AI Innovations – Shaping the Future

Leveraging AI for Freelancing

Current and Future Prospects

Edited by
Richard Boateng • Sheena Lovia Boateng
Thomas Anning-Dorson • Emmanuel Awuni Kolog
Joseph Budu • John Serbe Marfo
Obed Kwame Adzaku Penu

A **Productivity Press** Book

Leveraging AI for Freelancing

In recent years, the profound impact of artificial intelligence (AI) on fostering new forms of entrepreneurship has become increasingly evident. Entrepreneurs worldwide are harnessing the capabilities of AI to develop innovative solutions and create businesses that address pressing challenges.

Despite the growing recognition of AI's potential, there exists a crucial need to deepen understanding and awareness surrounding how individuals are leveraging AI to establish novel ventures. Many entrepreneurs are pioneering initiatives that deploy AI technologies to tackle complex problems. This challenge revolves around the imperative to explore, document, and comprehend the diverse ways in which AI is driving the emergence of new businesses, solving real-world problems, and reshaping the entrepreneurial landscape. It underscores the necessity for entrepreneurs, researchers, and the wider community to grasp the transformative role of AI in fostering innovation and enabling the creation of businesses dedicated to addressing societal issues. Addressing this challenge will contribute to a more comprehensive understanding of the synergy between AI and entrepreneurship, paving the way for informed and impactful ventures that leverage the full potential of AI technologies.

In this respect, the purpose of this book is to offer an in-depth exploration of the intersection between AI and entrepreneurial ventures. The book aims to provide a contemporary and thorough analysis of how AI is playing a pivotal role in shaping new forms of entrepreneurship across various industries. It seeks to illuminate the ways in which entrepreneurs are leveraging AI technologies to drive innovation, address challenges, and create businesses that contribute to societal progress.

Through the compilation of diverse perspectives, case studies, and practical insights, the book endeavors to serve as a valuable resource for professionals, entrepreneurs, investors, and professionals seeking to understand and navigate the dynamic landscape of AI-driven entrepreneurship.

Leveraging AI for Freelancing

Current and Future Prospects

Edited by
Richard Boateng
Sheena Lovia Boateng
Thomas Anning-Dorson
Emmanuel Awuni Kolog
Joseph Budu
John Serbe Marfo
Obed Kwame Adzaku Penu

Routledge
Taylor & Francis Group
A PRODUCTIVITY PRESS BOOK

Designed cover image: Shutterstock

First published 2025
by Routledge
605 Third Avenue, New York, NY 10158

and by Routledge
4 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN

Routledge is an imprint of the Taylor & Francis Group, an informa business

ISBN: 978-1-032-83015-5 (hbk)
ISBN: 978-1-032-83014-8 (pbk)
ISBN: 978-1-003-50731-4 (ebk)

DOI: 10.4324/9781003507314

Typeset in Garamond
by SPi Technologies India Pvt Ltd (Straive)

This work is dedicated to freelancers creating a better world for others and themselves through artificial intelligence technologies and services.

Contents

Foreword

Artificial intelligence (AI) has swiftly moved from the realm of science fiction to a cornerstone of modern entrepreneurship and society. This new book series, *AI Innovations: Shaping the Future*, as a welcomed and timely body of knowledge and practical guide, provides an insightful exploration of this transformative technology, offering valuable perspectives on its applications and implications across various sectors.

It is an honor to write the foreword for these maiden editions of the book series, which features a four-volume treatise spanning the influence of AI on freelancing, the creative economy, the music industry, and society. Each of the four books as the maiden editions of the series is meticulously structured to guide the reader through AI's practical applications, challenges, and opportunities. The case studies and practical guidelines offer real-world insights that are invaluable for entrepreneurs, practitioners, academics, students, and policymakers looking to integrate AI into their business, industry, and society. The first book, which is on AI and freelancing, for example, highlights the rise of AI freelancers and their strategies for value creation and sustainability. The second book, which focuses on AI and the creative economy examines how AI is revolutionizing content creation, while the third book, *AI and the Music Industry*, provides practical insights into AI tools and skills for music production and distribution. The final book, *AI and Society*, emphasizes the importance of ethical considerations, gendered perspectives, and regulatory frameworks in harnessing AI responsibly.

Particularly, in this first book, *Leveraging Artificial Intelligence for Freelancing: Current and Future Prospects*, the key takeaways are the growing impact of AI on freelancing, especially in Africa, Europe, and Asia. It highlights how AI creates job opportunities and offers strategies to succeed in the AI-driven freelancing market. The book also covers the

transition from freelance work to corporate roles and the rise of AI startups, showing how AI can boost entrepreneurship and digital startups' competitive edge. Additionally, it explores the role of generative AI in software development and its broader role in transforming remote work and digital innovation. These knowledge jugs are novel and many researchers, policymakers, and practitioners will keep drinking from them for a considerable time.

In effect, the editors have assembled a distinguished group of academics and industry practitioners whose combined expertise spans multiple continents and disciplines. This diversity ensures that the book addresses global and region-specific challenges and opportunities associated with shaping the future of AI. The comprehensive nature of this work, from freelancing and content creation to the music industry and societal impacts, provides a holistic view of AI's potential.

This book series and its maiden collection is not just an academic resource; it is a practical guide for anyone interested in understanding and leveraging AI. It offers a roadmap for navigating the AI-driven future for business, industry, and society, while providing the tools and insights needed to drive innovation and growth.

Daniel Sarfo Marfo
CEO, RxHealth Info Systems, Ghana
Former Senior Vice President for Africa,
Zipline International

Preface

Leveraging Artificial Intelligence for Freelancing: Current and Future Prospects is an insightful and comprehensive guide that explores the transformative impact of AI in freelancing and self-entrepreneurship. This book is designed for entrepreneurs, researchers, policymakers, and industry stakeholders who are keen to understand the role of AI in shaping the future of freelancing and self-entrepreneurship.

This book is structured into ten chapters, each focusing on a critical area where AI is making significant strides. The chapters explore the burgeoning field of AI in freelancing and its role in job creation, particularly in regions like Africa, Europe, and Asia. It discusses the opportunities and strategies for thriving in the AI freelancing market, the transition from freelance work to corporate opportunities, and the rise of AI startups. It also highlights how AI-driven strategies and techniques can enhance entrepreneurial opportunities, the competitive advantage of digital startups, and the integration of generative AI in software development. Finally, it underscores the transformative potential of AI in remote work and digital transformation, setting the stage for future entrepreneurial innovation. Through a mix of empirical data analysis, case studies, and practical guidelines, this book provides a nuanced understanding of how AI is being integrated into freelancing and its implications for the future.

This book is authored by a diverse group of 32 esteemed academics, researchers, and industry practitioners from around the globe. This collaboration brings together extensive expertise from various disciplines, including artificial intelligence, entrepreneurship, business systems, and digital transformation. The contributors hail from universities, research institutions, and professional settings, providing a comprehensive and multifaceted perspective on the subject matter. The contributors' backgrounds span across multiple continents, including Africa, Europe, Asia, and North America.

Their combined experience covers a wide range of areas such as AI freelancing, digital entrepreneurship, technology development, and societal impacts of AI. This diversity ensures that this book addresses both global and region-specific challenges and opportunities associated with AI and freelancing. We also appreciate the enormous time and effort put into the double-blind review process. Their collective knowledge and experience enrich this book, making it a valuable resource for entrepreneurs, researchers, policymakers, and industry stakeholders.

This book is the first of the book series, *AI Innovations: Shaping the Future*. The maiden edition of the series features four books. The first book, *Leveraging AI for Freelancing: Current and Future Prospects*, explores the growth of AI freelancers and their strategies for creating value and ensuring sustainability. The second book, *AI and the Creative Economy: Transforming Content Creation and Influencer Entrepreneurship*, looks at how AI is transforming content creation, while the third, *AI and the Music Industry: Transforming Production, Platforms, and Practice*, offers practical guidance on AI tools and skills for music production and distribution. The final book, *AI and Society: Navigating Policy, Ethics, and Innovation in a Transforming World*, underscores the need for ethical considerations, gender perspectives, and regulatory frameworks to responsibly manage AI's impact.

Together, the four books offer practical applications, challenges, and opportunities of AI, offering a roadmap for leveraging this powerful technology to drive innovation, efficiency, and competitive advantage.

Finally, and most importantly, we thank Kristine Rynne Mednansky, Senior Editor, and Bethany Nelson, Editorial Assistant, Taylor and Francis Group, for continuously supporting us and managing the publication of these projects.

We hope you will enjoy reading the book and applying the directions and perspectives communicated by these diverse contributions. We invite you to contact us for questions, feedback, and discussions.

Richard Boateng, University of Ghana
Sheena Lovia Boateng, University of Ghana
Thomas Anning-Dorson, University of Witwatersrand, South Africa
Emmanuel Awuni Kolog, University of Ghana
Joseph Budu, Ghana Institute of Management and Public Administration, Ghana

Acknowledgements

Although our names appear on the cover, this book would not have come to fruition without the support of many individuals. We take this moment to extend our heartfelt thanks to all those who contributed and supported us throughout the different stages of completing this work.

First and foremost, we are deeply grateful to God Almighty for inspiring us to embark on the journey of writing a book on Artificial Intelligence. We also extend our sincere thanks to all those who believed in this vision and collaborated with us to make it a reality. Special thanks go to the dedicated team at Taylor and Francis Group, particularly *Kristine Rynne Mednansky*, Senior Editor, for overseeing the book proposal, finalizing the contract, and encouraging us to extend this work beyond a single book. Our gratitude also goes to *Bethany Nelson*, Editorial Assistant, for her excellent project management skills and for ensuring the book kept to a timely schedule.

This book owes much to the invaluable contributions of numerous volunteer reviewers and the editorial advisory board. Their constructive feedback significantly enhanced the quality of the submissions. We are also deeply thankful to the chapter authors for their engaging and relevant contributions to this project. Additionally, we express our sincere appreciation to *Mr. Daniel Sarfo Marfo* for providing the foreword.

Finally, our deepest gratitude goes to our families, whose blessings, unwavering support, and encouragement enabled us to achieve this milestone.

Wishing everyone happy explorations in Artificial Intelligence!

Richard, Sheena, Thomas, Emmanuel,
Joseph, John, and Obed

Contributors

John-Paul Adjadeh
School of Economics, Political and Policy Science, The University of Texas, USA

Yaw Afriyie
Simon Diedong Dombo University of Business and Integrated Development Studies
Ghana

Divine Q. Agozie
University of Ghana Business School
Ghana

Esther Ama Amoh
Kwame Nkrumah University of Science and Technology
Ghana

Thomas Anning-Dorson
University of the Witwatersrand
South Africa

Pasty Asamoah
Kwame Nkrumah University of Science and Technology
Ghana

Andrew Asante
University of Pardubice
Czech Republic

Jonathan Barnor
University of Education
Ghana

Sheena Lovia Boateng
University of Ghana Business School
Ghana

Richard Boateng
University of Ghana Business School
Ghana

Stephen Boateng
University of Mines and Technology
Ghana

Frederick Edem Broni Junior
University of Mines and Technology
Ghana

Joseph Budu
Ghana Institute of Management and Public Administration
Ghana

Zdenka Cumano
Florida Atlantic University
USA

Samuel Nii Odoi Devine
Presbyterian University
Ghana

Abeeku S. Edu
University of Ghana Business School
Ghana

Sulemana Bankuoru Egala
Simon Diedong Dombo University of Business and Integrated Development Studies
Ghana

Edward Entee
University of Ghana Business School
Ghana

Sessah Sadicka Gyanwah
RX Health Info Systems
Ghana

Makija John
University of Ghana Business School
Ghana

Emmanuel Awuni Kolog
University of Ghana Business School
Ghana

Edem K. Lagble
Cyprus International University
Turkiyie

Ishaque Mahama
Simon Diedong Dombo University of Business and Integrated Development Studies
Ghana

Muesser C. Nat
Cyprus International University
Türkiye

Acheampong Owusu
University of Ghana Business School
Ghana

Pranay Patodi
MMF Infotech Technologies Pvt Ltd
India

Obed Kwame Adzaku Penu
University of Ghana Business School
Ghana

Ransford Pinto
The McGraw Center for Teaching and Learning
New Jersey, USA

Edouard Sainflou
AI Freelancer
France

Jerry Owusu Sarfo
Cyprus International University
Turkiyie

John Serbe-Marfo
Kwame Nkrumah University of Science and Technology
Ghana

Jefferson Seyanya Seneadza
University of Ghana Business School
Ghana

Swapnil Shivram Vyavahare
Datainsights Enterprises
India

Daniel Zokpe
Kwame Nkrumah University of Science and Technology
Ghana

Profiles of Editors

Prof. Richard Boateng is a professor of information systems at the University of Ghana Business School. He is a technology researcher who focuses on developing, communicating, protecting, promoting ideas and concepts into projects of commercial value and development impact. The AD Scientific Index (Alper-Doger Scientific Index) 2021 and 2022 ranked Prof. Richard Boateng as the number one (#1) Scholar in ICT for Development/E-business Research in Ghana and 9th in Africa. He was also ranked the number four (#4) Scholar in General Business and Management Research in Ghana and 24th in Africa in 2022. He is also the associate editor of the *Information Technologies & International Development Journal* and serves on the editorial board of the *Information Development Journal*. His research experience covers the artificial intelligence and entrepreneurship, digital economy, cloud computing, e-learning, information, and communication technologies (ICT) for development, electronic governance, social media, electronic business, gender and technology, mobile commerce, and mobile health at the national, industrial, organizational, and community levels. His research and project funds have been obtained from organizations including Mastercard Foundation, GIZ (German Development Agency, Ghana), World Wide Web Foundation (USA), Vodafone Group (Global/UK), Danish International Development Agency (DANIDA), International Development Research Centre (Canada), and the World Bank. On three occasions, Prof. Boateng has been invited to contribute to global reports on the digital economy. First, by the Renowned Economist, Diane Coyle for the Vodafone Global PLC's Socio-economic Impact of Mobiles (SIM) Report; second, by the World Wide Web Foundation for the 2019 Women's Rights Online Survey; and third as a panelist at the 2022 UNCTAD Global eCommerce Week, speaking on The AfCFTA and Data Governance Frameworks in Africa.

Dr. Sheena Lovia Boateng is a senior lecturer at the Department of Marketing and Entrepreneurship at the University of Ghana Business School. She is the Communications Coordinator for the College of Humanities, University of Ghana. She is an Associate Editor for the Springer journal, *Humanities & Social Sciences Communications*. Her research interests span artificial intelligence and marketing, gender and technology, fashion and beauty marketing, influencer marketing, online pharmaceutical marketing, online relationship marketing, digital business, and electronic learning. Sheena's research has been published in the *International Journal of Electronic Marketing and Retailing, Information Development, International Journal of Customer Relationship Marketing and Management*, *International Journal of Bank Marketing, Journal of Financial Services Marketing, Smart Learning Environments*, and the *Journal of Educational Technology Systems*. She has co-edited two Routledge books on *Empowering Women in the Digital Economy* and *Delivering Distinctive Value in Emerging Economies*, and a Springer book on *Digital Innovations, Business and Society in Africa*. Beyond the University, she has served as a speaker and panelist at the Coalition for Digital Equality (CODE) Forum 2021. She also served as a judge at the maiden Digital Equality Awards.

Prof. Thomas Anning-Dorson is an Associate Professor of Marketing at Wits Business School, University of the Witwatersrand, Johannesburg, South Africa and a Research Associate at the School of Consumer Intelligence and Information Systems, University of Johannesburg. Thomas is a Research Fellow at McGill University, Montreal, Canada, through the Queen Elizabeth Scholars Program. Thomas is a member of the American Marketing Association, fellow at the Academy of Marketing Science and Academy of International Business. He serves as the Track Chair—(International Business Theory) for the Academy of International Business—Sub-Saharan Africa Chapter (AIB Africa). Thomas is an enthusiastic scholar and management consultant with a keen interest in the issues of innovation, strategy, digitalization, enterprise growth, and marketing in emerging markets. Dr. Thomas's current research focuses on competitive strategy, brands, innovation, services management, emerging markets, customer experience management, 4IR, and enterprise development. His research has been published in top tier international journals including *Journal of Business Research, International Marketing Review, Computer in Human Behavior, International Journal of Contemporary*

Hospitality Management, Cross-Cultural and Strategic Management, Marketing Intelligence and Planning, European Journal of Innovation Management, and the *International Journal of Bank Marketing*.

Dr. Emmanuel Awuni Kolog is a Data Scientist and Senior Lecturer at the University of Ghana. He earned his PhD and MSc in Computer Science with a specialization in data science from the University of Eastern Finland. Additionally, he holds an MBA degree in International Business Management from the Lapland University of Applied Sciences in Finland. Dr. Kolog's research interests span a diverse spectrum, covering machine learning, artificial intelligence, data analytics, and behavioral computing. Leveraging his academic expertise, he holds an adjunct lecturer position at both the Malawi University of Science and Technology and the International University of Management (IUM) in Namibia. With a strong academic foundation, Dr. Kolog has authored/co-authored over 50 peer-reviewed publications in computing and information systems, showcasing his significant contributions to the academic community. Beyond academia, Dr. Kolog has made substantial contributions through capacity building and consulting services. His expertise has been sought by prominent institutions such as the Bank of Ghana, UNICEF-Ghana, UNESCO, University College Cork Ireland, USAID/DAI Policy Link, the Ministry of Food and Agriculture (SRID), and Eduix in Finland, among others. This reflects his commitment to bridging the gap between academia and practical application, making a meaningful impact in the field of data science and computing.

