. injection of state-owned equity) improves the innovation input (proxied by R&D intensity) of *ex ante* fully private-owned enterprises as long as the state-owned capital effectively cooperate with the private capital and the transfer of control is avoided. However, the innovation output (proxied by number of patents) seems not affected by the reform. We also find that the positive impact on R&D intensity is significant for firms in monopoly industries or in eastern regions.

Our study contributes to the existing literature in the following ways: first, this chapter is one of the few empirical studies that analyzes a big representative sample of firms and examines the impact of mixed-ownership on POEs' innovative capability. Our findings enrich the extant literature on enterprise innovation from the view of ownership restructure of private-owned enterprise while previous empirical literatures majorly focus on the impact of ownership reform on SOEs. Second, by studying the heterogeneous impact of mixed-ownership reform across industries and regions, the findings may provide some references to policy makers to show the boundary conditions of the reform (i.e. whether the reform is more effective in monopoly industries or competitive industries; whether the reform is more effective in eastern regions or non-eastern regions).

The remainder of the chapter is structured as follows. In Sect. 2, we briefly introduce mixed-ownership reform and the current state of POEs' innovation performance. Relevant literature is reviewed to develop testable hypotheses. Section 3 describes the data, variables and the empirical methodology. The results are then presented in Sect. 4. Finally, we conclude the chapter and discuss the implications in Sect. 5.

2 Literature Review

2.1 China's Mixed-Ownership Reform

The strategy of ownership restructuring towards a mixed one has been the core of the reform of state-owned enterprises in China. The third Plenary session of the 18th Central Committee of the CPC held in November 2013 explicitly proposed the strategy of developing a mixed-ownership economy which aimed to promote the operational efficiency of SOEs through ownership reform (Zhang et al., 2020). The execution of the reform has evolved over time based on trials and errors (Shao et al., 2019). Private-owned enterprises (POEs) gradually became the focus of the reform as

the State encourages state-owned equity to become the shareholders of non-SOEs in various forms while advocating POEs to actively participate in the mixed-ownership economy. The policies related to POEs in the mixed ownership reform are shown in Table 1.

Table 1 The policies related to private-owned enterprises in the mixed-ownership reform

Date	Events	Policies and guidelines
1993	The 3rd Plenary Session of the 14th CPC Central Committee	This is the first time that the term “mixed ownership economy” has been introduced, which illustrates the inevitable trend of the development of a mixed ownership economy characterized by a shareholding system under market economy conditions
2007	The 17th National Congress	Emphasize that a mixed ownership economy is an important form of realization of the basic economic system
2013	The 3rd Plenary Session of the 18th CPC Central Committee	The development of a mixed-ownership economy is explicitly proposed, with active development of a mixed-ownership economy, cross-ownership and cross-integration of non-public capital, state-owned capital and collective capital
2015	The state council	Article 18 of the Guidance Opinions of the Central Committee of the Communist Party of China and the State Council on Deepening the Reform of State-owned Enterprises clearly states that state-owned capital is encouraged to take stakes in non-state-owned enterprises in various ways, giving full play to the capital operation platform of state-owned capital investment and operation companies and making equity investments in non-state-owned enterprises with high development potential and strong growth
2019	The state council	Released of Central Government Document NO. 1 to support private sector reform
2020	The General office of the Central Committee of CPC	Issuing opinions to motivate POEs to participate in mixed-ownership reform and encourage private economic entities to implement the innovation-driven development strategy

2.2 The Impact of Mixed-Ownership Reform on Private-Owned Enterprises

Due to the underdeveloped financial market, private-owned enterprises in transition economies have always been challenged by the difficulties of obtaining financial resources. Johnson et al. (2002) argues that POEs in transition economies become increasingly dependent on external finance as the scale of their investment increases. However, China's financing system has always been characterized by government-oriented indirect financing. Loans from commercial banks are the main form of indirect financing. The underdeveloped financial system and the information asymmetry have made it difficult for POEs to obtain bank loans (Allen et al., 2003; Luo & Zhen, 2008).

Grounded on this, and based on the resource-based view, some scholars argue that the relationship with government may serve as a scarce resource for POEs to obtain concessions or privileges from the government and banks (Khanna & Palepu, 2000). Using Chinese A-share listed POEs over the period 2004–2010, Song et al. (2014) show that MixPOEs (the ones with state-owned equity) have greater access to bank credit facilities than fully POEs that do not contain state-owned equity. They also emphasize the importance of non-controlling state equity in alleviating financing constraints in private firms. In the same vein, Xiao et al. (2013) found that the resource effect of state equity eased the external financing constraints of MixPOEs and increased their sources of funding. Lin and Li (2014) point out that state equity, as a form of direct political connection, may partially eliminate the financial discrimination against POEs, and allow MixPOEs to enjoy lower interest rates on loans. They further elaborate the reason behind is that state-owned shareholders signal the government support of the enterprise, that is that the government recognizes the strength of the enterprises. This reputational mechanism helps MixPOEs gain access to additional development opportunities and financial resources.

Moreover, another stream of literature disentangles the relationship between mixed-ownership reform and innovation capabilities of private-owned enterprises. Zhang et al. (2020) find that mixed-ownership reform significantly improves the R&D investment and the number of patents for SOEs, based on a sample of A-share listed firms in China in the period 2011–2015. Using the number of invention patent applications to measure the innovative capability of SOEs and non-SOEs, Tan et al. (2015) examines China's split share structure reform through DID approach and finds that privatization has a positive effect on SOE's innovation.

In summary, based on the resource-based view and aforementioned empirical studies, we can argue that the underlying mechanisms on how mixed-ownership reform impact on private-owned enterprises are likely through ownership (re)structure and political connections which ease POEs' financial constraints, and this may further offer the rationale on the impact of mixed-ownership reform on innovation capability of POEs in the extant literature.

2.2.1 Ownership Structure: Single vs. Mixed-Ownership Types

Ownership is one of the most important factors affecting firm's innovation capability. This is because ownership may affect firm's incentives to pursue innovation and efficiency on transforming innovation inputs into outputs, on the one hand. On the other hand, ownership structure and the associated institutional environment may ease or constraint firms' access to useful information (e.g. policy) and scarce resources (Zhou et al., 2017). Drawing on agency theory and the resource dependence perspective, we may argue that firm's ownership structure affects innovation capability. Empirical evidences have shown how different types of ownership can affect innovation capability of a firm. For instance, Jiang et al. (2013) show that foreign-owned enterprises (FOEs) are with the strongest innovation capability while SOEs are less innovative than all other types of enterprises due to bureaucratic and political constraints. Moreover, based on a sample of large, medium and small enterprises, Chi (2003) shows that the technological efficiency of enterprises is ranked from highest to lowest according to the types of ownership: FOEs, POEs, collective enterprises and SOEs. Zhang et al. (2020) empirically examines the innovation performance of A-share listed SOEs in manufacturing industry from 2011 to 2015, using POEs as a control group. They found that SOEs showed lower level of R&D expenditure and innovation output relative to POEs.

Most studies have focused on the impact of single ownership type on firm's innovation performance, while the little attention has been paid to investigate the relationship between mixed-ownership structures and firm innovation. Liu et al. (2015) investigate a sample of 1184 Chinese enterprises that experienced ownership transformation. Their find that both the mixed state-owned enterprises (MixSOEs) and the mixed private-owned enterprises (MixPOEs) show higher production efficiency than POEs and SOEs. Luong et al. (2017) examines the impact of foreign institutional investors on the financial performance and innovative capacity of investee firms over a 10-year period. They found that when foreign institutional ownership (FIO) is combined with domestic institutional ownership (DIO), FIO plays an active role in promoting the innovation of the company. Li and Yu (2015) study the impact of non-state-owned equity ratio on the innovative capability of privatized enterprises (i.e. not POEs, but enterprises whose share of state-owned capital decreased from 100% to less than 100%), and the results show that non-state-owned equity has a significant contribution to innovation activities of privatized enterprises. In other words, this result indicates that the mixed-ownership equity enhances the innovation ability of enterprises.

2.2.2 Political Relationship

Firms' innovation activities are characterized by high upfront investment, financial and knowledge resource-intensive, Knightian uncertainty and large proportion of knowledge assets (Dosi & Nelson, 2010). Due to the lack of connection with the government, POEs encounter more obstacles in terms of policy uncertainty and

financial constraints than SOEs (Lin & Li, 2001). Political relationship and the associated resource allocation may play a role on the innovative capability of POEs. Song et al. (2014) categorize the political association between private enterprises and the government into the implicit and the explicit types. The former one refers to entrepreneurs' participation in politics and form some invisible ties with government, while the latter points toward an explicit form of political connection, that is that private enterprises take up state-owned equity such as the mixed-ownership structure, which may serve as the hub between government and the POEs, and may contribute to the process of innovation capability accumulation of POEs via two mechanisms.

First, political connections may channel various key resources to POEs for carrying out innovation activities (i.e. financial resource, knowledge resources, human capital resources). It may effectively alleviate the external financial constraints, eliminate the financing discrimination, and ultimately allocate more financial resources to POEs (Li & Zhang, 2007; Lin & Li, 2001; Xiao et al., 2013). POEs may get access to more government subsidies by linking with the government through absorbing state-owned equity (Yu et al., 2010). The POEs with government 'background' may quickly find more technologically advanced partners and gain more opportunities for R&D collaboration (Cassiman & Veugelers, 2006). Talent is a fundamental guarantee for corporate innovation and the signaling effect of political affiliation can help companies attract more talents. It also effectively reduces the burden of outsiders entering the market and the burden of late entrants (Cui & Jiang, 2012; Pan et al., 2014).

Second, the resource effect of political connections could effectively mitigate the uncertainty caused by information asymmetry and weak protection of property rights.

By better grasping the orientation of national or regional economic policy, POEs can overcome policy uncertainty and reduce the probability of innovation failure due to wrong direction of R&D investment (Ang & Boyer, 2006). The introduction of state-owned equity ties the interests of the government and private enterprises together, effectively compensating for the innovation constraints imposed on enterprises by weak property rights protection (Leuz & Oberholzergee, 2006).

Based on the discussion in Sects. 2.2.1 and 2.2.2, we thus propose the following:

Hypothesis 1 The mixed-ownership reform has a positive impact on the innovation performance of MixPOEs.

2.3 Institutional Environment

In addition to the direct relationship that we proposed in the Hypothesis 1, we further argue that external institutional environment, including the protection of intellectual property rights, the ease of access to external funding, regional factors and the competitiveness of industries, might also shape the innovation activities of MixPOEs.

2.3.1 Competitiveness of Industries: Monopoly vs. Competitive Industry

Whether an enterprise operates in a monopoly or competitive industry may affect the innovation activities. Mixed-ownership reform policies have encountered the dilemma: on the one hand, the reform aims to maintain the dominant position of public ownership. On the other hand, the reform is introduced to address the institutional rigidity of state-owned enterprises by assimilating private capital. To resolve the dilemma, the policy solution seems to carry out reforms in competitive industries to allow private enterprises to participate and dominate the governance of state-owned enterprises, but to ensure absolute government control of state-owned enterprises in monopolistic industries (Zhang et al., 2020). Some literatures suggest that mixed-ownership reforms in monopoly industries are more efficient, because enterprises in monopoly industries are subject to strong government constraints, which can free up more room for reform effects (Chen & Tang, 2014). While other literatures posit that firms operate in monopoly industries lack incentives for technological innovation due to excessive policy controls, and as a consequence ownership reforms result in lower efficiency gains for firms operate in monopolistic industries than competitive industries (Liu et al., 2016). Following these inconclusive discussions, we propose the following competing hypotheses:

Hypothesis 2 Compared to competitive industry, the mixed-ownership reform has a more significantly positive impact to the innovation capabilities of MixPOEs in monopoly industry.

Hypothesis 3 Compared to monopoly industry, the mixed-ownership reform has a more significantly positive impact to the innovation capabilities of MixPOEs in competitive industry.

2.3.2 Regional Factors

The regional factors also play important roles on the innovation activity of enterprises (Audretsch & Feldman, 1996; Tan et al., 2017). The clustering of innovation activities not only leads to regional differences in innovation output and investment activities, but also creates technology spillovers affecting R&D activities in the region and surrounding areas (Song & Zhang, 2017). Shang et al. (2012) show that regional knowledge spillovers positively affect economic growth and innovation through a spatial regressive model. Zhao and Liu (2016) study the influence of the degree of regional economic development on the innovation efficiency of enterprises and find that higher levels of macroeconomic development can promote innovation efficiency. Jia and Tian (2018) use a panel data to examine the influence of regional industry structure on regional innovation activity, showing that firms conducted innovation activities with greater intensity and density in China's coastal provinces.

Moreover, firms in regions with strong property rights protection are more willing to invest into innovation and undertake innovative activities. Based on the World Bank data, Jiao et al. (2015) study the correlation between the legal environment, the effectiveness of government governance and corporate innovation. They find that a better legal environment, a more efficient local government governance improves firm's ability to innovate. Liu and Zhang (2016) investigate the impact of mixed-ownership reform on the productivity of SOEs and find that the degree of protection of intellectual property rights is significantly and positively related to the effect of participation in mixed ownership reforms by SOEs in competitive industries. Given the fact that the coastal and eastern regions in China are advanced in economic development compared to those regions in land and in the west, we therefore propose the following:

Hypothesis 4 Compared with non-eastern regions, the mixed-ownership reform has a more significantly positive impact on the innovation performance in eastern regions.

3 Data and Methodology

This section describes the sample, variables, and the identification strategy. We first introduce how the sample of firms under our investigation are selected, and then describe the variables included in the model. Together, we explain how the treatment and the control groups are constructed. Next, the baseline DID and PSM-DID identification strategies are explained. Finally, we present the descriptive statistics.

3.1 Data and Sample Firms

To empirically assert the impact of mixed-ownership reform on *ex ante* POEs, we use a panel of Chinese A-share listed private companies covering the period from 2011 to 2017 collected from CSMAR Private Listed Companies database. And we only include firms in the manufacturing industry in our analysis, because that innovation activities play a more important role in manufacturing than in other sectors.¹ In order to ensure the completeness and credibility of the data, this paper draws on the literature and treats the database as follows. We first exclude the state-owned listed companies that have been restructured into private enterprises through equity transfer. We then exclude the enterprises whose actual controller type is state-controlled, employee shareholding association or union, foreign-invested, Hong Kong, Macao and Taiwan-invested, public shareholding and others. Only the enterprises with natural person or family as effective controller are kept ensuring that the sample

¹ Zhang et al. (2020) study the effect of mixed-ownership reform on the innovation capability of SOEs in manufacturing.

enterprises under our investigation are private-owned. The ST and *ST companies are excluded to avoid the outliers. Firms with incomplete data or outliers are also removed. Finally, we reached a balanced panel data that contain 292 private listed companies (including 112 MixPOEs and 180 POEs) and 2044 firm-year observations.

3.2 Variables

3.2.1 Innovation Performance

This paper uses both innovation input and output measures to comprehensively examine the impact of mixed-ownership reform on the innovation performance of MixPOEs. R&D intensity, as an indicator of innovation input, is the ratio of R&D expenditure to sales (R&D expense/SALES). The number of patents is our measure of innovation output. Patents can be classified into three types based on China's patent law, that are invention, utility model, and design patents. Invention patents are the most innovative ones, which are granted for new technological solutions concerning processes and products (Tan et al., 2015). As utility model and design patents are granted for limited technological advances, we combine these two types. Therefore, we adopt three indicators, the total number of patents (Patent), the number of invention patents (Patent1) and the number of utility model and design patents (Patent23), to measure firm's innovation output. Notice that the number of patents can be measured in three ways: patent applications, patent grants and patent disclosures (Zhou et al., 2014). The number of patents granted is subject to a high degree of uncertainty due to factors such as audit time, while the number of patent disclosures is affected by the subjective willingness of enterprises to disclose. Therefore, this paper adopts the number of patent applications to measure innovation output. Patent data are collected from CSMAR and SIPO database.

3.2.2 Classify Mixed Ownership Private-Owned Enterprises (MixPOEs) and Fully Private-Owned Enterprises (POEs)

The mixed ownership status of an enterprise is not formally defined by policies.² The policies do not provide a quantitative explanation that to what extent POEs assimilate state capital can be considered as mixed ownership private-owned enterprises (MixPOEs). In Shao et al. (2019), MixPOEs are defined as the type of private-owned enterprises of which the top ten shareholders include non-controlling state-owned

² The policy announced at the 3rd Plenary Session of the 18th CPC Central Committee, *The Decision of the Central Committee of the CPC on Several Major Issues of Comprehensively Deepening Reform*, clearly states that "deepening mixed ownership reform requires actively developing a mixed-ownership economy, and also encouraging state-owned capital to enter non-state-owned enterprises in a variety of ways".

ones. This paper uses the same approach to define MixPOEs (see details in the Appendix).

Since we adopt a difference-in-difference strategy in the latter analysis. The *ex-ante* fully private-owned enterprises that have been transformed into MixPOEs during the mixed-ownership reform are classified as treatment group. Fully private-owned enterprises (POEs), of which the top ten shareholders neither contain state-owned ones nor include any state-owned capital participation, that have not been transformed into MixPOEs, are treated as the control group. The treatment and control groups are distinguished using a dummy in the regression analysis (treatment group = 1 and control group = 0).

3.2.3 Mixed-Ownership Reform

Since the Third Plenary Session of the 18th CPC Central Committee explicitly announced that “developing mixed ownership economy, promoting state-owned capital, collective capital and private capital cross-shareholding, and ultimately achieving mutual confluence is fundamental to the economic system”, this paper uses this event (November 2013) to distinguish the pre-reform period (2011–2013) and the post reform period (2014–2017) (also see Zhang et al., [2020]). A dummy is defined to capture the reform occurred among the treated enterprises: equals 0 for the pre-reform period 2011–2013 and equals 1 for the post-reform period 2014–2017.

3.2.4 Control Variables

To control the impact of other relevant factors on the innovation performance of enterprises and consistent with the literature (Liu et al., 2016; Zhang et al., 2003, 2020), we include firm’s financial leverage, profitability, growth, size, age, current assets, liquidity and market to book ratio. We also control the industry heterogeneity (i.e. high-tech and non-high-tech industries).³ The definitions and the source of the main variables are summarized in Table 8 in the Appendix.

³ Based on Cheng and Liu (2014) and Ren (2010), we classify ten sectors in the manufacturing industry as high-tech: equipment manufacturing and electrical machinery; instrumentation and cultural office machinery; electronics and communication equipment; transportation equipment; general machinery; special; pharmaceutical; chemical product and raw materials; plastic manufacturing and metal manufacturing. The rest of the sectors are classified as non-high-tech.

3.3 Model Design

3.3.1 Difference-In-Difference

This paper investigates the effect of mixed-ownership reform on the innovation performance of MixPOEs. In our research setting, we treat the mixed-ownership reform as a quasi-experiment. The effect of the reform can be estimated by comparing the post reform innovation performance between the treated group and the control group (i.e., these two groups share similar characteristics before the reform by construction). Note that, the naïve comparison between private-owned enterprises participating in the reform and those not participating leads to biased results. There might be two sources of selection bias. First, state-owned capital prioritizes private enterprises with high operating efficiency and strong innovation capability in the reform (Megginson & Netter, 2001), and this is also confirmed in Article 18 of the Guidelines.⁴ Second, empirical evidences show that private enterprises that attach importance to innovation and R&D are more willing to attract state capital to participate in their production and operation (Sapra et al., 2011; Yu et al., 2012). Because those private enterprises may partially alleviate financing and policy discrimination, and mitigate the uncertainty associated with innovation investments by establishing political connection (Xiao et al., 2013). Therefore, the POEs that participate in mixed-ownership reform may not be randomly selected and this may lead to sample selection bias. Other unobserved heterogeneity of the firms which are correlated with participating in mixed-ownership reform may also lead to selection bias.

This paper first estimates the policy effect on MixPOEs by using a difference-in-difference (DID) approach as a baseline estimation, as described by Eqs. (1) to (4)

$$\begin{aligned} \Delta Y' - \Delta Y = & [E(Y|MixPOE = 1, Post = 1) - E(Y|MixPOE = 0, Post = 1)] \\ & - [E(Y|MixPOE = 1, Post = 0) - E(Y|MixPOE = 0, Post = 0)] \quad (1) \end{aligned}$$

where Y is one of the various measures of firm's innovation performance; $MixPOE$ categorizes the treated firms ($MixPOE = 1$) and the non-treated ones ($MixPOE = 0$); $Post$ is a time dummy that distinguishes the post reform years ($Post = 1$) and the pre-reform period ($Post = 0$). By comparing the pre and post reform changes of the outcome variable (Y) between the treatment and control groups, we get the net effect of the policy. The DID framework is usually implemented as a regression model of the form (Rong et al., 2016; Zhang et al., 2020; Zhou et al., 2021):

$$Y_{i,t} = \beta_0 + \beta_1 MixPOE_i + \beta_2 Post_t + \gamma (MixPOE_i \cdot Post_t) + aX_{i,t} + \varepsilon_{i,t} \quad (2)$$

⁴ Article 18 of the Guidance Opinions of the Central Committee of the Communist Party of China and the State Council on Deepening the Reform of State-owned Enterprises clearly states that state-owned capital is encouraged to inject funds into non-SOEs by various means, and to conduct equity investments in non-SOEs with high development potential and strong growth potential.

where $Y_{i,t}$ denotes one of the input or output measures of innovation (R&D intensity, number of total patent applications, number of invention patent applications, and number of design and utility patent applications) of firm i in year t ⁵; $MixPOE_i$ is a dummy distinguishing whether firm i has transformed its ownership, that equals 1 if ex ante POEs transformed into non-controlling state mixed-ownership type, 0 otherwise; $Post_t$ is a year dummy that equals 1 for the post reform period (2014–2017); $X_{i,t}$ represents a set of control variables, including profitability (ROE), the ratio of debt and total asset (Leverage), (log-) firm total assets (Size), firm growth (SalesGrowth), firm age (Age), (log-) the number of employees (Labor), market-to-book ratio (MB) and ratio of liquidity asset and total asset (Liquidity) and industry dummies; $varepsilon_{i,t}$ is an error term. The coefficient of the interaction term γ is the main parameter of our interest, capturing the net policy effect. A positive and statistically significant estimate indicates that mixed ownership reform leads to an increase in innovation input and output measures. We further control firm-fixed effect (λ_i) and year effect (σ_t):

$$Y_{i,t} = \beta_0 + \beta_1 MixPOE_i + \beta_2 Post_t + \gamma(MixPOE_i \cdot Post_t) + aX_{i,t} + \lambda_i + \sigma_t + \varepsilon_{i,t} \quad (3)$$

Because of the collinearity problem between $MixPOE_i$ and firm-fixed effect (λ_i) and between $Post_t$ and year effect (σ_t), we turn to estimate

$$Y_{i,t} = \beta_0 + \gamma(MixPOE_i \cdot Post_t) + aX_{i,t} + \lambda_i + \sigma_t + \varepsilon_{i,t} \quad (4)$$

3.3.2 Propensity Score Matching (PSM) and DID

To deal with sample selection bias, we further adopt Propensity Score Matching (PSM) to construct a new control group that shares similar characteristics with the treatment group, and then estimate the effect of reform based on DID. We adopt a Logit regression to estimate the probability of a firm to participate in the mixed-ownership reform (i.e. the propensity scores), conditional on a set of observable characteristics (including leverage, ROE, size, sales growth, industry) that may affect participation in the reform (Lu & Shi, 2012; Tan et al, 2015).⁶ Firms in the treatment group are then matched with non-treated firms with similar propensity scores, based on the non-replacement one-to-one nearest neighbor matching algorithm. The PSM matched sample include 178 firms (89 MixPOEs and 89 POEs).

⁵ We take $\log(\text{Patent} + 1)$, $\log(\text{Patent1} + 1)$ and $\log(\text{Patent23} + 1)$ as the dependent variable in the regression.

⁶ Only the 2013 data is used to calculate the propensity score and construct the control group. 112 firms are characterized as MixPOEs and 180 firms are considered as POEs in 2013.

Table 2 Descriptive statistics of variables (Full sample)

	(1)	(2)	(3)	(4)	(5)
VARIABLES	N	Mean	SD	Min	Max
R&D intensity	2,044	0.046	0.036	0	0.763
Patent	2,044	61.88	109.9	0	1,561
PatentI	2,044	23.68	42.62	0	659
Patent23	2,044	38.14	78.80	0	1,354
MixPOE	2,044	0.384	0.486	0	1
Salegrowth	2,044	0.188	0.462	-0.801	11.28
Labor	2,044	7.675	0.938	3.258	11.18
Liquidity	2,044	0.592	0.153	0.113	0.930
Size	2,044	21.86	0.915	19.20	25.43
Leverage	2,044	0.360	0.177	0.012	0.984
ROE	2,044	0.070	0.075	-0.620	0.400
Age	2,044	2.978	0.225	2.565	4.996
MB	2,043	0.038	0.093	0.004	4.052
Industry	2,044	0.863	0.344	0	1

3.4 Descriptive Statistics

Table 2 illustrates the descriptive statistics of the full sample.⁷ The mean value of R&D intensity is 4.6%, with some firms showing a very high R&D intensity around 7.6% while some not investing in R&D activities. Firms on average display 62 patent applications, among which 38% is attributed to invention patent applications while 62% is accounted for by utility model and design patent applications. 38.4% of firm-year observations in the sample is characterized as MixPOEs. The average ROE is around 7% and the sales growth is around 18.8%.

We further investigate whether MixPOEs and POEs show different attributes (see Table 3). The R&D intensity and number of patent applications of MixPOEs are significantly higher than that of POEs. MixPOEs show higher profitability and asset liquidity, bigger assets and the number of employees. Interestingly, MixPOEs display higher debt-to-asset ratio (leverage) than POEs. This might be because the state-owned equity in MixPOEs (as a bridge linking the firm and financial institutions) alleviates credit discrimination from financial institutions due to information asymmetry, and enables MixPOEs to access more credit and financing convenience (Li et al., 2021).

⁷ To eliminate the possible empirical errors arising from outliers, all non-dummy variables are winsorized at the 1st and 99th percentiles.

Table 3 Compare the attributes between MixPOEs and POEs

	(1)	(2)	(3)	(4)
VARIABLES	MixPOEs Mean	POEs Mean	Difference	t-test
R&D intensity	0.051	0.042	0.010***	5.8633
Patent	102.610	36.540	66.070***	13.8188
Patent1	38.063	14.729	23.333***	12.4820
Patent23	64.381	21.808	42.573 ***	12.3067
Leverage	0.390	0.340	0.050***	6.2970
SalesGrowth	0.200	0 0.181	0.018	0.8801
ROE	0.085	0.060	0.025***	7.5183
Liquidity	0.604	0.585	0.019***	2.6855
Labor	8.049	7.442	0.608***	15.0065
Size	22.198	21.645	0.553***	13.8857

Note Two-sample t-test of the mean of variable ***significance level $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

4 Results and Discussions

This section shows the regression results of DID baseline model, PSM-DID model and sub-sample analysis by industries and by regions.

4.1 Results of DID Estimation

The results of the baseline DID regression (model 3–2 and 3–4) are shown in Table 4. The coefficient estimates of the interaction term (MixPOE*Post) in columns (1) and (2) are significantly positive (especially in column 2 when controlling firm-fixed effects), indicating that the mixed-ownership reform has improved the innovation investment activities (R&D) of MixPOEs. Transforming POEs into MixPOEs is associated with 0.5% increase in R&D intensity. However, the coefficient estimates of the interaction (MixPOE*Post) are not significant in columns (3)–(8), meaning that the reform does not display a significant impact on increasing the number of patent applications of MixPOEs. The coefficient estimates of the treatment dummy (MixPOE) are significantly positive in all the models, meaning that conditional on various firm attributes the treated firms show significantly higher R&D intensity and higher number of patents than non-treated firms.

Table 4 The impact of mixed ownership reform on the innovation performance of MixPOEs (DID estimation)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	R&D intensity	log(Patent + 1)	log(Patent + 1)	log(Patent1 + 1)	log(Patent1 + 1)	log(Patent23 + 1)	log(Patent23 + 1)
MixPOE	0.007 (0.003) ^{***}	0.523 (0.099) ^{***}		0.483 (0.107) ^{***}		0.408 (0.120) ^{***}	
Post	0.003 (0.002) [*]	0.199 (0.058) ^{***}		0.200 (0.064) ^{***}		0.160 (0.066) ^{**}	
MixPOE*Post	0.005 (0.003) [*]	-0.090 (0.070)	-0.088 (0.068)	-0.075 (0.082)	-0.063 (0.081)	-0.017 (0.080)	-0.030 (0.078)
Leverage	-0.029 (0.012) ^{**}	0.091 (0.226)	-0.138 (0.257)	0.008 (0.260)	-0.319 (0.274)	0.358 (0.273)	0.177 (0.266)
ROE	-0.020 (0.016)	1.110 (0.421) ^{***}	0.147 (0.373)	1.022 (0.468) ^{**}	0.321 (0.401)	0.949 (0.479) ^{**}	-0.089 (0.366)
SalesGrowth	-0.004 (0.003)	-0.007 (0.004) [*]	-0.038 (0.039)	0.118 (0.053) ^{**}	-0.061 (0.035) [*]	-0.029 (0.051)	-0.032 (0.045)
Lias	-0.008 (0.009)	-0.008 (0.008)	0.099 (0.229)	-0.198 (0.294)	-0.062 (0.265)	-0.238 (0.273)	0.156 (0.261)
MB	0.021 (0.012) [*]	0 (0.005)	-0.310 (0.119)	-0.075 (0.173)	-0.114 (0.143)	-0.278 (0.223)	-0.437 (0.116) ^{***}
Labor	-0.006 (0.003) ^{**}	-0.002 (0.003)	0.202 (0.076) ^{***}	0.306 (0.071) ^{***}	0.140 (0.085) [*]	0.440 (0.074) ^{***}	0.230 (0.085) ^{***}
Size	0.004 (0.003)	0.003 (0.005)	0.440 (0.076) ^{***}	0.386 (0.076) ^{***}	0.505 (0.098) ^{***}	0.183 (0.078) ^{**}	0.367 (0.082) ^{***}
Age	-0.003 (0.007)	0.005 (0.001) ^{****}	0.160 (0.031) ^{***}	0.399 (0.195) ^{**}	-0.071 (0.035) ^{**}	0.339 (0.228)	0.280 (0.035) ^{***}
Regional dummies	Yes	Dropped	Dropped	Yes	Dropped	Yes	Dropped
Sectoral dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies		Yes	Yes	Yes	Yes	Yes	Yes
Firm-fixed effect		Yes	Yes	Yes	Yes	Yes	Yes
# of obs	2044	2044	2044	2044	2044	2044	2044
R ₂	0.2439	0.5230	0.7871	0.4420	0.7434	0.5397	0.8044

Note Regression results of the full sample using DID. Columns 1, 3, 5 and 7 show coefficient estimates based on model 3-2. Columns 2, 4, 6 and 8 show coefficient estimates based on model 3-4. Robust standard errors are in brackets. ***Significance level $p < 0.01$, **Significance level $p < 0.05$, *Significance level $p < 0.1$

4.2 Results of PSM-DID Estimation

We re-estimate model 3–2 and 3–4 using the propensity score matched sample, and the regression results are shown in Table 5. The coefficient estimates of the interaction (MixPOE*Post) are positive and significant in columns (1) and (2), which confirms the previous finding that the mixed-ownership reform increases the R&D intensity of MixPOEs. Transforming into MixPOEs increases the R&D intensity of *ex ante* POEs by 0.8%. The coefficient estimates of the interaction are *not* significant if we look at the number of patents, meaning that mixed-ownership reform does not have any significant impact on the number of patents (i.e. a proxy of innovation output) of MixPOEs. Therefore, our results from Tables 4 and 5 partially support Hypothesis 1, that is, mixed-ownership reform has contributed significantly and positively to the innovation input of POEs. This is consistent with our overarching theoretical framework based on the resource-based view, that is that the mixed-ownership can fuel in political resources to the POEs which might ease their financial constraints. This might result more investment into innovation while achieving innovation output is more associated with firms' own capabilities in transforming innovation input to output.

4.3 The Heterogenous Impact of Mixed-Ownership Reform

Protectionism in monopolistic industries and widely varying regional levels of economic development may lead to different reform effects across industries and regions (Zhang et al., 2020). Tables 6 and 7 reports the PSM-DID results by industries (monopoly versus competitive) and by regions (eastern and non-eastern).

11 sub-sectors in manufacturing are classified as monopoly industries while the others are considered as competitive ones (Chen & Tang, 2014).⁸ The regression results are shown in Table 6. The coefficient estimates of the interaction term is significantly positive in column 2 while it is not significant in column 1. The results indicate that mixed-ownership reform significantly increases the R&D intensity of firms in monopolistic industries by 0.9% while it does not display any significant impact on firms in competitive industries.

⁸ (1) oil processing and coking and nuclear fuel processing industry, (2) chemical raw materials and chemical products manufacturing, (3) pharmaceutical manufacturing, (4) chemical fibres, (5) rubber products, (6) ferrous metal smelting and rolling industry, (7) non-ferrous metal smelting, (8) general equipment manufacturing, (9) special equipment manufacturing, (10) transportation equipment manufacturing and (11) communication equipment, computer and other electronic equipment manufacturing.