Dr. Joseph Budu is a senior lecturer and researcher at the Ghana Institute of Management and Public Administration, based in Accra, Ghana. With a robust educational background, including a PhD in Information Systems from the University of Ghana, where he won the vice-chancellor's award for outstanding doctoral dissertation in the humanities, Joseph Budu is an expert in the intersection of information systems, artificial intelligence, and entrepreneurship. Beyond academia, Joseph Budu is an accomplished consultant, providing valuable insights into digital platforms and responsible AI. For instance, he was the country manager for Fairwork Ghana which evaluated the labor practices of digital labor platforms in Ghana, as a way of advocating for better working conditions for so-called independent contractors. His consultancy work also extends to collaborating with organizations seeking innovative

solutions at the crossroads of technology and entrepreneurship. Joseph's prolific research portfolio includes publications in notable journals, book chapters, and conferences, showcasing his commitment to advancing knowledge and understanding in the ever-evolving landscape of information systems and artificial intelligence.

Dr. John Serbe Marfo, a lecturer at Kwame Nkrumah University of Science and Technology (KNUST), Ghana, in the Department of Supply Chain and Information Systems, is a distinguished figure in information systems, artificial intelligence (AI), and entrepreneurship. With a PhD in Information Systems and an MBA in Business Information Technology, Dr. Marfo is both a researcher and consultant, specializing in big data analytics, AI, health informatics, supply chain digitalization, and eLearning. As the Senior Technical Advisor for Health Supply Chain, Technology, and Innovation at the Centre for Applied Research and Innovation in Supply Chain, Africa (CARISCA), and the Director of the CARISCA Innovations Lab, he leads efforts in technological innovation, including the development of the Cleeve AI medical diagnostic system. His lab turns innovative ideas into startups and has established Ghana's first Master of Science program in business and data analytics. His research in AI focuses on enhancing human-AI interaction, exploring the collaborative development of capabilities within organizations for the use of Generative AI. As a lead technology consultant, Dr. Marfo has significantly contributed to projects like Rx-AI, an AI system for medical necessity and claims fraud detection, and RxClaim, a Health Insurance Claim Management System used across several African countries. He is instrumental in developing Ghana's National Electronic Pharmacy Platform, showcasing his impact in leveraging AI for healthcare advancements in developing economies.

Dr. Obed Kwame Adzaku Penu is a researcher at the University of Ghana. He recently completed a PhD in Information Systems at the University of Ghana. He also holds an MPhil in Management Information Systems from the same university. He is a Jacobs Foundation CERES Scholar and a Building a New Generation of Academics in Africa (BaNGA-Africa) scholar. Obed has worked on numerous projects, including the 2022 Fairwork Foundation project on evaluating the labor practices of gig workers in Ghana. He has also been a consultant on the Social Agriculture project by Caribou Digital in partnership with the

Mastercard Foundation. He was also a researcher on the devices and connectivity needs assessment survey along the Shea Value Chain, a Mastercard Foundation commissioned project. The project sought to conduct an actor analysis, scoping and geographical mapping of communities in the five northern regions endemic to shea farming on leveraging technology along the shea value chain to empower the youth and women. He was also a research scholar on the "Open Learning Platform for Primary Education (OLPPE)" project. He is a prolific writer who has authored/co-authored several book chapters, conference papers, and journal articles indexed in Scopus. His research interests lie in inequalities, inclusion, and/or exclusion of vulnerable, minority, marginalized, or socially disadvantaged groups in the digital/platform economy, digitalization (enterprise IS/IT implementation and usage), ICT4D, e-learning/Edtech, and e-governance.

Chapter 1

AI and Job Creation for Africa: A Dive into AI Freelancing on Fiverr.com's Ecosystem

Richard Boateng, Frederick Edem Broni Junior,
Obed Kwame Adzaku Penu, Sheena Lovia Boateng,
Joseph Budu, John Serbe Marfo, and Thomas Anning-Dorson

Introduction

The evolution of technology and the digital transformation wave assisted by Artificial Intelligence (AI) have given rise to a burgeoning freelance economy (Turkina, 2018). Platforms like Fiverr.com are becoming increasingly instrumental, acting as a nexus where businesses and skilled professionals converge to exchange services (Zwettler et al., 2023), often driven by the multifarious applications of AI. Developing countries are among the leading contributors to the workforce for the online freelance economy. Kenya, for example, is ranked second in the supply of remote workers in writing and translation, while India is one of the leading countries in the supply of remote workforce for software development (Muhindi, 2019). Moreover, remote workers in Ghana, Nigeria, and South Africa have, for example, noted to receive far improved remuneration (twice the value) for the jobs (e.g., contact center agents, app development) they access via online

DOI: 10.4324/9781003507314-1

freelancing platforms as compared to those they receive from performing work in the traditional settings (Agrawal et al., 2015). This goes to show one of the benefits that is coming in the way of Africans who work on online freelancing platforms. Thus, exploring and understanding AI's pivotal role in creating job opportunities for young people in Africa is necessary.

Our primary aim is to explore the opportunities for Africans to take up freelancing gigs in AI. A nuanced understanding of these opportunities is crucial, as it will not only illuminate the winners and losers in AI freelancing in Africa but also provide insights into the broader AI freelance marketplace's functionality and sustainable pathways. The findings of this study could prove invaluable for technology freelancers, AI enthusiasts, policymakers, and businesses in collaboratively addressing the unemployment challenge of young Africans.

Research Questions

1. **Outlook:** Comparably, in relation to Africa, who are the winners and losers in relation to AI and Job Creation in the realm of AI on Fiverr.com? In which categories of AI freelancing jobs are the winners represented? How does this compare globally?
2. **Gender:** Concerning AI and Job Creation, what are opportunities for women? Which African Country is leading? Where are the notable examples of women AI freelancers on Fiverr.com?
3. **Ability:** What skills and competencies are essential for success as an AI freelancer on Fiverr.com?
4. **Sustainability:** How do freelancers navigate and leverage the opportunities presented by the platform to cultivate a sustainable freelance career in AI?
5. **Scalability:** How can we help expand this opportunity to more African youth?

Freelancing and Entrepreneurship

Freelancing and entrepreneurship embody the essence of independence and innovation in today's dynamic business environment (Mettler & Williams, 2011). Both avenues offer unique pathways for individuals to leverage their skills, creativity, and vision to create value, drive change, and

forge a unique professional trajectory (Aroles et al., 2019). This section of the chapter explores the interconnected facets of freelancing and entrepreneurship, unraveling their synergies, distinctions, and the profound impacts they manifest in the contemporary economic landscape.

Freelancing: The Flexible Frontier

The evolution of digital platforms, like Upwork and Fiverr, has further revolutionized the freelance landscape, enabling seamless connections between freelancers and clients across the globe (Agrawal et al., 2015). Such platforms have democratized access to opportunities, allowing freelancers to cultivate a global clientele, thus unleashing new dimensions of creativity and innovation (Sundararajan, 2017). Freelancing epitomizes flexibility, allowing professionals to offer their expertise project-by-project, typically without long-term commitments to a single employer (Barley, 2016). This modality fosters diverse opportunities, enabling freelancers to engage with multiple clients, explore various sectors, and continually hone and diversify their skill sets (Kalleberg, 2011).

Entrepreneurship: The Vanguard of Innovation

Entrepreneurship is a beacon of innovation and economic revitalization (Wennekers et al., 2010). Entrepreneurs harness their visionary insights to identify unmet needs, devise novel solutions, and build enterprises that drive socio-economic development (Drucker, 2014). Their ventures, often imbued with creativity and a disruptive spirit, pave the way for new industries, job creation, and enhanced societal well-being (Shane, 2003). Entrepreneurs navigate challenges, from capital acquisition to market competition and scalability, continually refining their strategies to foster sustainable business growth (Blank, 2013). Through this rigorous process, they cultivate ecosystems that amplify innovation, collaborative synergies, and holistic value creation (Isenberg, 2010).

Synergies and Distinctions

Freelancing and entrepreneurship share intrinsic synergies, particularly their capacity to foster independence, flexibility, and a direct alignment between effort and reward (Benz, 2009). Both pathways enable individuals to exercise autonomy, curate their professional journeys, and actualize their

aspirations and potential (Alvarez De La Vega, 2022). However, notable distinctions also prevail. Entrepreneurs typically invest in building and scaling business entities with a long-term vision, while freelancers operate primarily as independent professionals engaged in contractual project work (Kibler et al., 2017). The risk profiles, operational scales, and strategic orientations also exhibit nuanced variances across these two domains (Muller & Korsgaard, 2018).

In precis, freelancing and entrepreneurship are integral to the modern economic tapestry, embodying distinct work paradigms, value creation, and professional actualization. Their interplay continues to reshape business norms, fostering a vibrant spectrum of opportunities and challenges that catalyze continuous innovation and adaptation.

AI and Entrepreneurship—Research Outlook

To understand the landscape of existing studies on the relationship between AI and entrepreneurship, we conducted a bibliometric review of 127 journal articles from SCOPUS (Boateng et al., 2024). SCOPUS is one of the world's leading academic databases, introduced in 2004 by Elsevier. It has over 27,950 active titles, over 292,000 stand-alone books, over 90.6 million records, and more than 49.2 million patents from five patent offices. Among them are 26,591 active peer-reviewed journals (including 6,128 Gold Open Access journals in prominent subject areas, including business and management).

Our literature review revealed that three main points regarding AI and entrepreneurship are being discussed today. These include the role of AI technologies in making sense of big data and the methods and tools used for AI analytics (like machine learning and content analysis). We also note from the existing evidence that entrepreneurship education plays a crucial mediating role in the relationship between AI and entrepreneurship. It is crucial to emphasize the importance of providing entrepreneurs with the knowledge and skills they need to integrate AI effectively.

Opportunities for Researchers, Practitioners, and Policymakers

The need for more developing country-based studies and collaborations: Our examination of the literature's topography revealed an imbalanced geographic dispersion, with most of the scholarly

work coming from China, the United States, and the United Kingdom. However, a very small number has been recorded from the developing regions of Africa. Thus, there is a need for a lot more studies from developing economies such as Kenya, Ghana, Uganda, Nigeria, and South Africa. Furthermore, our findings reveal that there has been very scanty research on collaborations between two or more countries. China is the primary collaborative contributor to substantial research, followed by the USA and India. This raises the concern of geographical silos. Geographical silos can hinder diversity and advancement in the literature on AI and entrepreneurship. We propose adopting an inter-country collaboration perspective on AI and entrepreneurship research by fostering robust collaboration between advanced and emerging economies, especially in developing African regions. This will facilitate the comprehensive mapping of societal challenges and the formulation of solutions that are universally dependable and globally relevant. Conducting studies with collaborations with authors from Africa can come in handy, as Africa is a fertile ground for data collection in many research areas (Malanski et al., 2021). Notably, many funding agencies emphasize topical and influential subjects, valuing the infusion of innovative cross-disciplinary techniques and methodologies. Establishing alliances centered on these overlapping themes can harness collective expertise and assets, maximizing the potential for securing funding.

The need for studies on the role of AI tools and techniques in sustaining entrepreneurship: In terms of thematic areas of focus, AI has the potential to greatly enhance entrepreneurship through continuous education, stemming from the schools and colleges in entrepreneurship (Zhiyi et al., 2024). It is, therefore, imperative to explore more studies that understand the nexus between entrepreneurship education and AI. Also, research on the interplay between AI, entrepreneurship, innovation, machine learning, and sustainable development has received limited attention and development in the current research. Thus, scholars may consider focusing on these themes as they remain crucial to enhancing research.

The need for studies on how AI births and/or reshapes entrepreneurship: In addition, researchers need to examine forms and types of entrepreneurs birthed through AI and the institutional, technical, and behavioral factors that shape AI-driven entrepreneurship. Likewise, we see an opportunity to research the inherent obstacles and hindrances associated with utilizing tools, technologies, and techniques in

entrepreneurship and whether these tools spur migration from other forms of tech entrepreneurship into AI entrepreneurship (or Are AI entrepreneurs entirely new tech entrepreneurs?) (Battisti, 2022). It will be helpful if future research can shed light on the sectors of the economy where AI entrepreneurship has gained some mileage, be it Fintech, healthcare, education, retail, agriculture, and the sharing economy. Such knowledge can shape future AI business models and developmental priorities for firms, institutions, and governments.

The need for studies on AI competencies and skills development for entrepreneurship: Further, the role of entrepreneurial education programs in driving entrepreneurs' innovative capabilities cannot be over-emphasized (Hernández-Sánchez, 2019). We also note a gradual shift and interest of scholars toward entrepreneurship education, competence, and skill set (e.g., Joensuu-Salo et al., 2021; Kozlinska et al., 2020). Consequently, it is of considerable interest to delve deeper into the relationship between AI and entrepreneurship education, examining its practical applications, research implications, and policy considerations. Integrating "entrepreneurship education" with the prevailing ramifications of "COVID-19" might pave the way for fresh perspectives.

The African Youth Employment Challenge

The African Youth Challenge regarding jobs, as detailed in the "Young Africa Works" strategy document by the Mastercard Foundation (MCF, 2021), highlights several key issues:

1. **Demographic Trends:** Africa stands out as the youngest and fastest-growing continent, with an estimated 375 million young individuals expected to enter the job market by 2030. This demographic surge will eventually position Africa's workforce as the largest worldwide.
2. **Economic Growth vs. Employment Opportunities:** Despite impressive economic growth in many African nations over the past decade, this has not translated into sufficient employment opportunities. About 80% of the African workforce is engaged in informal employment. Young people, in particular, face challenges in securing formal employment and earning decent wages.

3. **Youth Employment and Poverty Reduction:** Formal employment is a critical pathway out of poverty. However, there is a significant disparity between the number of young people seeking jobs and the limited formal employment opportunities available.
4. **Skills Mismatch:** A notable challenge in youth employment is the mismatch between the skills of young job seekers and the needs of employers.
5. **Young People's Aspirations:** Young Africans aspire to be job creators and agents of change, striving for a more inclusive future driven by innovation and technology. The Foundation aims to support these aspirations by removing barriers to employment, particularly for vulnerable groups such as young women, rural youth, and refugees, and by promoting STEM education.
6. **Collaboration and Holistic Approach:** Tackling Africa's youth employment challenge requires a comprehensive approach and collaboration with African governments, the private sector, educators, and other stakeholders. This includes enhancing financial inclusion, digital inclusion, and modernizing critical sectors like agriculture.

The above arguments underscore the complexity of the youth employment challenge in Africa and the need for concerted efforts to create sustainable employment opportunities for young people.

Methodology

This study aims to explore the opportunities for Africans to take up freelancing gigs in AI and provide a thorough overview of the environment by concentrating on varied geographical regions and a number of AI service categories, in light of the growing significance of AI services in the gig economy. In order to do this, a manual scraping method was applied, which made use of Fiverr's platform filters to precisely classify and collect pertinent gig data. This section describes the precise data points that were gathered, the nations and gig categories that were selected, and the ethical standards that were upheld during the data collection procedure. Two types of data collection strategies were employed—manual data scraping and interviews with selected freelancers from the Fiverr platform. Figure 1.1 presents a visual summary of the methodology.

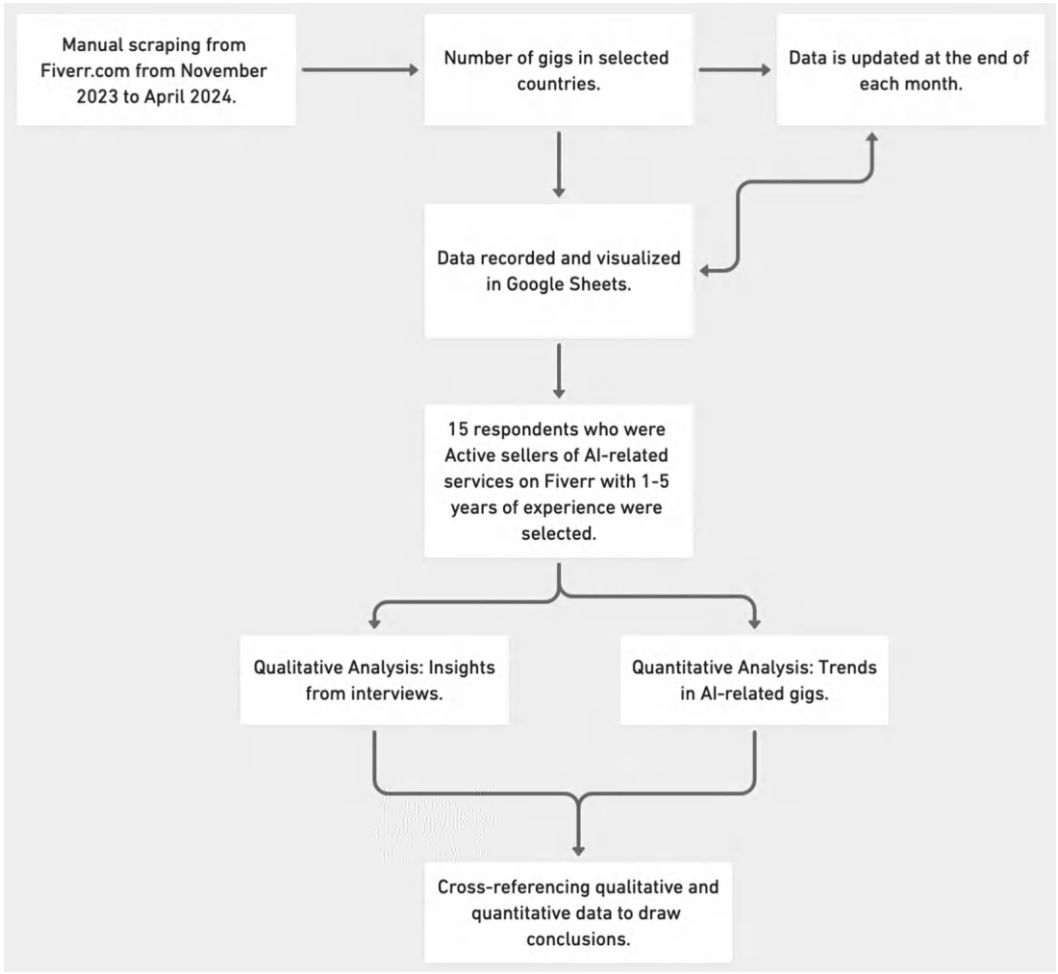


Figure 1.1 Flow diagram of the methodology.

Source: Author's Construct

Manual Data Scraping

The data set was obtained through a comprehensive manual scrape of Fiverr's AI services section, conducted from November 2023 to April 2024. This effort aimed to understand the distribution and categorization of AI-related gigs across selected African countries. In addition to African countries, data from the USA, India, and Pakistan were collected to provide a comparative analysis with high gig volume regions globally. This approach ensured a focused and ethical data collection strategy that adheres strictly to Fiverr's terms of service.

Using a manual web scraping technique, the data collection method was carefully designed and carried out to guarantee accuracy and adherence to Fiverr's ethical criteria. Web scraping, sometimes called web extraction or harvesting, is the process of taking data off the World Wide Web (WWW) and putting it in a file system or database so that it may be examined further. This task can be performed automatically by web crawlers or bots using HTTP or web browsers, or it can be performed manually by individuals (Zhao, 2017). By organizing data from the large and unstructured digital landscape, information extraction—defined as the automated process of collecting structured data, such as entities, their relationships, and attributes—addresses the problem of relevance in unstructured sources (Sarawagi, 2007). Using this technique, web pages and other online sources can have particular fields or data pieces extracted, converting online data into well-organized, useable datasets (Marres & Weltevrede, 2013). Moreover, data integration from many sources is made possible via web scraping (Marres & Weltevrede, 2013).

The manual scraping was performed using Fiverr's platform filters to categorize and collect relevant gig data. Countries within Africa were chosen based on Fiverr's country filters and a significant number of AI-related gigs. The inclusion of the USA, India, and Pakistan was based on their high volume of gigs, providing a broader comparative context. The gig categories selected include AI development, AI artistry, data-related services, and AI custom prompts, among others. The manual extraction captured key variables such as country identification, total gigs, AI Engine, seller levels, and counts of gigs under specific AI models or technologies. Additionally, demographic variables like gender of the sellers, their ranking, gig completion metrics, pricing structures, and financial transactions were also documented. Furthermore, adhering to ethical guidelines, the data collection respected Fiverr's terms of service. No personal or sensitive information was collected, ensuring the anonymity and privacy of the sellers.

Data Categorization and Variables

To facilitate a detailed analysis and interpretation, the data set was meticulously structured with key variables. Each gig was associated with its respective country to enable geographical analysis, providing insights into regional distributions and demand for AI services. The total number of AI-related gigs per country was recorded, revealing the volume of services offered in different regions. The data set also included an "AI Engine"

variable, capturing the specific AI technologies or models used in the gigs. This provided insight into technological preferences and trends across different geographical areas.

Seller levels were categorized based on Fiverr's ranking system, including new sellers, level one, level two, and top-rated sellers. This categorization allowed for an analysis of the distribution of expertise levels among the service providers. Gender information of the sellers was noted where available, facilitating a gender-based comparative analysis. Pricing structures were also categorized, enabling a thorough examination of the economic aspects of the gigs. Additionally, data on financial transactions related to gig payments were collected to understand the economic impact and revenue generation associated with AI services on Fiverr.

Interviews

After the data scraping, interviews were conducted to gain qualitative perspectives of the experiences of freelancer on the Fiverr platform. Respondents were selected based on a set of criteria to ensure a diverse and representative sample. All respondents were required to be actively selling AI-related services on Fiverr, ensuring their relevance to the study. The selection included a range of experiences, from those relatively new to Fiverr (with a minimum of one year of experience) to more experienced sellers (up to five years). This range allowed for a comprehensive understanding of the gig economy from various perspectives.

A variety of AI services were represented, including AI mentorship, chatbot development, algorithmic trading, AI consulting, and more. This diversity captured a broad spectrum of the AI gig economy, reflecting different service offerings and market demands. Efforts were made to include respondents from different geographical locations, with a particular emphasis on regions with emerging AI markets, such as Africa. This geographical diversity provided a nuanced understanding of the global distribution of AI services.

Sampling Technique

A purposive sampling method was employed to ensure that the selected 15 respondents from various African countries (Algeria, Egypt, Morocco, Nigeria, Ghana, Kenya, and South Africa) met the study's criteria and were likely to provide rich, relevant data. This approach was deemed appropriate

given the specialized nature of the research topic. Respondents were identified through Fiverr's platform by reviewing profiles of AI service providers and contacting those who fit the selection criteria directly via Fiverr's messaging system. Additionally, recommendations and introductions from professional contacts within the AI and freelancing communities were utilized to identify suitable participants.

Interview Process

An interview guide was developed, focusing on key areas such as the nature of AI services offered, client interactions, skills development, challenges faced, and future opportunities in the AI gig economy. Interviews were conducted online to ensure flexibility and convenience for respondents. To contact the respondents, a custom gig was designed to facilitate a Zoom meeting, ensuring compliance with Fiverr's terms of service regarding gig pricing and payment processing, thereby avoiding the risk of account suspension on behalf of the respondent. Each interview lasted approximately 45 minutes to one hour, providing ample time for in-depth discussion.

The interviews commenced with introductory questions designed to gather background information and professional experience of the interviewee, which facilitated rapport-building between the interviewee and the researcher. This approach contributed to a smoother interview process, as establishing rapport with participants fosters openness and a willingness to share their experiences (Moustakas, 1994). Open-ended questions allowed interviewees to express themselves without restriction, thoroughly addressing the central research question. Follow-up questions were employed to gain a deeper understanding of the responses (Guillick & West, 2012).

Data Analysis

Descriptive statistics were employed to analyze the quantitative data collected from Fiverr.com (Vetter, 2017). This data set included variables such as the nationality and country of origin of freelancers, job and gig categories, gender, pricing, and earnings. By using descriptive statistics, we were able to summarize and present the data in a meaningful way, providing insights into the distribution, central tendency, and variability of these variables. This statistical approach enabled us to identify patterns and trends

within the freelancing marketplace, such as the prevalence of certain job categories, gender distribution among freelancers, and the typical earnings associated with various gigs.

In addition to the quantitative analysis, a thematic analysis was conducted on the transcripts of interviews with selected freelancers (Boateng, 2020). This qualitative approach allowed us to delve deeper into the personal experiences and perspectives of freelancers. The thematic analysis involved coding the interview data to identify recurring themes related to motivation, abilities and skills, experiences, and challenges faced by freelancers. By systematically examining these themes, we gained a richer understanding of the factors that drive individuals to participate in the gig economy, the skills they leverage, the experiences they encounter, and the obstacles they must overcome. This dual approach of combining descriptive statistics with thematic analysis provided a comprehensive view of the freelancing landscape on Fiverr.com, integrating both numerical data and personal narratives to offer a well-rounded analysis.

Overview of Fiverr.com

Established in 2010, Fiverr is a prominent online freelance marketplace that connects individuals and businesses with freelancers offering diverse digital services called "gigs." Freelancers, known as sellers, operate across categories like graphic design, writing, programming, marketing, and more. Fiverr operates on a gig-based model, with services priced from $5, and additional features or complexity leading to higher costs. The platform covers various categories, fostering a global community of freelancers with varied skills.

Key features of Fiverr include a performance classification system for sellers (New Seller, Level 1, Level 2, and Top-Rated Seller), the option for freelancers to create custom offers based on project requirements, and a robust rating and review system enabling clients to provide feedback. Overall, Fiverr offers a user-friendly platform, contributing to its popularity in the gig economy by providing easy access to diverse digital services for individuals and businesses globally.

Classification Of AI Jobs on Fiverr

In the dynamic landscape of Fiverr, the platform's classification of AI gigs unveils a vibrant tapestry of specialized categories, each representing

a unique dimension of AI-related services (as of November 2023). They are as follows:

- **AI Development:** At the nexus of Fiverr's AI taxonomy lies the category of AI development, where practitioners engage in the meticulous creation and refinement of AI applications, algorithms, and software. The gig examples within this category manifest as bespoke solutions that propel innovation and efficiency in the developmental process, positioning Fiverr as a dynamic crucible for pioneering technological endeavors.
- **AI Artists:** The AI artists category transforms Fiverr into a canvas where technology becomes a collaborative force in the creative process. From AI-generated artwork to automated design and creative content development, this category epitomizes the transformative power of technology in the arts realm. Fiverr emerges as an ecosystem fostering a symbiosis between human creativity and technological augmentation.
- **Data Science and ML:** Within the ambit of data science & ML, Fiverr serves as a hub where data mastery converges with technological expertise. The gig examples, encompassing data analysis, visualization, and cleaning/preprocessing, underscore the platform's pivotal role in unraveling insights critical for informed decision-making and strategic planning.
- **AI Consulting:** The AI consulting category positions Fiverr as a strategic partner for organizations seeking to harness the power of AI for business applications. Tailored AI services in business strategy, process automation, and market analysis use AI tools to drive strategic impact. Fiverr becomes an enclave where AI seamlessly integrates with business operations, offering solutions that enhance efficiency, competitiveness, and decision-making.
- **AI Video Art:** In the AI video art category, Fiverr transforms visual storytelling by integrating AI into video production and editing. AI-assisted video editing, automated video creation, and AI-enhanced visual effects have become foundational elements in a new era of visual narratives. Fiverr assumes the role of a director's chair, where AI collaborates with video creators, pushing the boundaries of visual storytelling through technological innovation.
- **AI Music Videos:** Fiverr's AI music videos category represents a symphony where technology harmonizes with artistic expression. Offerings that leverage AI in creating or modifying music and visual content showcase the platform's role in elevating the creative arts. Fiverr becomes a stage where AI collaborates with musicians and visual artists, producing compositions that transcend traditional boundaries.

AI Custom Prompts: Fiverr assumes the role of a bespoke tailor in the AI custom prompts category, crafting personalized AI solutions based on specific prompts provided by clients. Custom AI solutions based on client-defined prompts and delivering personalized AI applications showcase the platform's adaptability to individual needs, thereby becoming a workshop where AI artisans craft solutions aligned precisely with client expectations.

Generative AI Lessons: The category extends Fiverr's reach into knowledge transfer. Gigs tailored to educational aspects of AI underscore the platform's commitment to nurturing the next generation of AI enthusiasts. Fiverr has become an educational hub where AI mentors impart knowledge and skills, bridging the gap between theory and practical application.

AI Content Editing: Within AI content editing, Fiverr becomes a haven where AI-driven services redefine the landscape of content creation. Gig examples, including AI-generated articles, blog posts, and creative writing utilizing natural language processing, showcase the marriage of AI and literary artistry. Fiverr emerges as a platform where wordsmiths collaborate with algorithms, producing content that resonates with precision and creativity.

Voice Synthesis and AI: Fiverr's voice synthesis and AI category represents a realm where technology crafts sonic landscapes—offerings that leverage AI in voice synthesis and modifications showcase the platform's role in enhancing vocal expression through technology. Fiverr becomes a studio where AI collaborates with vocalists, producing compositions pushing traditional voice modulation's boundaries.

In precis, the above unravels the intricate taxonomy of specialized AI categories on Fiverr. As a crucible for technological and creative convergence, the platform positions itself as a dynamic ecosystem where practitioners and clients engage in symbiotic relationships.

Presentation of Findings

Economic Distribution of AI Categories

Worldwide: 31,120 AI gigs in total.
Africa: 2,948 gigs, making up 9.47% worldwide.
USA: 2,380 gigs, which is 7.65% of the total.
India: 2,825 gigs, accounting for 9.08% of the total.

Pakistan: 9,129 gigs, representing the largest share from a single country at 29.33%.
Nigeria: 1,157 gigs, making up 3.72% of the total.

Insights from Figure 1.2:

- **Pakistan** has a notably large share of AI gigs (29.33%) compared to other countries, constituting nearly a third of all AI gigs on Fiverr. This could indicate a significant concentration of AI talent or a high demand for AI services in Pakistan.
- **Africa**, as a continent, holds a substantial portion of AI gigs (9.5%), more than any of the three leading non-African countries listed except Pakistan. This suggests a growing AI industry across African nations.
- **India** and **Africa** have a similar percentage of AI gigs (9.1% and 9.5%), indicating they are relatively comparable markets in terms of size for AI services on the platform.
- **The USA** (7.7%) has a smaller percentage than India and Africa, which may be surprising given the USA's role in technology. However, this could reflect the higher costs of hiring freelancers from the USA compared to other regions. AI freelancers may be more represented on other freelance platforms (e.g., Upwork and Glassdoor) or less likely to advertise their services on Fiverr, considering the burgeoning skill demand in the US tech industry.
- **Nigeria**, while smaller in number compared to continent-wide data for Africa, still makes up a significant portion of the AI gigs, highlighting its role as the leading player in the African AI freelance market.

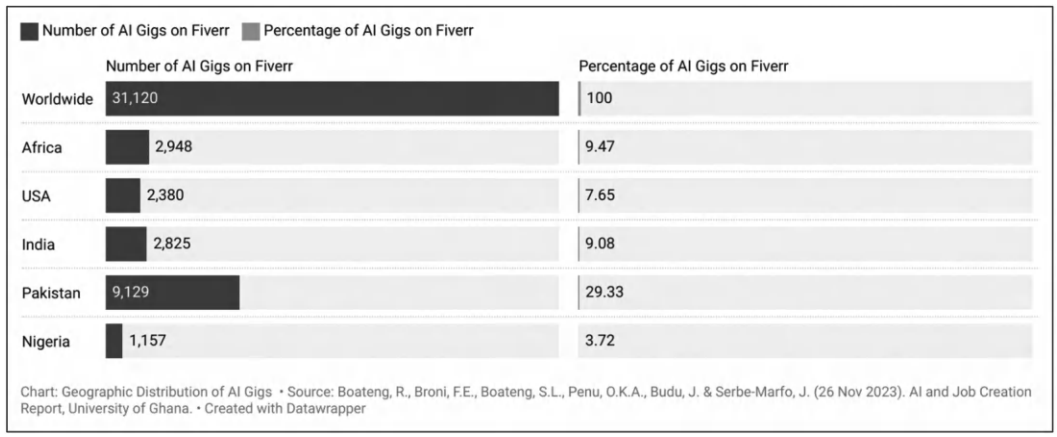


Figure 1.2 Geographic distribution of AI freelancers on Fiverr.

These findings suggest a diversifying global AI talent pool with significant contributions from countries like Pakistan and India, known for their IT and software development outsourcing markets. It also highlights the emerging presence of African nations in the AI freelance market. For businesses looking to hire AI freelancers, this data could inform decisions on where to source talent based on the number of gigs, which might correlate with availability and cost. For freelancers, this information can signal competition levels and potential markets to target.

Economic Distribution of AI Categories

Insights from Figure 1.3 and Table 1.1:

- **AI Artists** and **AI Development** are the most popular categories in all regions, indicating a strong global demand for creative AI services and technical development skills.
- **AI Development** has a particularly high representation in Africa and Nigeria, suggesting a focus on the technical aspects of AI in these regions.
- The USA and India significantly lean toward AI Artistry, which could reflect a higher demand for creative AI applications in these countries.

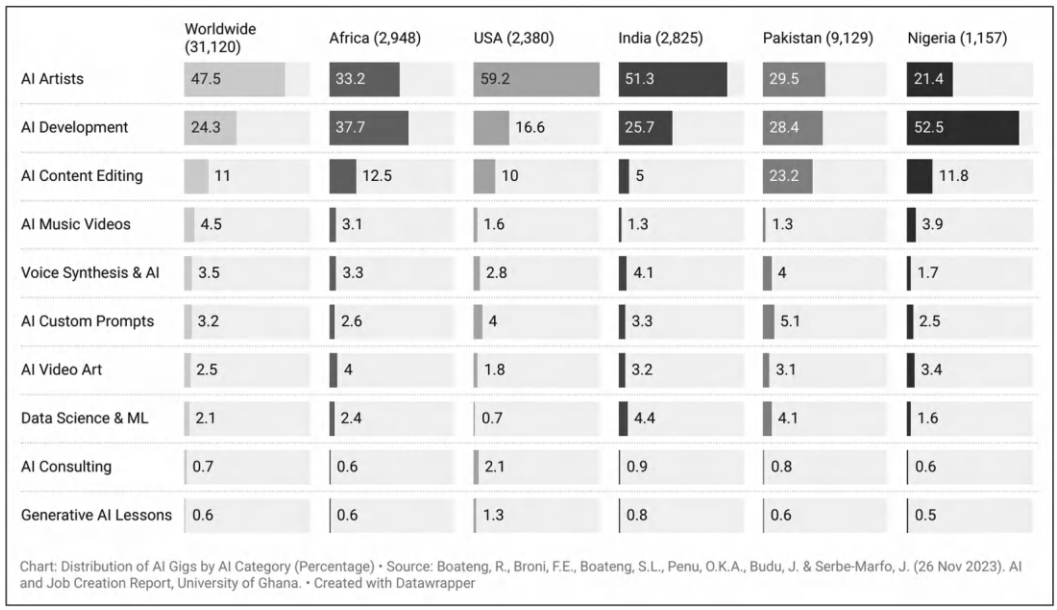


Figure 1.3 Distribution of AI freelancers by AI categories.