Table 5 The impact of mixed ownership reform on the innovation performance of MixPOEs (PSM-DID estimation)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
R&D intensity	R&D intensity	log(Patent + 1)	log(Patent + 1)	log(Patent + 1)	log(Patent + 1)	log(Patent + 1)	log(Patent + 1)
0.003 (0.003)		0.397 (0.123) ^{***}		0.385 (0.136) ^{***}		0.299 (0.144) ^{**}	
0.002 (0.002)		0.215 (0.077) ^{***}		0.200 (0.084) ^{**}		0.187 (0.091) ^{**}	
0.008 (0.003) ^{**}	0.008 (0.003) ^{**}	-0.060 (0.089)	-0.063 (0.084)	-0.032 (0.104)	-0.027 (0.102)	-0.029 (0.103)	-0.046 (0.098)
-0.041 (0.011) ^{***}	0.011 (0.012)	0.178 (0.298)	-0.017 (0.358)	0.031 (0.360)	-0.249 (0.341)	0.480 (0.341)	0.331 (0.390)
-0.058 (0.019) ^{***}	-0.053 (0.022) ^{**}	0.686 (0.420)	-0.083 (0.514)	0.469 (0.520)	0.090 (0.536)	0.678 (0.419)	-0.364 (0.504)
-0.003 (0.002)	-0.003 (0.002) [*]	-0.073 (0.045)	-0.027 (0.045)	-0.128 (0.048) ^{***}	-0.032 (0.037)	-0.043 (0.057)	-0.030 (0.056)
0.004 (0.012)	0.003 (0.008)	0.050 (0.323)	0.254 (0.293)	-0.107 (0.398)	0.281 (0.332)	-0.184 (0.346)	0.092 (0.357)
0.101 (0.050) ^{**}	-0.020 (0.035)	2.123 (1.800)	0.582 (1.989)	1.589 (2.041)	0.127 (1.700)	2.580 (2.049)	1.015 (2.183)
-0.004 (0.003)	-0.001 (0.003)	0.519 (0.071) ^{***}	0.258 (0.082) ^{***}	0.437 (0.091) ^{***}	0.248 (0.102) ^{**}	0.574 (0.083) ^{***}	0.272 (0.104) ^{**}
0.003 (0.003)	-0.002 (0.003)	0.151 (0.084) [*]	0.431 (0.089) ^{***}	0.251 (0.104) ^{**}	0.404 (0.115) ^{***}	0.043 (0.095)	0.441 (0.106) ^{***}
0.008 (0.007)	0.006 (0.001) ^{***}	0.326 (0.218)	0.175 (0.046) ^{***}	0.309 (0.245)	-0.077 (0.050)	0.169 (0.265)	0.312 (0.052) ^{***}
Regional dummies	dropped	yes	dropped	yes	dropped	yes	dropped
Sectoral dummy	yes	yes	yes	yes	yes	yes	yes
Year dummies	yes		yes		yes		yes
Firm-fixed effect	yes		yes		yes		yes
# of obs	1246	1246	1246	1246	1246	1246	1246
R ₂	0.7680	0.5507	0.7873	0.4338	0.7480	0.5863	0.8051

Note Regression results of the matched sample using PSM-DID. Columns 1, 3, 5 and 7 show coefficient estimates based on model 3-2. Columns 2, 4, 6 and 8 show coefficient estimates based on model 3-4. Robust standard errors are in brackets. ^{***} $p < 0.01$, ^{**} $p < 0.05$, ^{*} $p < 0.1$

Table 6 The heterogeneous impact of mixed-ownership reform in monopoly industries versus competitive industries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	R&D intensity	R&D intensity	log(Patent + 1)	log(Patent + 1)	log(Patent + 1)	log(Patent1 + 1)	log(Patent23 + 1)	log(Patent23 + 1)
	Competitive	Monopoly	Competitive	Monopoly	Competitive	Monopoly	Competitive	Monopoly
MixPOE*Post	0.002 (0.005)	0.009 (0.003) ^{***}	0.283 (0.236)	-0.092 (0.089)	0.294 (0.299)	-0.041 (0.107)	0.127 (0.262)	-0.075 (0.105)
Leverage	-0.013 (0.021)	0.020 (0.014)	1.077 (1.275)	-0.032 (0.373)	0.408 (1.061)	-0.253 (0.357)	1.299 (1.357)	0.422 (0.423)
ROE	-0.013 (0.022)	-0.068 (0.024) ^{***}	-1.171 (0.949)	0.034 (0.569)	-0.918 (0.860)	0.167 (0.592)	-0.396 (1.104)	-0.427 (0.586)
SalesGrowth	-0.001 (0.001)	-0.004 (0.003)	0.067 (0.136)	0.009 (0.044)	0.245 (0.119) [*]	-0.016 (0.040)	-0.011 (0.145)	0.006 (0.055)
Ltas	-0.003 (0.013)	0.007 (0.010)	-1.221 (1.187)	0.458 (0.332)	-1.054 (1.012)	0.548 (0.352)	-1.743 (1.337)	0.310 (0.422)
MB	-0.118 (0.066) [*]	-0.012 (0.038)	-1.852 (4.062)	0.901 (2.167)	-10.468 (4.693) ^{**}	0.227 (1.850)	2.271 (4.777)	1.381 (2.392)
Labor	-0.003 (0.002)	-0.001 (0.003) ^{***}	0.134 (0.176)	0.325 (0.086) ^{***}	-0.166 (0.124)	0.305 (0.117) ^{**}	0.325 (0.247)	0.348 (0.115) ^{***}
Size	0.005 (0.006)	-0.003 (0.003)	-0.111 (0.409)	0.389 (0.094) ^{***}	0.491 (0.362)	0.338 (0.119) ^{***}	-0.429 (0.434)	0.416 (0.115) ^{***}
Age	Dropped	0.006 (0.001)	Dropped	0.163 (0.048) ^{***}	Dropped	-0.077 (0.053)	Dropped	0.303 (0.054) ^{***}
Regional dummies	Dropped	Dropped	Dropped	Dropped	Dropped	Dropped	Dropped	Dropped
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# of obs	112	1134	112	1134	112	1134	112	1134
R ²	0.9010	0.7572	0.8426	0.7789	0.8960	0.7199	0.8294	0.7984

Note Regression results of the matched sample using PSM-DID (model 3-4). Columns 1, 3, 5 and 7 are competitive industries. Columns 2, 4, 6 and 8 are monopoly industries. *** significance level $p < 0.01$, ** significance level $p < 0.05$, * significance level $p < 0.1$

Table 7 The heterogeneous impact of mixed-ownership reform in eastern versus non-eastern regions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	R&D intensity	R&D intensity	log(Patent + 1)	log(Patent + 1)	log(Patent + 1)	log(Patent1 + 1)	log(Patent23 + 1)	log(Patent23 + 1)
	Non-eastern	Eastern	Non-eastern	Eastern	Non-eastern	Eastern	Non-eastern	Eastern
MixPOE*Post	0.009 (0.006)	0.007 (0.003)**	-0.025 (0.176)	-0.081 (0.098)	-0.100 (0.210)	-0.010 (0.117)	0.166 (0.241)	-0.120(0.106)
Leverage	0.043 (0.021)*	-0.001 (0.014)	-0.586 (0.570)	0.120 (0.425)	-0.047 (0.493)	-0.378 (0.428)	0.245 (0.688)	0.263 (0.471)
ROE	-0.036 (0.023)	-0.062 (0.027)**	-0.924 (0.543)*	0.107 (0.629)	-1.267 (0.619)**	0.395 (0.664)	-0.689 (0.561)	-0.334 (0.633)
SalesGrowth	-0.001 (0.002)	-0.005 (0.003)*	-0.057 (0.046)	0.010 (0.067)	-0.083 (0.069)	0.018 (0.052)	-0.091 (0.051)*	0.013 (0.086)
Lias	-0.004 (0.019)	0.006 (0.008)	0.653 (0.505)	0.140 (0.357)	0.938 (0.734)	0.179 (0.376)	0.714 (0.598)	-0.163 (0.443)
MB	0.085 (0.080)	-0.037 (0.039)	7.743 (5.281)	-1.616 (1.910)	3.644 (3.750)	-0.863 (1.866)	6.466 (6.412)	-1.207 (2.069)
Labor	0.005 (0.004)	-0.003 (0.003)	0.389 (0.117)**	0.247 (0.113)**	0.514 (0.225)**	0.175 (0.099)*	0.342 (0.140)**	0.301 (0.133)**
Size	-0.009 (0.006)	0.000 (0.003)	0.479 (0.201)**	0.383 (0.103)**	0.362 (0.322)	0.413 (0.113)**	0.760 (0.214)**	0.334 (0.108)**
Age	Dropped	0.007 (0.001)**	Dropped	0.179 (0.054)**	Dropped	-0.074 (0.059)	Dropped	0.323 (0.063)**
Sectoral dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	yes
Firm-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# of obs	294	952	294	952	294	952	294	952
R ²	0.7883	0.7681	0.8278	0.7792	0.7702	0.7476	0.8433	0.7978

Note Regression results of the matched sample using PSM-DID (model 3-4). Columns 1, 3, 5 and 7 are non-eastern regions. Columns 2, 4, 6 and 8 are eastern regions. ***, ** significance level $p < 0.01$. *, ** significance level $p < 0.05$. * significance level $p < 0.1$

Therefore, our empirical results partially support Hypothesis 2 that mixed-ownership reform has a more significant contribution to the innovation capabilities of MixPOEs in monopoly industry compared to competitive industry while Hypothesis 3 is not supported. Our finding thus supports the view that mixed-ownership reforms in monopoly industries are more efficient as strong government constraints in monopoly industries can free up more room for firms to achieve reform effects (Chen & Tang, 2014).

Furthermore, we categorize firms into eastern and non-eastern regions based on their locations⁹ and replicate the PSM-DID estimation by regions (see Table 7). We find that mixed-ownership reform significantly increases the R&D intensity of firms located in eastern regions (see column 2 in Table 7), while it does not display any impact on firms located in non-eastern regions.

Therefore, our empirical results partially support Hypothesis 4. Compared with non-eastern regions, mixed-ownership reform has a more significant impact on the innovation investment (R&D intensity) in eastern regions. We argue that eastern regions are relatively more developed, with more advanced technologies (for example, knowledge spillovers from foreign-invested enterprises or from universities) and from the cluster of talents (due to favorable talent attraction policies). Conditional on the innovation-favoring regional environment, POEs in the eastern regions are more likely to conduct innovation activities and the transformed POEs may get access to more resources in R&D. On the contrary, mixed-ownership reform has limited role on increasing the innovation input of POEs in non-eastern regions.

5 Concluding Remarks

While China's mixed-ownership reform advocates non-state-owned capital to participate in the restructuring and operation of state-owned enterprises, it also encourages state-owned capital to take shares of non-state-owned enterprises. The extent empirical literature has focused on investigating the impact of the reform on SOEs. However, little is known about the impact of the mixed-ownership reform on the innovation performance of *ex ante* fully private-owned enterprises. This chapter aims to fill this gap. Based on a sample of A-share listed private-owned enterprises in China's manufacturing industry from 2011 to 2017, we distinguish POEs into two groups: the group of POEs which have participated in the mixed-ownership reform that have

⁹ According to the National Bureau of Statistics, the 10 eastern provinces (cities) include Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong and Hainan; the six central provinces include Shanxi, Anhui, Jiangxi, Henan, Hubei and Hunan; the 12 western provinces (districts and cities) include Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shanxi, Gansu, Qinghai, Ningxia and Xinjiang; the three northeastern provinces include Liaoning, Jilin and Heilongjiang.

absorbed the non-controlling state-owned equity and the group POEs which remained fully private-owned. We investigate the impact of mixed-ownership reform on the innovation performance of the transformed POEs using a PSM-DID approach. We find that the mixed-ownership reform significantly drives up the innovation input, proxied by R&D intensity, of ex ante fully POEs. However, mixed-ownership reform does not display any significant impact on the innovation output, measured by the number of patents, of the transformed POEs. We also explored the industrial and regional heterogeneous impact of mixed-ownership reform on the innovation performance of ex ante POEs. The results show that the significant impact of mixed-ownership reform on the R&D intensity of ex ante POEs only appear in monopoly industries and only in eastern regions.

5.1 Theoretical Contributions

This chapter contributes to the existing literature as follows: first, the findings on the positive impact of mix-ownership reform on the innovation input of POEs support the resource-based view. Innovation activities require a lot of scarce resources, such as financial, knowledge, and human capital resources while private-owned enterprises in transition economies have always been challenged by the difficulties of obtaining financial resources due to the underdeveloped financial market, this in turn also make them less attractive to talents. Our findings show that mix-ownership reform could help private-owned enterprises to build political connections by offering non-controlling shares to the state-owned enterprises. This in turn eases the barriers of private-owned enterprises to access necessary resources for innovation activities, particularly mix-ownership reform increases R&D intensity of the firm. This finding is in line with the finding that the relationship with government may serve as a scarce resource for POEs to obtain concessions or privileges from the government and banks, based on the resource-based view (Khanna & Palepu, 2000).

Second, our findings offer new empirical insights on the impact of the mix-ownership reform on the POEs. Previous literature mainly focuses on the impact of such reform on the SOEs. Our results show that mix-ownership reform is beneficial for POEs as it can help them alleviate the barriers they have encountered in the past. Moreover, we provide more nuances in the identified benefits of mix-ownership reform by showing that only MixPOEs in monopoly industries and are located in eastern regions are benefited by the reform. This points toward the importance of institutional environment.

5.2 Policy Implications

Our findings imply that by absorbing non-controlling state-owned equity, private-owned enterprises may ease various resource barriers to innovation activities. The non-controlling state-owned equity and the associated political connection may alleviate the barriers for the private-owned enterprises to get access to financial, knowledge, and human capital resources, that is reflected by the increase of R&D intensity of the transformed POEs (MixPOEs). However, mixed-ownership reform shows limited impact on the innovation output of the transformed POEs (MixPOEs). Policy-makers need to be aware of this limitation. In particular, innovation output is a direct contributor of transforming and upgrading the economy. Though the resource constraint of POEs maybe alleviated by the mixed-ownership reform, such reform seems hardly affect the internal innovation capability of POEs. The accumulation of technological and organizational capabilities of the POEs is a long term and painstaking process, which requires firms' idiosyncratic strategic orientations and innovation managerial efforts.

5.3 Limitations and Further Research

This chapter only examines the mixed-ownership policy effects in the manufacturing industry. The findings cannot be generalized to firms in other industries. Second, due to data availability, this chapter only uses R&D intensity and the number of patent application to measure innovation capability, which may not provide a comprehensive picture about the innovation activities. Other variables, such as the number of R&D personnel and sales of new product, may lead to different conclusions. Third, this chapter used a categorical variable to identify the mixed-ownership transformed POEs. Future research could further explore the impact of the share of state ownership and different types of state ownership on the innovation capability of POEs to gain more insights about mix-ownership reform.

Appendix A: Approach to Identify MixPOEs

To distinguish private-owned enterprises which have participated in the mixed-ownership reform, we need to identify whether the top ten shareholders of an enterprise include non-controlling state-owned shareholders. This chapter resorts to the approach to equity categorization adopted by Hao and Gong (2017) and the data acquisition scheme introduced in Shao et al. (2019).

First, consistent with Hao and Gong (2017), we divide the top ten shareholders of an enterprise into five categories: state-owned shareholders, private shareholders, natural person shareholders, foreign shareholders, and financial shareholders. The financial shareholder is classified as a separate category because it has a strong financial investment attribute and is significantly different from traditional state-owned and private institutions. It is difficult to judge whether it belongs to state-owned shareholders or private shareholders.

Then, adopting the method introduced by Shao et al. (2019), we manually queried the information about the nature of the top ten shareholders of 2044 firm-year observations one by one. The procedure is as follows: (1) The information of the top ten shareholders was obtained through the shareholder sub-database in CSMAR database, including the name of shareholders, the number of shares held, the proportion of shares held, the nature of shares, the ranking of shares held, etc. (2) The actual controller of the enterprise is used to identify the nature of equity. The strategic orientations and behavior mode of the enterprises are dominated by the actual controller of the enterprise for those enterprises with diversified equity structure. The firms are classified as MixPOEs (treatment group), if the top ten shareholders of the private enterprises include state-owned shareholders whose actual controllers are state-owned capital, namely government departments at all levels (e.g. Ministry of Finance, State-owned Assets Supervision and Administration Commission, etc.), state-owned enterprise legal persons, the four major asset management companies and their wholly owned subsidiaries. The firms are classified as fully POEs (control group), if the top ten shareholders do not include state-owned shareholders or financial shareholders (also not include state-owned capital). The top ten shareholders may include natural person shareholders, private shareholders, foreign shareholders.

Table 8 The definition and calculation of variables

Variable	Notation	Definition	Data source
<i>Explained Variable</i>			
R&D Input	R&D Intensity	The ratio of technological innovation expenditure to sales	Wind CFD
R&D Output	Patent	The number of total patent applications	CSMAR and SIPO
	Patent1	The number of invention patent applications	CSMAR and SIPO
	Patent23	The number of design patent and utility patent applications	CSMAR and SIPO
<i>Explanatory Variable</i>			
Ownership Property	MixPOE	Dummy Variables, equals 1 when it is a Mixed-ownership Private-owned enterprise (POE with non-controlling state-owned shareholders among the top ten shareholders) and equals 0 when it is a wholly POE (State-owned shareholders are not included in the top ten shareholders in Private-owned enterprise)	CSMAR
Mix-ownership Reform	Post	Time dummy variables, 2011–2013 is equal to 0, indicating that the reform has not been implemented, 2014–2017 is equal to 1, indicating that the reform has been implemented	Wind CFD
<i>Company-level control variables</i>			
Financial leverage	Lev	Ratio of total debt to total asset	
Profitability	ROE	Ratio of net income to stockholders Equity	Wind CFD
Company Growth	SalesGrowth	Income growth rate	Wind CFD
Size of Company	Size	The logarithm of total assets	Wind CFD
Age of Company	Age	The year of 2021 minus the company's listing year	CSMAR
Liquidity	Llas	The ratio of liquidity asset and total asset	Wind CFD
Number of employees	Labor	The logarithm of total employees	Wind CFD

(continued)

Table 8 (continued)

Variable	Notation	Definition	Data source
Market-Book Ratio	MB	Ratio of company's market value to book value	Wind CFD
<i>Industry-level control variables</i>			
Industry Classification	Industry	Industry dummy variables, equals 1 when the company is in a high-tech industry, otherwise is 0	

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Dark Side of Digitalisation: Discussion on Digital Assets Leakage and Its Protection Mechanisms in Operations and Supply Chain Research



Ying Chen and Fangli Zeng

Abstract The value and intensified prevalence of digital assets have been well recognised in today's digital age. Despite the benefits of digitalisation to firms, little is known regarding its potential dark side, that is, the concern on the digital assets leakage. For example, firms are now using on-demand IT services based on cloud technologies, which poses the risk of losing the right to control their information security. This chapter will discuss the research discourse on digital assets leakage and suggest protective mechanisms to counter back this problem, thus helping firms to maximise the value of digital assets in their digitalisation trajectories.

Keywords Digital assets leakage · Digitization · Supply chain · Protection mechanism

1 Introduction

Firms are in the midst of digitalisation to improve operational efficiency and supply chain performance (Holmström et al., 2019), which necessitates the transformation or integration of interfirm technological activities in the supply chains (Li et al., 2020; Lorenz et al., 2020). For instance, it could play a part in interconnecting more digital assets and making information flows more transparent among supply chain parties (Seyedghorban et al., 2020). Nevertheless, most studies have a predominant focus on the technological implications of digitalisation and overlook the consequences these technological activities can bring to involved parties (Yang et al., 2021a).

Apparently, digital assets leakage can cause considerable financial and managerial problems. In particular, data security and information leakage have become

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prominent challenges of data sharing in a supply chain context (Wang et al., 2020a, 2020b). The above challenges become more salient along with supply chain digitalisation, within which each party could generate a lot of data and shares data with other partners. As a result of the collaboration, products and services are created and delivered (Bhargava et al., 2013). Related literature demonstrates that on one hand, with increased use of digital technologies, it could impose greater risk of data assets leakage. The instant exchange of information is made possible by digital communication channels (Ried et al., 2020). Typing mistakes or misplaced clicks can easily result in emails containing confidential information being sent to the wrong person. On the other hand, one literature stream has recognised the role of modern technologies in preventing data leakage (e.g., Lawton, 2008; Wang et al., 2020b; Zhang et al., 2019).

Indeed, Feng et al. (2020) hold the view that digital assets leakage could occur even in unexpected scenarios, such as in the process of outsourcing information security to external technology suppliers such as managed security service providers (MSSPs). This is not without risk. Information could leak owing to technical failures, such as misconfiguration though MSSP's efforts have made to maintain a secure context. What's worse, it seems that the MSSP monetises a company's information through exchange or selling (Feng et al., 2018; Hoecht & Trott, 2006; Jammalamadaka et al., 2013). Since the release of the *Cost of a Data Breach Report* released by IBM (2021), it has been pointed out that the highest average total cost of data breaches has risen from \$3.86 million to \$4.24 million. Remote working necessitated by the Covid-19 pandemic is considered a contributing factor in the increased number of breaches.

To make matters worse, formal, traditional ownership appropriation approaches (e.g., patents, copyrights) might be useful for confidentiality protection of physical production or possession, but they are ineffective in the case of digital assets when they have no agree-upon value. Moreover, digital information can be transferred without temporal and geographical boundaries and can be easily cross one or more jurisdictional lines (Joglekar et al., 2016), which mutes the effectiveness of formal ownership appropriation mechanism.

Given that very limited attention is paid to include confidentiality considerations in their managerial prescriptions, operation and supply chain management (OSCM) academics and practitioners risk neglecting a vital driver of organisational success in the digitalisation era. The worst case that firms can face is that they risk following recommendations or policies that may jeopardise a firm's digital confidentiality, and as a result, its long-run success. More specifically, there are instances in which confidential data losses could directly lead to an organisation's operation breakdown, like government agencies (Cheng et al., 2017). For firms facing them, they face financial losses such as payment, restitution and financial resources for investigation. Furthermore, intangible costs like reputational damage, disruption in efficiency and management could be just as significant as tangible costs. Firms frequently take corrective actions in response to their own breaches of confidentiality (e.g., Norton, 2017; Thompson, 2017) that, in line with theories of operational trade-off (Rosenzweig & Easton, 2010), may eventually be incapable of maintaining past levels of traditional operational performance metrics such as cost, delivery, quality.

As the most common form of digital assets, data/information leakage that occurs under various scenarios remains to be a dilemma, but it has not received enough attention to provide effective implications to academics and practitioners (Ried et al., 2020), especially considering fragmented solutions exist across different disciplines (Schlackl et al., 2022). Moreover, as digital technologies are increasingly adopted by firms to extend supply chain networks, exploring the issues of confidentiality performance of digital assets is necessary and crucial. Further, firms can be faced with multiple solutions, upon which confidentiality performance relies.

To fill in this gap, this chapter attempts to enrich the knowledge base of digital assets confidentiality and suggests protection mechanisms to counter back this problem, thus helping firms to maximise the value of digital assets in their digitalisation trajectories. To achieve the above objective, we aim to address the following question: what are potential mechanisms to prevent digital assets leakage and improve confidentiality performance of digital assets in the digital supply chains? To address this question, attention-based view (ABV) is adopted to provide theoretical explanations why some firms can choose certain solutions or respond differently to leakage issues with varying degrees of performance. This constitutes the contribution of this chapter.

2 The Benefits and Dark Side of Digitalisation

The topic of digitalisation in business context has attracted considerable attention from both academics and practitioners (e.g., Holmström et al., 2019; Yang et al., 2021a, 2021b). The benefits of digital technologies have been widely recognised by organisations, which motivate them to adopt them in the supply chain context with the aim of achieving operational efficiency through supply chain digitalisation. The digital supply chain features a smart, customer-oriented, globally networked, data-enabled, and system-integrated mechanisms by using novel technologies, thus realizing the goal of delivering value-added products and services at a lower cost (Seyedghorban et al., 2020).

As emerging digital technologies literature further argues, the use of the digital technologies prevalent in industry 4.0 phenomenon paves the way towards more knowledge exchange and data sharing with the external network, and such effect is particularly visible with firms operating in the value chain or the same sector (Agrifoglio et al., 2017). Other scholars believe technological resources (e.g., big data, 3D printing) or innovations frequently emerge with the joint efforts in supply chains (Seyedghorban et al., 2020). Supply chain digitalisation offers opportunities to explore the assets residing in the supply chains (Seyedghorban et al., 2020). In addition to asset exploitation, digitalisation is argued to be positively related to direct benefits such as information sharing, improved efficiency performance, as well as less visible benefits like digital trust (Mubarak & Petraite, 2020), and relationship building.

First of all, information sharing is simplified with the introduction of Industry 4.0 (Li et al., 2019). Cloud computing, as an important instrument of Industry 4.0, provides various computing infrastructures, such as software-as-a-services (SaaS), which aid in the sharing of information among stakeholders (Langmead & Nellore, 2018). Chavez et al. (2017) provide similar evidence that digital technologies increase intrafirm and interfirm information sharing and connectivity, thus greatly mitigating the information asymmetry problem. For example, relying on advanced ICT components, FIspace operates as a supply chain platform that is intended for B2B collaborations. By virtue of FIspace, it makes the sharing of supply-side information transparent, and thus further facilitating the supply chain integration in the food sector (Barmounakis et al., 2015; Kruize et al., 2014).

Second, according to the literature conducted by Yang et al. (2021b), the most salient outcome of using digital technologies is to aid organisations with their supply chain performance by increasing efficiency, such as cost, speed, quality and flexibility (Calatayud et al., 2019; Chavez et al., 2017). One key building block of improving firm operational efficiency and supply chain efficiency seems to be the data-driven supply chain, within which information sharing is made with business partners. Based on this line of reasoning, big data, as an integral tool of Industry 4.0, can be used to generate and handle large volumes of data and information. Indeed, others suggest that supply chains with big data application would continue to cut business costs and underpin competitive advantages through increased supply chain operational efficiency and effectiveness (Sanders, 2014; Sauter, 2014). For example, Sauter (2014) estimates that big data utilisation might boost procurement efficiency by 10–30%.

Third, in line with traditional trust, it has been argued that digital trust can emerge by combing the application of the Industry 4.0 technologies and traditional trust (Mubarak & Petraite, 2020). Digital trust can be referred to as ‘the confidence of stakeholders on the competence of actors, technologies, and processes for establishing reliable and secure business networks’ (Mubarak & Petraite, 2020, p. 3). In contrast to traditional human-centric trust that often dissolves in the situation of distrust, these advanced technologies can play a part in replacing humans in trust creation. To illustrate, big data—including the information of firms’ past performance, collaborations, and business portfolio, can be assessed to shed lights onto the trustworthiness and reputation of partners, suppliers, and other related stakeholders. Therefore, such a technology-centric method (Mubarak et al., 2019) is seen as the core of any business relationship development because of its more reliable, more secure and less risky nature.

Last but not least, in a digitalised world, manufacturers in the pursuit of Industry 4.0 have adopted the ‘Smart Factory’ (Strozzi et al., 2017) and is characterised as ‘the integration of all recent IoT technological advances in computer networks, data integration, and analytics to bring transparency to all manufacturing factories’ (Lee, 2015, p. 230). Firms taking this strategy can strengthen their value chain relationships with other businesses to collaborate on integrated platforms as co-creators. It is believed that managing relationships and resources is an important source of firms’ competitive advantage (Tian et al., 2021).

Meanwhile, literature has discussed that through harnessing technological intelligence for intrafirm operations, such as real-time predictive and prescriptive analysis enabled by big data analytics, adoption at a high level can correspondingly assist businesses in responding more quickly to changing conditions and facilitating risk management (Büyükoçkan & Göçer, 2018; Schoenherr & Speier-Pero, 2015; Wood et al., 2016). However, such digitalisation may be a boon or a bane to the firms. For instance, companies relying on digital technologies to run their business are likely to be exposed to a number of acts, such as theft of corporate secrets, sabotage of system integrity, and the sale of customer data on the dark web to facilitate other crimes (Agrafiotis et al., 2018).

Undeniably, as an increasing number of mobile devices are applied in business and other scenarios, there has been a surge in data breaches and cyberattacks that exploit the devices as a means of gaining access to an organisation's network (Olmstead & Smith, 2017), increasing the vulnerability of organisations to security and privacy breaches. The major concern about the adoption of personal mobile devices is to reveal confidential data inadvertently (Hauer, 2015). In case of data leakage, firms can become a victim, or they conduct the data leakage offense more easily as firms witness increasing connectivity with each other and data transparency for interfirm coordination.

3 Digital Asset Confidentiality and Leakage

3.1 Definition of Confidentiality of Data, Information, and Knowledge in Digitalisation

Assets can be defined as a particular entity which engenders possible future economic benefits due to past events or transactions (FASB, 1985). When it comes to digital assets, confidentiality is often used interchangeably with terms such as cybersecurity, digital IP protection, and data/information security and/or leakage. Essentially, it can be pointed out that digital assets can be in the separated or combined forms of data, information, and knowledge. In practice, data leakage can violate a multitude of security dimensions, which is particularly the case when they occur in an organised way (Schlackl et al., 2022). Information leakage can be formally defined as unauthorised disclosure of confidential information (Zhang et al., 2011, p. 1351). Moving data and information to a high level, knowledge is referred to as the combination of experience, contextual information, values and expert insights framed in a fluid manner (Davenport & Prusak, 1997). In the digital era, the boundary between data, information and knowledge becomes more ambiguous. When firms use big data technologies and AI technologies, data becomes strategic assets for firms, as valuable insights can be generated. Firms can access customer feedback about their products either from external technology supplier, and then they can further analyse

the feedback to guide their product development (Cappa et al., 2020; Zhan et al., 2020). As firms implement digital transformation, they increasingly recognise the value of data, which can be analysed to develop actionable information. Therefore, data, information and knowledge are all perceived as digital assets that can promise future economic benefits to varying extent.

3.2 Main Sources of Digital Assets Leakage in Supply Chains

As supply chain digitalisation has been widely implemented by firms, there is an increasing awareness of benefits deriving from supply chain integration and supply chain risk management through digital exchanges. However, it can be posited that these widely accepted practices can be main sources of digital assets leakage in the supply chain field. Admittedly, supply chain integration at a high degree poses significant obstacles to ensure confidentiality performance, particularly when digital assets are required to be exchanged for successful integration. Widely cited anecdotal evidence from Apple (Fingas, 2015), Home Depot (Hawkins, 2015), among others, suggests higher level of supply chain integration could substantially lead to confidentiality losses. As mentioned in the above, importance of improving confidentiality performance grow in tandem with digital sophistication (Massimino et al., 2018). As such, both practitioners and researchers should take a new perspective on the supply chain integration in the digital age as supply chain integration can be made easier, however, whether benefits would increase as the level of supply chain integration increases deserves more attention.

At the same time, the benefits of digital exchanges amongst supply chain parties to impede the occurrences of supply chain disruption can also be muted if there is any digital assets leakage. First, this line of literature recommends establishing redundancy in the supply chain. That is, cultivating a multitude of sources for a component or activity (Minner, 2003). Due to the advances of digital technologies, it becomes easier for any organisation if they intend to harness the advantages of global sourcing. Sharing these easily distributable but highly proprietary digital assets with certain suppliers could magnify potential leakage issues. Secondly, prescriptions on supply chain disruptions suggest increasing intensity of digital asset exchanges, such as improved visibility into all involved supply chain partners that is first-tier, second-tier and beyond (Norrman & Jansson, 2004), and including suppliers in the entire phases of knowledge development (Zsidisin & Smith, 2005).

4 Attention-Based View (ABV)

From the ABV perspective, the focal point of attention, or its distribution relies on attention structures (Ocasio, 1997), or organisational dimensions like economic, cultural and social aspects. Given that asset leakage could be attributed to two main

patterns of inadvertent or intentional opportunistic disclosure and the focal firms could take on the roles of being a victim organisation, an observer organisation, and/or sometimes an offender. Their managerial attention paid to or their understanding of how to deal with digital assets leakage could vary, hence taking different preventative approaches. The above reasoning could be founded on the argument that there is considerable heterogeneity in the focus and allocation of attention, not only among decision makers of the organisations but also among individual employees inside the organisations (Barreto & Patient, 2013). As a result, it has been argued that strategic actions might be fundamentally driven by managerial cognition (Daft & Weick, 1984; Nadkarni & Barr, 2008). In fact, recent studies of Ocasio et al. (2017) make an implicit argument that ABV delineates an organisation's strategy as the pattern of managers' attention. Further, evidence points out that attention-based sensemaking activities as regards the phenomenon of interest in the context leads to the creation of novel institutional logics (Nigam & Ocasio, 2010), i.e., beliefs, norms and rules, and "explanations of what is and what is not, what can be acted upon and what cannot" (Hoffman, 1999, p. 351).

As the ABV indicates, "'issues' refer to the available repertoire of categories for making sense of the environment: problems, opportunities, and threats, and 'answers' refer to the available repertoire of action alternatives: proposals, routines, projects, programs, and procedures" (Ocasio, 1997, p. 3). The issues encountered by the organisation constitute of the cognitive categories of opportunities, threats and problems, which are then decided by the decision-makers of the organisation to cope with or to ignore (Jackson & Dutton, 1988). Translated to this chapter, digitalisation can both be perceived as opportunities and potential threats in the form of digital assets leakage, and based on this, answers are proposed, which are the cognitive models of alternatives evaluated by the decision-makers (Ocasio, 1997). The repertoire of answers is shaped by existing organisational resources, positions, and players (ibid).

Translated to this study, answers represent a repertoire of potential solutions (see the subsection below), and which solutions to choose depends on the resources the firms have obtained and the managerial cognition of the issues, which is the digital assets leakage in this study. Essentially, ABV provides a useful lens for understanding an underexplored phenomenon regarding digital assets breach in firms when they digitalise, and how they can respond to potential challenges based on their concern, organisational resources and capabilities. For instance, in the case of blockchain adoption, a lack of in-house technical expertise could be a critical barrier, which could be made worse given that experts possessing blockchain-related skills on the labor market is still lacking (Kurpjuweit et al., 2021).

5 Solutions

Researchers suggest different channels to ensure the confidentiality of information to certain extent. We classify the approaches into three categories here, which are: contingent strategic decisions, technological solutions, and collaboration design. Technological solutions imply that organisations employ different kinds of technologies to reach information confidentiality. For instance, blockchain technology (Francisco & Swanson, 2018). However, it has been argued digital assets leakage prevention and responses should not be limited to organisations' IT department, but also include management and non-IT employees (Schlackl et al., 2022). Indeed, researchers and practitioners increasingly realise the necessity to extend the options beyond technological approaches (Massimino et al., 2018).

5.1 Approach 1: Contingent Strategic Decisions

As previously noted, a dark side of information sharing is information leakage. The purpose of strategic decisions is to prevent suppliers from obtaining the full picture of the organisation's strategic information. This approach would be widely seen in scenarios in which potential competitors have common suppliers. For example, compared with small firms, large firms may have more knowledge about market demand, especially when introducing new products. In this instance, large firms' order to their supplier could reveal some of the information related to uncertain demand, and the suppliers can reveal this information to their competitors. Realizing this, they would respond to order strategically. For example, Anand and Goyal (2009) propose in their model that a firm's operational and informational imperatives are often in conflict, necessitating their joint management to maximise profits. This research is in the stream of literature that assesses the magnitude of information leakage and suggests approaches to reduce the likelihood of their occurrences. In the case of one manufacturer with competing retailers or one retailer with two competing manufacturers, different ways of information leakages could lead to different economic consequences (Li & Zhang, 2008; Li et al., 2022). Even in some cases, partial information leakage could be advantageous under certain conditions (Kong et al., 2017). As now supply chains extend into network and/or ecosystem, plus the fact that the firms' position could change as supply chain partners join or leave, such strategic decisions in hindering information leakage become more complicated. Therefore, it may require the constant attention of organisational decision-makers to maximise profits regarding what information and how much information can be divulged.

5.2 Approach 2: Technological Solutions

Blockchain technologies are one of the promising approaches to enable information sharing in a reliable and trustable way among supply chain partners. Essentially, blockchain technology features a distributed database or shared ledger of digital events like transactions that are carried out and shared among all participating parties using blockchain (Crosby et al., 2016). Wang et al. (2021) provide a detailed technical tutorial of how to create a data exchange prototype with hashgraph through tapping into the multiple blockchain characteristics, such as consensus mechanisms, decentralisation, micropayments, and cryptography, to develop a secure, trustworthy and efficient data-sharing mechanism.

As firms increasingly use cloud computing to reduce their IT cost and to achieve convenience (Crotty & Mostaghimi, 2014), specific models are proposed in relation to cloud computing to ensure information confidentiality. In this regard, Vazquez-Martinez et al. (2018) propose a model of CloudChain to achieve flexibility, sovereignty, and security to ensure the smooth flow of information and avoid violations of confidentiality and/or legal issues. Zhang et al. (2019) comprehensively discuss the trust and security issues in digital supply chain management through the application of disruptive digital technologies, including blockchain technologies, IoT and cloud computing, aiming to improve various system performance and properties, such as visibility, transparency, visibility, reliability and traceability. The researchers propose the specific application of these digital technologies to achieve security management and trust.

In addition to these disruptive technologies, Bhargava et al. (2013) propose end-to-end security auditing based method which allows for tracking shared data flows and detecting business processes that compose supply chains. This method is developed through relying on taint analysis and third-party trust broker. It addresses data and information leakage problems in the context of supply chains.

Information technologies can also be employed to counter back internal breach. For example, Ogiela (2015) suggests cryptographic algorithms to protect strategic information. Specifically, cryptographic information division algorithms can be utilised in such a way that organisation security is entrusted to a given trusted group rather than one person to form a correct and secure knowledge management process. The protocols can be employed to divide information within a certain group of secret trustee, thus preventing the information from disclosing to the public or unauthorised parties inadvertently or intentionally.