Table 1.1 Regional Comparison of Dominant AI Categories

Worldwide	*Africa*	*USA*	*Nigeria*
■ **AI Artists**: Highest percentage at 47.5%. ■ **AI Development**: Second at 24.3%. ■ **AI Content Editing**: 11%. ■ **AI Music Videos**: 4.5%.	■ **AI Development**: Largest share at 37.7%. ■ **AI Artists**: 33.2%. ■ **AI Content Editing**: 12.5%. ■ **AI Video Art**: Notable at 4%.	■ **AI Artists**: Dominates with 59.2%. ■ **AI Development**: 16.6%. ■ **AI Custom Prompts**: 4%.	■ **AI Artists**: Dominates with 59.2%. ■ **AI Development**: 16.6%. ■ **AI Custom Prompts**: 4%.

- **AI Content Editing** is notably prevalent in Pakistan, implying a specific market demand or expertise in that region.
- **Data Science and ML** have a higher representation in India than other regions, indicating a possible concentration of educational and professional focus on these areas.
- Regions like the USA and India that have a larger share of **AI artists** may have a more developed market for AI in creative fields, whereas African countries with higher percentages in **AI development** might be focusing on building foundational AI skills and capabilities.
- The low percentages in **AI Consulting** and **Generative AI Lessons** across the board suggest that these are niche markets, possibly still emerging or highly specialized.

The data tend to signal the relative maturity of the AI industry in each region, the availability of skilled professionals, and the types of AI services in demand locally and globally. It also reflects cultural and economic factors that influence the development of different AI sectors in various regions.

Outlook on Winners and Losers by AI Job Categories in Africa

African AI Freelancers' Gigs in AI Development: Geographic Outlook

Figure 1.4 shows a bar chart detailing the distribution of AI development gigs by African freelancers on Fiverr.com as of two different dates,

November 26, 2023, and a previous date for comparison, November 17, 2023. It provides a count of gigs for several African countries and increases in gigs over the specified period.

Overview of Data:

- **Total Gigs:** The total number of AI development gigs increased from 728 to 1,112, showing a significant increase of 384 gigs in this short period.
- **Nigeria:** Leads with the highest number of gigs, growing from 362 to 607, an increase of 245 gigs.
- **Morocco:** The second highest, increasing from 119 to 168 gigs, with an increase of 49.
- **Kenya:** Shows growth from 41 to 66 gigs.
- **South Africa:** Increased from 38 to 59 gigs.
- **Egypt:** Went from 41 to 54 gigs.
- The list continues with Algeria, Mozambique, Tunisia, Ethiopia, and others, all showing increased gigs.

Insights from Figure 1.4:

- **Rapid Growth:** The data indicates rapid growth in the availability of AI development gigs by African freelancers on Fiverr over just nine days, which is due to a surge in demand, an influx of new freelancers, or both.
- **Nigeria's Dominance:** Nigeria has seen the largest increase and holds the majority share of gigs, which could reflect a robust and growing tech industry, possibly linked to initiatives that foster skills development and entrepreneurship in the AI sector.
- **Morocco's Position:** Morocco's significant growth suggests a burgeoning interest or investment in AI development.
- **Diverse Participation:** Representation from a wide range of African countries indicates a continent-wide interest and participation in the AI development sector.
- **Small but Growing Markets:** Countries with smaller numbers of gigs, such as Tunisia, Ethiopia, and Ghana, are nonetheless part of the AI development landscape, which points to potential areas for growth and investment in these emerging markets.

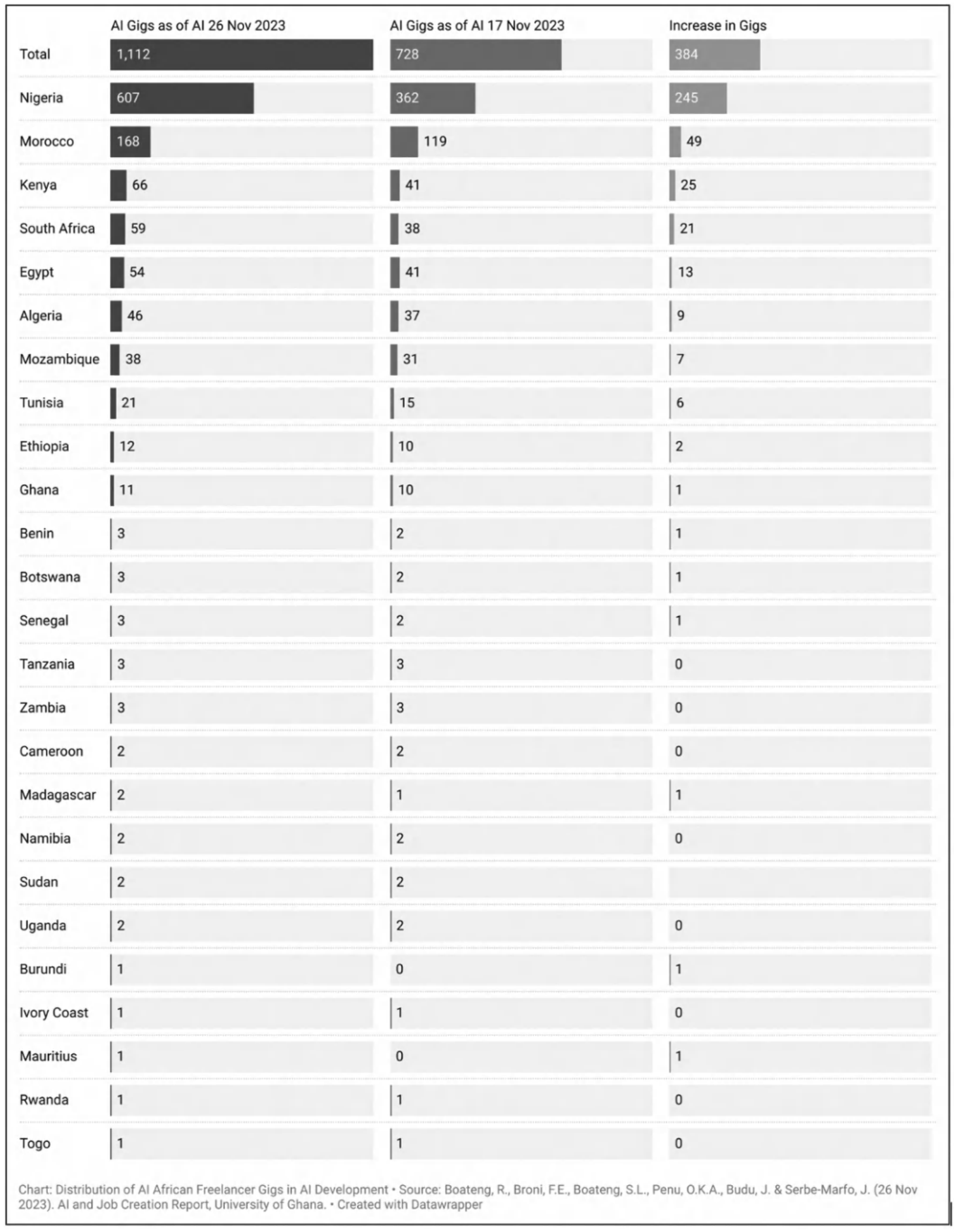


Figure 1.4 Distribution of AI African freelancers' gigs in AI development.

Considerations:

- **Rate of Increase:** The rate at which gigs increase could indicate a highly dynamic market, with the possibility of significant fluctuations over short periods.
- **Market Potential:** The overall increase across all countries suggests a positive trend and a growing market for AI development skills in Africa, which could attract more freelancers to the platform and more clients to source talent from the continent.
- **Economic Impact:** This growth in the AI sector could have broader economic implications, contributing to job creation and skill development within the continent.

These findings offer valuable insights for freelancers and businesses looking to engage with the AI development market on the continent and could also be of interest to policymakers, investors, and educational institutions looking to understand and support the AI industry in Africa.

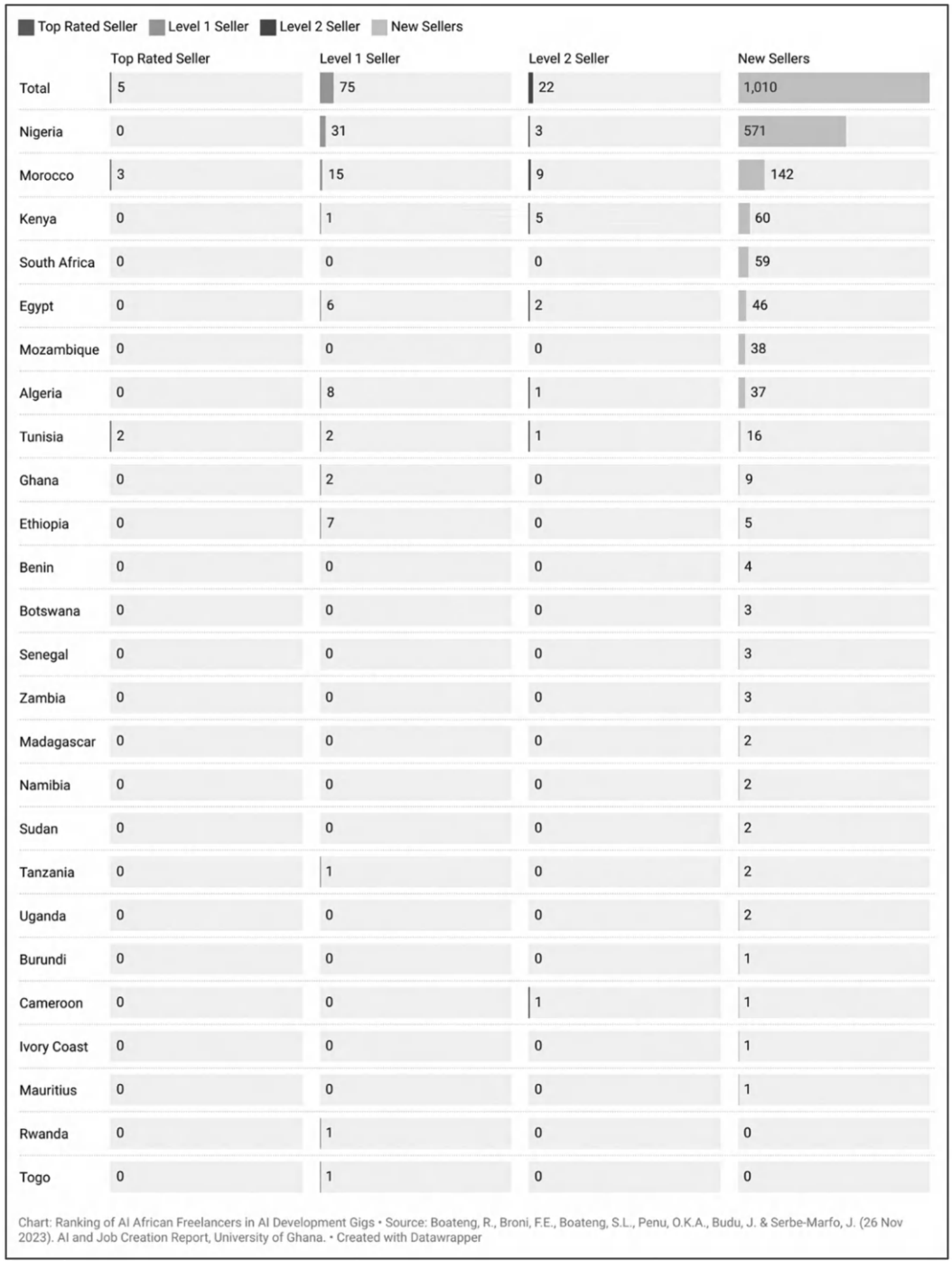
Ranking of African AI Freelancers in AI Development

Figure 1.5 shows the ranking of African freelancers in AI development gigs categorized by seller level on Fiverr.com. **Seller Level Categories: Top Rated Seller**: The highest recognition on Fiverr, requiring consistent high-level performance. **Level 1 Seller**: Freelancers who have met specific criteria in terms of sales and quality. **Level 2 Seller**: A step above Level 1, with more sales and sustained high performance. **New Sellers**: Freelancers who are relatively new or have not yet met the criteria for Level 1.

The data tend to suggest the following insights.

Overview of Ranking:

- **Total Sellers:** There are 1,112 AI development gigs by African freelancers, with the vast majority being New Sellers (1,010).
- **Top Rated Sellers:** There are very few Top-Rated Sellers (5) in this category, indicating that high-level recognition in AI development gigs is rare.
- **Level 1 Sellers:** A moderate number (75) of freelancers have achieved Level 1 status.
- **Level 2 Sellers:** Fewer freelancers (22) have reached Level 2 status compared to Level 1.



	Top Rated Seller	Level 1 Seller	Level 2 Seller	New Sellers
Total	5	75	22	1,010
Nigeria	0	31	3	571
Morocco	3	15	9	142
Kenya	0	1	5	60
South Africa	0	0	0	59
Egypt	0	6	2	46
Mozambique	0	0	0	38
Algeria	0	8	1	37
Tunisia	2	2	1	16
Ghana	0	2	0	9
Ethiopia	0	7	0	5
Benin	0	0	0	4
Botswana	0	0	0	3
Senegal	0	0	0	3
Zambia	0	0	0	3
Madagascar	0	0	0	2
Namibia	0	0	0	2
Sudan	0	0	0	2
Tanzania	0	1	0	2
Uganda	0	0	0	2
Burundi	0	0	0	1
Cameroon	0	0	1	1
Ivory Coast	0	0	0	1
Mauritius	0	0	0	1
Rwanda	0	1	0	0
Togo	0	1	0	0

Chart: Ranking of AI African Freelancers in AI Development Gigs • Source: Boateng, R., Broni, F.E., Boateng, S.L., Penu, O.K.A., Budu, J. & Serbe-Marfo, J. (26 Nov 2023). AI and Job Creation Report, University of Ghana. • Created with Datawrapper

Figure 1.5 Ranking of African AI freelancers in AI development gigs.

Insights by Country:

- **Nigeria:** Has the highest number of freelancers overall with a significant number of New Sellers (571). It also leads with Level 1 Sellers (31) and has some representation at Level 2 (3).
- **Morocco:** Follows Nigeria with a good number of Level 1 (15) and Level 2 Sellers (9), and also has three Top-Rated Sellers, which is significant given the small number of Top-Rated Sellers overall.
- **Kenya and South Africa:** Have a small presence of Level 1 and Level 2 Sellers and a relatively moderate number of New Sellers.
- **Egypt and Algeria:** Have a presence across Level 1 and Level 2 Sellers but no Top-Rated Sellers.

General Insights:

- **New Talent:** The preponderance of New Sellers suggests that the AI development field is attracting many new freelancers in Africa, which might be indicative of growing interest and emerging talent in the AI sector.
- **Progression Path:** The distribution of sellers across different levels shows a typical progression path, with many new entrants and progressively fewer individuals reaching higher levels of recognition.
- **Opportunity for Growth:** The low number of top-rated sellers highlights an opportunity for growth and development for African freelancers in the AI field to achieve higher recognition and success.
- **Quality vs. Quantity:** The high number of New Sellers compared to Level 1 and Level 2 Sellers may also indicate that while there is a large number of service providers, the established, high-quality providers are still relatively few, suggesting that there is room for freelancers to differentiate themselves by building a track record of high-quality service delivery.

These findings are useful for clients looking to source AI development work from African freelancers, as they provide insight into the maturity and distribution of the market. For freelancers, it highlights the potential to establish themselves in a growing market. For platforms like Fiverr, these findings indicate areas where they could support freelancers in skill and business development to move up the ranks.

African AI Freelancer Gigs in AI Artists: Geographic Outlook

Figure 1.6 provides data on the distribution of AI artist gigs by African freelancers on Fiverr.com. A total of 979 gigs are reported across several African countries.

Overview of Geographic Distribution:

- **Morocco:** Leads with 265 gigs, indicating a strong presence in the AI art sector.
- **Nigeria:** Follows closely with 248 gigs, suggesting it is a significant hub for AI art talent.
- **Egypt:** Has 124 gigs, showing a healthy AI art market.
- **Algeria:** With 108 gigs, it is also a key player in the AI art space.
- **South Africa:** Shows a strong presence with 95 gigs.

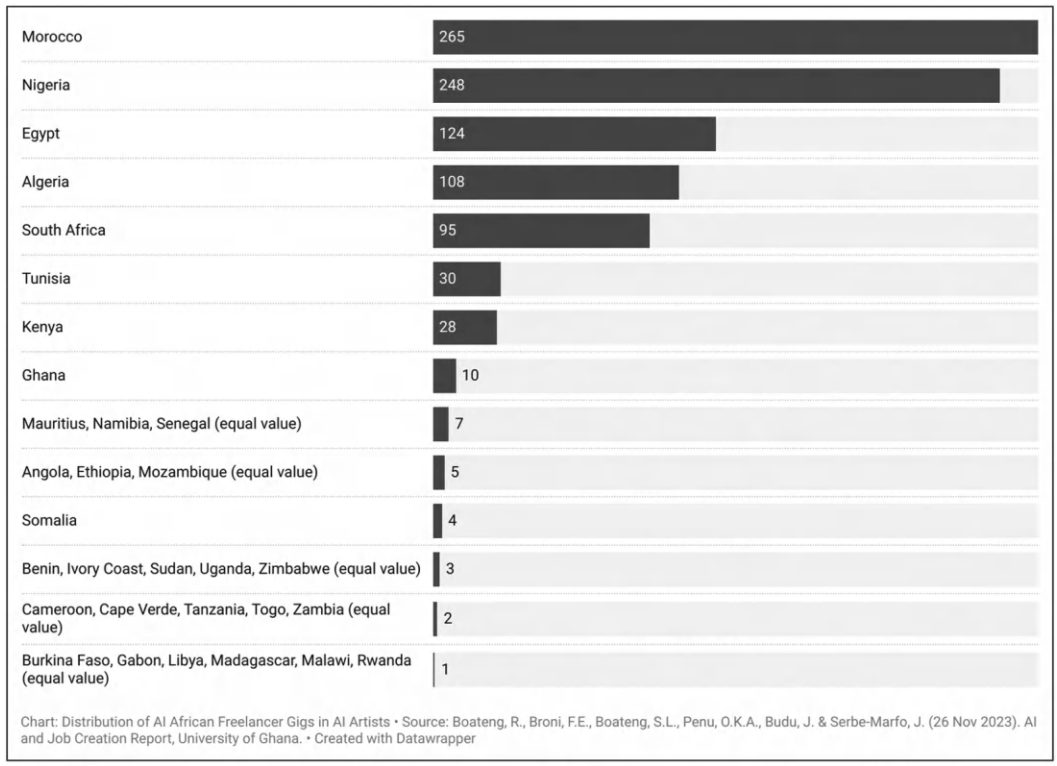


Figure 1.6 Geographic distribution of African AI freelancer gigs in AI artists.

- **Tunisia and Kenya:** Have 30 and 28 gigs, respectively, indicating growing markets for AI art.
- **Ghana:** Has a smaller number of gigs (10), suggesting a nascent market.
- **Mauritius, Namibia, Senegal:** Each have 7 gigs, showing some activity in the AI art domain.
- **Angola, Ethiopia, and Mozambique:** Each have 5 gigs, which may indicate emerging interest or talent in AI art.
- **Somalia:** With 4 gigs, it has a presence in the market.
- **Countries with 3 gigs:** Include Benin, Ivory Coast, Sudan, Uganda, and Zimbabwe, indicating a smaller but existent market.
- **Countries with 2 gigs:** Cameroon, Cape Verde, Tanzania, Togo, and Zambia, pointing to very early stages of market development.
- **Countries with 1 gig:** Burkina Faso, Gabon, Libya, Madagascar, Malawi, Rwanda, suggesting initial steps into the AI art sector.

Insights from Figure 1.6:

- **Regional Hubs:** Morocco and Nigeria are regional hubs for AI art, which could be due to better access to technology, higher quality of education in AI, or more developed digital markets.
- **Emerging Markets:** Countries like Ghana, Mauritius, Namibia, and Senegal, with fewer gigs, represent emerging markets with growth potential.
- **Market Maturity:** The data suggests varying levels of market maturity for AI art across the continent, with Morocco and Nigeria leading.
- **Diversity in Offerings:** Gigs in almost every listed country indicate a continent-wide interest in AI art, with freelancers offering diverse creative services.

Market Implications:

- **Support for Growth:** There may be opportunities for growth in countries with fewer gigs through support in education and technology.
- **Potential for Collaboration:** The leading countries could act as centers of excellence, sharing knowledge and best practices with emerging markets.
- **Investment and Development:** The data can guide investment and development efforts to support the growth of the AI art sector in Africa.

In summary, Africa's AI Artist freelancer market shows significant geographic diversity, with Morocco and Nigeria leading in the number of gigs offered. The overall landscape indicates that while established markets exist, there is still much room for growth and development across the continent.

Ranking of African AI Freelancers in AI Artists

Figure 1.7 details the ranking of AI African Freelancer Gigs in the category of AI Artists, categorized by the sellers' level on Fiverr.com.

Overview of Ranking:

- **New Sellers:** They represent the majority across almost all countries, with Nigeria having the most (230 gigs), followed by Morocco (214 gigs) and Egypt (106 gigs). This suggests a burgeoning market with many new entrants.
- **Level 1 Sellers:** Morocco stands out with 36 gigs, the highest number of Level 1 Seller gigs, while other countries show a more moderate presence.
- **Level 2 Sellers:** Nigeria leads with 10 gigs, followed by Morocco and Algeria with 15 and 12 gigs, respectively. This indicates that there are freelancers in these countries who have advanced beyond the new seller rank.
- **Top Rated Sellers:** There are no top-rated sellers for AI Artist gigs among the African countries listed, which might imply either a new market or one where freelancers have yet to achieve the highest seller rank on Fiverr.

Insights from Figure 1.7:

- **Dominant Markets:** Nigeria and Morocco are dominant markets for AI Artist gigs, which could be due to a larger freelance community or a higher demand for AI-driven art in these countries.
- **Market Maturity:** The presence of level 2 sellers in some countries indicates a maturing marketplace where freelancers have progressed beyond the initial stages and have begun establishing reputations.
- **Potential for Growth:** The lack of top-rated sellers suggests that there is significant room for growth and an opportunity for freelancers to ascend to higher levels of recognition.

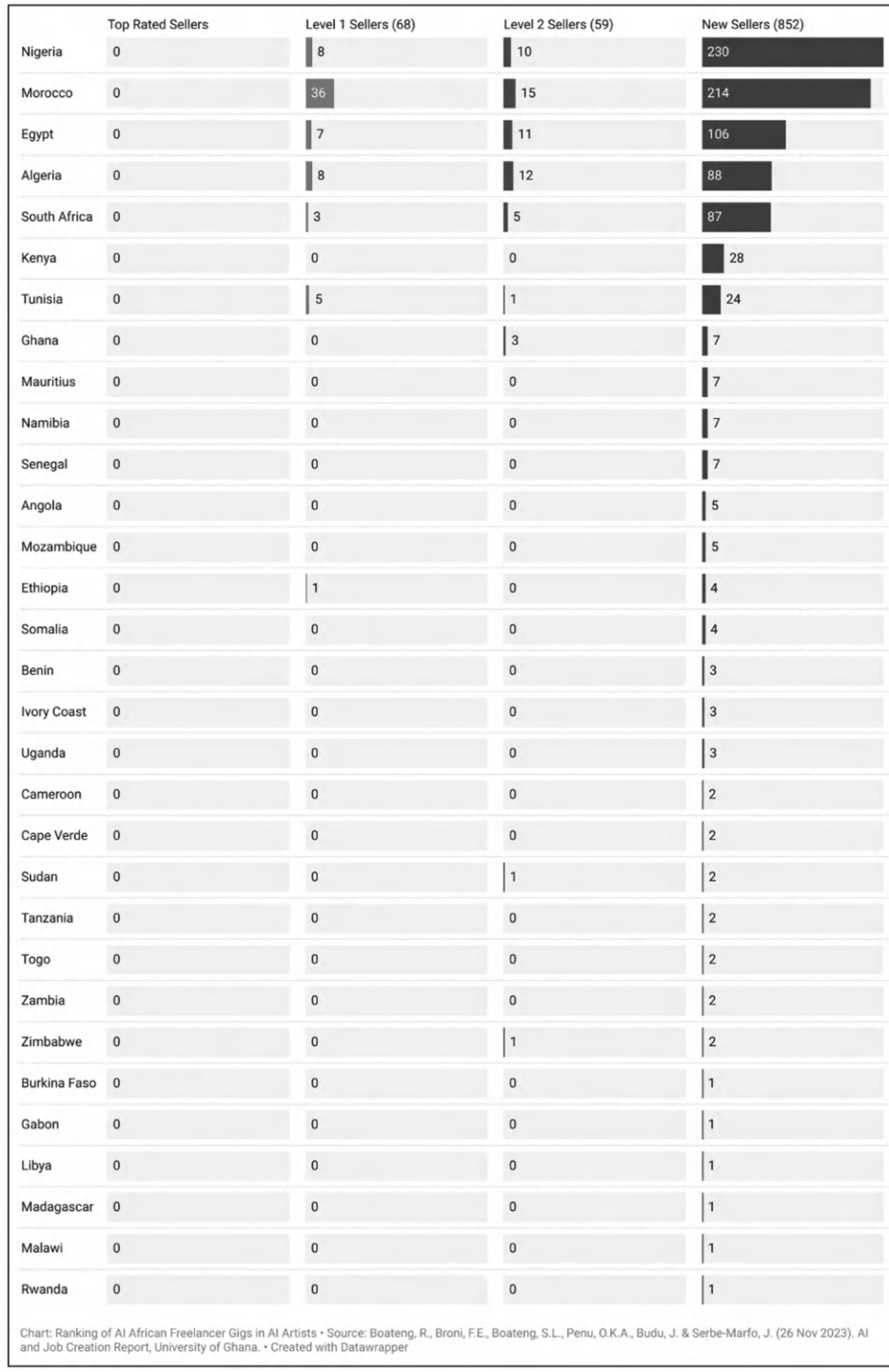


Figure 1.7 Ranking of African AI freelancers in AI artists.

- **Market Entry:** The high number of new sellers across the board indicates that the AI artist gig market is accessible to new entrants, which could attract those looking to start a freelance career in this domain.

Considerations:

- **Support and Training:** Countries with fewer level 1 and level 2 sellers might benefit from more support and training to help freelancers climb the ranks.
- **Market Differentiation:** With many new sellers, differentiation based on quality, unique art styles, or niche AI applications could be key for freelancers looking to stand out.
- **Building Reputation:** Given the absence of top-rated sellers, there is a clear opportunity for freelancers to build their reputation and become market leaders.

Overall, Africa's AI artist gig market is characterized by a large influx of new talent, with significant potential for freelancers to establish themselves and progress within the industry.

Gender and AI Job Opportunities in AI Development

African AI Freelancers' Gigs in AI Development by Gender

The data in Figures 1.8 and 1.9 shows the distribution of gigs in AI Development by African freelancers on Fiverr.com, categorized by gender. Figure 1.8 presents a detailed breakdown by country, while Figure 1.9 shows an aggregated percentage distribution for male, female, and agency/firm-based freelancers.

- **Male AI Freelancers (887):** They dominate the AI development space with the highest numbers in Nigeria (446), followed by Morocco (159), South Africa and Kenya with over 50 gigs each. Figure 1.7 shows Nigeria contributing to 50% of the gigs by male freelancers, indicating a strong male presence in the Nigerian AI development sector.
- **Female AI Freelancers (218):** The highest number of gigs by female freelancers is in Nigeria (160), with a significant drop to the second-highest in Mozambique (22), followed by Morocco (8) and other

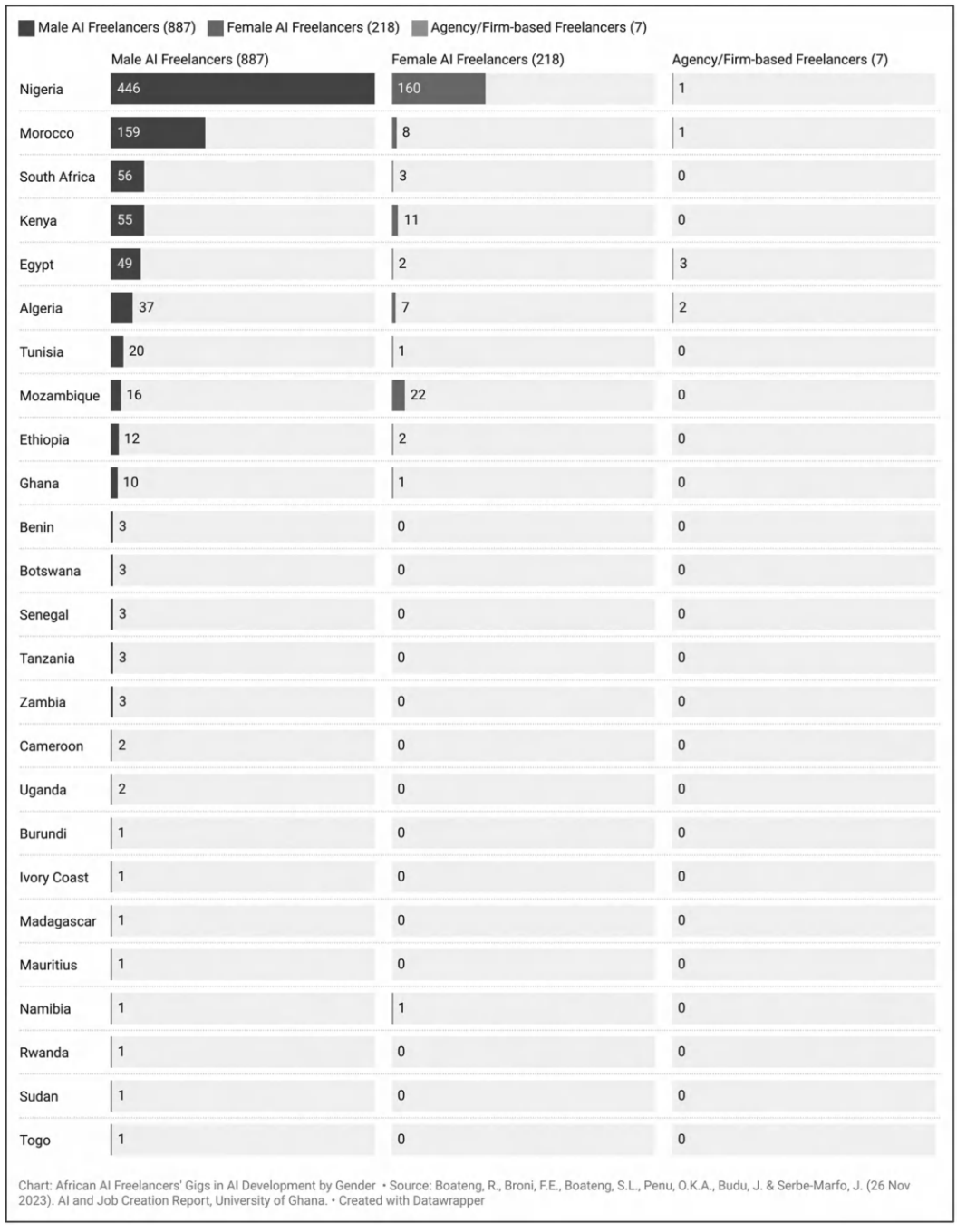


Figure 1.8 African AI freelancers' gigs in AI development by gender.

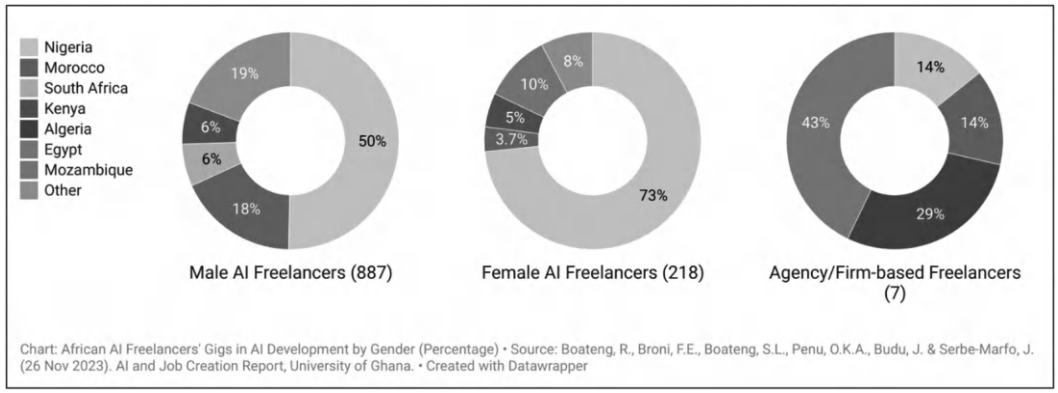


Figure 1.9 Distribution of AI freelancers by AI categories.

countries having fewer than 12 gigs each. Nigerian female freelancers account for 73% of the gigs, showing a significant concentration of female AI talent in Nigeria. Nigeria is the leading country for male and female freelancers in AI Development, suggesting it is a key hub for AI talent in Africa.

- **Agency/Firm-based Freelancers (7):** Very few gigs are represented by agencies or firms, with the highest being in Egypt (3), followed by Algeria (2), and only one in Nigeria.

Insights from Figures 1.8 and 1.9:

- **Gender Disparity:** There is a significant gender gap in the number of gigs, with male freelancers holding the majority. This reflects a common trend in the tech industry where men are more represented than women.
- **Nigeria's Prominence:**
- **Opportunities for Women:** The concentration of female freelancers in Nigeria could indicate better access to education and opportunities in the tech sector for women, or it could reflect a larger trend of women in Nigeria engaging in the gig economy.
- **Agency/Firm-Based Involvement:** The presence of agency/firm-based gigs, although small, might point to a growing interest in structured, possibly larger-scale AI projects.
- **Regional Disparities:** The data shows regional disparities in AI development work across Africa, with some countries having little representation. This could be due to differences in education, infrastructure, or economic factors influencing the tech industry.

Considerations:

- **Encouraging Diversity:** Initiatives need to encourage more women and underrepresented groups to enter the AI field.
- **Strengthening Education:** Countries with fewer freelancers could benefit from educational and infrastructural investments to build AI capabilities.
- **Supporting Growth:** With Nigeria leading in AI development gigs, there may be opportunities for cross-country collaboration and knowledge sharing to support growth in other African countries.
- **Understanding Barriers:** Further research may be required to understand the barriers that prevent a higher representation of women and agency/firm-based freelancers in AI development.