5.3 Approach 3: Collaboration Design

Collaboration to promote relational ties are encouraged, as relational governance (Kim & Choi, 2015; Liu et al., 2008; Wang et al., 2020a) values integrity, reciprocity, reliability and trustworthiness among supply chain entities (Kim & Choi, 2015) and features self-enforcing mechanisms to sustain relationships. A good illustration is that a manufacturer's trust in its major suppliers would make the suppliers recognise and appreciate the benevolence in the relationship. Consequently, the manufacturers would feel the same reciprocity from the suppliers and less opportunism would occur in this type of relationship. Prior research has emphasised the importance of relational links in managing supply chain interactions (Liu et al., 2008; Wang et al., 2014). Further, empirical work conducted by Yang et al. (2021a) demonstrates that digitalisation on the supplier side can indirectly induce digital assets leakage through IT integration, and this relationship can be indirectly suppressed through supply visibility. Relational ties play a significant role in moderating these paradoxical relationships. The relational ties can also be enhanced by the digital trust mentioned in the above. However, relational ties could take a longer time to establish and could be more conducive in combination with certain technologies to promote supply chain visibility.

6 Summary and Future Direction

This study presents an overall security framework that is focused on antecedents of digital assets leakage on various business scenarios and propose protective mechanisms accordingly. A multitude of measures can be adopted by firms and the choices of the measures and confidentiality performance of digital assets, according to ABV, depend on the managerial cognition of decision-makers and organisational resources. Meanwhile, it should be noted that as organisational attention can shift as new issues arise or organisational resources and capabilities are developed, so does the solutions adopted to counter back the potential risk of digital assets leakage. That is to say, a set of multifaceted and ongoing solutions should be adopted based on the issues (digital assets leakage in different scenarios) and answers (a repertoire of protective solutions). And to maximise the profit or improve confidentiality performance, firms should deepen their understanding of a set of leakage issues and responses, which are most relevant, legitimate based on firms' resources, players, positions within and across firm boundaries (Ocasio, 1997). Future researchers are encouraged to empirically look at the phenomenon of digital assets leakage by drawing on ABV.

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Understanding Irresponsibility in Digital Advertising



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Abstract This research systemically reviews the directions in existing research in the digital marketing domain and unveils the irresponsibility in the digital advertising domain. The inefficiencies inherited from traditional advertising are enhanced or magnified by digital channels. This research reviews previous studies on advertising efficiency and states the enhanced challenges in the digital era: agency problem, advertising effect measurement, and the black box by programmatic advertising. Further, this research proposes the data as one potential direction for future study in the digital advertising domain.

Keywords Irresponsibility · Digital advertising · Advertising efficiency · Agency problem

1 Introduction

Marketing managers tend to spend more budget on digital channels, which provide unprecedented and inimitable innovations, such as precise targeting and customized content (2021 Marketplace Outlook, 2020). In 2021, global digital advertising revenue reached 436.8 billion US dollars and is expected to grow to 632.7 billion by 2025 (Statista, 2021). However, the latent vulnerability in digital advertising may be the Achilles' heel for marketers, including well-established brands and start-ups. It is common in the advertising industry that desperation driven by poor marketing

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performance in a new media platform turns into highly reckless investment action on advertising, which barely returns and leads to further failure in the marketing campaign.

The efficiency of advertising is a long-standing issue. More than a century ago, the first department store founder, John Wanamaker, who is also considered a marketing pioneer, said “Half the money I spend on advertising is wasted; the trouble is I don’t know which half.” (Pritchard, 2021) Some optimistic laymen currently believe marketers now can precisely evaluate and predict the advertising effect, because of the prevalence of traceable programmatic advertising systems. In 2021, programmatic channels consumed more than 80% of the digital advertising budget (Lindlahr, 2021). Some veteran advertising practitioners, especially marketers, however, joked, “unlike John Wanamaker, we can now waste 90% of our budget, thanks to the development of programmatic advertising systems.” In the 2017 Interactive Advertising Bureau annual leadership meeting, Procter & Gamble’s Chief Brand Officer Marc Pritchard urged the marketing industry to come together to tackle inefficiencies in the digital advertising business, stating, “We serve ads to consumers through a non-transparent media supply chain with spotty compliance to common standards, unreliable measurement hidden rebates and new inventions like bot fraud” (Roderick, 2017). Surprisingly, digital advertising not only fails to solve the problems in traditional advertising but becomes a breeding ground of dishonesty and fraud as well.

Although academia has conducted wide research on digital advertising, the research on the dark side of digital advertising is limited. Hence, this study aims to unveil the dark sides of digital advertising and propose a conceptual framework to understand the chaos: *advertising effect measurability, agency problems, and the programmatic black box*.

2 Existing Research in Digital Advertising

Previous scholars have various perspectives on digital advertising. Information system scholars provide more efficient algorithms in advertising, such as recommendation systems (Zhao et al., 2022), advertising exchange systems (Perren & Kozinets, 2018), advertising attribution algorithms (Anderl et al., 2016), advertising bidding algorithms (Christopher et al., 2022; Perlich et al., 2012), user profiling algorithms (Trusov et al., 2016; Tsimperidis et al., 2020), user experience protection algorithms (Stourm & Bax, 2017), integrated targeted display algorithms (Turner, 2012), and ad blocking detection algorithms (Zhu et al., 2018). Meanwhile, marketing scholars have more focused on participators’ strategies in the digital advertising market; these perspectives are described below.

Advertising publisher. For the publishers, marketing scholars have discussed the trade-off between advertising and pricing (Fan et al., 2007; Ghose & Han, 2014; Halbheer et al., 2014), and further integration approaches, such as apps remaining

free but with in-app advertising (Appel et al., 2020) or virtual selling strategies (Meng et al., 2021).

Advertising frequency. The high frequency of advertising may arouse negative attitudes among users (Chae et al., 2019; Sahni et al., 2019). Customers in different stages of the decision journey vary on the threshold of advertising annoyance (Todri et al., 2020). One solution to balance user experience and advertising frequency is the optimal insert policy, which proposes to insert the advertisement when the user's engagement level reaches the trigger threshold, and the length of the advertisement should let the user's engagement level drop to the target level (Kumar et al., 2020). The platform can also allow users to avoid irrelevant or non-interesting advertisements with the skippable option, hence boosting audience perceived control and reactance (Choi & Kim, 2021) and generating a positive indirect-demand-enhancing effect (Dukes et al., 2021).

Advertising content. Compared with informational content, emotional marketer-generated content is more likely to receive positive consumer sentiment and their following behavior, such as purchasing (Meire et al., 2019). Valence, receptivity, and consumer susceptibility are three components of firm-generated content communication, in which consumers' perceived receptivity has the largest impact on customer buying behavior (Kumar et al., 2016). Gamified advertising content is another trend in digital advertising (Sreejesh et al., 2021; Terlutter & Capella, 2013). Previous study has also examined the role of creativity in advertising, which has a stronger impact on high-involvement products and unfamiliar brands (Rosengren et al., 2020).

Targeting. How to target is a predominant question for advertisers. Besides richness of user profile (Benmamoun et al., 2019; Ghose et al., 2019; Trusov et al., 2016) and advanced targeting tools such as location-based services (Constantiou et al., 2014; Ketelaar et al., 2018; Molitor et al., 2020), previous scholars have also emphasized the effectiveness of the retargeting strategy (Sahni et al., 2019) with a profiling and capping strategy (Chae et al., 2019). Another synergy relationship on eventual conversion is among timing, content, and targeting on social media advertising (Chen, 2018).

Advertising effect. Previous research has proposed new approaches to measure the advertising effect, such as ghost advertisements (Johnson et al., 2017) and the digital attribution model (Ghose & Todri, 2015). Studies have also revealed several interesting facts on the advertising effect, including the spillover effect across digital platforms (Krijestorac et al., 2020; Liang et al., 2019), and synergies of online and offline channels (Bar-Gill & Reichman, 2021; Chandrasekaran et al., 2018; Dinner et al., 2014; Lesscher et al., 2021; Osinga et al., 2019).

Multichannel advertising. Previous scholars have examined the interaction among online multichannels. Social media referral, research engine referral, and third-party referral have positive synergy effects on advertiser performance (Duan & Zhang, 2021), but advertisers should note the potential cannibalization, especially in the multi-touch-point, multi-competitor environment (Li et al., 2019). Although advertisers are spending 80% of their budget on digital channels (Lindlahr, 2021), the effectiveness of integration with traditional channels is also encouraged, including

direct mail (Lesscher et al., 2021), print advertising (Ciceri et al., 2020; Venkatraman et al., 2021), and television advertising (Nagy & Midha, 2014). Furthermore, the poaching phenomena in digital advertising, especially search engine optimization (SEO), may force advertisers to reallocate budget back to the traditional approaches to strengthen brand awareness (Sayedi et al., 2014).

Advertising avoidance. Advertising avoidance is common in both traditional and digital channels. Research has suggested interactive program-loyalty banners to reduce commercial avoidance in television advertising (Dix et al., 2010). Previous research has explained the drivers of avoidance of digital advertising on social media, including the trust in the platform, privacy concerns, and need for control (Miltgen et al., 2019). An adblocker is a programmatic tool to avoid digital advertising. The emergence of adblockers reduces the efficiency of advertising. Adblockers jeopardize consumers' acceptance level of new brands, shift consumer budget to the product they previously used, and reduce their search behavior (Todri, 2021). Previous research has also unveiled the psychological mechanism of adblock selection and corresponding solutions, such as banner appeals, to reduce adblocker deployment (Soellner & Dost, 2019).

Ethical issues with the algorithm. Researchers have also discussed the ethical issues within digital advertising, such as gender-based discrimination (Lambrecht & Tucker, 2019) and sexist messages (Lopez Jimenez et al., 2021). Furthermore, with the implication of the algorithm, the human right to free speech changes from "what can be said" to "what can be heard" and "by whom" (Riemer & Peter, 2021). Some scholars also note the manipulation of social media artificial intelligence on society and politics, which should be further regulated (Reisach, 2021).

Only a few studies have discussed the dark side of the digital advertising market. Gordon et al. (2021) categorized the problems related to the innovation of digital advertising into four clusters, namely advertising effect measurement, organizational inefficiencies, advertising blocking, and advertising fraud, but omit many easily ignored aspects in digital advertising and fail to unveil the fundamental mechanism of these inefficiencies. This research often discusses the frictions and misalignments in digital advertising from the perspective of the stakeholders of the digital advertising market, and the problems that result from the core of digital advertising: the black box of the advanced algorithm.

3 Advertising Efficiency and Inefficiency

Smith and Park (1992) defined advertising efficiency as "generating a greater level of sales from a given advertising investment". Rahman et al. (2020) expanded this definition into a larger scope and conceptualize advertising efficiency as "the ratio of advertising inputs to outputs." Advertising inputs are not only the direct financial advertising expense, but also include other resources invested in advertising, such as relationship and intellectual property (Cheong et al., 2014; Luo & Donthu, 2001; Pergelova et al., 2010). The output is also not limited to direct sale numbers from

advertisements; it also contains customer awareness, attitudes, and loyalty (Edeling & Fischer, 2016; Herzenstein et al., 2004; Rahman et al., 2020).

However, previous studies on frictions in digital advertising are scattered with only a few studies discussing the dark side of the digital advertising market. Gordon et al. (2021) categorized the inefficiencies in digital advertising into four clusters, namely advertising effect measurement, organizational inefficiencies, advertising blocking, and advertising fraud. Gordon et al.'s work presents the chaos in digital advertising and proposes further third-party supervision, transparency, and government regulations as corresponding approaches.

Previous research has emphasized dishonesty in audience metrics. Advertising networks may have no incentive to improve the data accuracy. Although more granular targeting accuracy can improve total surplus, it cannot maximize advertising network revenue (Rafieian & Yoganarasimhan, 2021). Improved data accuracy may prove a potential hazard to the total revenue of the platform, as it may reduce the budget the advertiser spends on the less relevant audience. Conversely, advertising networks may over-report audience metrics to advertisers for higher revenue (Gordon et al., 2021).

Other scholars have mentioned the overlong chain of the digital advertising network. Introducing the third-party data audience can improve the targeting accuracy, but is often economically ineffective, as agencies in the advertising process charge high service fees, such as supply-side-platform and demand-side-platform fees (Neumann et al., 2019). Additionally, adblockers and third-party verifiers cut the share from the advertising budget. Most adblockers are not priced for users, but for advertisers: as long as the advertiser pays the service fees to adblockers, the advertisement is allowed to be displayed to the customers (Gritckevich et al., 2021). Although the whitelisting practice has not been studied in the third-party advertising effect supervision context, it is not an uncommon approach for third-party verifiers. Incentive misalignment between advertisers and advertising agencies are jeopardizing the digital advertising market ecosystem (Gordon et al., 2021). When working with multiple agencies becomes a new norm (Dan, 2014), clients are likely to share (or steal) creative ideas from one another (Chang et al., 2010), which may lead to underinvestment in idea production (Horsky et al., 2016).

4 Advertisement Effect Measurement

Quantifying the incremental effect of advertising on customer attitude or behavior, known as advertising effect measurement, is a lasting topic in the marketing domain, and practically difficult for enterprises. When it comes to advertisements' efficiency, some scholars have proposed evaluating the advertising effect via the ratio of advertising spending to sales (e.g., Havakhor et al., 2019; Kwoka, 1993; Picconi, 1977; Simon, 1969; Sougiannis, 1994; Sridhar et al., 2014). Other outcome variables are also considered to evaluate the efficiency of advertising, such as return of asset (Comanor & Wilson, 1972; Eng & Keh, 2007; Meyer & Ujah, 2017), market value

(Core et al., 2003; Erickson & Jacobson, 1992; Hirschey & Wichern, 1984), and market share (Erickson & Jacobson, 1992; Megna & Mueller, 1991; Picconi, 1977). Rahman et al. (2020) expanded Smith and Park's (1992) definition of advertising efficiency into a larger scope as "generating a greater level of sales from a given advertising investment" into a larger scope as "the ratio of advertising inputs to outputs." In this perspective, input is not only the direct financial advertising expense, but also includes other resources invested in advertising, such as relationship and intellectual property (Cheong et al., 2014; Luo & Donthu, 2001; Pergelova et al., 2010); the output is also not limited to direct sale numbers from advertisement, but contains customer awareness, attitudes, and loyalty (Edeling & Fischer, 2016; Herzenstein et al., 2004; Rahman et al., 2020).

Besides the measuring parameter, the measurement method is another obstacle for advertisers. Although experiments are commonly regarded as the gold standard to estimate the effect of advertising campaigns, experimental approaches are problematic and impractical for advertisers due to the following four reasons.

Firstly, when advertisers attempt to examine the effect of one individual advertising action, these actions are commonly small and even not statistically significant. Large sample size is required in order to examine the advertising effect, which is unacceptable to advertisers, especially for small and medium businesses.

Secondly, the synergy effect across channels blurs the boundary of advertising activities. The synergy is not limited to online channels (Duan & Zhang, 2021), but also permeates across online and offline boundaries (Osinga et al., 2019). From the perspective of the customer decision journey (e.g., AIDA model), upstream advertising such as banner and print advertising are generally attributed less credit than downstream advertising obtained, such as SEO (Sayedi et al., 2014). Direct comparison of eventual conversion is not suitable with the synergy effect, as the consumers often go through complex, long, and interacting steps before purchase (Batra & Keller, 2016).

Thirdly, uncontrollable and unknown market conditions hinder advertisers from evaluating advertising effects. Dynamic advertiser behavior, dynamic platform behavior, and dynamic consumer behavior are challenging to establish with accuracy (Gordon et al., 2021). Advertisers' behaviors with advertising, such as temporary price reduction or free samples, lead to a confounding correlation between advertising investment and performance (Barajas et al., 2016). Changes in platform strategy also impact effect measurement. For instance, publishers are constantly and secretly adjusting the parameters of ad load (Wagner, 2017), which can significantly impact advertising outcomes. Furthermore, the attention paid to an advertisement is influenced by the ingrained habits of the customer (Becker & Murphy, 1993; Gordon et al., 2021; Tuchman et al., 2018). This makes it difficult for advertisers to distinguish the incremental effect of advertising from the baseline propensities to the brands (Gordon et al., 2021).

Fourthly, introducing control groups in advertising experiments is theoretically feasible, but practically impossible. In the control group approach, advertisers must guarantee half of the targeted customers receive no message from the adviser, including online and offline, which requires advertisers to bear the opportunity cost

of leaving half of the targeted customer unadvertised to (Gordon et al., 2021). Even if the advertisers are willing to take the cost, customers in the control group should also not be exposed to any other advertising from the competitors, as this may remind the control group of the advertiser brand (Sayedi et al., 2014).

For these reasons—that is, the effect of individual advertising activity is minimal and incomplete, the synergy effect is unlikely to be divided, advertising participators show unstable behavior, and there are practical obstacles—advertisers are still facing the same question: which part of the advertising budget is wasted?

5 Agency Problems

Interfirm frictions are between the advertiser and a complex array of external agencies, who may divide advertising contracts into pieces and further outsource to secondary contractors. The scattered and loose advertising contractors align incentives poorly to produce creative advertising materials. External agencies are unwilling to emphasize creativity, especially when clients have multiple homogeneous contractors (Dan, 2014), as it is common that clients “share” creative ideas or even finished advertising materials from one agency to another (Chang et al., 2010). Furthermore, advertisers themselves barely have clear criteria of the quality of agencies’ advertising materials, because of the complexity and high dimensionality of the messaging problem (Gordon et al., 2021). Hence, financial resources (rebate and cash advance) and interpersonal resources (Rahman et al., 2020, 2021) become the most influential factors during the contracting process instead of creativity, which is conversely often considered as a key success factor in advertising (Rosengren et al., 2020).

Misaligned incentives also can lead firms to advertising failures. Commonly, the revenue of advertising agencies can be divided into two streams: service fees paid by advertisers and rebates paid by the publishers. Both paths of revenue generation are based on the total volume of advertisers’ spending. Hence, the priority of advertising agencies is to boost clients’ budgets. As long as the total return on investment is not too low for clients to abandon digital advertising, advertising agencies have no incentive to improve the efficiency of advertising. Some clients may increase advertising investment when the advertising efficiency is improved, while other clients may shrink their budget, as the advertising outcome could be achieved with less investment under a more efficient advertising strategy.

Furthermore, scattered external advertising agencies also block the path to integrated marketing. Gordon et al. (2021) believed that marketers normally hire specialist agencies for each individual medium, such as traditional media, SEO, and social networking, and each agent operates independently and competes for the advertising budget. In fact, marketers may nowadays divide their business into smaller degrees of granularity. Different platforms, even in the same industry and sharing similar functions, still require different advertising strategies. Different platforms, even in the same industry, have different user bases, different recommendation algorithms, and different advertising parameters. A proven marketing strategy on one

platform is unlikely to work well on other platforms. Furthermore, even in the same media platform, clients are unwilling to leave all budgets to a single agency, so that they can fluently adjust budget share among agencies and compare their pricing or rebate. However, as the number of agencies employed increases, it is more difficult for advertisers to coordinate agencies “whose work complements each other” or fulfill the spillovers across advertising channels (Du et al., 2019; Fossen & Bleier, 2021; Gordon et al., 2021), and across media platforms (Krijestorac et al., 2020).

Despite the quality reduction from media platforms, other players in digital advertising delivery take cuts from the advertising transaction (Gordon et al., 2021). In 2021, 81% of the digital advertising budget was consumed by programmatic advertising systems (Lindlahr, 2021), which have a much longer process journey and more participators than traditional media or non-programmatic approaches. To deliver advertisement programmatically, despite agencies, the commercial messages need to go through a demand-side platform, data management platform, ad exchange, supply-side platform, ad alliance, and ad server, and finally arrive at the publisher platform (Choi et al., 2019). Besides the participator and conveyer, multiple third-party supervisors enroll the whole journey as verifiers. All these participants are designated to improve digital advertising’s efficiency and accuracy, but eventually, 42% of the advertising budget is consumed by the media supply chain and transaction fees, and only 58% is paid to the publisher platform for display inventory (ANA, 2017).

6 Programmatic Black Box

The most prevalent approach for the ad auction is calculated in eCPM (expected charge per mille), in which all advertiser-desired user behavior is converted to display. The algorithms of the ad system offer one expected conversion rate (eCVR) based on the previous behavior of the ad content and other related parameters, such as the conversion rate of a similar advertisement. In practice, the calculation of eCVR enrolls various artificial intelligence models to improve accuracy.

The eCPM calculation formula is:

$$\text{eCPM} = \text{eCVR} * \text{Bids}$$

Furthermore, two firms may purchase digital advertisements in the same ad auction. Firm A decides to purchase by 1 dollar per complete view, while firm B prefers 10 dollars for one user to download the game. Hence, the eCVR for firms A and B would be the number of effective views divided by total advertisements displayed, and the number of downloads divided by total advertisements displayed. For instance, 8 of 10 users watch the complete advertisements from firm A, and 1 out of 10 users download the game from firm B. Hence, the eCVR for firms A and B would be 80% and 10%, respectively. In this stage, the eCPM for firm A is 0.8 (80% * 0.1), which is lower than firm B’s eCPM 1 (10% * 10).

Besides eCPM, the strategy factor is another component in the advertising algorithm (Sayedi et al., 2014). Media platforms can set a negative strategy factor to firm-B-related advertisements if firm B is notorious and may jeopardize the platform user base. In this case, we assume the strategy factor is 0.7.

$$\text{Ranking Score} = \text{eCPM} * \text{Strategy Factor}$$

Hence, the final ranking score of firm B would be 0.7 (1 * 0.7). Under this circumstance, advertisements from firm A will win the auction, though B has a higher eCPM. The ranking process is purely in the black box; neither the eCPM nor the strategy factor are unveiled to advertisers, who can only set the input (bidding price and the advertising material) and the output (the performance provided by the advertising system).

The black box is not only to clients but also to insiders, including the programmers who coded related algorithms. When the advertiser questions the publisher as to why the bidding failed—besides an apparent technical bug, such as accidentally blocking the advertiser’s account—the only answer is “over low eCPM,” as the calculation is inscrutable to outside observers, and even the platform engineers cannot tell why a specific output is generated (Asatiani et al., 2020). The solutions proposed to advertisers are always to increase the bid or improve the advertising material quality.

In order to obtain the ideal outcome from advertising through the black box, one practice is to set almost identical or very slightly different advertising campaigns on Demand Side Platform (DSP) with a minimal budget. As long as one campaign has outstanding performance, the advertiser will concentrate all budget into the campaign.

Although techniques derived from experience are unreliable, unfounded, and even superstitious, they are sometimes effective in the black box. Some approaches concluded from experience are surprisingly doable, as they may coincidentally catch a bug in the algorithm. For example, when the client is advertising live streaming, the client can end the live streaming at the peak of popularity, so when they restart live streaming next time, the popularity will automatically remain at the same level as the last paid live streaming. However, these approaches are temporary, unstable, and could be easily changed by parameter adjustment of the algorithm.

7 Data: The Future Direction

Data are the key to advertising, especially in the digital era. Digital consumer data should be regarded as a common resource, and dealing with such data is an important, ongoing, and often undervalued aspect of advertising practice (Cluley, 2020). However, both practical advertisers and academic researchers have emphasized the importance of data-driven marketing, while neglecting the fact that data do not naturally exist. Users’ data is generated during various services on the internet, collected by the service provider, structured, stored, and maintained by a data management

platform, and eventually traded and reassembled in an advertising system. The hero's journey from raw data to tradable data is called data commodities (Aaltonen et al., 2021). Assisted with digital consumer data, programmatic advertising can customize messages based on personal identification and customer preference (Van Doorn & Hoekstra, 2013).

Identification is the foundation of data assembling, where a user's behavior in various services attributes to the user's identification. When you are enjoying a digital service on the internet, the service provider automatically obtains the identifier for advertisers (IDFA) of your device, and your online behavior is assembled across various platforms in the data management platform. For instance, when a user searches for "microwave" in a search engine, their IDFA will be marked as "microwave searcher" in the data management platform. Following this, microwave sellers can accurately advertise to those audiences with "microwave searcher" IDFAs on the e-commerce website. Although the IDFA is not tied to a person, users can still be easily identified and tracked by ostensibly anonymized data, leading to privacy leaks (Koetsier, 2021).

However, one unexpected game-changer emerged in 2021. Under Apple's new policy of app tracking transparency (ATT), devices equipped with iOS 14 are no longer automatically permit digital service providers to access the IDFA (O'Flaherty, 2021). ATT is claimed to increase data collection transparency for user privacy protection. Under the new policy, service providers can still know your preference but do not know who you are and are unable to combine your behavior across various platforms. Despite the privacy issue, the new policy diminishes the richness of digital consumer data, and indirectly boosts advertising costs, as the advertising accuracy is jeopardized. According to the Chief Finance Officer of Meta, Apple's new privacy policy may cost a 10 billion US dollar revenue reduction in 2022 (Leswing, 2022). Advertisers now have to spend 31% extra budget for advertising display on Meta to obtain the same advertising effect as before the ATT policy (Holiday, 2022).

Besides gaining the reputation of privacy defender, device manufacturer Apple also financially benefited from ATT. Apple's in-house advertising business tripled its market share in the six months after the new policy, and more than half of app downloads now result from Apple's in-house advertising (McGee, 2021). Digital consumer data, a critical strategic resource, is fundamentally and physically controlled by the upstream server. With the boom of the digital market, upstream service providers are re-imagining the role of advertising in their ecosystem and repositioning themselves with the predominance of digital consumer data in the advertising market. Advertisers should be prepared for new entrants in the market: who is next? Operation system providers, chip producers, or the internet service provider?

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Does Ageing Limit Employees' Creativity? A Brief Review of Research on Ageing and Creativity



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Abstract The concept of creativity has emerged as an essential topic in management research in recent decades owing to its importance to innovation, effectiveness, and sustainability. Although scholars have explored a variety of factors that influence an individual's creativity, earlier studies have ignored the role of an individual's age. Furthermore, age has been treated as a control variable in most studies of creativity, and less as an antecedent or moderator of creativity. Nonetheless, research on ageing has developed significantly in recent years, primarily in response to the global ageing population and workforce. This has led scholars to acknowledge the complex associations between age and creativity; a variety of relationships—even contrary findings—have been empirically documented. Organisations need to adopt a more comprehensive, accurate, and objective understanding of older workers' creativity to guarantee organisational performance, development, and survival. In this chapter, we aim to review the main theoretical perspectives and empirical findings on creativity and ageing, as well as studies at the intersection of both of these fields, before finally outlining promising directions for future research.

Keywords Ageing · Creativity · Workforce

1 Introduction

The world's most innovative companies have expanded considerably over the past few decades due to their advancements in creativity. Firms achieve success by encouraging their employees to be innovative, thereby releasing their creative potential

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(Tams & Dulipovici, 2019). For instance, 3M, a world-renowned manufacturing company, has introduced a strategy of open innovation in its teams, encouraging employees to ‘bring complementary resources to the innovation process’ (de Aro et al., 2020). Through its strong R&D capabilities, 3M has developed innovative products for various industries and won the trust of its customers (3M Annual Report, 2019). Moreover, 3M’s strategy of creativity and responsible innovation has allowed it to withstand the economic challenges posed by the COVID-19 pandemic; its revenue even increased in 2020 (3M Company, 2021). Creativity is a key focus of management research because it is the critical basis for innovation, effectiveness, and sustainability (Binnewies et al., 2008, p. 442), as well as the overall growth of an economy (Pfeifer & Wagner, 2014). Additionally, creativity can help organisations to take advantage of emerging opportunities in a dynamic business environment (Shalley et al., 2004). Thus, there has been an increasing research interest in the factors that can enhance the creativity of an organisation’s employees (Binnewies et al., 2008, p. 442).

It is necessary for organisations to stimulate the creativity of their employees, especially that of older employees who increasingly constitute a larger proportion of the workforce. There are currently unprecedented levels of ageing in populations worldwide due to consistently low birth rates and gradually increasing life expectancies (Truxillo et al., 2015; Viviani et al., 2021). The proportion of the elderly is on the rise in most countries, regardless of their respective income levels (Ye et al., 2021). It is estimated that by 2050, there will be approximately 2.1 billion people aged 60 years and above; they will account for 22% of the world’s total population (i.e., twice the proportion of this population in 2000) (World Health Assembly, 2016; World Health Organisation, 2021). Moreover, Data from the Organisation for Economic Co-operation and Development (OECD) indicate that this demographic change is altering the age composition of the global workforce (Organisation for Economic Co-operation & Development, 2020) and creating a challenge for the world labour market (Nagarajan et al., 2019). The ageing of the world’s population will also create economic challenges for both organisations and individuals (Boehm et al., 2021; Kulik et al., 2014). To cope with this demographic change, countries have begun to postpone ages of retirement and to promote an extended work life (Gilsoul et al., 2021; Steenstra et al., 2017). A postponement in the age of retirement will mean that more workers aged 55 years and above will remain in the workforce (FitzGerald et al., 2017). In China, ‘the current retirement age is 60 for men, 55 for female civil servants, and 50 for female workers’ (China Daily, 2011). However, China’s top labour official has stated that as these ages of retirement were originally set in the 1950s, they are no longer compatible with today’s economic environment and will therefore have to be postponed (The Economist, 2021). Similarly, on 4 June 2021, Japan enacted a bill to gradually raise the retirement age of civil servants from 60 to 65 by the fiscal year of 2031 (Nippon Politics, 2021).

An ageing population results in a decrease in the availability of younger workers in the workforce as well as ‘an increase in the overall age of the workforce’ (Ross, 2010). The effect of ageing on the labour market has increasingly become an important area of research. Studies have sought to understand the relationship between the age of an

organisation's workforce and different organisational outcomes, especially creativity (Binnewies et al., 2008, p. 442). In a meta-analysis, Eder and Sawyer (2007) found that there was no direct relationship between age and individual creativity. Nonetheless, there remain widespread negative stereotypes about older workers, such as the belief that they are less innovative and more resistant to change (Gaillard & Desmette, 2010). Such negative age-based stereotypes may have a significant cumulative impact on older workers (Murphy & DeNisi, 2021).

Does ageing really lead to a decrease in an individual's creativity? The many examples of individuals who are both old and highly creative contradict this claim. Sir James Dyson, a 74-year-old British industrial designer and entrepreneur, leads more than 5,800 engineers globally in the development of new products for his company, Dyson Limited. Hayao Miyazaki, an 80-year-old Japanese animator and manga artist, has been creating and publishing animated works that convey the relationships between humanity and nature, pacifism, feminism, and other concepts since 1963. Zhong Nanshan, an 85-year-old Chinese pulmonologist, spearheaded China's fight against the severe acute respiratory syndrome (SARS) outbreak in 2002 as well as the recent COVID-19 pandemic (Li et al., 2021). In addition to these examples, many studies show that age does not hinder innovation-related behaviours; rather, they suggest that it is counterproductive to exclude older workers from creative tasks (Ng & Feldman, 2013b).

Organisations globally are faced with an ageing workforce while simultaneously competing to recruit the most talented employees. Thus, they should realise the innovative potential of older workers, who make up a significant part of the workforce. This calls for a deeper understanding of the relationship between creativity and age (Hernaus et al., 2019; Volmer et al., 2019). In this chapter, we review the existing research on creativity, age, and the combination of these two fields. We first review the dominant literature on creativity, followed by that on age. Next, we summarise the empirical research on the relationship between creativity and age. Finally, we outline promising directions for future research on creativity and age.

2 Creativity

2.1 Definition of Creativity

In 1988, Amabile set out the then broadly accepted definition of creativity: 'Creativity is the production of novel and useful ideas by an individual or small group of individuals working together' (Amabile, 1988). According to this definition, 'novel' refers to an idea being unique relative to other existing productions, while 'useful' means that the idea could bring potential value to an organisation (Shalley et al., 2004). Although these two core components of creativity are often considered in concert and occasionally treated as a one-dimensional indicator of creativity, they do not necessarily have equal status in some industries (Gruys et al., 2011). In practice, creativity can be

measured as the ‘novel worth’ or ‘worthy novelty’ of a product or service, which can be variously evaluated based on the specific preferences or intentions of the party in question (Im et al., 2015; Sánchez-Dorado, 2020). For instance, while creative art industries value novelty over worth, technology and innovation-based companies value novelty and worth equally, and some manufacturing industries value worth over novelty (Gruys et al., 2011). However, knowledge of the relationship between novelty and value remains incomplete, despite this being a widely investigated topic (Gruys et al., 2011). In the following section, we discuss a conceptual framework of creativity and the main theoretical perspectives on the subject.

2.2 Main Theoretical Perspectives on Creativity

2.2.1 The Componential Model of Creativity

Based on her definition and assessment of creativity, Amabile (1982) proposed a componential framework for conceptualising creativity. This framework included three components necessary for an individual’s creativity: domain-relevant skills, creativity-relevant skills, and task motivation. Subsequently, task motivation was refined to intrinsic task motivation (Amabile, 1983, 1988). Domain-relevant skills constitute an individual’s complete set of response potentials. Individuals that possess domain-relevant skills may perform more creatively and have greater proficiency in intellectual tasks when they are appropriately organised (Newell et al., 1958; Ruscio & Amabile, 1999b). Creativity-relevant skills include several elements, such as the cognitive styles that facilitate the understanding of task complexities and the solving of problems from new perspectives, the heuristics used to explore new cognitive pathways, and the work styles that ensure that work is persistently and enthusiastically pursued. Creativity-relevant skills can be improved through training and the development of personal strategy (Amabile, 1988; Ruscio & Amabile, 1999b).

Intrinsic task motivation, an essential component of creativity, refers to an individual’s self-determination as well as their intrinsic need to derive a sense of competence (Deci, 1975; Ruscio & Amabile, 1999a). An individual’s intrinsic task motivation can be modified and enhanced through training (Deci, 1975; Deci & Ryan, 1980). Individuals who possess high levels of intrinsic motivation are motivated by personal challenges, show greater interest in job or tasks, exhibit creative responses, have greater risk-taking tendencies, prefer to remove barriers to innovative approaches, and provide innovative products or ideas even when they are in a new and complex job (Gu et al., 2015; Hackman & Oldham, 1980; Shalley et al., 2004; Utman, 1997; Zhou & Shalley, 2003). Additionally, according to cognitive evaluation theory (Deci & Ryan, 1985), an individual’s intrinsic motivation and creativity can be enhanced through the careful use of rewards and incentives (Hennessey & Amabile, 1998).

Nonetheless, as research on creativity has progressed, the conceptual framework of creativity has been modified to incorporate new elements. The first is that of the work environment, which can be an essential factor influencing a worker’s creativity

(Amabile & Conti, 1999; Amabile & Pillemer, 2012). A second important element is that of time pressure, which has been shown to impair an individual's creativity (Amabile et al., 2002). A third element influencing creativity—and a crucial feature of the work environment—is the support that an individual receives from their leader. For instance, positive leader behaviours have been suggested to promote employee creativity (Amabile et al., 2004). A fourth element is positive affect, which can enhance an individual's creativity in an organisational setting (Amabile et al., 2005). Recently, Amabile and Pratt (2016) updated the conceptual framework of creativity by incorporating the effects of the organisational work environment and accounting for the interplay between creativity at the level of the individual or in small groups and organisational innovation.

2.2.2 Interactionist Perspective of Individual Creativity

Woodman and Schoenfeldt (1989, 1990) argued that individual creativity is the complex product of an individual's behaviour in a particular situation. Building on this argument, they developed an interactionist model of creativity at the individual level that combined personal and contextual factors (Hora et al., 2021b). According to the interactionist model, an individual's creativity is an output transformed from creativity-relevant characteristics through innovative processes and contexts (Hora et al., 2021a; Woodman et al., 1993). This implies that: 'an individual's creativity can be influenced by a variety of factors that operate at different levels' (e.g., at the level of the individual, team, or organisation) (Yekaniyalibeiglou et al., 2021).

Many empirical studies have recently documented the personal and contextual factors that influence an individual's creativity from the interactionist perspective. Such personal factors include growth need strength (Shalley et al., 2009), need for cognition (Wu et al., 2014), insecure attachment styles (Kirrane et al., 2019), proactive personality (Waheed & Dastgeer, 2019), as well as employee psychosocial needs (Yekaniyalibeiglou et al., 2021). The contextual factors influencing an individual's creativity include a supportive work context (Shalley et al., 2009), task autonomy and feedback from the job (Battistelli et al., 2013), transformational leadership (Gilmore et al., 2013), the role of social exchange relationships (Kirrane et al., 2019), daily time pressure and resource allocation (Bormann, 2020), the psychological safety of a team (Hora et al., 2021b), the nature of the physical environment (e.g., the availability of activity-based offices or ABOs) (Yekaniyalibeiglou et al., 2021), and the level of supervisor support (Ragini & Ghosh, 2022).

2.2.3 Model of Individual Creative Action

Creativity, a process of innovation, is a complex phenomenon; one that researchers have attempted to comprehensively describe. A model of individual creativity should include elements that drive an individual to take on creative actions. Ford (1996) developed a theory that explained individual creative action as being influenced by

three processes: sense-making, motivation, and knowledge and ability. According to this theory, combinations of factors would produce complex and nonlinear effects on individual creative actions, and a significant imbalance in one factor could result in poor creative actions (Ford, 1996). Self-efficacy, for instance, is an essential condition for creative productivity and a crucial motivational component in the model of individual creative action (Bandura et al., 1997; Ford, 1996). Research has shown that self-efficacy can be enhanced via task-specific training, and that a high level of self-efficacy improves creative performance (Axtell & Parker, 2003; Tierney & Farmer, 2002, 2011).

According to Ford (1996), individuals lose their enthusiasm for creative actions when they are concerned about the potential effects of those actions on other levels of their organisation. Examples of such concerns include the intentions of other team members, the availability of various types of support from the organisation, external requirements or restrictions, and the potential profits from the sales of new products. Ford (1996) also argues that an individual's creative and habitual actions in the organisational environment represent two kinds of conceptually independent actions. Individuals usually perform creative actions when they deem the potential consequences of those actions to be more desirable than those of their habitual actions that have led them to success in the past (Ford et al., 1995; March, 1991). However, according to the model of individual creative action, successfully creating innovative actions does not necessarily entail breaking out of conventional behaviours; rather, individuals can achieve creativity while maintaining their habitual behaviours (Ford, 1996).

2.2.4 Dual Pathway to Creativity Model

In studying mood and creativity, Isen et al. (1987) suggested that while a negative affect would neither facilitate nor impair creativity, an individual with a positive affect would be more likely to display greater creativity. Furthermore, they argued that creativity can be facilitated by a temporary pleasant affective state, such as a pleasant surprise; however, surprise events also become ineffective at inducing creativity if they occur frequently (Isen et al., 1987). Subsequent studies proposed a contrasting view. For instance, it was proposed that negative moods influence creativity—and in some cases even promote creativity—by affecting an individual's evaluation, motivation, and behaviour (Martin & Stoner, 1996; Martin et al., 1993).

To reconcile such contrasting perspectives and findings on the relationships between mood and creativity, De Dreu et al. (2008) developed a dual pathway to creativity model. They argued that previous studies may have predominantly focused on positive and negative affect as well as cognitive flexibility. To address this, they conceptualised mood states as comprising two underlying dimensions: a hedonic tone (that is positive vs. negative), which is the prerequisite for creativity, and cognitive activation (that is activating vs. deactivating), which determines the route that creativity takes. According to the dual pathway to creativity model, only activating mood states can facilitate creative fluency and originality, while creativity can be

stimulated by both positive mood (through an increase in cognitive flexibility) and negative mood (through 'increased perseverance within thought categories and a longer time spent on the task') (De Dreu et al., 2008).

2.2.5 Creative Cognition

The concept of creative cognition is a natural extension of cognitive psychology (Shalley & Perry-Smith, 2008). Creative cognition includes the recognition of new opportunities or problems, the process of trying innovative actions, and the exploration of different methods to solve a problem (Shalley & Perry-Smith, 2008; Sternberg & Lubart, 1991). Theory on creative cognition emphasises that 'creative capacity is an essential property of normative human cognition' that every individual possesses to some degree (Shalley & Perry-Smith, 2008; Ward et al., 1999). In general, the concept of creative cognition aligns with previous research on the factors that influence creativity. However, scholars suggest that non-cognitive factors can also indirectly impact an individual's creativity by influencing their cognitive functions (Ward et al., 1999). Hence, individuals' creativity levels vary according to the general differences in their cognitive capabilities and functions (Ward et al., 1997, 1999).

2.2.6 Social Network Perspective on Creativity

The social network perspective views creativity as a social process. Studies adopting this perspective on creativity have explored a multiphase spiralling interplay between creativity and centrality (Perry-Smith & Shalley, 2003). Such studies have found that although individuals in peripheral positions have weaker ties in social networks, they maintain greater connections to external parties, and are therefore likely to spark creative insights and valuable ideas (Shalley et al., 2004). In addition, when individuals who are at the margins of social networks achieve high levels of creativity, they tend to move from the peripheral to central positions of their social networks. In doing so, they establish internal connections with diverse groups of people and gain access to wider arrays of information that can be used to support their creative ideas (Perry-Smith & Shalley, 2003). Nonetheless, when those individuals eventually arrive at the centres of their respective social networks, their central positions, social relationships, and excessive ties constrain their creativity (Perry-Smith & Shalley, 2003).

Studies have also demonstrated the effects of three characteristics of the social context in moderating the relationship between a social network and creativity: 'diversity relative to the network, cultural norms, and tightness of the symbolic structure' (Perry-Smith & Shalley, 2003). First, when demographic similarities (e.g., race, sex, educational background, and tenure) exist in a social network (Williams & O'Reilly III, 1998), people can interact and communicate more efficiently, thereby enhancing the relationship between network centrality and creativity (Byrne, 1971; Perry-Smith & Shalley, 2003). Second, if the culture of a social network is strongly

shaped by competition, creativity is stifled because individuals are less motivated to discuss work-related information (Bouty, 2000; Perry-Smith & Shalley, 2003). Lastly, a tightly organised social network is more likely to unanimously accept a new idea or product as a creative achievement compared to one that has less defined rules, even if the originator of the idea is a newcomer to the social network (Csikszentmihalyi, 1996; Perry-Smith & Shalley, 2003).

Summary. In reviewing research on creativity from recent decades, we find that scholars have sought to attain a comprehensive and in-depth understanding of creativity, primarily by developing theories or models that explain when and how an individual engages in creative action. In general, theories of individual creativity have adopted four perspectives: the motivational, affective, cognitive, and social perspectives. In reviewing several representative theories of creativity, we find that contextual factors (e.g., the work environment, leader support, and cultural norms) and individual factors (e.g., domain-relevant skills, creativity-relevant skills, and creative cognition) interact with an array of individual-level variables (e.g., intrinsic motivation, creative self-efficacy, emotional states, cognitive processes, social network centrality etc.) to shape an individual's creativity. Below, we turn to another critical section of this chapter, age.

3 Age

3.1 Definition of Age

With the growing up of the 'baby boomer' generation and their entry into the global labour market, studies have paid greater attention to ageing (Avery et al., 2007; Cleveland & Shore, 1992; Wang & Wanberg, 2017). For instance, in the 1970s, the topic of the 'older worker' became a policy priority in both the public and business domains (Robertson & Tracy, 1998). In general, researchers define older workers as employees that are above the age of 40; however, such definitions also vary across different parts of the world. For instance, in Europe, older workers initially referred to individuals who were aged 40 years and above (Welford, 1985), but this was subsequently raised to refer to individuals aged 50 years or older (Rechel et al., 2013). In America, older workers referred to individuals above the ages of 45 or 55 years (American Association for Retired Persons, 1985; World Health Organisation, 1993). The Organisation for Economic Co-operation and Development (2006) defines older workers as individuals aged 50 years or older.

Despite the variation in the defined age range, older workers in different countries generally display similar characteristics. They may be affected by declines in their physical functioning (Strebq, 2008), such as a decline in vision, hearing, and muscle capacity (Boenzi et al., 2015), as well as a lowered activity level, poor lung capacity and blood circulation, and chronic illness (Gilsoul et al., 2021). In addition, when an accident occurs at the workplace, older workers are more likely to be severely affected

and to require more extensive periods of recuperation, which can result in them being absent from work longer (Silverstein, 2008). Based on these apparent physical characteristics of older workers, researchers have argued that the job performances of older workers can be affected by increases in absenteeism and lowered productivity (Wells-Lepley et al., 2013). However, other studies have suggested that worker age and creativity are only weakly related (Ng & Feldman, 2013b).

The studies discussed above defined age as the chronological age of an individual by default. Nonetheless, Sterns and Doverspike (1989) list five approaches to conceptualising the ageing of an employee (Dordoni & Argentero, 2015); this can be based on the individual's chronological age, functional or performance-based age, psychosocial or subjective age, organisational age, or lifespan age. These approaches are explained with respect to older workers as follows.

Chronological age refers to an individual's calendar age. In terms of chronological age, older workers are individuals who are above the age of 40. Functional or performance-based age is based on a worker's job performance, which can vary based on their capability and physical functions at different ages. For instance, old workers may perform differently from younger workers in their biological and psychological capacities, cognitive abilities, and job performance. Psychosocial or subjective age is based on an individual's self-perception of age as well as social perceptions of age. An individual's self-perception of age is based on their personal feelings, appearances, actions, and desires (Kaliterna et al., 2002). The social perception of age involves three issues: how a society perceives the ages of older workers, the attitude a society takes towards older workers, and how the labelling of older workers affects personal decisions. Organisational age usually refers to a worker's seniority and organisational or job tenure. Alternatively, it can be based on an individual's career stage, an organisation's internal age norms, and the skill obsolescence of a company. The life-span concept of age emphasises the likelihood of behavioural changes occurring at any stage of an individual's life cycle in accordance with the four previous approaches to conceptualising an individual's age. This concept considers the behavioural changes of older workers to be influenced by two normative factors (i.e., age-graded biological or environmental determinants and history-graded influences) and one non-normative factor (i.e., rare career and life changes).

Given that conceptualisations of older workers vary considerably, it is challenging to state conclusively that older workers always display poor individual performance (Robertson & Tracy, 1998). Moreover, the variability in motor performance among individuals increases dramatically with age (Spiriduso & MacRae, 1990). Increasingly, studies on ageing combine multiple theories, and suggest that older workers maintain life satisfaction by being productive in society while resisting their declining physical capabilities (Gergen & Gergen, 2006; Lemon et al., 1972). Below, we discuss the main theoretical perspectives on age.

3.2 *Main Theoretical Perspectives on Age*

3.2.1 *Life-Span Development Theory*

The theory of life-span development has strongly shaped research on ageing. This theory can be traced to Super (1957), who established a ‘life-span career stage model’ to analyse individuals’ career progress. Subsequently, Levinson and Darrow (1978) established ‘the life stage theory of adult development’, an influential theory used to understand the forces shaping an individual’s life. Later, Levinson and Darrow (1978) established another theoretical notion from life-span development theory titled ‘rational choice theory’; this will be explained in the following sections.

Life-span career stage model. According to Super’s (1957) life-span career stage model, the majority of older workers are in the ‘Maintenance’ stage (i.e., those aged 45–64) and the ‘Decline’ stage (i.e., those aged 65 and older). The adult development of workers at these stages has already been cemented by their personalities and cumulative life experiences (Baltes, 1987; Wieck et al., 2021). Therefore, older workers are expected to engage in career management-related activities in the Maintenance stage, such as in decision-making for their career choices, professional training, and the pursuit of career success. By contrast, older workers in the Decline stage are expected to exit their careers and retire.

Rational choice theory. Levinson and Darrow (1978) identifies a key theoretical notion from the life-span development theory; that is, an individual’s life structure is mainly affected by their social and physical environment, which include their family and work. Many studies combine this theoretical notion with rational choice theory and apply it to the phenomena of career management and retirement (Wang et al., 2008). Rational choice theory suggests that retirement represents a trade-off between the financial resources that one accumulates through work and one’s requirement to retire (Martin & Xiang, 2015). Accordingly, older workers will choose to disconnect from work when they think that their resources are sufficient to cover their needs for consumption during retirement (Wang & Wanberg, 2017).

3.2.2 *Selection, Optimisation, and Compensation Model*

The selection, optimisation, and compensation model posits that individuals maximise their gains and minimise their losses from ageing through three essential processes that regulate developmental regulation (Baltes, 1987; Hernaus et al., 2019). The model implies that older workers are more likely to deliberately focus on a specific goal, which may take up most of their energy and resources (Kooij & Kanfer, 2019). Moreover, research suggests that older workers tend to be more satisfied with the status quo, avoid potential risks, and use familiar solutions to deal with new problems (Ford & Gioia, 2000). Therefore, in comparison to their younger colleagues, older workers may be less likely to cause occupational accidents (Benjamin & Wilson, 2005).

3.2.3 Continuity Theory

Continuity theory, established by Atchley (1999), posits that individuals have a common tendency to maintain uniformity in their life patterns over time. According to this theory, older workers are more likely to maintain internal continuity, such as in their experiences, dispositions and skills, and external continuity, such as in their social roles, activities, and relationships (von Bonsdorff & Ilmarinen, 2013). With respect to their internal continuity, older workers are more likely to purposefully select tasks that optimise their experiences (Kim & Hall, 2013); this contrasts with younger workers, who are more willing to gain knowledge and information from diverse sources (Li et al., 2021). Thus, older workers may not change their modes of working or accept innovative ones easily. With respect to their external continuity, older workers' age and organisational tenure tend to increase in tandem because they are less likely to change organisations (Werbel & Bedeian, 1989). Additionally, given the tremendous challenges associated with re-entering the labour market, older workers may be less likely to willingly leave their organisations or change their jobs (Gielen & van Ours, 2006).

In sum, continuity theory posits that older workers tend to prioritise their abilities and the nature of the situation over organisational rewards when planning to take action. This prioritisation is reflected in the protean career model.

Protean career model. The protean career model states that one's career direction is mainly driven by their personal values rather than organizational demands and constraints (Hall, 1986, 2002). Furthermore, individuals should adapt to dynamic work environments according to their personal values (Wang & Wanberg, 2017). However, older workers are less likely to change organisations (Werbel & Bedeian, 1989), and can achieve significantly higher productivity in organisations that provide specific work environments or age-specific jobs (Göbel & Zwick, 2012).

3.2.4 Social-Emotional Selectivity Theory

According to Social-emotional Selectivity Theory (SST) (Carstensen, 1992), older individuals typically view the concept of 'time' as the limited amount of time they have left in life. Studies have documented three main differences between older and younger workers that evidence this theoretical proposition. First, older workers tend to have more present-oriented goals. Thus, they tend to be more concerned about the valence and delivery method of the feedback they receive on their performance; this contrasts with younger workers, who are more concerned about the quality of feedback and their future career opportunities (Smit et al., 2015; Wang et al., 2015). Similarly, older workers have been found to be more cooperative and less competitive than their younger colleagues (Wong et al., 2008). Second, older workers prefer to maximise joyful emotional experiences over passive ones (Kanfer & Ackerman, 2004; Mather & Carstensen, 2005). They are better at recognising positive relationships from problematic ones (Fingerman et al., 2004), and are especially likely to be encouraged by positive emotional experiences from their social relationships

(Wang et al., 2015). The third difference between older and younger workers is more controversial, as the relevant studies have reported contradictory findings thus far. Some studies have suggested that older workers can better understand and manage the emotions of their younger colleagues than their own (Bruine de Bruin et al., 2014). However, Wieck et al. (2021) recently found that older workers showed a decline in the cognitive facets of empathic accuracy, stable emotional congruence, but increasing emotional sympathy. Additionally, in emotionally demanding jobs, older workers may maintain lower levels of emotional congruence than younger workers (Wieck et al., 2021).

Summary. Older workers are in the later stages of their life-spans and careers. They engage in activities that align with their collective life experiences and do not readily change their behaviour patterns, jobs, or environments. Compared with younger individuals, older individuals tend to be more satisfied with the status quo. Thus, when they face new challenges, older individuals tend to combine their resources to solve problems in familiar ways, try their best to avoid risks, and seek to maximise benefits while minimising losses. Even when changes need to be made, older individuals make their decisions based on their personal capacities and purpose, rather than considering organisational rewards. In addition, older individuals are more inclined to obtain and maximise positive emotional experiences. Thus, when receiving feedback from others, they are more likely to be concerned about the delivery of the feedback, rather than its content, such as the quality of the feedback or the potential future benefits it entails. In the following section we summarise the findings of empirical studies on age and creativity.

4 Research on Age and Creativity

In the earliest research on creativity and age, Lehman (1960) proposed that human creativity declines with age, as older individuals may be more intelligent but less expressive of their originality than younger individuals. From the 1970s, scholars began to explore the links between creativity and ageing populations (Zhang & Niu, 2013). Simonton (1975) supported Lehman's perspective and further suggested that the negative relationship between creativity and age is likely to be applicable across cultures and is stable over time. Nonetheless, by the 1980s and early 1990s, the concept of 'late-life creativity' had become a well-established topic in gerontological research (Gallistl, 2018). Subsequent studies scrutinised the age-creativity relationship in greater detail and suggested that the relationship is a multi-dimensional concept (Sasser-coen, 1993). Nonetheless, in reviewing data only related to creativity, Ng and Feldman (2008) found that age was irrelevant to creativity. Recent research has claimed that where older individuals are concerned, creativity should be conceptualised as a counterpart to difficulties with self-expression. Furthermore, a person's creativity can reveal their individuality at all stages in their life-span (Baars, 2012; Gallistl, 2018). Overall, the relationship between age and creativity remains complex and relatively understudied (Rietzschel et al., 2016).

Previous studies typically maintained negative attitudes about the links between older workers' creative abilities and their calendar ages. In exploring the relationships between age and innovation-related behaviours (IRB), Ng and Feldman (2013a, 2013b) conducted a meta-analysis of 98 empirical studies and found that, contrary to the general opinion, an employee's chronological age only had a weak positive effect on their IRB, while their organisational age did not affect it. In addition, both conceptualisations of age had a weaker effect on an individual's creativity than IRB. Thus, an older worker's age would not directly influence their creativity. Nonetheless, the relationship between age and creativity may be moderated by other factors.

Based on the selection, optimisation, and compensation model, Ng and Feldman (2013a) examined the potential moderating effect of supervisor undermining and proactive personality on the relationship between age and IRB. They found that age was positively related to IRB. Additionally, they found a discordant three-way interaction between age, supervisor undermining behaviour, and proactive personality on IRB. Specifically, when the level of supervisor undermining is relatively high but an individual has a relatively low proactive personality, the relationship between age and IRB is negative. Otherwise, older workers exhibit greater IRB than younger workers.

Binnewies et al. (2008) investigated the moderating effects of two other factors: job control and support for creativity. First, they found little evidence that job control affects the creativity of older workers. They also found that older workers display slightly better performance when placed under high levels of job control. However, younger workers clearly show greater creativity at low levels job of control. These age-based distinctions may be due to the accumulated working experience and self-confidence of older workers, who can develop innovative ideas more independently. Second, Binnewies et al. (2008) found that age is not linked to creativity under conditions of strong support for creativity. Specifically, when support for creativity is relatively low, older workers show less creativity, as they prefer to use standard approaches due to a lack of encouragement from their co-workers and supervisors.

Schubert and Andersson (2015) examined the moderating effect of employee turnover on the relationship between age and innovation. They suggested that a 'turning point' shapes employee turnover in organisations: when the turnover rate is below this point, managers should increase turnover to promote employees' innovative behaviours. In addition, the more significant the proportion of elderly workers in an organisation, the smaller the turning point.

More recently, Guillén and Kunze (2019) found a negative curvilinear relationship between age and innovative behaviour that only applied to older workers who were above 41 years old. They also noted that in the presence of high interdepartmental collaboration, the reduction in older workers' innovative behaviours takes longer to manifest.

In most management studies on creativity, an individual's age is often treated as a control variable (Binnewies et al., 2008). The empirical findings of recent studies are cases in point. Hernaus et al. (2019) investigated the relationship between job complexity and supervisor-rated employee innovative work behaviours from the life-span perspective. Their results suggested that workers in various age stages

provide a similar level of innovative work behaviours when dealing with sample job tasks. When job complexity increases or job innovation requirements decrease, older workers respond to lower innovative work behaviours than younger colleagues.

Another set of empirical findings stem from Volmer et al.'s (2019) research on the relationship between personal affect and creativity. This study applied a two-dimensional approach to distinguish positive affect (e.g., 'interested', 'active', and 'alert') from negative affect (e.g., 'upset', 'afraid', and 'nervous') (Zhou & Shalley, 2011). The results of the study indicated that an individual's age provided a significant and positive effect on the relationship between their positive affect and creativity. Specifically, compared with their typical daily level, older workers were more likely to show a higher level of creativity when they had high levels of positive affect. In contrast, only younger workers' creativity was promoted by negative affect, which did not influence the innovative performance of older workers.

Summary. In conclusion, age represents an important independent variable that affects creativity, or that moderates the various relationships between other variables and creativity. The direct relationship between age and creativity is weak, but can be enhanced by various moderators such as job, support, and work environment (Amabile et al., 2004; Ng & Feldman, 2013b; Ruscio & Amabile, 1999a). In addition, age has moderating effects on the relationship between creativity and other independent variables. Overall, older workers can make creative contributions to organisations under specific circumstances (Spanjol et al., 2015). However, few scholars have explored the mediating effects of age on creativity, and this is a future direction for research in this field.

5 Future Research Directions

Although scholars worldwide have argued about the relationship between age and creativity for decades, the gradually ageing population and more age-diverse workforce have opened up new directions for additional research in this area. Below we summarise the areas of research on creativity and age that deserve more attention.

5.1 *The Operationalisation of Ageing and Age*

The share of older workers in the global workforce is increasing due to increases in human life expectancy, a product of significant improvements in public health, the social environment, and economic development (Ghorbanizadeh et al., 2019; World Health Organisation, 2002). In this context, an increasing number of countries are planning to gradually raise their statutory retirement age to over 65 (Gilsoul et al., 2021). Nevertheless, previous research on individual creativity has primarily focused on groups aged 40 and above. Thus, future studies about the creativity of workers

should consider raising the average age of the study population (Ng & Feldman, 2013b).

Additionally, most studies have used an individual's chronological age to test the relationships between age and creativity. However, recent research on the conceptual framework of ageing identified five approaches for defining an individual's age: that is, 'chronological age (i.e., calendar age), functional age (i.e., cognitive abilities and physical capacity), psychosocial age (i.e., self-perceptions and social perceptions), organisational age (e.g., tenure and career stage), and lifespan age (i.e., life stage or family situation)' (Kooij et al., 2008). Individuals that share the same life stage but are from different generations, tenure or experiences display significantly different performance in the workplace (North, 2019). As these groups diversify, some older employees (as defined by their chronological age) will remain healthy, skilled, and sufficiently creative to contribute to organisations and society (Price & Tinker, 2014; Warr, 1992). Therefore, scholars investigating creativity and age should provide a more precise definition of the older worker in the workplace context.

5.2 Age-Based Stereotypes and Older Workers' Creativity

One typical stereotype of older workers is that they are conservative and lack the openness to generate creative ideas or behaviours (Rietzschel et al., 2016). Even within academic fields, some researchers have tended to negatively assess older employees, adopting a pessimistic approach (Peeters & van Emmerik, 2008). Such attitudes overlook or underestimate the innovative ideas proposed by older workers. This may in turn lead to adverse reactions from older employees, termed the 'creative backlash effect', whereby older employees cease to express further creativity if their ideas are undervalued because of their age (Rietzschel et al., 2016; Rudman & Fairchild, 2004). Nevertheless, there is insufficient empirical evidence that older workers receive more negative evaluations of their creativity. A longitudinal study to track and compare whether older workers are more vulnerable to such negative responses from their surroundings, thereby reducing their future creativity, would be beneficial.

5.3 The Multiple Roles of Older Workers in Creativity

In a recent study, Zhou et al. (2019) reviewed four factors that influence creativity: target, creator, perceiver, and context. Among these, it was proposed that older workers may play the role of the target, creator, and perceiver. However, existing research on the creative performance of older workers has mainly assumed that older workers only take on the role of creator. Thus, we call for more research on the multiple roles of older workers in creativity. For instance, researchers could explore whether older workers have poor creativity because they are ineffective creators or

because they receive poor evaluations as targets. Researchers could also investigate whether older workers have different conceptions and evaluations of creativity from their younger colleagues when they play the role of perceivers. If there are indeed differences in performance that relate to creativity between older and younger workers, it would be worthwhile to examine whether these differences are due to differing contextual characteristics. If this is the case, then researchers should ask whether organisations can provide effective interventions to support older workers, such as by reducing contextual differences. This could help bring older workers' perception and performance of creativity in line with those of younger workers in the organisation (Truxillo et al., 2015).

5.4 The Mechanisms Mediating the Relationship Between Age and Creativity

Studies that address creativity and age should explore the role of age as an independent variable or moderating factor, not simply as a control variable. However, no studies to date have examined the mechanisms that determine the effects of age on creativity. This gap suggests that variables that affect creativity through the role of age as a full or partial mediator have probably been overlooked (Hur et al., 2018). How may age influence creativity through motivational, affective, cognitive, and social mechanisms? For instance, does intrinsic task motivation mediate the influence of age on creativity? Does age lead to different creative actions through positive or negative affect? How does creative cognition affect the impact of age on individual creativity? How do different positions in social networks influence the creativity of individuals of different ages? These significant knowledge gaps can be addressed by studies that specifically explore the mediating effects of age on creativity.

To conclude, in light of the global ageing workforce, we have reviewed prominent studies in the fields of creativity and ageing, and studies examining the relationship between the two. We have reviewed the definition of and the main theoretical perspectives on creativity, as well as the approaches to conceptualising age and the main characteristics and theories of ageing. We have also summarised the empirical findings of integrated research on creativity and age and outlined promising directions for future research. The relationship between ageing and creativity has broad significance that extends beyond academic discussions. Although we have revealed the general relationship between ageing and creativity, this remains an emerging field of research. Therefore, we encourage researchers to provide more reliable and valid findings to facilitate the advancement of knowledge on the relationship between ageing and creativity.

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Beyond a Curse or Blessing: The Effects of Team Diversity on Team Creativity and Innovation



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Abstract Creativity and innovation are vital to the success of any organisation. Diverse teams and human resources are often desired by organisations aiming to benefit from team members' varied perspectives, values, ideas, and networks, which support the growing demand for creativity and innovation. However, team diversity is often associated with conflict, judgement, bias, stress, and a lack of communication or trust, which are detrimental to team performance, creativity, and innovation. Therefore, building knowledge about team diversity's mechanism is essential to making the best use of diverse teams, and sustainably managing them to achieve long-term benefits. This paper aims to provide a brief review of theoretical and empirical research on diversity and creativity/innovation at the team level and to shed light on the most promising areas for future research.

Keywords Creativity · Innovation · Effects of team diversity

1 Introduction

The ongoing “fourth industrial revolution”, or “Industry 4.0”, has strongly influenced the lives of people and businesses in today's world. Industry 4.0 is characterised by the application of technologies such as advanced robotics, Internet of Things (IoT), cognitive computing, and artificial intelligence, which have been adopted by different industries, including manufacturing, finance, service and health.

One typical example of Industry 4.0 is Amazon Go (Herrera & Tilley, 2020), which features “cashier-less” stores where customers can purchase products without

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being checked out by cashiers or using self-checkout stations. These stores are made possible with technologies such as computer vision, deep learning algorithms, and sensor fusion. According to the latest information released by Amazon, cashier-less stores have been established in Seattle, Chicago, San Francisco, London, and New York City.

The emergence of Industry 4.0 is undoubtedly creating new demands—especially for greater creativity and innovation—in all sectors of business. Creativity and innovation are identified as the key factors driving the creation of new technology and sustainability of organisations' competitive advantages (Huang et al., 2016), which in turn determine their overall performance, long-term survival, and success. In order to realize creativity and innovation, teams have been widely recognised as significant composition in organisations given their potential to display “skill diversity, high levels of expertise, rapid response, and adaptability” (Kozlowski & Ilgen, 2006, p. 78). Furthermore, teams can excel in creative tasks by capitalising on the wide pool of perspectives and knowledge contributed by different members (Williams & O'Reilly III, 1998).

Accordingly, many organisations value diverse teams and human resources because of their potential to take full advantage of individuals' varied perspectives, values, ideas, and networks to meet the growing demands for creativity and innovation (van Knippenberg, 2017). For instance, companies in high-tech or fast-moving consumer-goods industries commonly maintain research and development (R&D) teams or new product development (NPD) teams. Members of these teams tend to come from a wide range of educational and professional backgrounds, such as chemistry, physics, engineering, manufacturing, industrial design, sociology, marketing, and psychology. These teams not only shoulder the responsibilities of developing successful new products and producing innovations but also do the crucial work of obtaining and sustaining competitive advantages for their organisations.

Nonetheless, more diverse teams may also suffer from negative team processes such as stress, communication problems, conflicts, bias, and excessive competition. For example, members of cross-functional teams often report experiencing increased job stress, poor internal communication, poor cohesion (Keller, 2001), and high levels of interpersonal conflict (Knight et al., 1999) owing to their need to work with colleagues who do not possess the same education, training, and functional goals as themselves. Such negative team processes are detrimental to team performance.

Moreover, given the competitive culture in R&D team, staff working in the same team may easily tend to compose a situation of excessive competition. Members of such teams frequently distrust each other and may hide knowledge from or even provide misleading information to their teammates (Jatinder & Varkkey, 2018). While these unethical actions may benefit individuals in the short term, in the long term, they will inevitably undermine both benefits to individuals and cooperation within the team (Connelly et al., 2012).

How can an organisation make the best use of a diverse team? How can a diverse team be sustainably managed to reap long-term benefits? What mechanisms determine the positive or negative impact of diversity on creativity and innovation? Such questions are of fundamental importance to managers and organisations, as well as

team member themselves. In this paper, we review the existing research on diversity and creativity (or innovation) at the team level. We first discuss the definitions of creativity and innovation and the main theoretical perspectives concerning their antecedents. Next, we discuss the definition and taxonomy of diversity and the key theoretical perspectives regarding its effects on team processes and team performance. We also examine various meta-analyses, reviews, and representative empirical studies on the topic of diversity and creativity (or innovation). Finally, we outline several important areas for future research.

2 Creativity and Innovation

2.1 *The Meaning of Creativity and Innovation*

Creativity is often defined as the generation of both novel and useful ideas regarding products, services, processes, and procedures (Amabile, 1988; Oldham & Cummings, 1996; Zhou & Shalley, 2003). Thus, to be considered creative, ideas must meet both the criteria of being new and having the potential to create value in the short or long term. Therefore, “novelty for novelty’s sake” (George, 2007, p. 442) is not the same as creativity. Similarly, effective problem solving is certainly necessary but does not necessarily manifest creativity (George, 2007).

Whereas creativity is mostly concerned with the production of ideas, innovation includes both the generation and implementation of creative ideas (Zhou & Hoever, 2014). In this regard, creativity is akin to the first stage of innovation.

Despite their distinct emphases, creativity and innovation have been regarded as closely inter-related and overlapping concepts. For instance, some researchers have argued for their conceptual boundaries to be unclear (Anderson et al., 2014). Other scholars have claimed that creativity does not only occur during the early stages of innovative processes but instead suggest a continuous, cyclical, recursive process of idea generation and implementation (e.g., Paulus, 2002). At the team level, it has been proposed that “measures of team creativity and team innovation often overlap to such an extent that team creativity and team innovation research can be reviewed as two parts of the same body of evidence” (van Knippenberg, 2017, p. 212). In this review, we adopt the operation of previous studies (van Knippenberg, 2017; Wang et al., 2019), which do not distinguish team creativity from team innovation due to their high correlations but instead treat these as “exclusive focal dependent variables” (Wang et al., 2019, p. 694).

2.2 Theoretical Perspectives on Creativity and Innovation

There are four main theoretical perspectives of the antecedents of creativity and innovation in teams. Although the models have various similarities and differences, they complement each other and provide a strong framework for understanding creativity and innovation.

2.2.1 Componential Theory of Organisational Creativity and Innovation

The componential theory of organisational creativity and innovation (“componential theory” for short) was proposed by Amabile (1988). In its early form, the theory focuses on three components that are deemed necessary for individual creativity (i.e., domain-relevant skills, creativity-relevant skills, and intrinsic task motivation), as well as three analogous components that influence individual creativity at the organisational level. Notably, the original theory also identifies intrinsic motivation as a significant psychological mechanism underlying an individual’s engagement of creativity and innovation, while considering creativity and innovation to be undermined by extrinsic motivation (Amabile, 1983).

An updated version of the componential theory, which contains a more comprehensive portrayal of organisational creativity and innovation (Amabile & Pratt, 2016), has been proposed to reflect the rapid development of the field of organisational behaviour and the increasing research interest in creativity and innovation. The updated theory depicts individual creativity and organisational innovation as two closely interrelated systems and proposes four new areas of significance. First, creativity and innovation are viewed more dynamically and considered to occur in cycles (i.e., a “progress loop”). Second, the progress principle, which is associated with the psychological state (e.g., self-efficacy), is suggested as crucial to meaningful creative work. Third, the importance of emotions (i.e., affect) is highlighted in addition to the existing attitudinal, cognitive, and behavioural elements of the model. Last, the updated theoretical model considers extrinsic motivation as a significant form of motivation in addition to intrinsic motivation.

Although the above theoretical advancements focus heavily on individuals and the interactions between individual and organisational creativity, they provide insights into the generation and implementation of creativity and innovation in teams, which essentially operate between the levels of individuals and organisations. For instance, recent studies building on the theory of Amabile and Pratt (2016) have found that affect is an important factor influencing team creativity (Emich & Vincent, 2020; Parke et al., 2021).

2.2.2 Interactionist Model of Organisational Creativity

The interactionist model of organisational creativity proposed by Woodman and his colleagues (1993) stresses that creativity is the outcome of a complex interaction between a person and a situation at the individual-, team-, and organisational levels. While the models of Amabile and Woodman et al. both emphasise the role of contextual factors in the emergence of creativity and innovation, the latter more explicitly stresses the importance of interactions among individuals, teams, and situations (Zhou & Shalley, 2003) and considers contextual factors that are both internal to the organisation and external (e.g., the economic and social environments).

Crucially, Woodman and colleagues claims that team creativity depends on but “is not the simple aggregate of all group members’ creativity” (p. 304). In a systematic assessment of creativity, Woodman and colleagues (1993) found that team creativity is influenced by factors such as team composition (e.g., diversity), team characteristics (e.g., cohesiveness, group size, norms), group process (e.g., problem-solving strategies, social-information processing), and contextual influences.

2.2.3 Four-Factor Theory of Team Climate for Innovation

Instead of emphasising individuals’ capabilities in developing new ideas, the four-factor theory of team climate for innovation emphasises that the extent to which team members align with a team’s values and norms determines their capacity to implement creative ideas and thus realise innovation (West, 1990, as cited by Somech & Drach-Zahavy, 2013). In this theory, West (1990) proposed four team climate factors that facilitate innovation: vision, participative safety, task orientation, and support for innovation. Specifically, it postulates that innovation will be enhanced if (a) a team’s vision is readily understandable, valued, and accepted by the team members; (b) team members feel that they can propose new ideas and solutions without the worrisome of being judged or criticised; (c) all team members strive for excellence under a constructive cooperation and feedback system; and (d) team members perceive support for innovation (Anderson & West, 1998).

2.2.4 Ambidexterity Theory

Tensions, paradoxes, contradictions, and dilemmas are common to processes that generate creativity and innovation at the individual-, team-, and organisational levels. Accordingly, the ambidexterity theory has been proposed as a means for understanding and successfully managing such conflicting demands and paradoxes (Bledow et al., 2009).

Instead of addressing these paradoxes from a “static and dichotomous” perspective (Bledow et al., 2009, p. 310), ambidexterity theory proposes a dialectic perspective, which stresses the mutual dependence and interrelationship between seemingly contradictory phenomena, activities, or processes. Specifically, the authors define

ambidexterity as the successful regulation of both explorative and exploitative actions (Bledow et al., 2009). They also provide practical suggestions for the successful implementation of team creativity and innovation (Bledow et al., 2009).