The data provides valuable insights for stakeholders in the African tech ecosystem, including governments, educational institutions, and tech companies, on where support and development efforts could be directed to build a more inclusive and robust AI industry.

African AI Artists by Gender and Country

The data provided in Figures 1.10 and 1.11 shows the distribution of gigs of African AI artists on Fiverr.com, categorized by gender. Figure 1.10 presents a detailed breakdown by country, while Figure 1.11 shows an aggregated percentage distribution for male and female freelancers.

Gender Distribution Insights:

- **Male Dominance:** There is a significant gender disparity in the AI artist field in Africa, with male artists comprising a large majority (85.19%) of the total. This depicts a significant gender imbalance in the AI art space, with male artists dominating the field. Further, the total number of gigs offered by male AI artists is substantially higher than those offered by female artists. This could reflect broader trends in the STEM fields where men often outnumber women.
- **Female Representation:** Female AI artists represent a much smaller proportion (14.81%), highlighting a need for increased female participation and support in the tech and AI sectors in Africa.

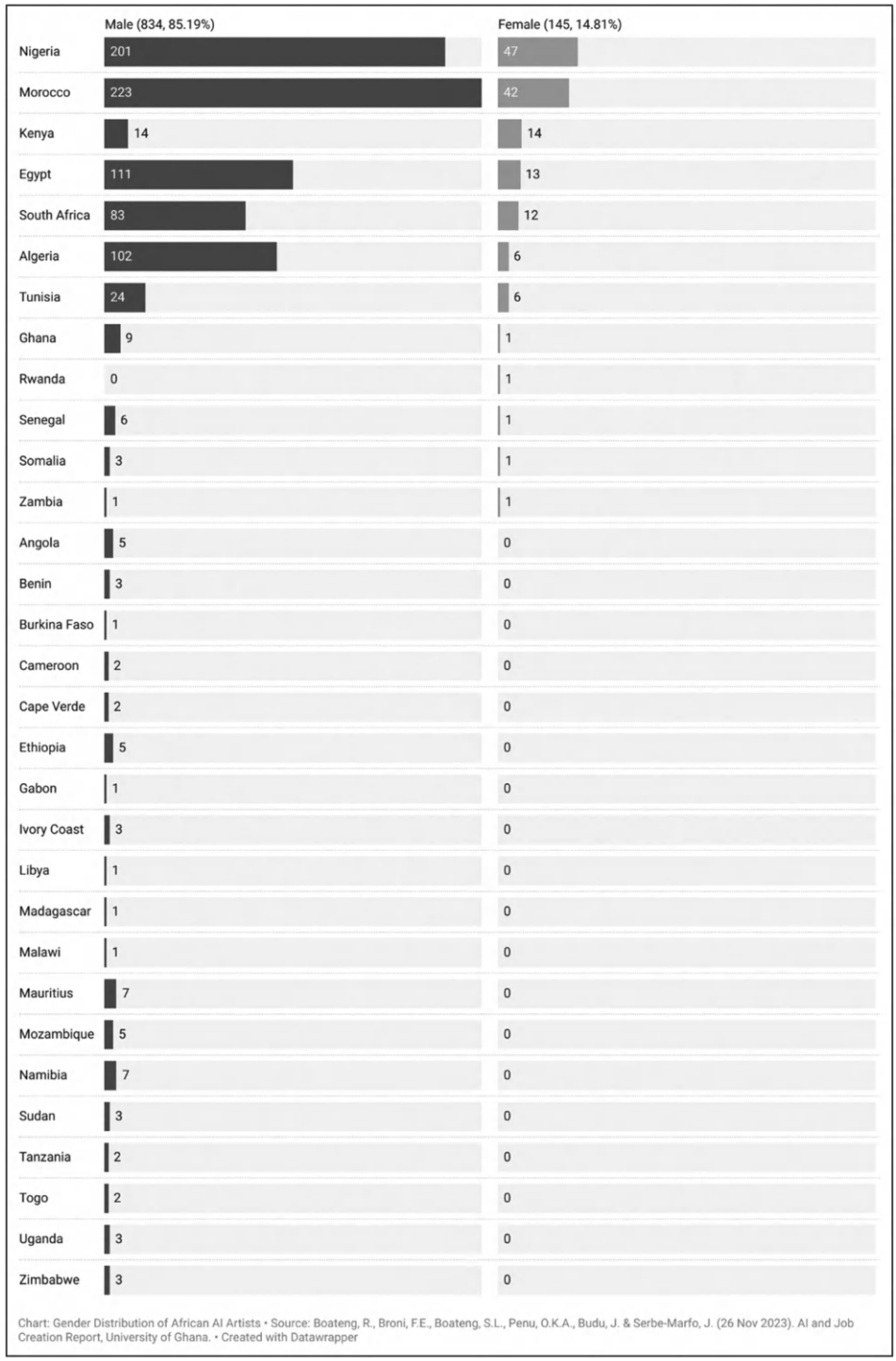


Figure 1.10 African AI artists by gender and country.

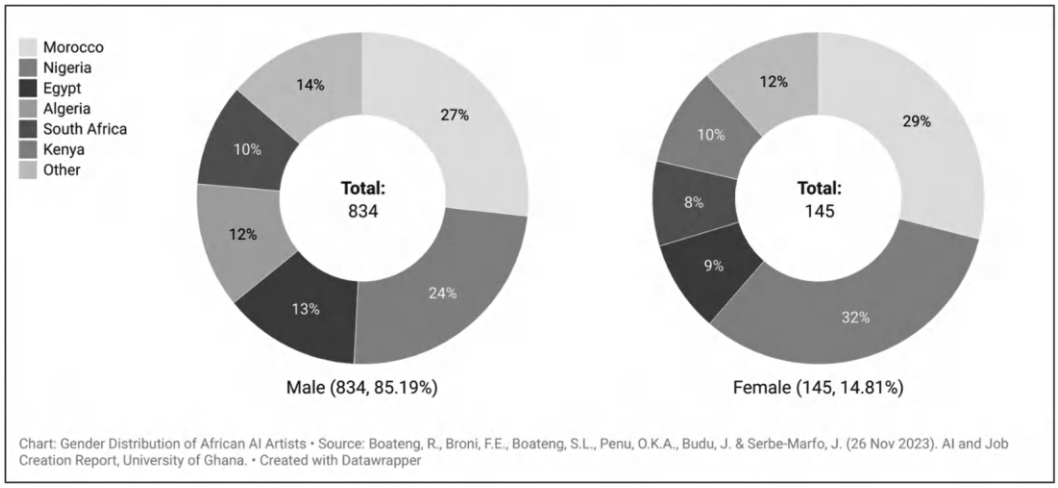


Figure 1.11 African AI artists by gender (Percentage).

- **Gender Winners:** The numbers indicate that countries like Morocco and Nigeria have a higher number of gigs by male artists, while Kenya shows an equal distribution of male and female AI artists, suggesting that some countries may have more gender-balanced AI sectors than others.

Country-Specific Distribution:

- Morocco shows the highest number of gigs by male AI artists, suggesting a robust AI sector but also indicating potential gender inequality.
- While also showing many gigs by male AI artists, Nigeria has a more notable representation of female AI artists than other countries, which could point to a relatively more inclusive environment or effective initiatives to support women in AI.
- Kenya stands out for its equal number of male and female AI artists, which is unique among the listed countries and suggests a potentially more gender-balanced AI community.

Market Implications:

- **Need for Diversity Initiatives:** The significant gender gap suggests a need for initiatives to encourage and support more women to enter and thrive in the AI field.
- **Potential for Growth:** The relatively low number of female AI artists indicates a large untapped potential and market opportunity for

women in AI, which educational institutions and tech companies could leverage.
- **Cultural and Policy Considerations:** Cultural factors and policies might influence the gender distribution in different countries, and understanding these could help address the gender disparity.

Considerations:

- **Encouraging Female Participation:** The data may encourage policymakers and educators to develop targeted programs to support female AI artists.
- **Market Development:** For AI platforms and communities, there may be a need to create inclusive policies and support systems that encourage more women to offer their services as AI artists.
- **Cultural Factors:** Cultural factors could play a role in gender distribution, and understanding these can help develop strategies to encourage a more balanced representation.

In summary, while there is a clear disparity in gender representation among African AI artists, there are indications of a growing presence of women in some regions, and Kenya's balanced figures are particularly noteworthy. Addressing the gender gap could lead to a more inclusive AI sector in Africa and open up new perspectives and innovations in the field. The insights also suggest that while there is a vibrant community of AI artists in Africa, there is a disparity in gender representation, which presents both a challenge and an opportunity to grow a more inclusive AI art marketplace.

Abilities—What Skills and Competencies Matter

AI Engines as Used in AI Development by African AI Freelancers' Gigs

Figure 1.12 details the use of various AI engines in AI development by African AI freelancers, according to the number of gigs offered and their respective percentages of 1,112 gigs.

AI Engines and Their Utilization:

- **ChatGPT:** Dominates the field with 595 gigs, making up 53.51% of all gigs, highlighting its popularity in language-related AI tasks.

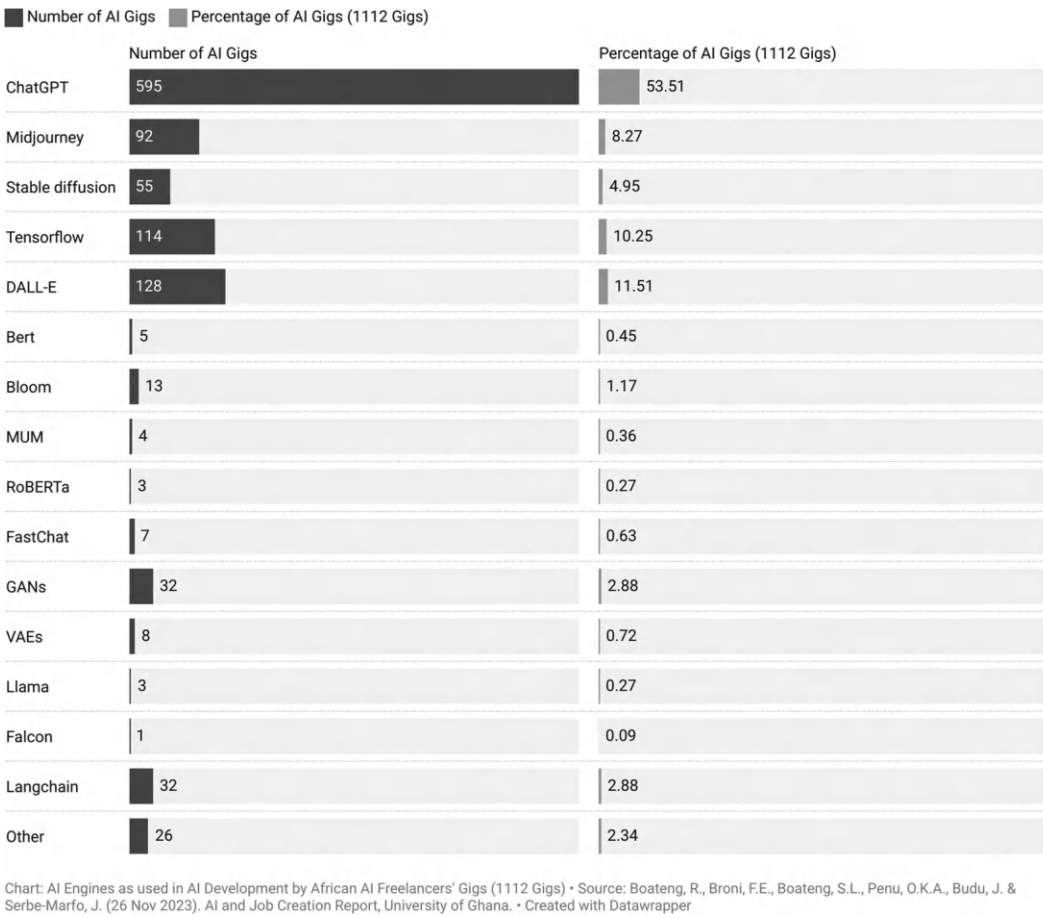


Figure 1.12 AI engines as used in AI development by African AI freelancers' gigs.

- **DALL-E:** Holds 128 gigs, accounting for 11.51% of the total, indicating significant use in AI-driven art and design.
- **TensorFlow:** Used in 114 gigs (10.25%), showing its strong presence in machine learning and neural network projects.
- **Midjourney:** Appears in 92 gigs (8.27%), which may reflect its use in specific AI tasks or emerging areas of AI development.
- **Stable Diffusion:** Is used in 55 gigs (4.95%), likely for generative tasks such as text-to-image synthesis.
- **GANs (Generative Adversarial Networks):** Represent 32 gigs (2.88%), used in niche areas like unsupervised machine learning.
- **Langchain:** Also has 32 gigs (2.88%), which could suggest its application in language understanding and processing tasks.
- **Other:** Encompasses various AI engines not listed individually, making up 26 gigs (2.34%), indicating a diversity of freelancer tools.

Insights from Figure 1.12:

- **Popularity of Language Models:** ChatGPT's significant share reflects a strong focus on natural language processing, automation, and possibly conversational AI applications among African AI freelancers.
- **Visual AI Demand:** DALL-E's substantial share suggests a demand for AI in creative fields such as graphic design and digital art.
- **Machine Learning Frameworks:** TensorFlow's notable presence implies that many freelancers offer services that involve building and training machine learning models.
- **Emerging Technologies:** Midjourney and Stable Diffusion, while less common, indicate freelancers are engaging with cutting-edge AI technologies.
- **Diversity of Tools:** The variety of AI engines, including those categorized as "Other," shows that African AI freelancers are not limited to mainstream tools and are exploring various AI technologies.

Considerations for AI Development in Africa:

- **Training and Education:** The data suggests the need for training programs covering popular and emerging AI engines to keep freelancers competitive.
- **Niche Specialization:** Freelancers may find opportunities by specializing in less commonly used AI engines, catering to specific market needs.
- **Market Positioning:** Freelancers using more common AI engines might need to differentiate their offerings, given the apparent market saturation with popular tools like ChatGPT and TensorFlow.
- **Investment in AI:** The diversity in AI engines used by freelancers highlights an active market that could benefit from further investment and support to foster innovation and growth in the AI sector.

In summary, African AI freelancers are highly engaged with various AI engines, with a clear preference for language and visual AI models, indicating a vibrant and diverse AI development scene on the continent.

AI Engines as Used by African AI Artists Freelancers Gigs

Figure 1.13 shows African AI artists' use of different AI engines on Fiverr.com, with a total of 979 gigs.

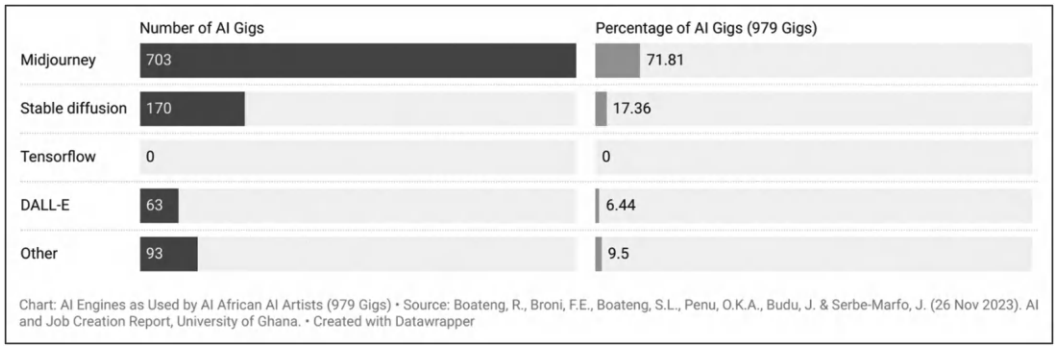


Figure 1.13 AI Engines as used by African AI artists freelancers gigs.

AI Engines and Their Utilization:

- **Midjourney:** Leads with 703 gigs, making up 71.81% of all AI Artist gigs.
- **Stable Diffusion:** Follows with 170 gigs, accounting for 17.36%.
- **DALL-E:** Is used in 63 gigs, representing 6.44%.
- **Other:** Includes various AI engines not listed separately, contributing to 93 gigs or 9.5%.
- **TensorFlow:** It is not used in any of the AI Artist gigs listed, implying its use is likely more prevalent in other AI domains than art.

Insights from Figure 1.13:

- **Preference for Generative AI:** The heavy use of Midjourney and Stable Diffusion indicates a strong preference for generative AI tools that can create art, design, and visuals. This is consistent with the current trend of AI being used for creative purposes.
- **High Market Share for Midjourney:** Midjourney's dominance in the market could be due to its capabilities or popularity in creating complex and high-quality images that clients demand.
- **Diverse Tools:** The presence of "Other" AI engines with a non-negligible share suggests that AI artists are utilizing various tools, possibly to cater to specific niche requirements or to leverage unique features of different AI engines.
- **Less Focus on Technical AI:** The absence of TensorFlow from the AI Artist gigs reflects its more technical and data-oriented use, which may not be as relevant for artistic applications typically offered by freelancers in this category.

Market Implications:

- **Rising Demand for AI Art:** The data suggests a growing market for AI-generated art in Africa, with freelancers quickly adopting new generative AI tools.
- **Opportunities for Specialization:** With a significant number of gigs falling under "Other," there are opportunities for AI artists to specialize in unique or less common AI engines to differentiate themselves in the market.
- **Need for Diverse Skill Sets:** AI artists might benefit from being adept in multiple AI engines to cater to a wider range of client needs and to stay competitive as the technology evolves.
- **Potential for Training and Development:** Educational and training programs focusing on generative AI could support the growing number of freelancers looking to enter this space.