At the team level, ambidexterity theory has been used to explain the coexistence of divergent and convergent processes during the engagement of creativity and innovation (De Dreu & West, 2001; Hülsheger et al., 2009), the seemingly contradictory but complementary relationship between creativity and standardised procedure (Gilson et al., 2005), and the co-occurrence of both exploration and exploitation in the process of knowledge combination (Taylor & Greve, 2006).

In summary, the four distinct theoretical frameworks discussed above complement each other and collectively provide a more comprehensive picture of the antecedents of creativity and innovation. For instance, whereas componential theory and the interactionist model are more concerned with the development of creativity, four-factor theory and ambidexterity theory relate more to innovation and the implementation of ideas. Nonetheless, team creativity and team innovation are not easily distinguishable in practice owing to their high correlation.

3 Diversity

3.1 *Diversity: Definition, Taxonomy, and Advancement*

3.1.1 Definition of Diversity

Diversity describes social composition (Jackson, 1996) and “refers to differences between individuals on any attribute that may lead to the perception that another person is different from self” (van Knippenberg et al., 2004, p. 1008). In principle, the sources of diversity can be infinite. For instance, diversity may arise from differences in age, gender, nationality, ethnicity, religious background, culture, educational background, personality, and even political preference.

Demographic diversity, which refers to diversity in gender, ethnicity, and age, is most commonly encountered in the practical contexts of organisations and teams (Jackson, 1996; Milliken & Martins, 1996). Meanwhile, researchers also emphasise team composition with regards to differences in functional and educational backgrounds (Hofhuis et al., 2018; Knight et al., 1999; Milliken & Martins, 1996).

Other sources of diversity such as tenure (Pfeffer, 1983), pay dispersion (Bloom & Michel, 2002), and differences in personality, values, or attitudes (van Knippenberg & Schippers, 2007) are also influential variables related to team process and performance. In addition, particular aspects of diversity such as status diversity, cultural or organisational diversity manifested after mergers and acquisitions (M&A), and geographic diversity may become particularly salient in certain situations or industries (Jackson, 1996).

3.1.2 Taxonomy of Diversity

Because the term diversity can refer to numerous different aspects of composition, many early scholars (Jackson, 1992; Maznevski, 1994; Tsui et al., 1992) have suggested ways to categorise and thus better organise the concepts of different types of diversity.

One common distinction is made between diversity with respect to observable or readily detectable attributes, such as sex, age, and ethnicity, versus less detectable or underlying attributes, such as educational and functional background, tenure, personality, and personal values (Jackson, 1996; Milliken & Martins, 1996). Subsequent scholars have applied terminology such as “surface-level diversity” to describe differences that are easily detected, in contrast to “deep-level diversity”, which refers to non-observable attributes (Mohammed & Angell, 2004; Stahl et al., 2010). One reason for differentiating between observable (surface-level) and non-observable (deep-level) types of diversity is that when people with obvious differences meet, it is particularly easy to “evoke responses that are due to biases, prejudices, or stereotypes” (Milliken & Martins, 1996, p. 404). However, it should be noted that these categorisations of diversity are not mutually exclusive. For example, although ethnic diversity may be regarded as a form of surface-level diversity, it is also related to cultural diversity, which entails differences in individuals’ perspectives and values.

Apart from the distinction between observable and non-observable differences, scholars (Jackson, 1996; Joshi & Roh, 2009) have distinguished between the effects of task-oriented (e.g., function, education, and tenure) and relations-oriented (e.g., gender, race/ethnicity, and age) or demographic aspects of diversity (van Dijk et al., 2012). Such distinctions are common to investigations of team dynamics, which propose that task-oriented diversity brings benefits to the team, while relations-oriented diversity leads to stereotypes that negatively impact the ways that team members feel, think and act (Jackson, 1996).

In contrast, given the unsatisfactory research outcomes based on former categorisation (e.g., task-related versus non-task-related), Harrison and Klein (2007) raised concerns about straightforward and oversimplified categorisations of diversity, and called for better clarification on the meaning of differences. In their investigation of diversity, Harrison and Klein (2007) proposed three types of diversity: *variety* (i.e., differences in the kinds, sources, or categories of relevant knowledge or experience), *separation* (i.e., differences in lateral position), and *disparity* (i.e., vertical differences in the proportion of socially valued assets or resources held among unit members, especially in terms of income and status). Harrison and Klein (2007) suggested that these three types of diversity not only represent different constructs but also “differ in their relevance to key theoretical perspectives” (p. 1207) and are associated with “different outcomes” (p. 1207). For example, building on previous studies, these authors claimed that although gender diversity could be classified under any of the three types of diversity, the resultant theoretical emphases and outcomes among these would be fundamentally different. With regard to separation, gender diversity could be conceptualised and operationalised with a connotation of opposing beliefs and a negative

relation with cohesiveness and identification; with regards to variety, gender diversity could be associated with the notion that “men and women have qualitatively different caches of knowledge such that gender diversity within a unit may spark creativity and innovation” (p. 1225); and with regards to disparity, gender diversity could be operationalised as “power differences between men and women” (p. 1225). In sum, the framework of Harrison and Klein (2007) offers scholars a completely new construct of diversity in which matches between the specific conceptual and operational aspects of diversity are important, as each match represents a different theoretical perspective and implies a distinct methodological application.

In fact, arguments and debates on the categorisation of diversity have persisted (Stahl & Maznevski, 2021). Several new approaches to categorising diversity have been recently proposed. For example, based on a study of global virtual teams (GVT), Taras and colleagues (2019) proposed a refined model which differentiates between *personal diversity* and *contextual diversity*. In their study (Taras et al., 2019), the authors went beyond visible and invisible diversity, and claimed that diversity was a broad concept, including “demographics and various characteristics of team members’ national environments and contexts they represent, understand, or can utilize” (p. 3). Based on the argument, *personal diversity* is defined as “differences pertaining to the personal characteristics or perceptions of the team members” (p. 2) (e.g., age, gender, language skills); and *contextual diversity* is defined as “differences in the characteristics of the contexts and environments that the team members represent, have access to, or come from” (p. 2) (e.g., economic development, human development, income inequality). The authors also discussed how these disparate forms of diversity affect task outcomes and psychological outcomes in distinctive ways (Taras et al., 2019). Differently, Tasheva and Hillman (2019) proposed a comprehensive conceptual framework that emphasises the multifaced nature of diversity and distinguishes three types of diversity sources (i.e., human capital, social capital, and demographic) at two levels of analysis (i.e., within-individual and among individuals in a team). The framework emphasises interactions between individual-level and team-level diversity and attributes variation in team outcomes to these interactions (Tasheva & Hillman, 2019). Collectively, the above theoretical perspectives have advanced the categorisation of diversity and provided researchers with new angles from which to evaluate diversity.

On the whole, diversity is a broad concept that encompasses any source of difference. Over the years, scholars have proposed different approaches for categorising these differences, such as the distinction between observable (surface-level) and non-observable (deep-level) diversity and the three subtypes of diversity (i.e., separation, variety, and disparity). Indeed, such categorisations of diversity provide a more nuanced understanding of team diversity and help to explain the reasons for weak or inconsistent findings on the impacts of team diversity on team process and performance. In the next section, we elaborate on the theoretical frameworks of diversity and discuss how these categorisations can be applied to provide better explanations for phenomena relating to diversity in the workforce.

3.2 Main Theoretical Perspectives on Diversity

Most studies on diversity have sought to understand how the differences between team members affect team processes and performance, as well as the attitudes and subjective well-being of team members. Based on several seminal literature reviews on diversity research (van Knippenberg & Mell, 2016; van Knippenberg & Schippers, 2007; Williams & O'Reilly III, 1998), we identify four major theoretical frameworks of diversity below, and discuss how team diversity has been conceptualised and operationalised for each of these.

3.2.1 The Similarity/Attraction Paradigm

The similarity/attraction paradigm is a major body of research resulting from the work of many scholars (Berscheid & Graziano, 1979; Byrne, 1969; Pfeffer, 1983; Tsui & O'reilly, 1989) and is highly related to the principle of homophily, which describes the situation that when given free choices, individuals would prefer to select a similar person to interact with (Williams & O'Reilly III, 1998). In general, this paradigm proposes that individuals who share a similar background are more likely to share common life experiences, values, and perspectives and may therefore find interactions with each other to be easy, positively reinforcing, and desirable (Williams & O'Reilly III, 1998), which leads to an increase in interpersonal attraction and approval. According to Williams and O'Reilly III (1998), the theoretical framework assumes that individuals who share a similar background will work with positive affect and thus perform more effectively during team interactions and team cooperation. In contrast, heterogeneous teams are considered less effective due to poorer communication and more frequent conflicts among team members, as well as the higher likelihood of turnover.

3.2.2 The Social Identity Approach: Social Identity Theory and Self-Categorisation Theory

The framework for the social identity theory and self-categorisation theory was proposed by Tajfel and his colleagues in a series of edited books published during the late 1970s and early 1980s (Abrams & Hogg, 1990). Because these two theories had similar ideological paradigms and meta-theoretical perspectives, they were jointly referred to as the "social identity approach" (Hornsey, 2008, p. 208). In some applications, the theories were grouped under "social categorisation" (van Knippenberg & Schippers, 2007).

Social identity refers to "the individual's knowledge of belonging to certain social groups, where group membership has some emotional and value significance to that individual" (Tajfel, 1972, as quoted and cited in Abrams & Hogg, 1990, p. 2). Individuals form their social identities based on membership in social categories and

tend to distinguish between ingroup members and outgroup members. Notably, the theory maintains that individuals desire to maintain high self-esteem and to realise two fundamental human motives (i.e., self-enhancement and uncertainty reduction) through group membership (Chattopadhyay et al., 2016). Therefore, in real situations, individuals tend to identify more with groups that can “facilitate, rather than lower, the enhancement of their social identity” (Tsui et al., 1992, as cited in Chattopadhyay et al., 2016, p. 120) and teams that better reduce the uncertainty they experience from their social environment (Chattopadhyay et al., 2004).

Turner, a student of Tajfel, further developed the social identity approach and extended it to group processes and intergroup relations (Turner et al., 1987). Rather than treating interpersonal and intergroup dynamics as exclusive mechanisms, Turner’s “self-categorisation theory” claims that identity operates at different levels of inclusiveness. In addition, Turner proposed that categorisation occurred as a result of both accessibility and fit, which jointly determined whether a particular identity would become salient in a specific context.

Essentially, both social identity theory and self-categorisation theory asserted that variations in the demographic composition of work groups negatively impact the group process, resulting in decreases in self-rated team cooperativeness (Chatman & Flynn, 2001), team identification (Chattopadhyay et al., 2004), and social integration (Harrison et al., 2002).

One extreme case of the social identity approach relates to “faultline” (Lau & Murnighan, 1998; van Knippenberg & Schippers, 2007), which emerge when group members’ positions on “different dimensions of diversity are correlated” (van Knippenberg & Schippers, 2007, p. 523), leading to the formation of clear distinctions between subgroups. For example, a group in which all of the men are doctors and all of the women are nurses is more predisposed to subcategorisation than a group in which gender and occupation are unrelated. The stronger the faultline, the more likely that subcategorizations will arise, and the greater the likelihood that group functioning will be disrupted (van Knippenberg & Schippers, 2007). In empirical studies, faultline have been commonly identified and shown to cause intergroup bias, impairing the viability and performance of teams (Thatcher & Patel, 2012) and hampering intrateam social integration and coordination by raising the risk of intergroup bias (Meyer et al., 2014).

3.2.3 Information-Processing Theory

In contrast to the similarity/attraction paradigm and the social identity approach, which both emphasise the negative impacts of workgroup diversity, the information-processing theory explores how information and decision making can be positively influenced by variations in group composition (Williams & O’Reilly III, 1998) and therefore offers a completely different theoretical perspective on the effects of diversity.

Described as “value-in-diversity” (Cox et al., 1991), this theory claims that individuals from diverse backgrounds bring a broad range of knowledge, skills, abilities,

experience, and perspectives to their team and thus build a larger pool of informational resources that the team can draw from (van Knippenberg, 2017). Such additional information, perspectives, and values also enhance the team's capacity for generating creative or innovative ideas through brainstorming (Paulus et al., 2002).

More importantly, this theoretical framework identifies and emphasises crucial team processes that are facilitated by diversity and beneficial to the process of knowledge integration, such as team reflexivity, team learning behaviours, and task conflict (van Knippenberg & Schippers, 2007). These processes allow for synergetic benefits to be realised through the integration of different perspectives (van Knippenberg, 2017).

3.2.4 The Categorisation–Elaboration Model

Reconciling the paradoxical predictions proposed by the social identity approach and the information-processing perspective, the categorisation–elaboration model (CEM) (van Knippenberg et al., 2004) incorporates mediator and moderator variables (e.g., identity threat, task motivation) that typically have been missed in diversity study. Also, the CEM posits that the effects of diversity unfold via two routes that interact with each other: differences between team members engender both social categorisation process and information elaboration process; intergroup biases flowing from social categorisation would disrupt information elaboration.

Notably, the CEM (van Knippenberg et al., 2004) emphasises that rather than the increase in knowledge, skills, experiences or abilities associated with greater diversity, employees' elaboration of information matters most in enhancing team performance, namely information's "exchange, discussion, and integration" (van Knippenberg & Mell, 2016, p. 138).

In essence, the CEM abandons the link between specific diversity and its positive or negative effects and claims that all types of diversity have the potential to "invite disruptive intergroup biases as well as synergetic benefits through team information processing" (van Knippenberg & Mell, 2016, p. 2011). In this way, the CEM posits that the overall effect of diversity on performance results from interactions among various contingency mechanisms, along with various mediating and moderating processes.

Given the above assessment of all four theoretical frameworks on diversity, it becomes clear that both similarity/attraction theory and the social identity approach emphasise the negative effects of diversity on team performance and posit that inter-team diversity leads to decreases in efficiency and communication, increases in conflict and the likelihood of turnover, and other undesirable team outcomes. In contrast, the information-processing perspective emphasises the potential of diversity because different people bring the team with a bigger pool of knowledge, skills, perspectives and etc., and thus improve team performance. Building on the opposing predictions proposed by different theoretical perspectives, CEM (van Knippenberg et al., 2004) posits that team diversity unfold its effects via both social categorisation and information elaboration processes that interact with each other. Besides, CEM

incorporates moderating variables (e.g., identity threat, task motivation) that have commonly been neglected in studies of diversity. Given the comprehensiveness of its contingency effects, the CEM (van Knippenberg et al., 2004) has been widely applied, cited, and supported by empirical studies (Guillaume et al., 2017).

4 The Synergy of Diversity and Creativity/Innovation

4.1 General Overview of the Current State of Knowledge

Based on the assumption of “value-in-diversity”, early studies have shown that creativity and innovation are often-invoked benefits of employing individuals with different backgrounds, who are expected to provide their teams with a broader range of knowledge, skills, and abilities (Cox & Blake, 1991; Nemeth, 1986). However, the operationalisation of diversity in the workplace is more sophisticated than theoretical conceptions. Accordingly, research on the topic of diversity and creativity/innovation has burgeoned.

To illustrate the trend in research on the topic of diversity and creativity/innovation, a combination of keywords, namely “team creativity” OR “team innovation” OR “group creativity” OR “group innovation”, and “diversi*” OR “composition” OR “homogeneity” OR “heterogeneity” OR “similarity” OR “dissimilarity”, was entered into the search engine of the Web of Science database to search for relevant articles published between 1991 and 2021. Figure 1 illustrates the changes in the volume of research on diversity and creativity/innovation over the past 30 years.



Fig. 1 The volume of research on diversity and creativity/innovation over the past 30 years

We identified and reviewed several meta-analyses (Bell et al., 2011; Hülshager et al., 2009; Stahl et al., 2010; van Dijk et al., 2012; Wang et al., 2019) and reviews (Stahl & Maznevski, 2021; van Knippenberg, 2017; van Knippenberg & Mell, 2016) that explicitly investigated or discussed the relationship between diversity and creativity/innovation in teams.

We were able to draw three main conclusions about the relationship between diversity and creativity/innovation from these studies. First, team diversity, especially in terms of job-related diversity (i.e., relating to team members' educational and functional backgrounds), is positively related to creativity and innovation in general team settings (Bell et al., 2011; Hülshager et al., 2009; van Dijk et al., 2012). Second, the most recent meta-analysis indicated that deep-level diversity has positive effects on creativity and innovation in cross-cultural teams (Wang et al., 2019). Third, contrary to most assumptions, demographic diversity has been found to have a non-significant relationship with both team creativity and team innovation (Bell et al., 2011; Hülshager et al., 2009; Wang et al., 2019).

Despite these general findings, the above conclusions do not necessarily imply that only certain types of diversity enhance team innovation. Rather, even the results of the most recent meta-analysis (Wang et al., 2019) support the framework of the CEM (van Knippenberg et al., 2004) and suggest that the effects of diversity on team innovation are moderated by factors such as task complexity, task interdependence, and team virtuality.

Below we briefly review several representative empirical studies on the relationship between diversity and creativity/innovation in teams.

4.2 Empirical Studies on Diversity and Creativity/Innovation

4.2.1 The Direct Effect of Team Diversity

Diversity, as an aspect of team composition, is suggested to benefit team creativity/innovation by providing a broad range of informational resources. In a classical study on the impact of diversity on innovation, Ancona and Caldwell (1992) found that a team's functional diversity (i.e., professional with different expertise in R&D, marketing manufacturing, and etc.) was positively related to its innovation (as rated by managers). The authors found that the greater the functional diversity in the team, the more the team members communicated outside the boundaries of the team and the higher the managerial rating of that team's innovation (Ancona & Caldwell, 1992). Subsequent studies have provided support for this view. For instance, Díaz-García and colleagues (2013) found that gender diversity is positively related to radical innovation rather than incremental innovation in R&D teams. Brixy and colleagues (2020) found that "unusualness"—an indicator of ethnic diversity based on the "likelihood that the observed combination of national origins occurred by chance" (p. 2)—had a strong positive association with the likelihood that a start-up would bring in an innovation in its first two years of establishment.

In contrast, studies applying similarity attraction theory (Williams & O'Reilly III, 1998) and the social identity approach (Tajfel & Turner, 2004; Turner et al., 1987) have tended to observe negative effects of diversity on creativity or innovation in teams, of which conflict was the most frequently cited effect (De Dreu & Weingart, 2003; Jehn et al., 1999; Stahl et al., 2010). Aside from conflict, other negative team processes associated with diversity were observed. For instance, Tsui and colleagues (1989) found that increasing dissimilarity in the demographic characteristics between subordinates and their superiors, or “relational demography”, was associated with subordinates’ lower effectiveness as perceived by superiors and with superiors’ lower personal attraction as perceived by subordinates.

Scholars also have sought to distinguish the different types of diversity that contribute to positive or negative team processes. For example, in comparison with observable types of diversity, skill-based diversity, which originates from differences in educational, functional, occupational, and industrial backgrounds, was found to have more positive effects on team process and outcome when these task-related diversities translated into a greater variety of perspectives (Milliken & Martins, 1996). Similarly, Cummings (2004) found that structural diversity (i.e. differences in team members’ geographic locations, functional assignments, reporting managers, and business units) increased the value of the external knowledge shared by the team members.

Aside from job-related and demographic diversity, other scholars have focused on deep-level diversity, such as the diversity in team members’ traits and personalities. For instance, Schilpzand and colleagues (2011) found that diversity in team members’ openness to experience had positive association with team creativity. Later, den Hartog and colleagues (2020) investigated the variance among team members’ personalities in terms of extraversion, agreeableness, openness, and conscientiousness and its relationship with team innovation. They found that teams with less heterogeneity in extraversion had higher levels of team innovation.

Additionally, several studies acknowledging the conflicts and dissatisfaction that arise in heterogeneous teams have documented a U-shaped relationship between team heterogeneity and team effectiveness (Earley & Mosakowski, 2000; Watson et al., 1993). In these studies, the performances of heterogeneous teams improved over time. After the team members learned to cooperate with each other, heterogeneous teams eventually outperformed homogenous teams in the long term.

In sum, we find empirical support for the similarity/attraction perspective, the social identity approach, and the information-processing perspective. This finding suggests the contributions of mediating and moderating processes to the relationship between diversity and creativity/innovation, a topic that deserves further examination.

4.2.2 Mediating Processes: Information Elaboration and Social Categorisation

According to the CEM (van Knippenberg et al., 2004), the team diversity unfolds its effects via two mediating processes: information elaboration and social categorisation. We briefly review empirical studies of these two mediating processes below.

Information Elaboration

Research focusing on the cognitive resources associated with diversity has shown that diversity promotes creativity, as theoretically hypothesised (Stahl et al., 2010). Multiple empirical studies have investigated the mechanisms by which diversity affects creativity/innovation via the mediating process of information elaboration—“the exchange, discussion, and integration of task-relevant information” (van Knippenberg & Mell, 2016, p. 138). Over the years, studies have applied different lenses to evaluate the different stages of information elaboration.

For example, Zhang (2016) focused on the specific mediating effects of knowledge sharing on functional diversity and creativity in teams. By assuming that team longevity positively influenced team members’ information-processing abilities, the study confirmed that a stronger effect of functional heterogeneity on creativity could be realised in a team where members had a strong sense of knowledge sharing and had worked together for a long time.

Given their potential to benefit information elaboration, task conflict and dissent have been another focus in diversity research (van Knippenberg et al., 2004). Indeed, several scholars have observed positive effects of task conflict and dissent on team creativity (Dreu, 2002; Jehn et al., 1999; Pelled et al., 1999). However, others have obtained contradictory findings. In the most recent meta-analysis of the subject (O’Neill et al., 2013), the correlations between team creativity and each of the three distinct types of team conflict (i.e., task conflict, relationship conflict, and process conflict) were found to be essentially zero, suggesting that conflict has a more complicated contingency mechanism than initially expected (de Wit et al., 2012). For instance, de Wit and colleagues (2012) found that task conflict and group performance had a more positive relationship in studies where the connections between task conflict and relationship conflict was weak and in studies that investigated top management teams.

In a more comprehensive study that accounted for multiple complicated processes of information integration, Açıkgöz and colleagues (2016) found that the functional diversity of teams was positively related to the success of new products through the mediating effect of team absorptive capability, which was operationalised as a multidimensional construct that involved knowledge acquisition, assimilation, and exploitation.

Other notable studies investigated the cognitive processes of diverse teams from the perspective of “diversity as learning” (Ely & Thomas, 2001), which posited

that diversity might play a role in providing a team with the resources to learn. For instance, an empirical study by Sun and colleagues (2017) revealed that team diversity had a significant capacity in enhancing both individual and team learning, which in turn led to innovative performance. Chow (2018) explored the relationship between a team's cognitive diversity and its creativity, as well as the roles of team learning and team inclusion in mediating this relationship. Unexpectedly, team cognitive diversity was found to have no direct impact on team creativity, and the effects of cognitive variance on team creativity were more complicated than expected.

Social Categorisation

In contrast to the mediating effect of information elaboration, which has been commonly investigated in research on the effects of diversity on creativity/innovation in teams, far fewer studies have empirically investigated the mediating effects of social categorisation, with only one study identified (Zhang, 2016). The study by Zhang (2016) found that functional diversity negatively impacted group cohesion and thus indirectly undermined group creativity.

A conceptual paper examining a more general team setting (rather than focusing on diversity) by Haslam and colleagues (2013) shed light on how studies on team diversity could leverage the lens of the social identity approach. Specifically, the study emphasised the “roles that groups played in stimulating and shaping creative acts and in determining the reception” (p. 384) that these creative acts were given. The authors also argued that a shared social identity among group members would motivate individuals to “rise to particular creative challenges and provide a basis for certain forms of creativity to be recognised” (p. 384). Empirical findings supportive of these perspectives were also demonstrated. For instance, one study focused on the perceptions of team members found that members tended to rate ingroup products with more favoritism than the products of outgroups (Hewstone et al., 2002). Apart from intergroup bias, social norms were identified as a factor influencing the effect of social identity on creativity and innovation (Hewstone et al., 2002). A study by Adarves-Yorno and colleagues (2006) showed that an idea that did not appear to be innovative on its own could nonetheless be perceived as creative and appealing under certain circumstances. Regarding actual creativity behaviour and performance, several authors (Brewer, 1991; Jetten & Postmes, 2006) argued that when two or more team members perceived themselves to share a social identity, they would ignore their self-perceptions and be more motivated to coordinate their behaviours to align with the goals of the team.

As proposed by the CEM (van Knippenberg et al., 2004), the effects of diversity unfold via the two mediating processes of information elaboration and social categorisation. However, in contrast to the large number of studies investigating the effect of diversity on creativity/innovation via the mediating effect of information elaboration, very few studies have empirically investigated the mediating effects of social categorisation in this relationship. Therefore, future studies may consider paying more attention to the mediating effects of social categorisation.

4.2.3 Moderating Processes: Various Moderating Effects and Contingency Mechanisms

Following the call by van Knippenberg and colleagues (2004) for more studies to investigate processes that potentially moderate the effect of diversity on creativity/innovation in teams, as well as the increasing research interest on organisational creativity and innovation, numerous studies on diversity and creativity/innovation have accumulated over the years. To demonstrate the empirical findings of such work in a more explicit way, we identify three thematic categorisations of moderators of the effect of diversity and creativity/innovation in teams.

Task Design

Task complexity has been widely recognised as an important factor influencing social processes and team creativity (Hülshager et al., 2009; Leung & Wang, 2015). In the most recent meta-analysis (Wang et al., 2019), task complexity was found to attenuate the negative relationship between surface-level diversity and team creativity/innovation but not the positive relationship between deep-level diversity and team creativity/innovation (as was hypothesised). This result resonated with earlier findings showing that task complexity had non-significant effects on mediating functional diversity and the success of new products, which was attributed to the degree of complexity associated with new product development (NPD) projects. For instance, one study showed that when an NPD project was more complicated and challenging to carry out, the members of the NPD team were more likely to be cautious when putting their assimilated knowledge into practice (Açıköz et al., 2016).

Other important factors in task design are related to task structure (e.g., task interdependence and task autonomy). In contrast to the consistent findings concerning the moderating effects of task complexity on the relationship between diversity and creativity/innovation, the findings on task structure have been unequivocal. Gilson and Shalley (2004) found that the more team members considered a task to require creativity and the higher their task interdependence is, the greater their collaborative efforts will be made during the creative process. In contrast, Girotra and colleagues (2010) found that having team members to deal with in an idea-generation task independently before engaging in collective brainstorming led teams to generate ideas of bigger amount and higher quality than those where members were directly engaged in group-based ideation. In addition, some empirical studies have observed that high autonomy in teams with strong faultline could exacerbate the negative effects of interpersonal differences (Rico et al., 2007). In such teams, intense communication among members increased the likelihood that certain diversity attributes would align and become even more salient, which would divide the team into competing subgroups, and thereby undermine the quality of decision-making. These empirical findings challenged the notion of autonomy as an important factor influencing creativity

and innovation (Amabile & Pratt, 2016), as well as arguments that an autonomous work environment was conducive to creativity; such arguments were based on the assumption that autonomy was closely related to motivation and self-determination (Anderson et al., 2014; Liu et al., 2011; Zhou & Hoever, 2014).

With the rapid development of technology in information and communication, virtual or geographically diverse teams have been established in many organisations and are becoming increasingly prevalent. Focusing on these emerging team settings, Giambattista and Bhappu (2010) tested the joint effects of personality (i.e., agreeableness and openness), ethnic diversity, and communication technology (i.e., computer-mediated communication, nominal group technique, and face-to-face communication) on group creativity. In line with previous findings on the greater *addictive* capabilities¹ of virtuality on heterogeneous teams than teams in face-to-face settings (Carte & Chidambaram, 2004; Staples & Zhao, 2006), this study found that computer-mediated communication (compared with face-to-face communication) led to a substantial increase in creative performance in an ethnically diverse team, as it inhibited the negative effects of social categorisation that were associated with ethnic heterogeneity. However, a study by Gibson and Gibb (2006) based on qualitative and quantitative methods reported negative relationships between the innovation of virtual teams and the geographic dispersion, diversity in nationalities, electronic dependence, and structural dynamism of the team members.

Team Climate and Characteristics

Over the years, multiple scholars have emphasised that the success or failure of a work team depends greatly on its specific context or surrounding environment (Amabile & Pratt, 2016; Anderson & West, 1998). Indeed, teams targeting innovation are required not only to develop and explore new ideas but also to “align team members to the implementation of these creative ideas” (Somech & Drach-Zahavy, 2013, p. 689). Accordingly, team climate and team characteristics have emerged as particularly important factors in the process of innovation.

Studies focusing on the positive effects of open and supportive team climates have consistently provided empirical evidence to support the proposition that team innovation is improved when team members share a commitment to the team’s goals (Anderson & West, 1998; Bain et al., 2001; Pirola-Merlo, 2010). In addition, both top-down and bottom-up team climates have been investigated and found to significantly impact team innovation and creativity.

¹ Carte and Chidambaram (2004) propose that communication technologies have many capabilities and these capabilities can be categorised as *reductive* or *additive*. *Additive* capabilities improve normal communication exchanges and include coordination support (e.g., helps track people, projects and priorities), electronic trail (e.g., helps record and retrieve relevant information), and enhanced capabilities (e.g., support decision making and rich messaging).

For instance, environments that are considered “top-down inclusive and encouraging”, such as climates of psychologically safe communication (Gibson & Gibbs, 2006), support for innovation (Somech & Drach-Zahavy, 2013), and inclusion (Li et al., 2017), have been found to attenuate the negative effects of diversity on creativity or innovation or to accentuate the positive operationalisation of diversity. Specifically, the study by Gibson and Gibbs (2006) focused on virtual teams and showed that a psychologically safe communication climate moderated the effects of the team members’ geographic dispersion, electronic dependencies, structural dynamics, and diverse nationalities on team innovation. Similarly, the study by Li and colleagues (2017) emphasised the function of a climate of inclusion in amplifying the positive effects of team cultural diversity on team and individual creativity; this amplification occurred due to an increase in information sharing and information elaboration among the team members.

Other studies examined the moderating effects of a bottom-up behavioural climate (e.g., team involvement and team openmindedness) in the relationship between team diversity and team creativity/innovation (De Dreu & West, 2001; Mitchell & Boyle, 2015; Yang & Konrad, 2011). For instance, a multilevel study by Yang and Konrad (2011) examined the interactive effects of team diversity and employee involvement on innovation and found interactive effects among employee involvement, variation in this involvement, and racial–ethnic diversity on team innovation. Specifically, when employee involvement is high, racioethnic diversity is positively related to innovation in the circumstances of high variation in involvement.

Previous studies on the moderating effects of team characteristics on the relationship between diversity and creativity/innovation have likewise emphasised that team characteristics (e.g., diversity belief, perspective taking, relational strength) that encourage the free exchange of perspectives.

For example, the study by Hoever and colleagues (2012) emphasised the importance of perspective taking during information elaboration. These authors proposed that a team member’s perspective taking—operationalised as the effort that a team member made to understand the views of other members—would moderate the effect of team diversity on team creativity, which would in turn be mediated by information elaboration. Investigating the moderating effect of diversity training on the relationship between diversity and creativity, Homan and colleagues (2015) found a three-way interaction between diversity, diversity training, and diversity belief, indicating that diversity belief also moderates the effectiveness of diversity training on a team’s creativity. Specifically, the authors found that diversity training only affected the creativity of teams with low diversity beliefs and had far smaller effects on the creativity of teams with high diversity beliefs. Additionally, Tzabbar and Vestal (2015) observed an inverted-U-shape relation between team members’ geographic dispersion and team innovation, which was moderated by relational strength and status asymmetry. Specifically, they observed that the relational strength among team members would positively moderate the effects of geographic dispersion on innovation, the greater the relational strength, the stronger the initial positive effect. In contrast, a greater degree of status asymmetry among team members led to a weaker initial positive effect of the geographic dispersion on the team’s innovation.

Leadership

Scholars have widely documented the influence of leadership behaviours on team processes, emergent states and outcomes (Burke et al., 2006; Homan et al., 2020; Mathieu et al., 2008; van Knippenberg, 2017).

Leadership mainly enhances a team's creativity/innovation by constructing an environment beneficial for knowledge elaboration or by hindering the potential for inter-team social categorisation. For example, Somech (2006) found that greater diversity in team members' functional backgrounds increased team innovation by increasing the level of participative leadership, which presumably stimulated information integration. Another study by Shin and Zhou (2007) confirmed the moderating effect of transformational leadership on the relationship between diversity in team members' educational backgrounds and team creativity, which was mediated by the team's creative efficacy. Similarly, Reuveni and Vashdi (2015) found that transformational leadership moderated the effect of diversity in team members' functional backgrounds on team innovation, which was mediated by team members' shared mental model.

Aside from these positive effects, research findings on other effects of leadership on team outcomes have been unequivocal. For instance, studies on the roles of transformational leadership behaviour reported its positive, negative, and null moderating influences on the effects of team diversity on team innovation (Homan et al., 2020). By further classifying leadership behaviour under person-focused and team-focused leadership, Homan and colleagues (2020) recently provided a more comprehensive model for understanding and explaining the moderating effects of leadership on the relationship between team diversity and team performance. This model would provide researchers with more integrative perspectives for future analysis.

In sum, empirical studies have suggested that moderating factors that promote information elaboration in teams (e.g., psychological safety, perspective taking, open-mindedness norm, diversity beliefs, participative leadership) tend to promote team creativity and team innovation. Meanwhile, moderating factors that attenuate social categorisation and prevent inter-team bias formation (e.g., team cohesion) help to mitigate the adverse impacts of social categorisation on team creativity and team innovation. Other factors, such as team autonomy, team interdependence, and team virtuality have shown relatively inconsistent effects as moderators of the relationship between diversity and creativity/innovation in teams. These factors may moderate both information elaboration and the social categorisation process, have cross-cutting effects, or have effects that only emerge in specific contexts. By scrutinising these inconsistent findings, future studies may be able to develop more integrative models. Figure 2 provides a conceptual summary of the empirical evidence for the mediating and moderating factors in the relationship between diversity and creativity/innovation in teams.

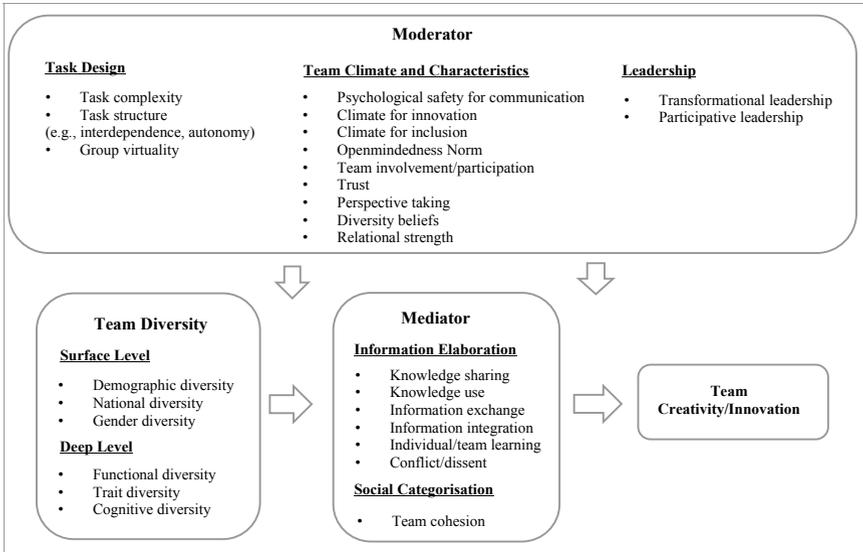


Fig. 2 Empirical studies on diversity and creativity/innovation in teams

5 Discussion and Future Research

In the above sections, we thoroughly review the literature on team diversity and creativity/innovation by identifying seminal reviews of the topic, outlining the major theoretical perspectives, and discussing the representative empirical findings. Here, we recommend several important and promising areas for future research on this topic.

5.1 Further Clarification of the Concept of Diversity in Teams

Given its association with cognitive resources, diversity has been proposed and shown to have a positive relationship with creativity (Stahl et al., 2010). A meta-analysis on culturally diversified teams conducted by Wang and colleagues (2019) further reinforced that deep-level diversity in a team enhances team creativity because it promotes information diversity; while the relationship between surface-level diversity and team creativity was null.

The meta-analysis by Wang and colleagues (2019) appeared to validate the value of theoretical categorisations of diversity, such as deep-level and functional diversity. However, such categorisation may not have been accurately implemented in practical settings due to biases of the researchers and respondents (van Dijk et al., 2012). Such bias is consistent with the findings of Chow (2018), who observed that

cognitive diversity had no direct effect on creativity; rather, team learning and team inclusion acted as mediators in this relationship. Accordingly, the mechanism by which cognitive dissimilarity influences team creativity is more complicated than expected.

Moreover, although most studies of diversity have assumed that different sources of diversity influence group performance in similar ways, unfolding their effect by driving “process gains” (e.g., increased creativity and informational resources) and “process losses” (e.g., increased conflict and reduced cohesion) through divergent forces and barriers to convergence (Stahl & Maznevski, 2021), there has also been evidence to suggest that different sources of diversity can differently affect team outcomes (Horwitz & Horwitz, 2007; Joshi & Roh, 2009).

These results have highlighted the need to more carefully define the concept of diversity in future research. Enlightening work by Harrison and Klein (2007), as well as more recent research by Taras and colleagues (2019) and Tasheva and Hillman (2019), has provided researchers with different perspectives on a more comprehensive conceptualisation of diversity and understanding of its effects on creativity and innovation. For instance, the conceptual framework proposed by Tasheva and Hillman (2019) suggests that diversity is multifaceted and differentiates three types of diversity sources (i.e., human capital, social capital, and demographic) at two levels of analysis (i.e., within-individual and among individuals in a team). Their framework highlighted interactions between individual-level and team-level diversity and attributes variation in team outcomes to these interactive dynamics.

5.2 The Effects of Social Categorisation in the Relationship Between Diversity and Creativity/Innovation

The literature has established that diversity can have both positive and negative effects on creativity. Studies have shown that the effects of diversity on creativity are not direct but rather indirectly mediated by two main processes: information elaboration and social categorisation.

However, as discussed earlier in this review, in comparison to the many studies on information elaboration as a mediator in the relationship between diversity and creativity, very few studies have explored the potential mediating effects of social categorisation in the same relationship. We found only one study (i.e., Zhang, 2016) that investigated how team cohesion mediated the relationship between diversity and creativity in a team.

Therefore, future studies should investigate the potential mediating effects of social categorisation in the relationship between diversity and creativity/innovation. For example, a conceptual paper on the social identity approach to creativity by Haslam and colleagues (2013) sheds light on how studies of diverse teams can leverage the lens of social identity and evaluate its influence on a team’s performance

in creativity and innovation. In addition, Qi and colleagues (2022) recently introduced the concepts of demographic faultline and subgroup balance as moderators in the relationship between cognitive diversity and information elaboration.

Future studies may also consider examining the relationship between the information elaboration and social categorisation processes. For example, studies might ask whether, given a specific level of diversity, the two mediating processes will act in parallel or sequentially in a “chain mediation” process. If the former speculation is true, under what conditions can the benefits brought about by information elaboration exceed the harms introduced by social categorisation? Subsequently, if the latter speculation is true, which process will occur first? These are all very interesting and worthwhile topic to explore in our future studies.

5.3 Diversity and Creativity in the Era of Digitalisation

The workplace environment has undergone tremendous changes with the rise of the digital age. For instance, remote or virtual workforces have become a regular contemporary phenomenon. Aside from the increasing research interest in virtual team processes, many other novel forms of digital technology have impacted the workforce.

For example, as highlighted by Chen and colleagues (2018), when teams encounter changes in turbulent technological environments, their existing power and dependency model may easily break down. Therefore, investigating the structural change in a team, as well as its chain effects on team process (e.g., the re-distribution of power and interest) under the lens of a digital transformation may provide an interesting and worthwhile body of research.

Other unprecedented challenges also have emerged. In a recent publication, Larson and DeChurch (2020) reviewed the literature and provided four perspectives on technology and its meaning for teams. Notably, they proposed the view of “technology as teammate” (p. 10), which treats technology as a motivated and equal member of the team with the potential to fulfil a distinct role and make a unique contribution. The authors noted that, on the one hand, the power of machine learning would surely have positive impacts on information elaboration; on the other hand, machine learning could also cause conflicts between individuals and machines, which would worsen social categorisation and ultimately be detrimental to team performance. The research on teams with “technology as teammate” remains in the early stages of development (Larson & DeChurch, 2020). Therefore, future studies can investigate novel topics in this area, such as team processes involving humans and robots/artificial intelligence (AI) and changes in human–human interactions in the presence of AI.

5.4 The Paradoxical Effects of Diversity on Creativity and Innovation

Creativity and innovation are nuanced theoretical concepts with different emphases. However, most scholars treat these concepts as two interchangeable and overlapping owing to the difficulty in operationalising them as separate concepts in practice (Anderson et al., 2014). However, increasing numbers of scholars now emphasise that creativity (i.e., idea generation) and innovation (i.e., implementation) are different constructs that arise from distinguishable processes and are associated with different outcomes. Several scholars now call for the development of more nuanced and applicable theories, empirical estimates, and practical implications that recognise these differences between creativity and innovation (Anderson et al., 2014; Hughes et al., 2018).

Indeed, creativity, as a process of idea generation, involves divergent thinking in which different perspectives and ideas are brought to the team and juxtaposed. In this context, diversity is posited as a driving force for the divergent process (Stahl et al., 2010). In contrast, innovation, which is a process of idea implementation, requires a team to engage in more convergent processes such as achieving common goals, making collective commitments, and arriving at the same conclusions (Stahl et al., 2010). Such processes require a great deal of coordination work, which can be negatively affected by diversity (e.g., resulting in conflicts).

In sum, diversity, which can facilitate the divergent processes involved in creativity and impede the convergent processes involved in innovation, may have paradoxical effects on the different stages of developing creativity and innovation in teams. Future empirical studies may consider differentiating between these two concepts.

In conclusion, this chapter has provided a review and analysis of the effects of diversity on creativity/innovation in teams. By reviewing the theoretical perspectives on the antecedents of creativity and innovation and the operationalisation of diversity, we have elucidated how team diversity can exert both positive and negative effects on team creativity and team innovation. In addition, seminal meta-analyses, reviews, and representative findings from the empirical literature have been presented to help readers form a better understanding of the current state of knowledge. Finally, based on our review of the topic, we have identified several promising areas that are worthy of future research. We hope that this chapter provides the impetus to stimulate more fruitful research on diversity and creativity/innovation at the team level.

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Building the Culture of Developing Responsible Innovation: A Case Study of FOTILE



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Abstract Organisational culture exerts significant impacts on various corporate activities including innovation. An emerging branch of innovation, namely responsible innovation, receives the increasing scholarly attention, however, the corporate culture that contributes to this type of innovation are still understudied. Therefore, this chapter aims to explore what are the cultural roots of responsible innovation and how could firms nourish such a culture. Based on the case of FOTILE, a firm that devotes to responsible innovation, we found that the extensive presence of love and kindness (benevolence) in its corporate culture contribute significantly to the responsible innovation. Furthermore, a comprehensive cultural structure is required to build such a strong corporate culture; in the case of FOTILE, it includes the underlying philosophy, the core values, the fundamental principles, and the implementation system of culture. In the end of this chapter, relevant implications are provided based on the practices of FOTILE.

Keywords Responsible innovation · Corporate culture · FOTILE

1 Introduction

Organisational culture is defined as a set of values, assumptions, beliefs, and symbols which shows the way an organisation administers its business (Barney, 1986). Meanwhile, it can pose strong influences on the value system and behaviours of employees;

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an effective organisational culture could bring positive impacts to an organisation, such as higher productivity, employee job satisfaction, customer satisfaction, and better business performances (Bellou, 2010; Büschgens et al., 2013; Rahimi, 2016; Sihombing et al., 2018). The impacts from organisational culture on innovation are also widely studied (e.g., Büschgens et al., 2013; Sarros et al., 2008; Tian et al., 2018), and mixed effects from different cultural traits have been identified (Büschgens et al., 2013). Cultures in support of innovation are found to value organisational growth, continuous development, flexibility, productivity and efficiency, examples of this type of culture include competitive culture, long-term oriented culture (Tian et al., 2018), developmental culture, learning-oriented culture and performance-oriented culture (Büschgens et al., 2013). Meanwhile, cultures that might deteriorate innovation are found to value stability, security, and the strict adherence to rules; examples include short-term oriented culture and hierarchical culture (Büschgens et al., 2013).

Although the extant literature identifies different types of organisational cultures, they mainly focus on studying their impact on innovation in general, whereas the different types of innovations as outcomes are neglected. Some researchers have started to categorise innovations into different types such as exploratory–exploitative innovation, and radical–incremental innovation and they have found that certain cultural values might only benefit certain types of innovation whereas they could be detrimental to the other (Tian et al., 2018). For instance, Tian et al. (2018) have stated that the short-term oriented culture, while being harmful to exploratory innovation, could facilitate exploitative culture given its time pressure to reach markets. However, the classification of innovation and subsequent studies on cultural impacts are still in its infancy, and the cultural roots of an important yet emerging stream of innovation, namely responsible innovation, are understudied.

Responsible innovation emphasises the social desirability, ethical acceptability and environmental sustainability (Blok & Lemmens, 2015; Lubberink et al., 2017; Penders et al., 2009). This topic increasingly gains academic attention as scholars further realise the potential adverse impacts of innovation on human beings, societies and environment, and the consequent necessity for firms to innovate with responsibility (Blok & Lemmens, 2015). As a result, creating a type of organisational culture that could enhance responsible innovation also becomes important. We therefore take the chance to contribute to this gap by exploring two research questions with the case of FOTILE water purifier.

1. *What are the organisational cultural roots that facilitate the responsible innovation?*
2. *What are the practices that could be adopted to construct the responsible innovation-oriented culture?*

We intend to make the theoretical contribution by identifying the cultural traits that lead to responsible innovation and the practical contribution by providing relevant culture-building practices. This chapter is organised as follows. First, the case of FOTILE water purifier, which is an example of responsible innovation, is presented

with brief background information of the firm. Second, the culture of FOTILE is analysed from four aspects, namely its underlying philosophy, core values, fundamental principles, and culture implementation system. The latter three elements also form the three pillars of FOTILE culture. Then, the discussion of how FOTILE culture has facilitated the responsible innovation is provided followed by practical implications for other companies.

2 Case of FOTILE—The Cultural Roots of Responsible Innovation

2.1 Case Background

FOTILE Group (hereafter as FOTILE or the firm) is a Chinese kitchen ware company that manufactures and distributes kitchen utensils in the global market. It provides a wide range of offerings, including but not limited to hoods, hobs, cooktops, ovens, sterilisers, integrated kitchen solutions and other electric appliances (FOTILE, 2021; MarketLine, 2017). FOTILE has long been the industry leader for its high-quality products & services, continuous responsible innovation, and commitment to provide a healthy and happy lifestyle. This case selects its water purifier product as the example of responsible innovation to analyse what types of culture can help firms to develop responsible innovation and what firms could do to build this kind of culture.

Back to the year of 2012, FOTILE notices a serious deficiency of all currently available water purifiers, including both domestic and global products, which is the failure to achieve selective filtration (FOTILE, 2020). Selective filtration requires a technology that could keep the beneficial mineral while filtering out the harmful substances; however, water purifiers at that time either filter out all substances (with good and bad ones alike) except for the water molecules itself or fail to filter out all non-drinkable elements (FOTILE, 2020). In other words, existing products could not satisfy the dual needs of safety and health at the same time. Under this circumstance, FOTILE faces two options. First, becoming a market follower to produce the deficiently mainstream products. In this way, FOTILE could adopt existing technologies and avoid the costly and time-consuming R&D to quickly take products to the market for revenue and market share. Second, conducting independent innovation to develop the selective water purification technology from scratch to pursue the accessibility of the truly healthy, rather than just drinkable water for customers. In this way, FOTILE not just lose the opportunity of generating quick money but also need to spend much more on the R&D, in terms of both capital and time. Worse, no success can be guaranteed despite the spending and efforts. However, FOTILE goes for the second option, and what follows is the eight-year long R&D process (FOTILE, 2020). During the eight years, impressive efforts within the organisation have been devoted to create the ideal water filter. For example, the president of FOTILE, Mao Zhongqun (here after as Mao) has read 18 relevant books within one year to develop

a better understanding of healthy water (FOTILE, 2019). More than that, an R&D team with 50 people is created to work specifically on the water filtration; a 2000m²-laboratory is built to conduct tests, experiments, and simulations (FOTILE, 2019). Luckily, remarkable success finally comes at 2019 with the patented invention—NSP selective filtration technology, which could effectively filter out harmful metals such as arsenic, cadmium and chromium while maintaining the healthy mineral such as calcium, potassium, magnesium, sodium (CET, 2021). FOTILE also earns the qualification to participate in compiling the *White Paper on The Development of Chinese Healthy Water Industry* to further set the industry standard (CET, 2021).

Based on the case of FOTILE, we argue the organisational culture plays a critical role in leading the firm to pursue and develop responsible innovation. In the case of FOTILE, its culture is built upon the traditional Chinese culture, with the heavy influence from Confucianism and now it is consisted of three pillars, which are the core values, fundamental principles and the implementation system (Zhao, 2020). Following sections will in turn discuss them.

2.2 Culture of FOTILE

2.2.1 Underlying Philosophy—Confucianism

Confucianism is an ancient Chinese philosophy developed by the famous Chinese philosopher, Kongzi (Confucius) around 500 B. C. (Yan & Sorenson, 2006). It takes the dominant position in the Chinese culture (Tsui et al., 2004), strongly influencing the value system and behaviours of Chinese people even till today (Yao & Yao, 2000). Lau (1979) depicts there are five virtues of Confucianism, they are *Ren* (benevolence or kindness); *Yi* (justice or righteousness); *Li* (propriety or courtesy); *Zhi* (wisdom); and *Xin* (fidelity or trustworthiness). *Ren* and *Zhi* are the two most salient virtues in influencing the culture of FOTILE (Li, 2007). *Ren* mainly includes benevolence, humaneness, and philanthropy (Zhou et al., 2019a). It also requires people to love and be kind to every human being and every form of life (Chon & Hao, 2020). In addition, benevolence is associated with altruism and self-sacrifice by exhibiting selflessness, interpersonal care, and perseverance (Chen & Chung, 1994). *Zhi* denotes the dual meanings of wisdom and knowledge, emphasising the ability to learn (Chon & Hao, 2020). It also requires such wisdom and knowledge should be based on morality, and ‘the ultimate purpose of *Zhi* is to achieve *Ren* (Chon & Hao, 2020, p. 1058).

Mao is also heavily affected by the Confucianism and builds the organisational culture of FOTILE based on it. He firstly adopts all five virtues to guide corporate core value in 2008. However, he gradually finds out it can be hard to compete with the aggressive competitors in market if a firm fully follows non-aggressive Confucianism (Yang et al., 2020b). Therefore, the FOTILE culture evolves to keep only two original virtues, namely *Ren* and *Zhi*, and added one more *Yong* (braveness/courage) to guide employee behaviour (Yang et al., 2020a). In the organisational context of FOTILE, apart from the original meaning of benevolence, *Ren* further requires employees to

meet the reasonable needs of others (e.g., customers) and to take responsibility to solve the problem of others.¹ The organisational mission which will be discussed in the next section is also originated from *Ren*. The second virtue *Zhi* further includes using knowledge with flexibility to conduct innovation (see Footnote 1). The third virtue *Yong* represents the brave spirit to think, to challenge the existing market condition, to identify the market gap, and to be the market leader (see Footnote 1). To sum up, the Confucianism and its core virtues form the underlying philosophy of FOTILE culture which emphasises love, kindness, responsibility-taking, and innovation.

2.2.2 Core Values

The core values of FOTILE form one of its cultural pillars. It includes three critical values and nine peripheral ones in total, this section will provide a detail illustration on the three critical ones, namely FOTILE's mission, vision, and core beliefs as they are closely related to responsible innovation.

The mission of FOTILE originates from the virtue *Ren* (benevolence and kindness) as mentioned above, and it aims to seek for the happiness of hundreds of millions of families (FOTILE, 2021).² This involves the genuine love and care for customers by providing products and services of excellent quality, creating a better life for customers with the products and services, and satisfying the potential needs beyond customer expectations. The key is to make families to enjoy a happy, healthy, and peaceful life.

The vision of FOTILE is to 'to be a great company' (FOTILE, 2021).³ Being great requires being something more than an economic organisation, it recognises the necessity to act as a social entity and to fulfil social responsibility. In FOTILE, greatness further entails four specific requirements or pursuits, which are to (1) ensure customer with high-quality products and services for a healthy and happy lifestyle, (2) provide employees with opportunities for continuous learning and self-development, (3) promote social justice in the society, and (4) achieve sustainable business by implementing effective strategies and management (Yang et al., 2020a; Zhao, 2020).

The core belief of FOTILE is to integrate the personal quality, enterprise quality and product quality (FOTILE, 2021). In terms of personnel quality, FOTILE encourages employees to pursue a high standard from the moral perspective and the professional perspective. In terms of the moral aspects, benevolence and the consequent love and care again stand at the centre. Regarding the professional aspects, the firm encourages individuals to achieve proactive responsibility taking, team working, continuous innovation and the pursuit of excellence (Wang, 2016). In addition to working on personal quality, the firm also puts efforts to raise the enterprise quality. Enterprise quality specifically includes three types of qualities, namely (1) the quality

¹ Source: FOTILE organisational culture brochure.

² The mission before 2018 was to make families feel better (Zhao, 2020).

³ The vision before 2015 was to be a respectable world-class enterprise (Zhao, 2020).

of business management which prioritises effective strategies and implementation, (2) the quality of organisation as an employer that emphasises the construction of a supportive and attractive working environment, and (3) the quality of organisation as a market player that concerns the firm's business reputation (Wang & Qian, 2018; Zhao, 2020). In short, the enterprise quality requires FOTILE to be a trusted and reputable organisation for both employees and customers. Then, the high-quality products and services should be offered naturally by such a high-quality organisation and its personnel. The key is not to put the sole emphasis on products and related economic values, instead, it is critical to possess an integrative view that could connect the three elements to support each other.

2.2.3 Fundamental Principles

As the above three core values set the overall direction of FOTILE culture, a series of fundamental principles originate from them to guide the practices. In other words, the fundamental principles of FOTILE culture act as a bridge between the core values and implementation system. They mainly include 10 instructions about business operation, organisation management, and leadership development (Zhao, 2020). One worth-noting principle that closely relates to the topic of this chapter is called 'innovation for good'. It explicitly requires innovations from FOTILE to prioritise the 'goodness' to customers, society and environment over the economic values (Zhao, 2020; Zhou & Sun, 2016).

2.2.4 Implementation System

Rather than producing slogans, FOTILE possess a complete and structured implementation system to reinforce and socialise the organisational culture into employees' daily life and to achieve aforementioned pursuits (Wang, 2016). The implementation system includes four dimensions, respectively originating from the four requirements of FOTILE greatness. They are the customer-centric dimension, employee training dimension, social responsibility dimension and sustainable business dimension (Zhao, 2020). The second dimension (employee training dimension) particularly covers specific cultural practices. Therefore, this section provides a detailed description of this dimension.

To better conduct employee training, Mao firstly builds a Confucius Hall inside the company to signify the importance of cultural learning and to provide a physical place to organise Confucianism classics in 2009 (Yang et al., 2020a). Then, Mao promotes four main practices to enhance the organisation culture, namely role modeling, education, employee practice, and sharing. Role modeling firstly requires managers and leaders to possess a thorough understanding of FOTILE culture and act accordingly to exert positive influences on fellow employees. For instance, Mao persists to act as

a role model by organising monthly meetings with managers to discuss about virtue-related topics to facilitate these significant values in organisation. Under his influences, FOTILE employees gradually develop the interest in the traditional Chinese culture and FOTILE culture (Zhao, 2020). Apart from the efforts from management team, outstanding employees with good conducts would also receive recognition and reward (Wang & Qian, 2018). As a result, all FOTILE people are encouraged to follow the good practices autonomously (Zhao, 2020). Education involves the classes, workshops, and seminars on various topics including traditional Chinese culture, life philosophy, relationship management, and other targeting training courses (Wang & Qian, 2018). It represents the formal way of FOTILE to provide employee training. Employee practices mainly involve five routines to strengthen the organisational culture. These routines including setting goals, reading books, correcting mistakes, being filial, and doing for good. All employees are required to plan for their routines and managers need to share their routine within the organisation. This practice successfully transforms the organisational culture of FOTILE into the behavioural habits of employees. For example, many employees have now developed the habit of reading Chinese classics, FOTILE organisational culture brochure, and so forth in the morning before the work starts. Last but not least, sharing enables the exchange and promotion of learning experience, personal reflection and good practices, further reinforcing employee development (Zhou & Sun, 2016). Main forms of sharing include meetings, forums, and online channels. For instance, a WeChat group called “to consciousness,” is created by Mao to provide managers with an online platform to share ideas and thoughts after reading classic books. For employees, they can share their ideas in the morning reading sessions, and relevant meetings. All these four practices help FOTILE to strengthen the organisational culture in the daily life of employees.

3 How Does FOTILE Culture Lead to Responsible Innovation

It can be seen that the FOTILE culture put a heavy emphasis on love and kindness, coupled with the effective implementation system, these values and beliefs has led to the real actions of FOTILE to take a genuine care of customers’ wellbeing. In turn, FOTILE’s famous ‘three codes of innovation’ have been formed to guide the innovation of FOTILE (Zhang, 2018). The three codes respectively specify (1) the source of innovation is benevolence, (2) the principle of innovation is balanced moderation,⁴ and (3) the goal of innovation is happiness. To further explain, in terms of the source, innovation of FTOILE must originate from the love for customers, rather than the need to have a long list of patents or the reputation of an active innovator (Wang & Qian, 2018). To be more specific, when generating innovative ideas, FOTILE takes

⁴ See the theoretical background of balanced moderation in (Zhou et al., 2019b).

the perspective of customers and observe the real needs of them to decide whether it is truly necessary to conduct certain innovations (Zhang, 2018). For instance, Mao says: *'one of the important reasons of the success of our first product is that we.....-could look at the products and competitors from the customers' point of view* (Mao, 2013, p. 22)', implying the love and care for customers. The principle, balanced moderation, further requires that FOTILE should not push innovation to be radical for the sake of it. Rather, the innovation needs to be practically valuable for customer (Zhang, 2018). FOTILE believes what families need is not the 'smarter products' or 'fancier functions', but the products that offer the higher convenience level, higher safety standard, and in general, better customer experiences. As the vice president of FOTILE says: *'The development of smart products has no designated track, (rather), the benevolence and love determine the final form of smart products* (Zhang, 2018, p. 52)'. Therefore, the innovation from FOTILE can be small of moderate as long as it provides the 'just right' value for customers. The first two codes naturally lead to the ultimate goal of FOTILE innovation, which is to bring the healthier and happier lives to millions of families instead of pursuing economic values. Mao emphasises: *'(we make products) to set customers, and the whole family of them free from worries, and to bring them happiness'* (Zhou, 2019, p. 45). The three codes altogether set the foundation of the responsible innovation of FOTILE. The pursuit of responsible innovation does not only apply to the FOTILE water purifier, but also other products of the firm. Take the kitchen hood of FOTILE as an example, it has originated from the need to reduce the harm from cooking fume and smoke to customers' health. Therefore, all relevant innovations of the hood focus on the requirement to achieve 'zero-smoke' even when cooking smoke-heavy Chinese dishes. Even the latest hood of FOTILE does not possess trending functions such as the internet- and cloud-related ones just because they are labelled 'smart' (Chinese IT News, 2021; Wang & Cui, 2017). Additionally, they believe cooking itself is more important than operating the hood. So, they would not invent a kitchen hood with the seemingly impressive but impractical functions to overtake customers' focus just because they want to have a stunning innovation (Wang & Cui, 2017). Another typical example of responsible innovation in FOTILE could be the dishwasher designed for Chinese families. As the dishwasher technology originates from European market, it is designed to satisfy the needs of foreign customers in terms of size and cooking habits. When facing the similar dilemma between importing existing technologies and creating new technologies, FOTILE again chooses to conduct the costly and risky independent innovation to design the Chinese version of dishwasher for the convenience and happiness of Chinese families (Qian, 2019; Wang & Qian, 2018).

To summarise, all aforementioned examples prove the efforts of FOTILE to pursue responsible innovation and we believe it is the organisational culture of love and kindness form the three codes of innovation, and in turn, leads to the consistent commitment to responsible innovation. A model (see Fig. 1) is provided to present how FOTILE culture contributes to its responsible innovation.

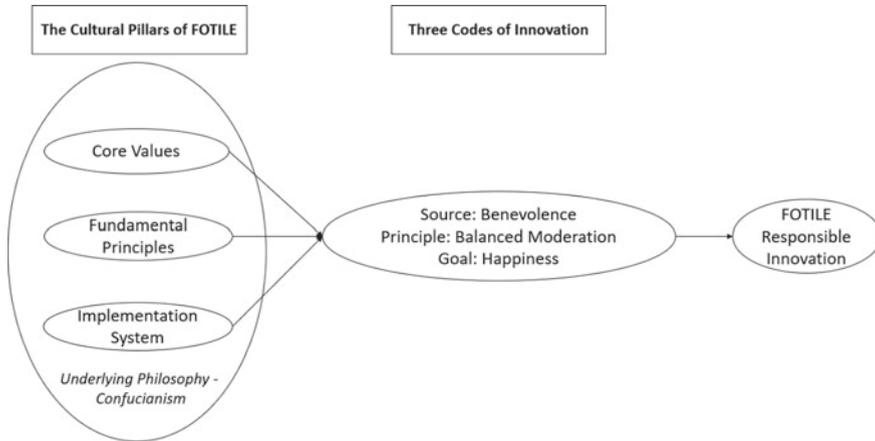


Fig. 1 FOTILE Culture & Responsible Innovation

4 Implications

From the case of FOTILE, four implications from the cultural perspective are provided for enterprises that also aim to conduct responsible innovation regarding its content and implementation.

(1) Incorporate responsible innovation-relevant elements into the organisational culture. Following the case of FOTILE, a culture that emphasises love, benevolence (kindness), and caring could be important to responsible innovation. It also echoes with the definition of responsible innovation which explicitly requires the care for certain social, economic, and environmental values (Koops et al., 2015). While FOTILE identifies and focuses on love and kindness, multiple other cultural traits should be available. For example, in the general business context, responsibility-related beliefs might be summarised into a customer-centric culture. Other helpful values might come from areas such as humanism, business ethics, corporate social responsibility and etc. (Koops et al., 2015). The point is to identify and integrate supportive elements into the organisational culture.

(2) Build a culture that fits into the national context. As suggested, FOTILE culture is constructed on the basis of Confucianism, which has the long-lasting presence and recognition in China. Employees’ familiarity of the underlying philosophy leads to pre-acquaintance with relevant beliefs. This saves the organisational efforts to conduct education and socialisation. Companies from certain countries should find the cultural elements that fits into their national context to construct the organisational culture more effectively.

(3) Build a complete structure of culture. The power of a single slogan is not as strong as a complete eco-system including the base of national culture, core beliefs, guiding principles and implementation schemes. Multiple elements in the cultural network could justify and reinforce the presence of each other. In this way, an organisation could surround their employees with the desired cultural atmosphere.

(4) The involvement of top management and leaders is particularly important to build an organisational culture, and it is evident in the FOTILE case. Firstly, top managers are role models for employees to learn from. This is in consistence with social learning theory that people learn social behaviours through observing and imitating models (Bandura & Walters, 1977). Managers are the ones who have the ability to provide subordinates knowledge and behavioural guidance via their actions. Secondly, leaders, especially the top ones are the people that could provide various supports from the tiny support such as designing culture-developing activities (e.g., morning reading) to the significant support such as building infrastructure (e.g., the Confucius Hall in FOTILE). Last but not least, top managers could make strategic decisions on whether or not to continue with a certain project just because it is responsible. For example, the 8-year long R&D of FOTILE water purifier cannot be realised without Mao's patience and support. Therefore, the attitude of top management team influences the level of organisational commitment to its culture and the responsible innovation.

5 Conclusion

In conclusion, this chapter takes the chance to explore the understudied cultural roots of responsible innovation with the case of FOTILE. After briefly introducing the theoretical background of organisational culture and its impacts on innovation, we adopt the example of FOTILE water purifier to demonstrate the real-world case of responsible innovation. By further arguing that the special culture of FOTILE contributes to its commitment to responsible innovation, we analyse the FOTILE culture by discussing its underlying philosophy (the Confucianism) and its three cultural pillars (i.e., the core values, fundamental principles, and implementation system). Then, the relationship between the FOTILE culture and responsible innovation is analysed and we make the contribution by suggesting the extensive presences of love and kindness are the cultural roots of responsible innovation. Finally, practical implications regarding the content and implementations of organisational cultures are provided for other companies.

Acknowledgements We are thankful to FOTILE for the support of this research project.

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Unpacking the Driving Forces Behind Sustainable Supply Chain Finance Adoption



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Abstract This chapter emphasizes the importance of managing capital flows through different Sustainable Supply Chain Finance (SSCF) models with the aim of improving the development of Sustainable Supply Chain Management (SSCM). We start by examining the driving force behind practical SSCF cases with three different SSCF models, which include leading enterprise-initiated SSCF, e-commerce platform-enabled SSCF and government-supported SSCF. Next, the main practical implications for future implementation of SSCF for policymakers, focal firms, and suppliers along with SCF service providers are summarised. Finally, we present theoretical implications to compare different SSCF models.

Keywords Sustainable supply chain finance · Sustainable supply chain management

1 Introduction

At present, an increasing number of Sustainable Supply Chain Finance (SSCF) programmes are being rolled out by focal firms and financial institutions (Citi, 2021; HSBC, n.d.; IFC, n.d.), with a view to improving the sustainability, development and resilience of supply chains (SCs) and managing working capital needs. A number of these focal firms are well-known multinational companies (MNCs). Meanwhile, there also exist practical examples of sustainability-linked SCF which are supported by governments or initiated by focal firms without the participation of financial institutions. It is, therefore, important to explore the phenomenon of this innovative

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emerging solution in order to better promote the development of Sustainable Supply Chain Management (SSCM).

In recent years, the evolution of Supply Chain Management (SCM) in academia has gone through several phases, moving from a focus on cost and efficiency, through quality dominated, to an increased concern with flexibility and resilience. Meanwhile, the era of managing manufacturing and logistics has extended to the era of managing capital. However, among the three flows (of material, information, and finance) in the supply chain (SC), the management and optimisation of material flow is likely the most well-developed area of SCM research (Vidal & Goetschalckx, 1997). There has also been increasing research into complicated information management systems for SC collaboration based on recent developments (Wong et al., 2015). It seems that businesses have put a lot of effort into improving product and information flow in SC, whereas practitioners have paid little attention to the financial flow until recently, and research relating to financial flow and its importance in integrating the product and information flows along the entire SC is very scant. SCF, as a relatively new and innovative financial development, is becoming an increasingly important approach for companies seeking to enhance the integration of the three flows across the SC as a whole. SCF schemes are attracting a growing number of buyers and suppliers as they can help with solving short-term liquidity issues and long-term financial burdens relating to SC operations. According to Wuttke et al. (2013), SCF refers to the utilisation of a portfolio of financing and risk mitigation practices and techniques designed to support the integration of physical, information and financial flows along the SC and to realise the optimisation of working capital management and liquidity tied up in SC processes and transactions. In terms of the scope of SCF, Templar et al. (2020) have described three types of SCF: buyer-centric SCF payable solutions such as reverse factoring in the narrow sense; concepts covering account receivables, payables and inventory in a wider sense; and SCF services targeting all SC-related transactions. According to the GSCF Forum (2016), the participants of SCF transactions are buyers and suppliers who trade and collaborate along the SC. These participants work with financial service providers such as financial institutions and fintech enterprises to improve SC financial performance using various SCF services driven by different SC-related events.

At the same time, the evolution of SCs is not simply accompanied by the growing dominance of financial focus. In recent years, there has also been an increasing focus on the development of the sustainability (including economic, social, and environmental aspects) of business competitiveness on a global scale. This has resulted from the expanding and varied expectations regulators, investors, and customers have regarding sustainable challenges, which corporations need to deal with. However, it can be extremely difficult to realise SC sustainability from upstream to downstream, especially in times of economic downturn (such as that caused by the Covid-19 pandemic) in which firms are facing heavier capital pressure and a higher risk of bankruptcy than before, with the pursuit of sustainability development becoming increasingly challenging.

Regarding the dilemma between capital pressure and sustainable development requirements, it is worth noting that researchers and practitioners are increasingly

interested in innovating and unlocking the scope of SCF beyond cash flow optimisation. They are becoming more interested in investigating the ability of SCF functions to direct capital into more sustainable firms or SCs to boost SCF's potential for empowering the entire SC's sustainability transformation. Chen et al. (2020) have highlighted the concept of sustainability that has become a new focus in SCF research. Meanwhile, An et al. (2021) found that green credit financing under a relatively stringent carbon emissions policy can help manufacturers to secure a win-win situation with the suppliers if the appropriate level of green investment is chosen, and governments can play a role in helping manufactures to achieve this win-win situation. To define this new and innovative concept of bringing sustainability into SCF, Business for Social Responsibility (BSR), a non-profit Corporate Social Responsibility (CSR) organisation in the United States, has developed the notion of SSCF, which refers to SCF solutions that enable trade transactions in a way that attempts to diminish unsustainable impacts and provide advantages for all stakeholders engaged in the SC in terms of economic, social, and environmental aspects (BSR, 2018).

Establishing a sustainable SC is a journey, not a destination. Therefore, regarding the adoption and diffusion of this innovative approach that combines finance and SC concepts, SSCF may also need both time and a driving force. It is reasonable that advocating the implementation of SSCF will take time. Some firms have no awareness of or willingness to implement such a scheme and some may implement some aspects faster than others, such as technological innovation. In the formative stage of emerging SSCF mechanism development, it is important to identify the driving forces behind SSCF introduction and the adoption of "initiators" (Who firstly initiates the SSCF schemes) along with the different impacts of such drivers.

This chapter will examine practical SSCF cases with three different models, namely, leading enterprise-initiated SSCF, e-commerce platform-enabled SSCF and government-supported SSCF, to explore the concepts of SSCF and illustrate the driving force behind each SSCF model. In addition, this chapter will provide some insight regarding the further adoption of SSCF for policymakers, buyers and suppliers, along with SCF service providers. To understand leading enterprise-initiated SSCF, we chose MNCs companies, Puma, Levi Strauss & Co, Walmart, and Starbucks as examples. Given the complexity of extended SCs, their suppliers are based in different countries and are likely to fail to comply with the environmental and social standards set by them due to the loose sustainability regulations or weak infrastructure in the suppliers' countries. SSCF can provide financial support to their suppliers and improve the level of lower-tier suppliers' sustainability performance. For e-commerce platform-enabled SSCF and government-supported SSCF, we choose as examples Alibaba and the Guangdong-Hong Kong-Macau Greater Bay Area in the Chinese context to explore the digital trends in SSCF and the impact of government support for SSCF in facilitating green transformation and exports in China compared to other countries.