Overall, the AI art gig market among African freelancers is robust, with a clear emphasis on tools capable of generating visually creative work, and it shows potential for further growth and diversification.

Programming Expertise of African AI Freelancers in AI Development

Figure 1.14 presents a distribution of programming expertise reported by AI gigs offered by 92 African freelancers gigs, who have completed at least one AI gig order in AI development.

From Figures 1.14 and 1.15 we can analyse the distribution of programming expertise among AI freelancers in Africa and how this distribution varies by country.

Distribution of Programming Expertise:

- **Python** is the most commonly reported expertise among AI freelancers who have completed at least one gig, consistent with global AI development trends.
- **JavaScript** is the second most common, suggesting a strong presence of web development skills among AI professionals.
- **PHP** surprisingly ranks third, indicating that AI solutions are also being integrated into traditional web technologies.

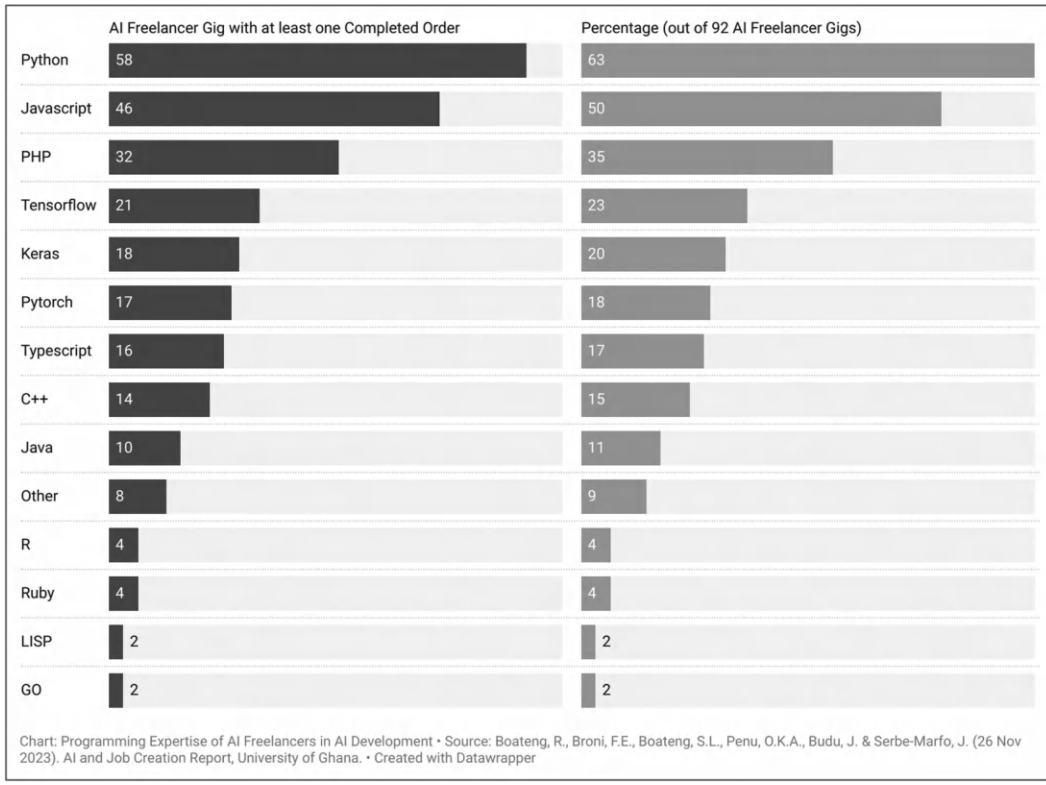


Figure 1.14 Programming expertise of African AI freelancers in AI development.

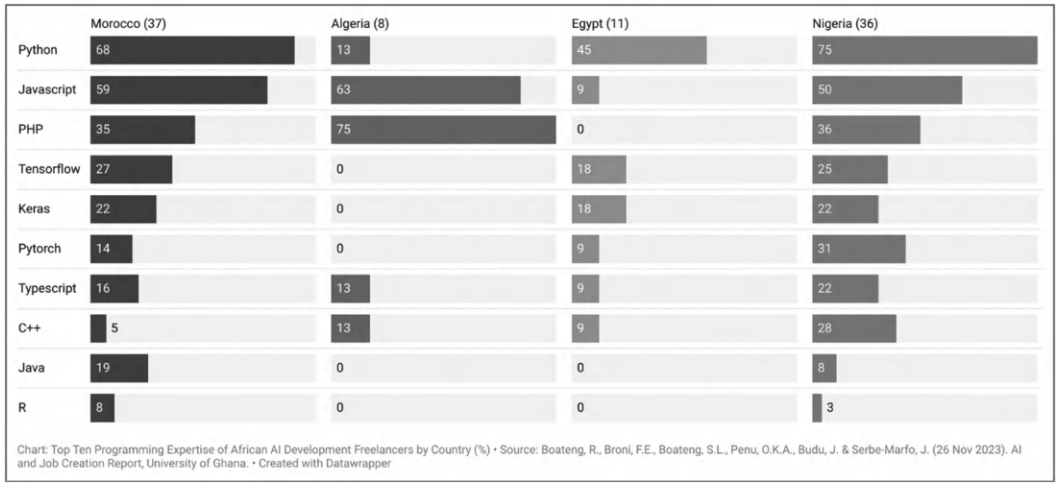


Figure 1.15 Top ten programming expertise of African AI development freelancers (percentage).

- **TensorFlow, Keras, and PyTorch** are listed, reflecting the importance of deep learning frameworks in current AI development.
- **Typescript** and **C++** also appear, suggesting some AI work is being done in areas requiring strong typing or high-performance computing.
- **Java** holds a smaller share, which may reflect its use in more enterprise-level or Android development contexts.
- **Other** languages, **R**, **Ruby**, **LISP**, and **Go**, appear less frequently, indicating niche uses or specialized AI applications.

Country-Specific Insights:

- **Morocco** strongly prefers Python and JavaScript, suggesting a versatile AI development scene that spans both data science and web development.
- **Algeria** has a significant percentage of PHP expertise, which may indicate a focus on integrating AI into existing web platforms.
- **Egypt** displays a varied skill set but with a notable absence of PHP and Java, perhaps indicating a focus on emerging AI technologies rather than traditional web development.
- **Nigeria** has the most diverse skill distribution, with a relatively high percentage of freelancers skilled in PyTorch (as compared to the other countries), indicating a strong presence in advanced AI development.

Insights on AI Development in Africa:

- **Diverse Skill Sets:** African AI freelancers possess various programming skills, from web development languages to specialized AI frameworks.
- **Language Specialization by Country:** Different countries show different strengths in programming skills, which may reflect the local demand, the education system's focus, or the presence of specific industries.
- **Emerging Trends:** Modern languages like Typescript and traditional ones like C++ and Java suggest that African AI freelancers are keeping pace with global tech trends.
- **Potential for Cross-Disciplinary Work:** The combination of web development languages and AI-specific frameworks indicates that freelancers are likely working on cross-disciplinary projects.

Market Implications:

- **Education and Training:** Given their market dominance, there is a clear need for ongoing education in Python and JavaScript. Additionally, training in deep learning frameworks will likely increase in demand.
- **Technology Integration:** The prevalence of PHP among AI gigs suggests a market for AI integration into existing web platforms, which may provide opportunities for freelancers.
- **Niche Expertise:** Languages with lower representation offer niche opportunities for freelancers with expertise in those areas.

In conclusion, the programming expertise of AI freelancers in Africa is diverse and aligns with global trends in technology, with a strong emphasis on Python and deep learning frameworks. This diversity reflects the dynamic nature of the AI development market in the continent and points to opportunities for both generalists and specialists in the field.

Sustainability: Pricing and Earnings

Pricing of African AI Freelancers' Gigs

Figure 1.16 shows the pricing of AI development gigs offered by African AI freelancers across different price ranges. Each chart breaks down the number of gigs within a specific price tier and gives a percentage distribution for various African countries.

Insights from Figure 1.16:

1. **Most Common Price Range:** The largest number of gigs (540) are offered at ≤$100, with 65% falling into this price range. This indicates that most AI development services by African freelancers are accessible at relatively low prices.
2. **High-End Services:** A small but notable segment offers services at the highest price point of $2,000+, totaling 7 gigs. This could indicate specialized, high-value AI development work.
3. **Mid-Range Services:** The ≤$500 price tier also has a considerable number (223) of gigs, suggesting a significant market for more

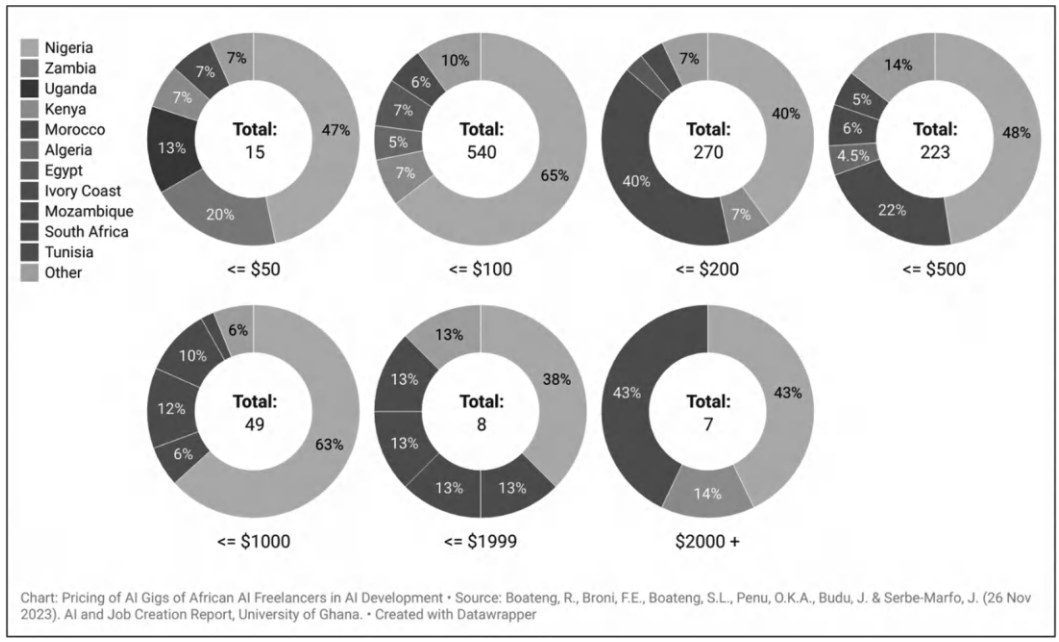


Figure 1.16 Pricing of African AI freelancers' gigs in AI development.

complex or comprehensive AI development projects that command higher prices.

4. Country Distribution:
   - **Nigeria:** Consistently has the highest percentage across all price tiers, dominating the ≤$50 and ≤$100 tiers particularly, which suggests a strong presence of entry-level to moderately priced AI services.
   - **Ivory Coast and Mozambique:** A notable presence in the ≤$50 tier indicates a focus on more affordable AI development services.
   - **Other Countries:** Countries categorized as "Other" have a more distributed presence across different price tiers, suggesting diverse service offerings.
5. **Growth Potential:** African freelancers in higher price ranges (≤$1,000 and above) show potential and demand for more advanced and high-priced AI development work.
6. **Market Accessibility:** The concentration of gigs in the lower price ranges (≤$100) might make AI development services from African freelancers more attractive to clients with smaller budgets or those looking for cost-effective solutions.

Market Implications:

- **Competitive Pricing:** African freelancers are competitive, potentially positioning the continent as a go-to for affordable AI development outsourcing.
- **Niche Expertise:** Gigs in the upper price brackets imply expertise capable of delivering high-value projects, possibly with niche specialization.
- **Opportunity for Upskilling:** Given the number of lower-cost gigs, freelancers may be able to upskill and move into higher price brackets with more complex service offerings.

Overall, the pricing structure of African AI freelancers' gigs reflects a diverse and competitive market with services catering to a wide range of client needs and budgets. This data can be useful for clients when considering sourcing AI development work and for freelancers when setting their prices relative to the market.

Earnings of African AI Freelancers in AI Development

Figure 1.17 presents an overview of AI gigs offered by African freelancers, focusing on those with completed orders, and includes financial details such as the amount earned and the payout to sellers after Fiverr's service charge.

Of the 1,112 African AI freelancer gigs offered on Fiverr, only 92 African AI freelancer gigs spanning four African countries, Morocco, Algeria, Egypt, and Nigeria, have completed AI gig orders. These 92 freelancers (gigs) completed 501 gig orders, earning a combined minimum payout of $59,956.00. On a closer look;

- **Morocco:** Of 168 gigs offered, 37 had completed orders, with no female freelancers completing orders. Top-rated sellers completed 28 orders, contributing significantly to the total of 163 completed orders. The total amount earned was $35,465, with a minimum payout to sellers of $28,372 after Fiverr's charge.
- **Nigeria:** With the most gigs offered (607), only 36 orders were completed. Female freelancers completed some orders (5), and the majority were by new sellers (61). The total completed orders numbered 95, earning $12,215, with a minimum payout of $9,772.

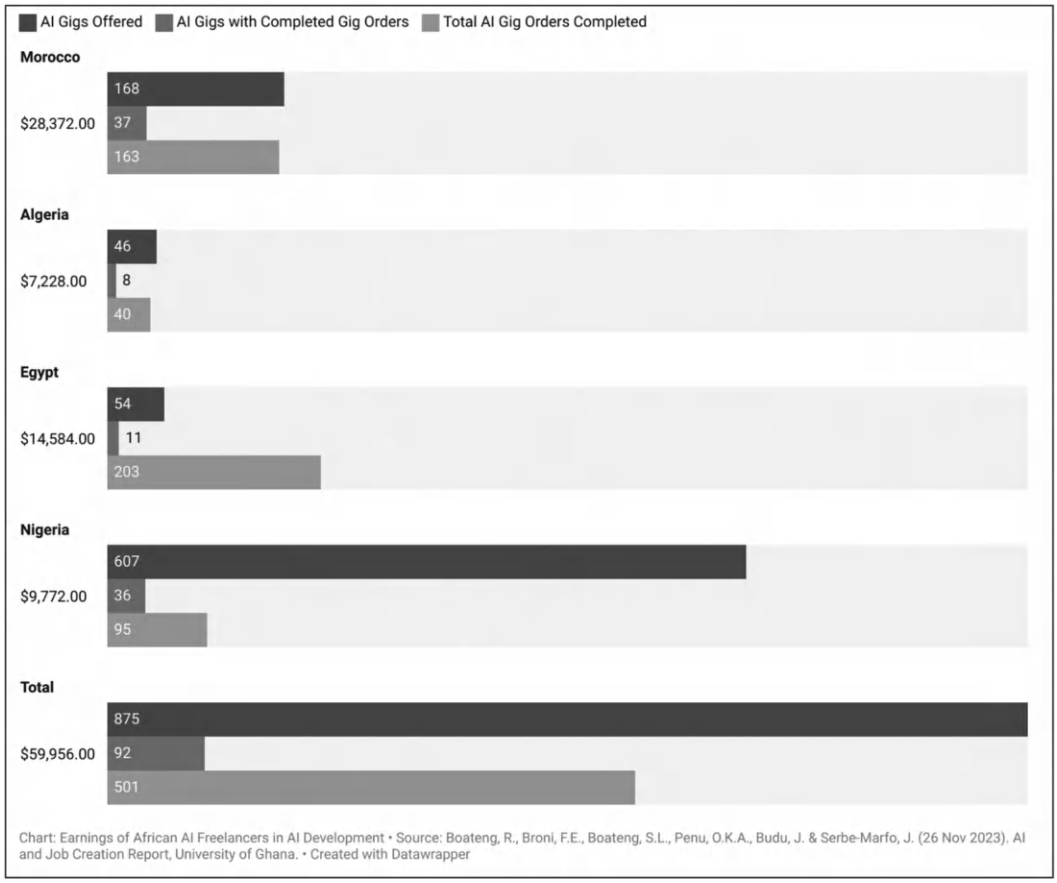


Figure 1.17 Earnings of African AI freelancers in AI development.

- **Total:** Across all countries, from the 875 gigs offered, there were 92 completed orders by all seller levels. The total completed orders were 501, with earnings of $74,945 and a payout to sellers of $59,956 after Fiverr's charge.

Insights from Figure 1.17:

- **Top-Rated Sellers:** The data shows that top-rated sellers in Morocco are particularly successful in completing gig orders, suggesting a high-level of customer satisfaction or market demand for their services.
- **Level 2 Sellers:** Egypt's freelancers at level 2 have completed many orders, indicating a mature and experienced seller base.
- **New Sellers:** Nigeria shows a significant contribution from new sellers, which may reflect a growing market with new entrants completing orders.

- **Gender Discrepancy:** The data suggests a gender discrepancy, with a very low number of completed orders by female freelancers, which could point toward a need for more gender diversity in the AI development gig market.
- **Pricing Strategy:** Given the significant cut taken by Fiverr (20%), freelancers need to price their gigs accordingly to ensure a sustainable income.
- **Market Opportunities:** A large number of gigs appears to be offered compared to those with completed orders, indicating either a competitive market or a gap in effectively meeting client needs.