This chapter presents the following key findings. First, downstream retailers in the fast-moving consumer goods (FMCG) industry tend to proactively implement SSCF practices aimed at building a positive brand image driven by consumers' attitudes and public scrutiny. Second, government support is necessary when the objective of SSCF implementation is to facilitate green transformation and industry upgrades in China's traditional manufacturing industry. Third, e-commerce platform-enabled SSCF can generate information advantages through which it is easier to monitor production behaviour and understand the designated financial needs of dispersed and individual suppliers, especially for China's agricultural SCs. In addition, the coordination of multiple participants such as financial institutions, professional SCF associations and NGOs should be considered as it can provide complementary resources for the "initiator" firms and help with the establishment of more solid sustainability evaluation standards. Finally, the implementation of SSCF needs more investment in knowledge-sharing sessions to educate manufacturers and suppliers and help them develop a consistent attitude toward sustainability and SSCF awareness.

The remainder of the chapter is structured as follows. In the next section, we will provide case descriptions and analyses of different SSCF models, including leading enterprise-initiated SSCF, e-commerce platform-enabled SSCF and government-supported SSCF. Finally, in the discussion and conclusion section, we will present practical suggestions regarding SSCF implementation, theoretical implications, and conclusion.

2 Type One: Leading Enterprise-Initiated SSCF Model

2.1 Case Description

2.1.1 Leading Enterprise-Initiated SSCF Model 1: Leading Enterprise and Financial Institutions

Several buzzwords have been used in recent years to emphasise international fashion brands' green credentials, such as "eco-conscious", "ecologically friendly" and "sustainable". However, these can be taken advantage of in ways that are not truly benefiting sustainability as greenwashing purposes, such as the use of misleading marketing and the publication of sustainability reports that reflect no truly sustainable performance. As sustainability claims become more exaggerated, complex global supply networks require more stringent investigations and the fashion industry has experienced more pressure from professional associations and consumers because of its limited progress in terms of sustainability. This pressure has motivated some fashion brands to develop more effective approaches to realising true sustainability through, for example, working with financial institutions to implement SCF solutions linked directly to sustainability.

To promote the overall sustainable development of SCs, leading enterprises may seek the cooperation of financial institutions in providing financial services and formulating different financial interest rates or plans based on the level of sustainable development investment from upstream companies. Forward-looking suppliers that perform better in terms of sustainability can obtain more favourable financing conditions, which motivates suppliers to consciously participate in sustainable development.

Puma and IFC SSCF Program

As an international brand, Puma has implemented a SSCF solution in collaboration with the International Finance Corporation (IFC) to provide financing service for Puma's suppliers in the emerging markets since 2016. This groundbreaking program aims to incentivize upstream suppliers to upgrade their environmental and social performance. By explicitly tying SCF services to a supplier's sustainability performance, suppliers who behave more sustainably will be offered more favorable financing conditions or earlier payment (Puma, 2016). IFC has introduced a short-term working capital financing system with tiered pricing in attempt to offer lower prices for suppliers who get a high score in Puma's supplier rating, which is applied after Puma has audited the supplier's adherence to the company's social and environmental requirements. Meanwhile, suppliers can benefit from Puma's strong brand and financial position to obtain reasonable financing. Moreover, an external auditor will assign a CSR grade (on a scale of 1 to 5) to these suppliers, which is then connected with the financing cost. Those ratings are checked on a regular basis, and "suppliers receive a reduction every time the rating improves, or an increase in their financing costs if the grade decreases."

Levi Strauss & Co and IFC SSCF Program

To make progress on the climate goals, another MNC Levi Strauss & Co also works with its suppliers by helping them set explicit goals on sustainability and supporting their efforts to obtain more efficiency regarding water and energy, as well as expanding their usage of renewable energy. Accordingly, Levi Strauss & Co has partnered with IFC to help suppliers that have already started executing sustainable investment plans obtain lower financing rate. In doing so, Levi Strauss & Co intends to support suppliers who are moving in the right direction, because the company also takes the suppliers' success into account. Built on already effective collaboration with IFC, Levi Strauss & Co has been involved in the Partnership for Cleaner Textiles (PaCT) since 2017 to help suppliers receive professional advice and further guidance on the initiative that led them to achieve more sustainable operations (Levi Strauss & Co, 2020). The initiative has covered almost 40 suppliers across nations, including Bangladesh, Egypt, India, Pakistan, Sri Lanka, Mexico, Turkey, and Vietnam after the early trial program proved tangible savings and efficiency benefits. Levi Strauss &

Co. has also participated in the IFC's Global Trade Supplier Finance (GTSF) program for a long time, which provides low-cost finance and early payments to suppliers who comply with the IFC's environmental and social requirements (Levi Strauss & Co, 2020). Given the financial issues suppliers faced — and continue to face through the pandemic, this program has played a significant role in mitigating their financial issues throughout the COVID-19 pandemic. According to Levi Strauss & Co (2020), there are more suppliers adopting this program and the company is working with IFC to raise the availability of funding for better satisfying the increasing demand. This SSCF initiative connects the two programs in an effective approach through bringing PaCT into the GTSF framework so that suppliers who adopt the former can increase their liquidity at favorable financial terms through the latter.

SSCF practice is not just newly developed in the apparel retailing, similar to the SSCF model that Puma's and Levi Strauss & Co have implemented, the retail giant Walmart has partnered with HSBC to boost the SC's sustainability development by connecting financing terms to suppliers' sustainability performance measured by Walmart's Sustainability Index (Walmart, 2021).

Walmart and HSBC SSCF Program

As early as 2009, Walmart began collaborating with The Sustainability Consortium (TSC) to launch its Sustainability Index. The Index gathers data and information from Walmart's full product life cycle to identify the most severe social and environmental issues and propose a course of action plan for further improvement. According to Walmart Sustainability Hub (2017), 70 percent of Walmart's products came from suppliers who participated in the Sustainability Index by 2017, covering 300 buyers in more than 125 categories and representing 3,000 distinct products. In addition, Walmart launched Project Gigaton in 2017, an initiative aimed at reducing greenhouse gas emissions by one billion metric tons by 2030 through offering preferential financing terms to suppliers who demonstrate progress toward sustainability goals.

The SSCF model initiated by the focal downstream retailers is illustrated in Fig. 1.

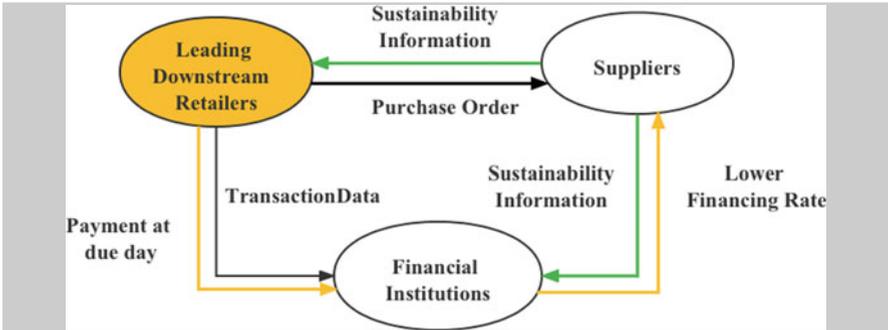


Fig. 1 Leading enterprise-initiated SSCF Model 1: Leading enterprise and financial institutions

2.1.2 Leading Enterprise-Initiated SSCF Model 2: Leading Enterprise Without Involvement of Financial Institutions

Starbucks SSCF program: Supplier Development Program

Starbucks, the most widespread international coffee-house brand, is committed to assisting coffee farmers in overcoming the problems they face. In collaboration with Conservation International, Starbucks is dedicated to procuring 100 percent ethically sourced coffee beans. In addition, Starbucks has built Farmer Support Centers located in coffee-producing nations worldwide to share knowledge and resources aimed at improving production and sustainability (Starbucks, n.d.). Meanwhile, there are increasingly horrifying incidents of violations of sustainable compliance relating to buying firms’ upstream SCs, which has undoubtedly had a detrimental effect on buying firms’ financial and operational performance (Hartmann & Moeller, 2014). Consequently, Starbuck has collaborated with Conservation International to jointly develop a verification program, Coffee and Farmer Equity Practices (CAFE), in 2004 to help upstream coffee farmers improve their livelihoods and ensure the long-term supply of high-quality coffee (Starbucks, n.d.). To ensure the sourcing of premium quality coffee, Starbucks pay higher prices on coffee that is measured as ethically sourced based on C.A.F.E. Practice standards rather than the commercial market to help farmers achieve greater profitability. In addition, SC participants can be rewarded with additional premiums if they implement further upgrades regarding C.A.F.E. Practices (Starbucks, 2019). In this case, while increasing the purchase price or paying the receivables in advance to upstream suppliers

may increase Starbucks' procurement costs, the upstream supplier is incentivised and trusted to improve product quality, thereby reducing the loss of core enterprises in quality control and improving the entire SC's sustainability. Collectively, there are four categories of criteria for evaluation: economic transparency, social responsibility, environmental leadership and quality. Starbucks can trace the original source throughout their coffee SC after upstream suppliers submit their payment records relating to coffee beans. At the same time, the company's sustainability development in terms of social dimension performs better, such as in fulfilling the requirement to protect coffee farmers' working conditions and minimum legal wages on a regular basis. Regarding environmental leadership, C.A.F.E. Practices support farmers in overcoming climate change impacts. In practice, Starbucks implements the SSCF model as follows. Initially, Starbucks will select its suppliers based on coffee quality and economic transparency before conducting any business. After that, detailed information on the whole coffee SC and commitment to implementing C.A.F.E. Practices guidelines should be presented in the supplier's formal application. At the next stage, SCS Global Services, a third-party organisation, will inspect the farms' SC operations through fieldwork that evaluates more than 200 indicators. Once approved, suppliers will join C.A.F.E. Practices and be invited to obtain know-how from the Farmer Support Centre. Furthermore, regular re-verification is required to maintain constant sustainability performance (Starbucks, 2020).

The SSCF model initiated by the focal downstream **retailers** is illustrated in Fig. 2.

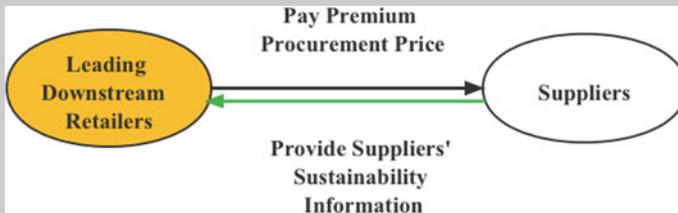


Fig. 2 Leading enterprise-initiated SSCF Model 2: Leading enterprise without involvement of financial institutions

2.2 Case Analysis

2.2.1 Leading Enterprise and Financial Institutions: Puma, Levi Strauss & Co, Walmart

In these scenarios, the focal firm collaborates with the commercial bank with the aim of providing lower financing terms to suppliers based on the focal firm's credit rating but adding the evaluation criteria of their efforts on the development of sustainability. In general, the focal firm is intrinsically motivated to introduce this innovative SSCF practice to suppliers due to their willingness to develop a positive brand image. The focal firm also has the objective of upgrading suppliers' sustainable production and inter-organisational innovation through a series of cultural and technical knowledge-transfer initiatives, such as Levi Strauss & Co using the Partnership for Cleaner Textiles (PaCT) to help suppliers receive professional know-how and further guidance on developing more sustainable practices.

As mentioned above, the fashion industry is facing great institutional pressure on sustainability development as downstream fashion retailers stress the importance of consumer perspectives through which consumers believe companies should take responsibility for activities relating to their SC. Fashion brands rely on the clothing industry, which produces serious environmental issues relating to areas such as water pollution during the production process. Moreover, the social scandals (such as international brands using "slave labour" in developing countries) has generated backlash from the public.

To improve environmental and social performance across the SC, Puma's and Levi Strauss & Co have implemented similar SSCF models in response to public scrutiny. The case of Levi Strauss & Co also shows that the "initiator" firm's implementation of SSCF practice is driven by pressure from the code of conduct advocated by professional industry associations related to sustainable production, such as PaCT, under the objective of better satisfying the requirement of communities, and organisations' feeling of being obligated to do the right thing for society. Furthermore, the focal firm is likely to implement SSCF practices because of its willingness to remain competitive through following the activities of its competitors.

2.2.2 Leading Enterprise Without Involvement of Financial Institutions: Starbucks

In this scenario, Starbucks not only offer financial support to their upstream suppliers by paying premiums but also helps them to work with their Farmer Support Centre in further improving their sustainable development. This SSCF model can be viewed as an incentive for the integration of financial and operational services, which greatly improves the motivation of upstream suppliers to invest in sustainable development. Furthermore, this approach not only improves the quality of Starbucks coffee but also creates a good public image for the brand, which helps Starbucks enhance its

inter-organisational competitive advantages along the whole SC. From the upstream farmers' perspectives, they will get paid a premium or receive payment in advance if they put more effort into sustainable production. In addition, upstream suppliers can transform their production through frequent communication and technical support from Starbucks, which also facilitates the establishment of a long-term relationship with the company. The Starbucks case indicates that this SSCF practice is a purely buy-centric approach, with the capital being provided by Starbucks itself. There is no involvement of commercial banks or regulatory agencies. Starbucks has only collaborated with NGOs to initiate its sustainable performance evaluation and provide financial support directly to its upstream suppliers.

Starbucks has invested substantially in sustainable coffee communities, which can be viewed as a form of investment in relation-specific assets. In the case of Starbucks, the adoption of a sustainable SCF programme is driven by a longstanding commitment to sustainability, greater investment in relation-specific assets and knowledge-sharing. In addition, effective self-enforcing governance such as the trust of its suppliers also builds the foundations of SSCF adoption.

3 Type Two: E-Commerce Platform-Enabled SSCF Model

3.1 Case Description

Regarding the previous case, SSCF adoption is largely driven by the focal firm's considerable investment in relation-specific assets, knowledge-sharing routines, and high levels of SC trust. However, it is difficult for lenders to monitor the actual use of sustainable funds when financial support is not directly raising procurement prices based on stringent sustainable evaluation. Therefore, the moral hazard problems identified in principle-agent theory may arise due to information asymmetry in certain instances, which means that sustainable funds are likely to be easily misappropriated without effective monitoring. Financial providers cannot ensure that funding is being used for the development of sustainable SC activities, and the managers of supplier enterprises have the potential to misuse the funding for self-interest.

To avoid such agency risks, another innovative SSCF practice has been introduced by Alibaba's affiliated group Ant Financial, in which borrowing suppliers are given designated purchase credit to purchase designated green brands rather than cash to promote the sustainable development of enterprises and cultivate suppliers' sustainable behaviour (Ant Financial, 2016). For the agricultural sector in China, farmers usually have no access to markets and limited financial resources. In terms of sustainable development in the agricultural sector, upstream farmers usually have no capacity or willingness to get involved. Therefore, Ali launched this agricultural SSCF in collaboration with large agricultural processors and state-owned insurance companies to motivate farmer suppliers to get involved in enhancing its SC sustainability performance.

E-commerce platform + Leading enterprise + Insurance

Empowered by Alibaba’s advanced technology support, this powerful e-commerce platform generates the designated purchase credit quota for meeting farmer suppliers’ capital needs. In this case, farmer suppliers can only use directional purchase quotas to shop on Ali’s online rural marketplace, Rural Taobao for specific production materials with green brands. Thus, the sustainable source of upstream production is secured through this directional credit payment method, and farmer suppliers’ behaviour can be developed and reinforced through continuous sustainable consumption. Furthermore, the leading agricultural enterprise offers technical support and training to help farmer suppliers improve their sustainable production skills. Apart from educating suppliers about environmental production processes and requirements, this additional information sharing between focal enterprise, Ant Financial and farmer suppliers can help build a long-term relationship and achieve better supplier involvement. The process of Alibaba’s SSCF model is illustrated in Fig. 3.

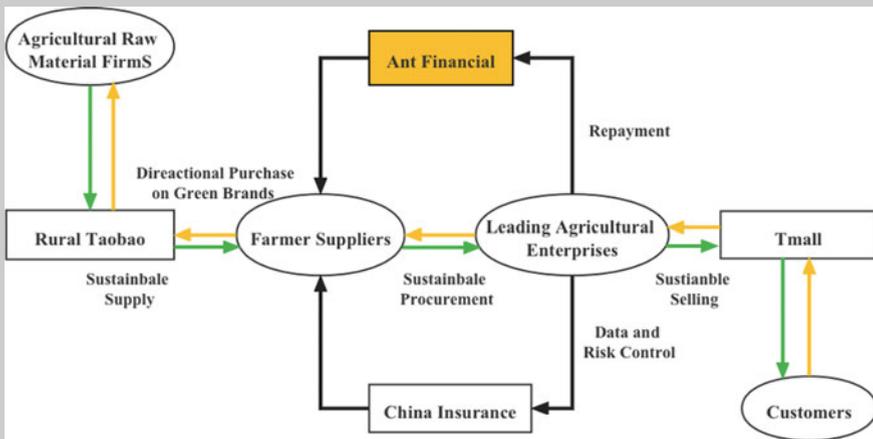


Fig. 3 E-commerce platform-enabled SSCF model of agricultural industry (Zhou et al., 2018)

As shown in the Fig., Alibaba connects all corresponding participants. Ant financial provides financial payment and fintech arrangements. T-mall and Rural Tao act as downstream and upstream retailing platforms respectively. A comprehensive green SC is created as farmer suppliers purchase green material for production and sell green farm products to the leading agricultural processors, who then sell their final green products to T-Mall; finally, end customers purchase the green products from T-Mall supermarkets. Due to the uncertainty

and high risk involved in agricultural production, Alibaba also entered partnership with a state-owned enterprise, China Insurance, to secure the whole SC (Ant Financial, 2016). In doing so, the repayments from leading enterprise and farmer suppliers' production are insured by a diverse range of supportive insurance.

3.2 Case Analysis

In general, there are two closed loops in this SSCF model, which are the loop of capital and the loop of green products. Farmer suppliers are granted a directional purchase credit quota from AF and use the credit to buy green raw materials on Rural Taobao.¹ Moving to the downstream SC, end consumers shop for finished goods on T-Mall² and use Alipay³ to pay. After completing the sale, focal agricultural enterprises received profits and reduced their procurement costs. Alipay facilitates the formation of a closed loop of capital flow among all entities in the SC. The loop of green products is also formed through the operation of the two retail platforms, Rural Taobao and T-Mall, respectively.

Furthermore, this model is well suited to addressing sustainable development issues in developing countries relating to social dimensions such as food safety problems (Zhou et al., 2018). In developing countries, food safety issues in farming are quite severe. For instance, the harmful pesticides and fertilisers used can lead to unmanageable food safety problems. This also suggests that it is difficult to use penalties or cash loans to make farmers purchase designated products, and it is also hard to monitor individual farmers' production behaviour. Thus, to incentive farmer suppliers to use pesticides and fertilisers that meet food and environmental safety requirements, the application of directional credit through SSCF is more effective in this context.

Ant Financial does not formulate any sustainability evaluation criteria for evaluating upstream suppliers' sustainable behaviour in this case. Empowered by e-commerce platforms and insurance companies' support, the focal agricultural firm become increasingly willing to implement SSCF practices in such circumstances. The evolution of SCF is becoming increasingly digital, with e-commerce platforms demonstrating their potency in terms of digital technology expertise, and their power increases with the growing number of users, due to networking effects. Therefore, the e-commerce platform is willing to implement SSCF to develop the agricultural market in China, since it is still a blue ocean market, in order to acquire more individual users. In addition, Alibaba can utilise its online capabilities to build better

¹ Alibaba's business-to-business (B2B) online rural marketplace.

² Alibaba's business-to-customer (B2C) retailing platform.

³ Alibaba's third-party payment (TPP).

relationships with its customers (such as leading agricultural processors). At the same time, the purpose of ensuring sustainable production and solving food safety issues through granting green purchase credit might be effective when combined with a willingness to gain complementary resources.

4 Type Three: Government-Supported SSCF Model

4.1 Case Description

There is no government involvement in the previous three SSCF cases, whereas the following SSCF cases have the characteristic of having local government support and participation in the context of the Chinese automobile industry. Guangdong can be viewed as a leading low-carbon province in China on behalf of 38% of the country's carbon emission trading pilots (Deloitte China, 2021). Meanwhile, Guangdong–Hong Kong–Macau Greater Bay Area has strong manufacturing foundations, drawing together 80% of China's SC businesses (Deloitte China, 2021). This suggests that GBA could play a leading role in China's green transformation. However, compared with other international bay areas, there exist incomplete coordinated governance mechanisms and obstacles such as relatively underdeveloped green standards, insufficient green technology development (Deloitte China, 2021). Meanwhile, automotive manufacturing in GBA, as a typical technology and capital-intensive industry, involves massive financing demands, especially for upstream and downstream SMEs on the chain. However, these SMEs usually face financing pressures such as low credit ratings and high financing costs. GBA has recognised its green transformation objectives and SMEs suppliers' needs and has proposed a green SCF practice.

Local Government Initiatives: Guangdong-Hong Kong-Macau Greater Bay Area SSCF Practice

Supported by the local government, Green Finance Committee of Guangdong formulates green SCM evaluation standards for the core vehicle manufacturing companies and invites experts to verify qualifications to these core companies. The core company who has passed the qualification system can obtain the "whitelist qualification", which means that there is no need to review green qualifications of its upstream suppliers in the core company's SSCM list again when these suppliers intend to apply for green financing if the core company is on the list (Guangdong Green Finance Committee, 2020). The Fig. 4 illustrates the GBA's SSCF model.

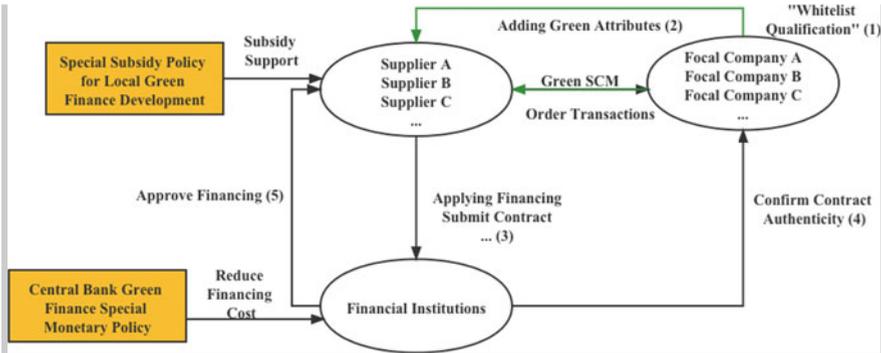


Fig. 4 Government-supported SSCF model of automobile manufacturing industry (Guangdong Green Finance Committee, 2020)

In general, GBA GSCF model operational processes include the following steps: as a core company in the SC, the vehicle manufacturer applies to the Green Finance Committee of Guangdong for “whitelist qualification”. And then Green Finance Committee of Guangdong organizes an expert review committee to review the core enterprises’ qualification based on the automotive manufacturing industry green SC indicator evaluation system, and the core enterprises that pass the verification can obtain the “whitelist qualification” (Guangdong Green Finance Committee, 2020). Upstream suppliers can apply for green SC financial services to financial institutions through submitting transaction evidence with core enterprises. Financial institutions will confirm whether core enterprises have “whitelist qualifications” based on the whitelist provided by the Guangdong Green Finance Committee. After the financial institutions complete the “whitelist qualification” confirmation and confirm to the core enterprise whether the supplier has entered the core enterprise’s green SCM list and confirms whether previous transaction evidence is true. More importantly, financial institutions, core enterprises and upstream SMEs can report green finance data to financial regulatory authorities to obtain corresponding subsidy support for the local green development (Guangdong Green Finance Committee, 2020).

4.2 Case Analysis

The Chinese government plays a leading role in environmental protection for the country and has put more pressure on enterprises through environmental inspections and sanctions as China faces severe environmental challenges along with the high speed of economic growth. By utilising innovative SCF solutions, GBA can

facilitate regional green industry transformation instead of simply imposing strict sustainability sanctions to mitigate SMEs suppliers' financing issues, regulate SC sustainability performance and boost regional economic development. Empowered by finance, industry and local government, green transformation is becoming more realistic. The local government's support in establishing a coordinated governance mechanism and a sustainable framework, along with the efforts made in terms of cultural pilot zone investment, can represent an external pressure but can also generate the motivation to investigate sustainable development strategies among focal manufacturers and SME suppliers. In this scenario, local green transformation is empowered by public/private partnerships, with local governments taking the lead in encouraging automobile manufacturers and their SME suppliers to get involved in green transformation by offering subsidy support and facilitating the establishment of sustainability performance criteria targeting the specific industry and area. Although it is difficult to measure this SSCF approach's actual performance in terms of the SC in the short-term, it indicates that the driving force for the focal manufacturer's sustainable responsibility in developing countries or areas may differ from those that impact other international companies or specific industries. The government-supported SSCF can help the green transformation of traditional manufacturing industries. It also helps enterprises to deal with green market access restrictions, green subsidies and green international trade measures such as anti-dumping policies. Finally, it can enable the elimination of barriers to international trade, expand exports and improve the competitiveness of automobile manufacturers in the global market.

5 Discussion and Conclusion

5.1 Practical Implications

This chapter provides the following practical suggestions for practitioners, which include specific actionable recommendations for focal firms, SSCF service providers and policymakers. The firm's onboarding of SSCF practices is essential to the further adoption of more suppliers. Understanding the types of "initiators" in a specific industry or geographical area that are likely to implement SSCF sooner may assist SSCF service providers and policymakers in developing more appropriate strategies. The most crucial inference is that the implementation of SSCF models varies based on the characteristics of different industrial sectors. Firms in industries that are not subject to the same institutional pressure may react differently and may require the implementation of different SSCF models.

In terms of the retailing industry, retailers who initiate SSCF schemes are located in the downstream of the SC, close to the end consumer; for instance, in the cases of Puma, Levi Strauss & Co, Walmart and Starbucks, they are more likely to face

high pressure from consumers' increasing concerns regarding the social and environmental impact of the products they purchase. Furthermore, consumers want information on how these products are sourced and manufactured, which means that consumers' awareness of sustainability is not limited to the firms they buy from but expands upstream to cover suppliers from multiple tiers (Hartmann & Moeller, 2014). The subsequent unsustainable behaviours or actions of suppliers in the SC may result in chain liabilities for downstream focal retailers, who are more likely to become the target of scrutiny and criticism from end consumers and the public. It suggests that the downstream retail giants are facing strong pressure from the public. Meanwhile, these retailers' revenue, market share and brand image are largely influenced by consumers' attitudes and purchase intentions. Furthermore, consumers' attitudes toward the retailers and purchase intentions can be viewed as essential precursors to purchasing behaviour (Duan et al., 2021), meaning that the adoption of strategic and effective SSCF practices can provide positive revenue implications.

Therefore, it is important that focal firms recognise that implementing the typical SSCF model is beneficial not only because it helps the retailers to regulate suppliers' sustainable production and mitigate their financial problems, but also because it can send signals to the public that will generate a more positive brand image as there will be a more positive consumer attitude and enhanced purchase intention. In summary, instead of passively engaging in SSCF as a response to legislation or public requirements in the wake of scandals, in order to promote a positive brand image and attract more consumers, retailers should proactively use their market positions to play the initiating role in implementing SSCF. Furthermore, they also need to seek partnerships with financial institutions or third-party NGOs to better satisfy the public's increasing expectations regarding sustainable development.

By contrast, the implementation of SSCF in traditional manufacturing industries is much more challenging for the focal firm because traditional manufacturing is located very far from the downstream SC. These focal firms have limited motivation from end consumers and limited professional capabilities to initiate SSCF practices. Heavy industries like traditional manufacturing involve larger starting costs. For example, automotive manufacturing requires substantial investment in building factories, and sustainability transformation for these industries is much more difficult as green upgrades on equipment and machinery are extremely costly; during times of economic downturn, in particular, basic operations may be hard to sustain for some lower-tier suppliers. Therefore, government involvement plays a critical role in motivating sustainable improvement in traditional manufacturing industries.

Supply-side structural reform, which was proposed by the Chinese government in late-2015, is a new strategy to handle difficulties emerging since China's economy entered its "new normal" phase (Ma, 2020). One of the main objectives of supply-side structural reform is to minimise overcapacity in traditional manufacturing industries. Overcapacity has been a source of concern in terms of China's economic growth for a long time, with a great excess of industrial products exceeding actual demand. Moreover, overcapacity has resulted in declining prices and profit margins for relevant enterprises from traditional manufacturing industries. To deepen supply-side

structural reform in the manufacturing sector, and to resolve the issue of overcapacity and realise green transformation, it is not enough to rely solely on the central government's support. The local government should put extra effort into promoting SSCF plans based on the actual situation of regional development by integrating green finance, SCF and green SCM to maintain steady development of the real economy.

The automobile manufacturing industry is an important pillar of a region or even a country, especially for the development of the new energy vehicle manufacturing. From parts production to vehicle assembly, the automotive SC is complex. Green transformation in automotive manufacturing requires capital investment which will lead to higher costs. More specifically, similar to automotive manufacturing, the implementation of SSCF schemes in traditional manufacturing industries such as textiles, steel, and home appliances also requires the establishment of incentive mechanisms backed by the government. Furthermore, adopting SSCF in traditional manufacturing can benefit the development of emerging strategic industries such as new energy vehicles and new materials as it involves the transformation and upgrade of traditional manufacturing. At the same time, sustainable upgrades by government-supported SSCF can promote exports to foreign countries with stringent sustainability requirements. Hence, the government can use measures such as fiscal discount interest, tax incentives and credit guarantees to reduce the financing cost of adopting SSCF projects and improve the risk tolerance and motivations of the focal manufacturers and their suppliers' participants regarding sustainability development, as well as more Environmental, Social and Governance (ESG) investments from investors like commercial banks in the initial stages, while withdrawing from the SSCF project gradually.

Second, we encourage the establishment of industrial SSCF strategic alliances based on cooperation between leading enterprises, suppliers, universities and research institutes using financing approaches to solve several technical "bottlenecking" difficulties in green manufacturing and facilitate breakthroughs in creating truly sustainable SCs from harm reduction to harm elimination. Additionally, we suggest that leading enterprises should formulate their own standards while trade associations should generate collective standards on sustainability development from the industrial sectors' perspectives. At the same time, local governments should build local standards that are stricter than national standards based on regional strengths and weaknesses.

Third, policymakers should develop a holistic SSCF service system for industry transformation in traditional manufacturing industries. It is necessary to accelerate the establishment of sustainability assessment and performance rating standards covering all three dimensions (i.e., economic, environmental and social indicators) and encourage more third-party SCF service providers to offer professional SSCF services in terms of certification, assessment and verification. Based on the characteristics of traditional manufacturing industry SCs, the unified third-party evaluation criteria and holistic procedures should be established to provide a reference guide and evaluation basis for the implementation of SSCF schemes.

Further, we suggest that more innovation regarding SSCF products and services is needed to meet the customised or personalised financial needs of upstream and

downstream enterprises in the SC. More innovative SSCF schemes such as green credit and funding can be implemented in the pilot area at first, before promoting its adoption if it performs well.

Inspired by the case of Alibaba's SSCF model, our findings also show that the driving force behind the implementation of SSCF practices for the light asset industry based on e-commerce platforms should utilise the information advantages backed by advanced digital technology. The SSCF based on advanced technology can help realise the holistic sustainability development covering the upstream-to-downstream SC. Therefore, we suggest that there is a need to accelerate the establishment of the SSCF information management, trading and financial platform for industries with extensive individual suppliers. E-commerce enterprises should make full use of their online informational advantages and establish interconnection platforms connecting various cooperative enterprises to obtain complementary offline resources and capabilities.

In addition, the implementation of SSCF in China's agricultural sector should be paid more attention as agriculture plays a critical role in China's economic output, environmental development and poverty alleviation. The support of advanced digital technologies can boost further development in intelligence agriculture. E-commerce platforms with payments, capital advantages and retailing channels usually have more capabilities for promoting the establishment of sustainable agricultural SCs via SSCF approaches. In addition, they also have well-established risk control mechanisms with the support of advanced technology, which can effectively monitor individual farmers' production behaviour. There is still potential for SSCF innovations in agricultural SCs. E-commerce platforms can further apply big data, cloud computing technology or crowdsourcing to strengthen the holistic applications in the agricultural fields. Moreover, e-commerce platforms can cooperate with leading agricultural enterprises to obtain business data containing various agricultural segmentations. They can identify additional business opportunities and create more SSCF schemes by producing and analysing large datasets. E-commerce platforms can also help in developing new business lines by serving as SSCF service providers.

The case of Alibaba's SSCF model also indicates that there are various entities involving SSCF schemes such as leading enterprises, individual farmers and insurance companies. The individual farmers have the weakest market position in e-commerce-enabled SCs, while other entities have more sources of power in terms of their size, market positions, expertise and technology. Therefore, it is necessary to explore more balanced revenue distribution models to motivate the elimination of unsustainable behaviour in agricultural production when there exist multiple participants with imbalanced positions in SSCF practices.

Collectively, the aforementioned sections suggest that the adoption of SSCF in FMCG industries is driven by the downstream retailers' willingness to build positive brand images, while SSCF adoption in the traditional manufacturing industries of emerging countries should be backed by regulatory agencies, which rely extensively on fiscal intervention for sustainability development. In addition, "uniform green standards" and "effective information disclosure" are important prerequisites for the

development of SSCF and need to be completed. It seems that the investment in establishing the criteria for identifying “sustainable SCs” in China is limited, and there is no standardised system for assessing and identifying sustainable entities. Moreover, the e-commerce platform-enabled SSCF becomes emphasised when there is a large number of individual suppliers, and technological advantages should be better utilised in the implementation of SSCF to analyse individual suppliers’ information where multiple enterprises are involved, especially for sustainability development in agricultural SCs.

Apart from the inference about SSCF adoption based on the characteristics of the industry, some common practical suggestions need to be considered. Generally, the role of governments, professional associations, NGOs, the public and relational drivers should be better exploited to enhance supply chain ecocentricity and organise a combined force of multiparty involvement on SSCF for long-term sustainable development. SSCF implementation does not only require greater investment or resource commitment in setting up an SSCF platform, sustainability standards and technological development from the “initiator”; it also needs to provide knowledge-sharing sessions to educate participants on the supply chain. Small suppliers need to be educated on the nature of SSCF. From the perspective of inter-organisational competitive advantage, SSCF schemes should provide a range of training programmes to help manufacturers or suppliers obtain a holistic understanding of sustainable production and consumption. The intrafirm recommendation is that more attention should be paid to cultivating experts with knowledge of finance, operations and sustainability. It is important to improve both knowledge and communication as well as the practical skills of SSCF practitioners. Furthermore, the implementation of SSCF requires intrafirm departmental collaboration that integrates diverse backgrounds in finance, operations and sustainability.

5.2 Theoretical Implications

This chapter outlines some important theoretical implications, which are summarised in the Table 1.

5.3 Conclusion

This chapter has discussed leading enterprise-initiated SSCF, e-commerce platform-enabled SSCF and government-supported SSCF models in an attempt to identify the key driving forces behind SSCF implementations in China and abroad. It demonstrates that different industries may choose different SSCF models. First, FMCG companies have more intrinsic motivation to implement SSCF due to their pursuit of a positive corporate image. Second, e-commerce platform companies are more likely to implement SSCF models empowered by their technological advantages and

Table 1 Theoretical implications

Attributes	Abroad				China	
	Type One: Leading Enterprise-initiated SSCF				Type Two: E-Commerce Platform-enabled SSCF	Type Three: Government-supported SSCF
Industry	Puma CASE	Levi Strauss & Co CASE	Walmart CASE	Starbucks CASE	Alibaba CASE	GBA CASE
	Retailing					
Involvement of Financial Institutions	✓	✓	✓			Automotive Manufacturing
Involvement of NGOs	✓	✓		✓		✓
Involvement of SCF Professional Associations						✓
Sustainability Regulators	✓	✓	✓	✓		✓
Sustainability Performance data	✓	✓	✓	✓		✓
Knowledge and information sharing (interfirm level)	✓	✓	✓	✓		✓
SCF and Sustainability Related Education (intrafirm level)						
Fintech Empowerment						✓
Competitiveness	Improving corporate image	✓	✓	✓		
	Enhancing the power of network effect					✓
	Industry Transformation and export purpose					✓

(continued)

Table 1 (continued)

Attributes	Abroad			China		
	Type One: Leading Enterprise-initiated SSCF					
	Puma CASE	Levi Strauss & Co CASE	Walmart CASE	Starbucks CASE	Type Two: E-Commerce Platform-enabled SSCF	Type Three: Government-supported SSCF
					Alibaba CASE	GBA CASE
Risk Control Mechanism					✓	

driven by the need to enlarge their user base and remedy offline SC voids. In addition, traditional manufacturing industries such as automobiles, textiles and steel in China need government-supported SSCF to help establish creditworthiness, solve overcapacity issues, encourage green transformation and increase competitiveness in international trade. Furthermore, SSCF implementation needs the combined force of multiple players such as financial institutions, insurance companies, SCF service providers and professional associations. Supply chain integration should, in terms of interfirm and intrafirm information sharing, be improved to better implement SSCF.

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Sustainable Human Resource Management and Innovation



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Abstract As sustainability becomes an increasingly important element in global business, sustainable human resource management (sustainable HRM) has received attention from both researchers and practitioners. Key focuses of this area include how HRM systems can be sustainable and how HRM can promote organizational sustainability. However, the work on sustainable HRM is still in its early phase. There is no clear and consensual definition of sustainable HRM. The effectiveness of sustainable HRM practices is uncertain. Little is known about the antecedents of sustainable HRM. Therefore, this chapter aims to provide a brief review of the state-of-the-art and offer some future directions in this emerging area, with special attention to the relationship between sustainable HRM and innovation.

Keywords Sustainability · Sustainable human resource management and innovation

1 Sustainability

In the past 20 years, the topic of sustainability has received greater attention and has become a prominent aspect of organisational strategic goals (Chouinard et al., 2011). Since the publication of the United Nation's World Commission on Environment and Development report (WCED, 1987), the concept of sustainability has become significant (Dyllick & Hockerts, 2002). Sustainability can be defined by the actions of various actors, including governments and companies seeking to ensure the 'preservation, regeneration and development of the ecological, economic and social resources of a system' (Senna & Shani, 2009, p. 84). Paying attention to environmental, social and economic performance is regarded as the triple bottom line (TBL)

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in sustainable development (Elkington, 1997). Thus, sustainability means that the success of a company is measured by social and environmental indicators in addition to the traditional financial indicators.

Organisations are increasingly engaged in sustainable development, which has been integrated into their organisational strategies to focus on the long-term impact of business operations on their environmental, social and economic performance (Ehnert, 2009). Using a database of more than 60,000 respondents from companies, Kiron et al. (2017) showed that 90% of executives consider sustainability to be important and 60% use sustainability strategies. Moreover, the KPMG Survey of Sustainability Reporting 2020 showed that almost all (96%) of the world's largest 250 companies report on their sustainability performance. In addition, 80% of the N100 (a worldwide sample of 5,200 companies from the largest 100 firms in 52 countries) announce the sustainability performance (KPMG, 2020). For example, Royal Dutch Shell's (2020, p. 4) Sustainability Report 2020 announced that '*Powering Progress* is our strategy to accelerate the transition of our business to net-zero emissions, in step with society, purposefully and profitably... We aim to provide more and cleaner energy solutions in a responsible manner – in a way that balances short- and long-term interests and that integrates economic, environmental, and social considerations'. IKEA (2020) also integrates social and ecological sustainability into all its operations following the development of a People & Planet Positive strategy that outlines its long-term sustainability agenda. Organisations benefit from incorporating sustainability into their corporate strategy. For example, Kiron et al. (2017, p. 2) reported that 'companies that focus on material issues report up to 50% added profit from sustainability'. In addition, Royal Dutch Shell (2020, p. 66) stated that 'Shell aims to work with suppliers, including contractors, that behave in an economically, environmentally and socially responsible manner, as set out in our Shell General Business Principles and Shell Supplier Principles'. A Royal Dutch Shell contractor, Technip Samsung Consortium (TSC), worked on a project on their behalf in Geoje Island, South Korea. During this project, one of the noisiest periods was three months of steam blowing. To reduce and track the noise pollution, TSC used dry acoustic silencers and developed an online system to record noisy situations. TSC simultaneously talked to people living nearby and sought feedback from the local community. This sustainability practice reduced noise pollution effectively, which helped the construction team to continue building without interruption. Therefore, sustainability practices can also benefit companies and communities.

Specifically, sustainability can promote innovation. Employees' innovation is a key component of an organisation's competitive advantage in the market (Anderson et al., 2014; Wallace et al., 2016). As an example of this competitive advantage, Audi (2021, p. 285) announced a new environmental foundation in its strategic vision: 'Audi has a vision of sustainable mobility that everyone can use with a clear conscience. That is why the company goes beyond manufacturing premium vehicles and offering innovative mobility solutions. Audi also takes responsibility for the future of our planet – in other words, for how we must shape the environment,

the economy, and society so that future generations can also live well... Audi Environmental Foundation promotes green innovations for a livable future'. Therefore, sustainability can drive employees' innovation and generate competitive advantages for companies.

2 Sustainability and Human Resource Management

Sustainability emphasises organisations' long-term performance and survival, which depend on their available resources (Pfeffer & Salancik, 2003). While the organisation pursues the efficient and effective use of organisational resources, it must also consider its human resource management (HRM) because the organisation's sustainability depends largely on the knowledge, skills and energy of its workforce. When the workforce is valued and invested in sustainability practices, the organisation can achieve its environmental, social and economic objectives (Podgorodnichenko et al., 2020b).

HRM has not been widely accepted as a meaningful influence in the formulation or implementation of sustainability strategies at the organisational level (Westerman et al., 2020). However, HRM must play a more strategic role within organisations because of the complexity of stakeholders and the organisations' increased engagement in sustainability. This poses a challenge to the organisations' work system, employment relations and HRM (Docherty et al., 2002; Wilkinson et al., 2001). In this case, Pfeffer (2010) claimed that the concept of 'human sustainability' must be taken seriously in relation to individuals and organisations. To achieve human sustainability, HRM may promote employees' commitment and participation in their company's sustainable development work, integrate its sustainable development principles into the existing HRM process and help establish internal and external multi-stakeholder alliances. For example, Dan Price, the chief executive officer (CEO) of Gravity Payments in Seattle, decided to reduce his salary in exchange for a salary increase for each of his employees. This reduced the financial pressure experienced by his employees and improved their well-being, which ultimately benefited the company's economic performance (BBC News, 2020). Internal stakeholders include senior management, front-line managers and employee representatives, while external stakeholders include shareholders, unions, governments, suppliers and interest groups (Poon & Law, 2020).

HRM also has many similarities with sustainability management. For example, both management systems involve internal and external organisational functions and factors. Thus, HRM should be in a unique position in terms of sustainable development at the organisational level and should assume a more strategic role (Westerman et al., 2020). Therefore, researchers must pay attention to the role of HRM in sustainability and therefore further promote the concept of sustainable human resource management (sustainable HRM).

3 Defining Sustainable HRM

Traditional HRM was essentially designed to support traditional market models and ensure that organisations use natural, social and human resources (HR) in pursuit of short-term financial benefits. However, HRM faced enormous challenges, including labour and skills shortages, job stress and employability (Ehnert, 2009; Kramar, 2014; Lopez-Cabrales & Valle-Cabrera, 2020) by ignoring long-term resource regeneration. Therefore, short-termism in the organisational structure is a problem, mainly because external CEOs are hired without any expertise in the organisation's technical areas, decentralisation of research and development departments and an over-emphasis on short-term benefits (Poon & Law, 2020). Moreover, traditional HRM only focus on shareholders' benefits. To achieve social, environmental and human development considerations in organisations' strategic and management practices, it should supplement basic HRM functions (e.g. including a greater focus on recruitment, selection, training and development, performance management, compensation) (Guerci & Carollo, 2016; Jackson et al., 2014).

While many drawbacks of traditional HRM are present in management practices, practitioners and researchers have suggested that employees play a central role in achieving organisational goals related to economic, social and environmental responsibility (Longoni et al., 2018; O'Donoghue & Torugsa, 2016; Obeidat et al., 2018; Renwick et al., 2016). HRM policies and practices can help guide employees' thoughts and actions to achieve the company's sustainable development goals (SDGs) (e.g. Egri & Hernal, 2002; Milliman & Clair, 1996). Therefore, studies have explored the new HRM—sustainable HRM (e.g., Ehnert et al., 2016; Ehnert, 2009; Kramar, 2014; Zaugg et al., 2001). The literature has described sustainable HRM differently by using labels such as green HRM and socially responsible HRM (SR-HRM).

We used the Web of Science database, which provides the most detailed and largest coverage of the literature over the years (Norris & Oppenheim, 2007). The searched keywords were 'sustainable HRM', 'sustainable HR', 'sustainable human resource management', 'green HRM' and 'socially responsible HRM'. We obtained 292 articles in our final data set between 2005 and September 2021. The frequency bar chart based on the date of publication (see Fig. 1) shows that sustainable HRM research has received increasing attention.

Sustainable HRM is an emerging area of research that has not been defined precisely in the literature and its research is still at the pioneering stage. Table 1 in Macke and Genari (2019, p. 808) provided a summary of key definitions of sustainable HRM. These definitions confirmed that sustainable HRM focuses on HRM strategies and practices from a long-term sustainable development perspective with concerns about outcomes other than predominantly financial outcomes. Early definitions of sustainable HRM tend to focus on organisations' internal management, such as employment within the organisation (e.g. Ehnert, 2009; Zaugg et al., 2001), but more recent definitions include the simultaneous achievement of the internal

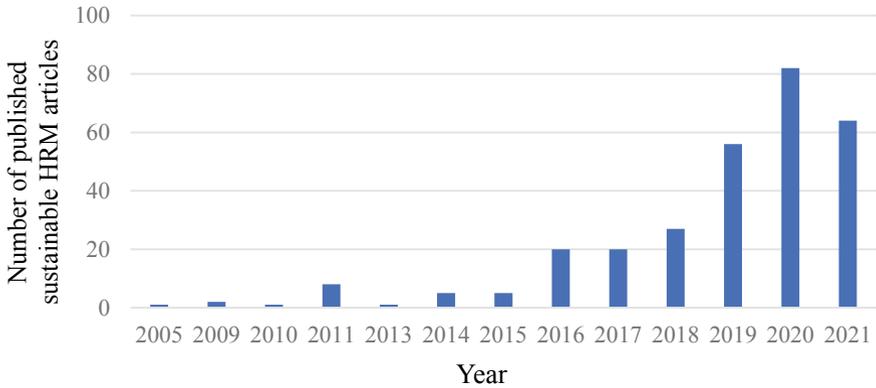


Fig. 1 Number of sustainable HRM articles published by year

(economic and human/social outcomes) and external (ecological/environmental outcomes and external parties' human/social outcomes) goals of the organisation (e.g. Ehnert et al., 2016; Kramar, 2014). To date, the most comprehensive definition of sustainable HRM is 'the adoption of HRM strategies and practices that enable the achievement of financial, social and ecological goals, with an impact inside and outside of the organisation and over a long-term time horizon while controlling for unintended side effects and negative feedback' (Ehnert et al., 2016, p. 90).

In addition to the inconsistent definitions of sustainable HRM, some researchers have referred to this concept as green HRM (Ren et al., 2018; Saeed et al., 2019) or SR-HRM (Heikkinen et al., 2020). Piwowar-Sulej (2021) found that when researchers consider sustainable HRM as green HRM, they tend to prioritise environmental performance. However, if sustainable HRM refers to SR-HRM, researchers use HRM based on the concept of corporate social responsibility (CSR), where employees are considered internal stakeholders of their company and CSR involves the interests of the company's internal and external stakeholders (Carroll, 1998). Aust et al. (2020) introduced a typology for SR-HRM, green HRM, TBL HRM and common good HRM to better understand the concept of sustainable HRM. These different definitions of sustainable HRM may be a result of its different elements. Kramar (2014) showed that sustainable HRM is not only a factor in mediating financial outcomes and corporate strategies, it is also recognised as positive social activities contributing to the organisation's long-term sustainable development, in addition to improving environmental outcomes. These definitions illustrate the multiple conceptualisations of sustainable HRM, which have the disadvantage of a lack of conceptual clarity on the meaning of 'sustainability' in the context of HRM.

4 Sustainable HRM Research

Kramar (2014) summarised and explained three sustainable HRM research streams: capacity reproduction, social and environmental health promotion and connectivity. Capacity reproduction extends strategic HRM research by primarily focusing on bringing positive results to both employers and employees. Thus, organisations can achieve sustainability by creating positive outcomes for their employees. Considering positive employee outcomes in HRM can provide a long-term sustainable competitive advantage for organisations (Ehnert, 2009). However, the development of employees' capabilities and for what purpose has not yet been studied. The second research stream focuses on social and environmental health, in which HRM contributes to positive ecological/environmental and human/social outcomes with the ultimate goal of achieving good financial outcomes for the organisation (Kramar, 2014), in addition to the positive impact on organisational competitiveness by focusing on sustainable investments and influencing stakeholders' perceptions of responsible business practices. Similar to capacity reproduction, however, employees are largely not involved in conversations about the inclusion of social and environmental health elements in HRM. The final research stream is connections-oriented sustainable HRM, including the interrelationship between HRM and organisational outcomes, such as social and environmental and financial outcomes (Kramar, 2014). This sustainable research stream is similar to the literature in the areas of CSR and green HRM (e.g. Wood, 2010), which is more intrinsically valuable than the aforementioned two research streams and has a stronger position in the sustainability literature (Van Buren, 2020). By linking these three research streams to sustainable HRM, organisations and HR managers become the main drivers of defining and implementing sustainable HRM practices, with less focus on the views and definitions of employees. In particular, sustainable HRM focuses on stakeholder interests and outcomes (Järlström et al., 2018); therefore, organisations should also include employees as key HR stakeholders. Podgorodnichenko et al. (2020a) considered that integrating HRM with organisations' sustainability agendas should enable employees to recognise their multiple roles and interests, which enables HRM to view employees as important organisational stakeholders. However, employees are largely absent from sustainable HRM discussions, which involve incorporating employees into the stakeholder and employee perspectives.

After reviewing the sustainable HRM research literature, we summarise our findings into these three main research streams in the following subsections.

4.1 Capacity Reproduction

The capacity reproduction literature stream is primarily focused on bringing positive results for both employers and employees (Ehnert, 2009), such as internal outcomes for organisations and employees from applying sustainable HRM strategies. The

theoretical study by Dixon-Fowler et al. (2019) linked sustainable HRM strategies to sustainability-based ideological psychological contracts (IPCs), which can play an important role in bridging the goals of organisations and individuals. Dixon-Fowler et al. (2019) proposed that sustainability strategies are more tend to translate into IPCs when the missions of organisations are fully aligned with their sustainability programmes. In addition, sustainability-related goals are more tend to translate into IPCs when employees' ideologies are aligned with their organisation's mission. Finally, sustainable HRM strategies and processes must be aligned with the organisations' sustainability strategies. Lopez-Cabrales and Valle-Cabrera (2020) proposed a conceptual model that integrates sustainability into HRM strategies based on vertical fit (i.e. aligning employment relationships with different sustainable companies and HRM strategies) and horizontal fit (i.e. internal consistency of HRM practices in each sustainable employment model). The foundation of HRM strategies is defined by a set of practices that in turn config. the organisations' employment relationship system. Adams et al. (2016) linked employee training to sustainability strategies and suggested that to strategically embed sustainability within organisations, the reward and incentive systems must include sustainability-related goals and targets while using employee training to change organisational processes, behaviours and capabilities (Cohen, 2010).

Furthermore, organisations' high-performance work practices (HPWP) have been introduced into the sustainable HRM literature. Integrated HRM practices can be identified in HPWP, which can be used to reconstruct organisations' expectations for their employees to enhance their competitive advantage (Mariappanadar, 2020). Therefore, HPWP is considered relevant to organisational performance (Mariappanadar & Kramar, 2014) and subjective work experiences of employees (e.g. job satisfaction, health and well-being) (Van De Voorde et al., 2012). For example, employees' HPWP generates a competitive advantage for the organisation, but has a negative effect on health and well-being of employees (Ramsay et al., 2000). HPWP requires employees to work harder and even take on additional work with the aim of benefiting the organisation. This overwork can have negative effects on employees, such as increased work stress (Mariappanadar, 2020) and reduced sense of security (Sverke & Hellgren, 2002). Similarly, Pfeffer (2018) observed that HPWP increases employees' work stress because of job intensification and workaholic behaviour, in turn inversely affecting their health and well-being. In an empirical study from a sustainable HRM perspective, Mariappanadar and Aust (2017) also observed the negative aspects of overwork. In addition, they found diversionary strategies (distract from the stressor at work) for work recovery experiences had a very limited role in reducing the social harms caused by overwork.

Positive effects from sustainable HRM approaches have been identified. For example, Guerci et al. (2019) explored the personal reactions of HR professionals to sustainable HRM and found that the meaning of HR work (what the HR managers and professionals understand about what work means and the role it plays in a broader life context; Pratt & Ashforth, 2003) can mediate the relationship between sustainable HRM and HR professionals' job satisfaction and turnover intention. In a preliminary study, App and Büttgen (2016) found that the sustainable HRM approach of perceived

sustainable organisational and supervisor support can lead to employees' commitment to their employers' brands. Mariappanadar (2020) also studied the advantages of perceived organisational support based on the negative impact of HRM practices on employee health and found that perceived organisational support can be a mediating factor to reduce the negative effect of HRM practices. These empirical studies have contributed to the sustainable HRM literature and provided preliminary empirical evidence that perceived organisational support, as part of sustainable HRM, can reduce the health risks of HRM practices and improve employees' quality of life. A preliminary examination of these findings by Chillakuri and Vanka (2020) suggested that HPWP has an indirect effect on the relationship between work intensification and health harm. In addition, perceived organisational support moderates the indirect effect of work intensification and health harm via HPWP.

4.2 Promoting Social and Environmental Health

The social and environmental health promotion literature stream includes positive human/social and ecological/environmental outcomes with the final goal of achieving good financial outcomes for organisations (Kramar, 2014). Thus, organisations should focus on financial performance while avoiding externalities that are harmful to society or the environment (Yang et al., 2013). Therefore, this research stream includes two dimensions of social and environmental health.

4.2.1 Promoting Social Health

The CSR perspective is an aspect of the social health promotion literature (Yang et al., 2013). In recent years, integrating socially responsible behaviour into the organisational structure has become a strategic priority, which has attracted research attention. Thus, the academic contribution to the consolidation of CSR and sustainable HRM has been expanding. This research stream is now known as SR-HRM, which demonstrates a wide range of benefits that are mainly reflected in consequences at the organisational and individual levels. The relationship between SR-HRM and organisations' competitive performance has been explored. For example, Sancho et al. (2018) found that SR-HRM has a positive impact on the small- and medium-sized enterprises (SMEs) performance. As has the relationship between SR-HRM and employees' higher level of commitment, motivation and performance (Jesús et al., 2019). For instance, Shen and Zhu (2011) examined the positive effects of SR-HRM on employee organisational commitment.

4.2.2 Promoting Environmental Health

Organisations have developed short-term solutions to the introduction of new and stricter rules on environmental protection; however, the role of HRM in promoting environmental management actions is still unclear. Green HRM is the result of integrating environmental approaches into sustainable development based on HRM practices that contribute to meeting the environmental sustainability needs of organisations (Wagner, 2013). Studies have mainly examined organisational- and individual-level antecedents and consequences. Organisational-level antecedents are generally related to green organisational culture (Haddock-Millar et al., 2016) and strategies (O'Donohue & Torugsa, 2016). Empirical studies of organisational-level antecedents have mainly explored the role of leadership styles (Ahmad et al., 2018) and relationships with external stakeholders (Guerci et al., 2016). The individual-level antecedents of green HRM mainly include green human capital (Yong et al., 2019), green academic knowledge (Mtembu, 2019) and green behaviour (Iqbal, 2020). Most studies have attempted to examine the organisational- and individual-level consequences of green HRM. The most mentioned impact at the organisational level was green HRM's influence on organisations' environmental performance (Kim et al., 2019; Longoni et al., 2018). The direct impact of green HRM on environmental performance (Masri & Jaaron, 2017; Shafaei et al., 2020) is often influenced by organisational practices and strategies, including the importance and credibility of leaders in addressing commitment, green issues, and green supply chain management. In addition, the impact of green HRM on green innovation and sustainability (Yong et al., 2019) has been explored as a relationship that is sometimes influenced by the management of environmental issues and green human capital. Considering the individual-level consequences, green behaviour and green organisational citizenship behaviour are the most explored consequences (e.g. Dumont et al., 2017). Thus, the effects of green HRM are influenced by organisational identification (Chaudhary, 2020), emotional commitment (Pinzone et al., 2016), environmental knowledge (Fawehinmi et al., 2020), green psychological capital (Saeed et al., 2019) and personal values (Andjarwati et al., 2019).

4.3 Connections-Oriented Sustainable HRM

Studies in the connections-oriented sustainable HRM literature include those on the interrelationship between HRM and organisational outcomes, which involve social, environmental and financial outcomes (Kramar, 2014). However, corporate sustainable strategies have not had the desired effect. One of the reasons for this failure is that organisations do not integrate HRM into their strategic planning and implementation processes (Fenwick, 2007). Mohrman and Worley (2010) demonstrated that sustainability strategies are only reflected in a small number of HRM practices. Generally, managers are responsible for developing decision-making processes in sustainable HRM practices. Phillips et al. (2003) confirmed the role of managers in

this process and observed that they can present a vision that goes beyond maximising shareholder wealth and targets the interests of individuals or the well-being of organisations, which can help to achieve organisational goals and benefit employees by developing policies and actions that focus on their long-term survival and business success, and contribute to their well-being (Bondarouk & Brewster, 2016).

Accordingly, some studies have explored managers' activities in the process of sustainable HRM practices in more detail. Sustainable leadership could be integrated into HRM practices (Kantabutra, 2014; Suriyankietkaew & Avery, 2014). Sustainable leadership aims to balance profits, cares about employees, protects the environment, establishes long-term strategic visions and focuses on the long-term development of organisations (Avery & Bergsteiner, 2011; McCann & Sweet, 2014). In addition, for organisations to realise positive environmental, social and financial outcomes, Lopez-Cabrales and Valle-Cabrera (2020) indicated that sustainable HRM strategies should be translated into a sustainable HRM system considering the internal and external implications of organisational controls. For example, an organisation's employment relationship system must integrate social, environmental and economic goals into its internal dimensions and consider their external impact (Ehnert et al., 2016).

Although researchers have confirmed the important role of leadership in the process of sustainable HRM practices, it is difficult for organisations to balance their short- and long-term objectives, financial performance with social and environmental sustainability and the benefits for internal and external stakeholders. Conflicting needs among multiple internal and external stakeholders have been identified in sustainable HRM (Ehnert et al., 2014; Podgorodnichenko et al., 2020a) at a negative cost (Kramar, 2014), such as work–family conflicts (Stankevičiūtė & Savanevičienė, 2019). Considering similar conflicting needs, Jackson and Seo (2010) also observed that organisations' financial performance may decline because of their customers and regulators' increased spending on environmental requirements. Increased investment in human capital to improve CSR may also be accompanied by lower shareholder returns (Pfeffer, 2010). Poon and Law (2020) proposed three paradoxes in the paradox framework of sustainable HRM. The first paradox is the efficiency–material paradox, which focuses on making more efficient use of HR to achieve economic rationality without threatening the future growth of the HR base. The second paradox is the paradox of efficiency responsibility, which mainly satisfies the basis of efficient and regenerative HR while not neglecting CSR. The third paradox is the current–future paradox, which describes the value, demand and development of the workforce and future demand forecasts (Ehnert, 2014). To mitigate these conflicting phenomena, Poon and Law (2020) formulated four coping strategies. First, the acceptance strategy adopts a balanced approach to accepting organisational tensions while managing the conflicting demands of stakeholders. Second, spatial and temporal separation strategies refer to the use of layering and sequencing to address stakeholders' competing needs in space and time. Third, the synthesis strategy refers to the need to absorb and overcome stakeholders' tensions by providing innovative solutions to integrate their conflicting needs. Fourth, applying the paradox lens, companies need to change the traditional 'either/or' to a 'both/and' mentality. Therefore, the needs of various stakeholders must be met to achieve sustainability considering TBL performance in

sustainable development (Dyllick & Hockerts, 2002; Ehnert et al., 2014; Elkington, 1994; Mariappanadar, 2014). A complex strategy that balances financial performance with employee benefits from a paradoxical perspective is necessary to balance multiple stakeholders' conflicting needs (Lewis, 2000; Smith & Lewis, 2011).

In summary, these three sustainable HRM research streams show that the sustainable HRM literature is still at a pioneering stage with several knowledge gaps that must be filled by future studies.

5 Sustainable HRM and Innovation

Sustainability and innovation are important in today's competitive business environment. Here, we elaborate on their relationship. Employees' innovation has been defined as the generation and implementation of employees' new ideas within an organisation (Grosser et al., 2017; Scott & Bruce, 1994). Accordingly, the relationship between innovation and performance could be influenced by organisational factors (e.g. HR policies and practices) (Wheatley & Doty, 2010). However, few studies have explored the relationship between sustainable HRM and employee innovation. In a preliminary empirical study, Wikhamn (2019) examined the positive effect of sustainable HRM on employee innovation, including paying attention to employees' well-being and promoting their learning and capacity development. Thus, employees are more receptive and able to innovate. Specifically, innovation requires the introduction of changes focusing on employees' empowerment and reskilling, which could be opportunities (e.g. improving each employee's innovation practices) or threats to employees (e.g. innovations that replace the workforce). The HRM approach plays a significant role in the implementation of change; therefore, it is also important in innovation. The goal of HRM is to see employees as valuable assets who can increase their skills, adaptability, commitment and satisfaction through employee training, which leads to competitive advantages for their organisation. One of the goals of sustainable HRM is to increase employee satisfaction by taking care of their well-being. Employee innovation depends on the implementation of sustainable HRM practices in organisations. Sustainable HRM practices focus on employees' well-being by providing opportunities for learning and capacity development, which employees can perceive as organisational support and empowerment (Spreitzer, 1995). These employees are then more willing to innovate to create value for their organisation. Wikhamn (2019) considered innovation and employees as 'complementary assets' that work together to create performance.

6 Conclusions and Suggestions for Future Directions

Research on sustainable HRM is currently at a pioneering stage, and there are still some research gaps that need to be explored in the future. To advance the understanding of sustainable HRM by researchers and practitioners. This chapter provide suggestions for future directions in different areas, which are also summarized in Table 1.

6.1 *Definition of Sustainable HRM*

A commonly accepted definition of sustainable HRM is needed. Although sustainable HRM plays an increasingly important role in organisations' CSR activities, it has not yet been clearly defined and the literature on sustainable HRM is still in its early stages. For example, a clear definition should clarify whose sustainability is being supported (e.g. society, organisation or employee) because these different referents have differing needs, perspectives and methods for sustainability.

6.2 *Sustainable HRM Measures*

Sustainable HRM measures must be developed to fully incorporate the TBL and the new definition of sustainable HRM. Although some measures are available, these scales primarily focus on green outcomes (Santana & Lopez-Cabrales, 2019). Developing measures with sounded psychometric properties is an essential step to the further understanding of the nomological network of sustainable HRM.

6.3 *Sustainable HRM as a Bundle of Practices*

Future studies should examine sustainable HRM as a bundle of practices (Jarzabkowski et al., 2015). Most of the current research has separately explored HRM practices such as training, rewards or benefits (e.g. Cho & Choi, 2021). The research attention of the mainstream strategic HRM literature is shifting from the narrow individual practices to a bundle of HRM practices (e.g. Alfes et al., 2013; Chang & Huang, 2005). Studying sustainable HRM as a bundle of practices will reveal the precise effects of sustainable HRM strategies and practices.

Table 1 Summary of Future Directions on Sustainable HRM

Definition of sustainable HRM	<ul style="list-style-type: none"> • A more clear and precise definition of sustainable HRM is needed
Sustainable HRM measures	<ul style="list-style-type: none"> • Developing measures of sustainable HRM is necessary to fully incorporate the TBL
Sustainable HRM as a bundle of practices	<ul style="list-style-type: none"> • Future studies should examine sustainable HRM as a bundle of interdependent practices
Antecedents and consequences of sustainable HRM practices	<ul style="list-style-type: none"> • Researchers should explore individual-level antecedents with team- and societal-level (or even macro- and global- levels) consequences • The ‘black box’ (e.g. internal and external stakeholders’ conflicting needs) • The ‘connections’ (e.g. how sustainable HRM interacts with other organisational practices and their outcomes)
Conflicts in sustainable HRM	<ul style="list-style-type: none"> • Future studies should discuss methods for managing multiple stakeholders’ inevitably conflicting goals, such as exploring specific methods for effectively addressing employees’ role conflicts and ambiguity. The TBL mechanism should be built on and explained from different theoretical perspectives • How can organisations properly address the tensions and contradictions that they experience in an increasingly complex and dynamic environment. How can they balance the different needs of their internal and external stakeholders while achieving multiple goals, such as profit maximisation, long-term viability and social legitimacy?
Different stakeholders’ roles in sustainable HRM	<ul style="list-style-type: none"> • The role of sustainable HRM must be examined in exploring different stakeholders’ roles (not just HR managers) in defining, driving and resisting sustainable HRM • The role of sustainable leadership in sustainable development and implementation within the organisation should be explored
From the paradox perspective	<ul style="list-style-type: none"> • What are the drivers and internal and external factors for integrating HRM into sustainability practices • Future studies should adopt a ‘both/and’ approach instead of an ‘either/or’ approach in addressing any paradoxes in simultaneous, serial or iterative patterns

(continued)

Table 1 (continued)

Institutional and contextual factors	<ul style="list-style-type: none"> • Researchers must explore which institutional and contextual factors can influence organisations to integrate sustainability into their HRM and organisational practices • Some unique templates (e.g. SMEs) must also be studied
Sustainable HRM structures and sustainability	<ul style="list-style-type: none"> • Researchers could assess and determine which sustainable HRM structures produce the best TBL performance results. Do these structures provide better TBL results if the traditional HRM department is responsible for the sustainable HRM activities, or if HRM activities are distributed into separate units or functionally sustainable HRM groups?
Sustainable HRM and innovation	<ul style="list-style-type: none"> • Future studies could examine whether employee innovation can promote sustainable HRM and explore this relationship based on social and environmental factors • Studies should explore whether the influential factors and boundary conditions are internal and also external • The effect of leadership on innovation must also be considered when developing and implementing sustainable HRM strategies in the future

6.4 Antecedents and Consequences of Sustainable HRM

Many studies have focused on the antecedents and consequences of green HRM at the organisational and individual levels. Studying antecedents of sustainable HRM is necessary, especially for HR practitioners, who must understand their micro-foundations (e.g. individual-level antecedents). Furthermore, in the related literature, there is a broad consensus on the impact of sustainable HRM on employees' attractiveness, retention, participation and organisational performance (Podgorodnichenko et al., 2020a). Future studies could explore team- and societal-level (or even macro- and global- levels) consequences and clarify the 'black box' (e.g. managing the differing responses from internal and external stakeholders). In addition, few studies have explored the 'connections' (e.g. how sustainable HRM interacts with other organisational practices, which may result in some positive or negative outcomes).

6.5 Conflicts in Sustainable HRM

Future studies should also explore how to manage multiple stakeholders' inevitably conflicting goals, such as exploring specific ways to effectively address employees'

role conflicts and ambiguity. For example, Bush (2020) discussed the conflicts between the TBL goals, which increase employees' role conflicts and ambiguity. Bush (2020) then proposed organisational support, leader start-up structure, leader consideration and type A behaviour as potential boundary conditions that may alleviate the positive relationship between the TBL and employees' role conflicts and ambiguity. Therefore, future studies could explore how to build on and explain the TBL mechanisms from different theoretical perspectives. For example, social information processing theory could explain employees' insights into their organisational environment through the implementation, communication and development of multi-goal organisation focus (Salancik & Pfeffer, 1978). In addition, the conservation of resources theory could explain how the TBL approach affects employee resources (Hobfoll, 1988).

Studies have shown conflicting needs among multiple stakeholders in sustainable HRM (Ehnert et al., 2014; Podgorodnichenko et al., 2020a). Thus, future studies must focus on how organisations can properly address these tensions and contradictions between multiple stakeholders experienced in their increasingly complex and dynamic environment. How can organisations balance the different needs of internal and external stakeholders while achieving multiple goals, such as profit maximisation, long-term viability and social legitimacy? For example, how can organisations make efficient use of HR while protecting their employees' well-being.

6.6 Different Stakeholders' Roles in Sustainable HRM

In examining the role of sustainable HRM in organisations, it is necessary to explore different stakeholders' roles (not just HR managers) in defining, driving and resisting sustainable HRM. Moreover, the role of sustainable leadership in sustainable development and implementation within the organisation could be explored because leadership plays an important role in defining the organisational mission and values as the company changes or evolves (Kurucz et al., 2017). For example, leadership styles and personality traits are associated with the establishment of sustainable organisational cultures and the implementation of SDGs, which can create an ethical atmosphere in the workplace. In addition, leaders have different interpretations and concepts of sustainability, which influences how they maximise their work to achieve their organisations' SDGs (Colbert et al., 2007).

6.7 From the Paradox Perspective

Future studies could explore the drivers of integrating HRM into sustainability practices and how internal and external factors affect this relationship. A 'both/and' approach should be adopted instead of an 'either/or' approach in addressing paradoxes in simultaneous, serial or iterative patterns.

6.8 Institutional and Contextual Factors

Institutional and contextual factors must be explored to identify how organisations can be influenced to integrate sustainability into their HRM and organisational practices because some organisations are under institutional pressure to initiate a strategic sustainability-oriented process to align themselves with environmental expectations. For instance, some variables that could have an impact include changes in legislative or professional standards, consumer concerns, social and environmental changes (Westerman et al., 2020), laws, regulations and social and moral obligations (Epstein & Roy, 2003). Can other unique templates, such as small and medium-sized enterprises (SMEs), also have sustainable HRM strategies or practices, and how can they balance the needs of their different stakeholders?

6.9 Sustainable HRM Structures and Sustainability

Assessing and determining which sustainable HRM structures can produce the best TBL performance results is necessary. Are better TBL results provided if traditional HRM departments are responsible for sustainable HRM activities or should HRM responsibilities be distributed into separate units or functional sustainable HRM groups? While relevant theories have been explored in the literature, there is a lack of implementable tools, which discourages HRM practitioners from participating effectively in sustainable HRM within their organisations (Westerman et al., 2020).

6.10 Sustainable HRM and Innovation

Future studies could examine whether employee innovation can promote sustainable HRM. Although Wikhamn (2019) showed that sustainable HRM is positively related to employee innovation, this causal relationship was not tested in this study despite the fact that more innovative, novel and useful sustainable HRM strategies could be created. Furthermore, Wikhamn (2019) only examined this relationship from the human factors influencing sustainable HRM perspectives. Studies could explore this relationship based on social and environmental factors because the influential factors and boundary conditions are not only internal but also external. In addition, the effect of leadership on innovation must be considered when developing and implementing sustainable HRM strategies in the future.

Table 1 provides a summary for the future directions.

As companies are in the transition to sustainability-oriented development, it is also a complex challenge for human resources. Although scholars and practitioners are aware of the important role of sustainable HRM, this chapter reveals there are many research gaps. Therefore, it is necessary to call for more rigorous research

and practical guidance for better understanding and developing sustainable HRM research. This chapter reviews sustainable HRM research, with a special focus on the relationship between sustainable HRM and innovation, and proposes future research directions in different areas.

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