Considerations for Stakeholders:

- **Freelancers:** Should focus on building their reputation to advance to higher seller levels, potentially increasing their chances of gig completion and earnings.
- **Clients:** Can take advantage of the competitive prices and variety of seller levels in the African AI development gig market.
- **Platforms Like Fiverr:** Could explore initiatives to support new and female freelancers, helping them to complete more orders and balance gender representation.

Overall, while there is a promising number of gigs offered, the completion rates and gender distribution highlight areas for growth and support within the African AI freelance community.

Earnings of Female AI African Freelancers

Of the 1,112 African AI freelancer gigs offered on Fiverr, 218 are by female African AI freelancers. However, only five female freelancers from Nigeria have completed orders. These five freelancers have completed 24 gig orders, earning a minimum payout of $1,768.00. This amount is part of the $9,772.00 minimum payout earned by Nigerian African AI freelancers who have completed 95 gig orders (Figure 1.18).

- Of the 1,112 African AI freelancer gigs offered on Fiverr, 218 are by female African AI freelancers. However, only five female freelancers

Figure 1.18 Earnings of female African AI freelancers in AI development.

from Nigeria have completed orders. These five freelancers have completed 24 gig orders, earning a minimum payout of $1,768.00.

- **Earnings Discrepancy:** There is a noticeable discrepancy among the new sellers, with one earning $720.00 from 10 gigs, significantly higher than the other two new sellers. The freelancer who completed 10 gigs earned the most, suggesting they either undertook higher-valued gigs or simply completed more orders.
- **Market Penetration:** Despite being a smaller subset of the total, these five female freelancers have completed a notable number of orders, indicating market penetration, but perhaps opportunities for more work exist.
- **Income Concentration:** The earnings are concentrated among fewer freelancers, which may imply a gap between the number of gigs offered and those completed, or it may reflect the success of a few freelancers in securing more or higher-paying gigs.

For stakeholders, this data highlights the importance of supporting female freelancers in AI to increase their presence and success in the gig economy. Additionally, it emphasizes the potential for growth and the need for capacity-building initiatives to help more female freelancers in Nigeria (and Africa) complete gigs and increase their earnings.

Qualitative Perspectives from African AI Freelancers

Table 1.2 provides a comprehensive analysis of 15 AI freelancers from different African countries, focusing on their services, gender, ratings, and seller levels on the Fiverr platform. The countries represented include Nigeria, Algeria, Morocco, Egypt, and Ghana, showcasing a diverse talent pool across the continent. The freelancers offer a wide array of services such as AI Development, Data Science and Machine Learning, AI Artistry, AI Custom Prompts, and Generative AI Lessons. This diversity in services highlights the versatility and broad skill sets of these freelancers, catering to various client needs within the AI domain.

In terms of ratings, the freelancers generally maintain high levels of client satisfaction, with most ratings hovering around 4.7 to 5.0. This indicates a strong performance and reliability in delivering quality services. The gender distribution shows a mix of male and female freelancers, although males are slightly more predominant. Notably, female freelancers are actively contributing and achieving high ratings as well, as seen with respondents from Nigeria, Egypt, and Algeria. This points to an inclusive and growing field where both genders are making significant strides.

The seller levels of these freelancers vary, with several being New Sellers, while others have achieved Level 1 or Level 3 status. New Sellers are particularly prevalent among respondents from Nigeria and Algeria, indicating a fresh influx of talent into the market. Meanwhile, freelancers from Morocco and Egypt have some representatives at higher seller levels, reflecting more established careers and potentially greater experience. This distribution suggests that while the market is welcoming new entrants, there is also a pathway for advancement and recognition for those who consistently deliver high-quality work. Overall, the document underscores a thriving and dynamic freelance AI community in Africa, marked by high competence, gender inclusivity, and opportunities for growth.

Services Offered and Opportunities

Diverse Range of AI Services

Freelancers offer a variety of AI services on platforms like Fiverr, including natural language processing, machine learning model development, and AI consulting. This diversity allows them to cater to a broad spectrum of client needs, enhancing their marketability and client satisfaction.

Table 1.2 AI Freelancers Interviewed in the Study

Respondents	*Country*	*AI Services*	*Gender*	*Ratings*	*Freelance Seller Level*
Respondent 1	Nigeria	AI Development, AI Artist	Male	4.8	New Seller
Respondent 2	Algeria	AI Development, Data Science and ML	Male	4.8	New Seller
Respondent 3	Nigeria	AI Development, AI Artist, AI Custom Prompt	Female	5	New Seller
Respondent 4	Nigeria	AI Development, Data Science and ML	Female	5	New Seller
Respondent 5	Morocco	AI Development, Data Science and ML	Male	4.8	Level 1
Respondent 6	Egypt	AI Development, Data Science and ML	Male	5	Level 1
Respondent 7	Egypt	AI Development, Data Science and ML, AI Custom Prompt	Female	5	New Seller
Respondent 8	Morocco	AI Development, AI Artist, AI Custom Prompt	Female	4.7	New Seller
Respondent 9	Nigeria	AI Development, Data Science and ML, AI Custom Prompt	Male	4.7	New Seller
Respondent 10	Morocco	AI Development, Data Science and ML	Male	5	Level 3
Respondent 11	Ghana	AI Development, AI Artist	Male	5	New Seller
Respondent 12	Algeria	AI Development, Data Science and ML	Male	5	Level 1
Respondent 13	Algeria	AI Development, Data Science and ML, AI Artist	Female	5	New Seller
Respondent 14	Nigeria	AI Development, Data Science and ML	Male	5	Level 3
Respondent 15	Nigeria	AI Custom Prompt, Generative AI Lessons, AI Development	Female	4.5	Level 1

Supporting Quotes:

- "My offerings encompass Twilio IVR development, Whisper AI speech-to-text integration, Eleven Lab text-to-speech solutions, and Google Bard AI implementations." (Respondent 3, Nigeria)
- "I specialize in crafting dynamic websites leveraging AI algorithms, developing bespoke chatbots for enhanced user engagement, and creating cutting-edge AI algorithms and deep learning models." (Respondent 5, Morocco)

Opportunities in Emerging AI Fields

The future of AI-related gigs shows a promising demand for specialized expertise in fields like federated learning, explainable AI, and ethical AI practices. Freelancers with skills in these areas are likely to find ample opportunities as the demand for such specialized services grows.

Supporting Quotes:

- "Specialized expertise in federated learning, explainable AI, reinforcement learning, and data privacy will likely be in high demand for future AI gigs." (Respondent 2, Algeria)
- "The future of AI gigs will likely focus on specialized expertise in AI ethics, explainable AI, multi-language text-to-speech, and enhanced API integrations." (Respondent 3, Nigeria)

The opportunities identified by the freelancers, including federated learning, explainable AI, and ethical AI practices, align with current trends and emerging areas of interest in AI research. Federated learning, for instance, is gaining traction as a method to improve data privacy and security while enabling collaborative learning (Kairouz et al., 2019). Explainable AI and ethical AI are also critical areas, as they address the need for transparency and accountability in AI systems (Doshi-Velez & Kim, 2017). These opportunities suggest a forward-looking approach among freelancers, anticipating and preparing for future demands in the AI industry.

Challenges in Adapting to Rapid Technological Changes

Freelancers face significant challenges in adapting to the fast-paced evolution of AI technologies. Staying updated with new algorithms and managing

large data sets are common hurdles that require continuous learning and skill enhancement.

Supporting Quotes:

- "Adapting to rapid technological changes, meeting diverse client demands, and managing large datasets posed significant challenges." (Respondent 2, Algeria)
- "Challenges include adapting to rapidly evolving technology, addressing diverse client needs, managing complex datasets, and integrating varied AI tools seamlessly." (Respondent 3, Nigeria)

The challenges identified by the freelancers, such as keeping pace with rapid technological advancements and managing large data sets, are well-documented in AI literature. The fast-evolving nature of AI technologies requires practitioners to continuously update their skills and knowledge, a challenge highlighted in the literature on AI and machine learning (Goodfellow et al., 2016). Moreover, the issues of data privacy and integration of AI into existing systems are also prominent concerns in the field (Gunning & Aha, 2019).

Skills and Competencies Required to Thrive as an AI Freelancer

Technical Proficiency Enhances Service Quality

The technical skills of freelancers, such as proficiency in Python, TensorFlow, and data analysis, are crucial for delivering high-quality and unique AI services. These skills enable them to implement cutting-edge algorithms and provide customized solutions that meet specific client needs.

Supporting Quotes:

- "My technical expertise ensures tailored and innovative solutions, enhancing the quality and uniqueness of each service I provide." (Respondent 2, Algeria)
- "My technical proficiency ensures custom and cutting-edge solutions, elevating the quality and uniqueness of each AI service I provide." (Respondent 3, Nigeria)

Effective Client Communication

Freelancers leverage their technical skills to simplify complex AI concepts for clients, ensuring clear communication and mutual understanding of project goals. This effective communication is key to aligning technical aspects with client needs and ensuring project success.

Supporting Quotes:

- "I articulate complex AI concepts clearly, align technical aspects with client needs, and ensure mutual understanding of project goals." (Respondent 2, Algeria)
- "I use my technical acumen to explain complex AI strategies, align technical functionalities with clients' unique requirements, and develop clear implementation plans." (Respondent 4, Nigeria)

The ability of freelancers to simplify complex AI concepts ensures that clients can grasp the potential and limitations of AI solutions. This is particularly important in AI projects, where a gap often exists between technical capabilities and client understanding (Amershi et al., 2019). The emphasis on clear communication and alignment with client needs is consistent with best practices in project management and client relations, which advocate for transparency and effective communication as keys to project success (Project Management Institute [PMI], 2017).

Continuous Skill Development Is Essential

To stay competitive, freelancers must engage in continuous learning and skill enhancement. This includes pursuing specialized training and courses, participating in online forums, and staying updated with the latest advancements in AI.

Supporting Quotes:

- "I engage actively with academic research, industry discourse, attend conferences, and participate in online AI communities to stay at the forefront of AI innovations." (Respondent 2, Algeria)
- "I stay abreast of the latest AI advancements through continuous engagement with academic research, industry events, attending workshops, and active participation in online AI communities." (Respondent 3, Nigeria)

This approach is supported by literature emphasizing the importance of lifelong learning in rapidly evolving fields like AI (Schmidt & Cohen, 2013). The proactive efforts of respondents in pursuing certifications and industry engagements ensure they remain updated with the latest advancements and best practices in AI.

Innovative Client Solutions

Freelancers use their expertise to create innovative AI solutions that go beyond client expectations. Their ability to customize AI models and provide bespoke services ensures they deliver high-caliber outcomes that stand out in the market.

Supporting Quotes:

- "Leveraging my technical prowess, I've successfully developed adaptable Forex trading bots, streamlined chatbot automations for seamless customer support, and fine-tuned ChatGPT models for engaging conversational experiences." (Respondent 4, Nigeria)
- "Utilizing my technical prowess, I've successfully developed intuitive websites, user-friendly chatbots, robust AI algorithms, sophisticated deep learning models, seamlessly integrated Midjourney API functionalities, and harnessed AI for image generation, meeting and exceeding client expectations." (Respondent 5, Morocco)

Importance of Ethical AI Practices

As the demand for AI services grows, ethical considerations and responsible AI practices are becoming increasingly important. Freelancers who prioritize these aspects in their work are likely to gain a competitive edge and build trust with their clients.

Supporting Quotes:

- "Anticipating the future trajectory of AI-related gigs unveils a demand surge for specialized expertise in burgeoning fields like federated learning, explainable AI, reinforcement learning, and ethical AI practices." (Respondent 2, Algeria)
- "Looking ahead, the future of AI-related gigs will likely demand expertise in emerging technologies like explainable AI and responsible AI. Skills related to ethical considerations and AI governance will become increasingly important." (Respondent 6, Egypt)

Collaborative Client Engagements

Effective client engagement involves active listening, collaboration, and transparency. Freelancers who engage clients throughout the project, ensuring their needs, are met and their expectations managed, are more likely to achieve successful outcomes and repeat business.

Supporting Quotes:

- "Active listening and collaboration: I'm all ears! I actively listen to client needs and work closely with them throughout the project." (Respondent 11, Ghana)
- "Transparency and clear communication: No hidden fees or confusing terms. I keep clients informed every step of the way." (Respondent 11, Ghana)

Gender, Racial, and Discriminatory Concerns in AI Freelancing

Gender Discrimination

Female freelancers often face significant challenges in the AI freelancing space, including biases from clients and difficulties in gaining equal recognition and opportunities.

Supporting Quotes:

- "Since they are coming up, I wouldn't say they have much to say because they're, most of them are trying to do a mindset shift." (Respondent 1, Ghana)
- "There was a particular client that messaged me… he started asking several naughty questions but I just used maturity because you know Fiverr it's not allowed for you to insult your client no matter what they do." (Respondent 6, Nigeria)

Racial Discrimination

Racial biases impact freelancers from African countries, as clients sometimes have preconceived notions about their capabilities and trustworthiness.

Supporting Quotes:

- "Despite the fact that you see that I'm making progress online or Fiverr, it doesn't mean other Nigerians don't question it. It's not actually that easy because there's a preconceived notion about Nigerians." (Respondent 4, Nigeria)
- "For example, this guy in the UK was telling me that he had never worked with a Nigerian before. He said, 'You lose lots of money because you are Nigerian.'" (Respondent 4, Nigeria)

Challenges for Female Freelancers

Female freelancers, especially in the AI field, encounter unique challenges such as balancing personal responsibilities with work, which can affect their ability to compete equally with male counterparts.

Supporting Quotes:

- "Most of them find it difficult, like some of them, must know, when she came she was a nursing mother, she's a nursing mother." (Respondent 1, Ghana)
- "Have you faced any challenges accessing clients because you're a woman? Yes, there was a particular client that messaged me… he just ordered my package without my permission." (Respondent 6, Nigeria)

Concerns About Earnings

Financial Instability

Freelancers often experience financial instability due to irregular income and the competitive nature of online platforms (Anwar & Graham, 2021). This uncertainty makes it difficult to rely solely on freelancing for a stable livelihood.

Supporting Quotes:

- "Despite making progress online or on Fiverr, other Nigerians question it because it's not easy due to preconceived notions and the instability of income." (Respondent 4, Nigeria)
- "The earnings from Fiverr are not always consistent. I think the highest amount I've made from a single gig is $150." (Respondent 3, Nigeria)

High Costs of Operations

The operational costs associated with freelancing, such as internet subscriptions, power supply issues, and the need for continuous skill development, eat into freelancers' earnings, reducing their net income.

Supporting Quotes:

- "Most of the time when I get my earnings, I use it to invest more into my business, like buying data, fueling my generator, and purchasing power banks to ensure I can work effectively." (Respondent 3, Nigeria)
- "Due to the power issue, I even had to buy a power bank to ensure I can keep working. This adds to my operational costs and affects my overall earnings." (Respondent 3, Nigeria)

Investment in Personal Development

Freelancers frequently reinvest their earnings into personal development and their business, which, while essential for growth, further strains their financial resources.

Supporting Quotes:

- "I engage in targeted training and courses within the AI domain to enhance my skills, but this requires significant investment." (Respondent 8, Morocco)
- "The money I make on Fiverr often goes back into buying food, data for internet access, and learning materials to improve my skills." (Respondent 3, Nigeria)

Implications

Implications to Practitioners/AI Freelancers

Skill Development and Training African freelancers should diversify their skill sets across various AI tools and frameworks to remain competitive. The prominence of tools like ChatGPT and Midjourney in different categories indicates that freelancers must be proficient in multiple

AI engines to cater to a broader market. Additionally, there is a need for advanced training programs focusing on high-demand AI technologies such as TensorFlow and PyTorch. This specialized training will enable freelancers to offer higher-value services and improve their competitiveness in the global market.

Market Positioning and Pricing Most AI gigs offered by African freelancers are priced at or below $100, highlighting the importance of competitive pricing. However, freelancers should also consider value-based pricing strategies to enhance their earnings while remaining accessible to clients. Specialization in niche areas of AI can help freelancers stand out in a crowded market. By focusing on less common AI engines or high-value services, freelancers can command higher prices and strengthen their market position.

Building Reputation With many new sellers entering the market, it is crucial for freelancers to focus on building their reputation to progress to higher seller levels on platforms like Fiverr. Consistent high-quality service delivery and active client engagement are key to achieving this. Additionally, addressing the gender disparity in the AI freelancing market is important. Encouraging more women to enter the field and supporting their professional growth can create a more balanced and inclusive market, ultimately benefiting the entire ecosystem.

Implications to Policymakers

Education and Training Programs Policymakers should invest in education and training programs that focus on in-demand AI skills. This investment will help equip the workforce with the necessary competencies to succeed in the global AI freelancing market. Additionally, specific initiatives aimed at increasing female participation in AI freelancing can help bridge the gender gap. Scholarships, mentorship programs, and training tailored for women can be particularly effective in achieving this goal.

Infrastructure and Ecosystem Development Improving digital infrastructure across African countries is essential to support the growth of AI freelancing. This includes ensuring reliable internet access, affordable computing resources, and access to the latest software and tools. Furthermore, creating a supportive ecosystem that includes access to

funding, co-working spaces, and networking opportunities can foster innovation and entrepreneurship in AI. Such an ecosystem will enable freelancers to thrive and contribute to the economic development of their regions.

Policy and Regulatory Frameworks Establishing clear regulatory frameworks that protect freelancers and their clients can enhance trust and stability in the market. These frameworks should ensure fair payment practices and protect intellectual property rights. Additionally, providing incentives for businesses to invest in AI development and freelance services can stimulate market growth. Tax breaks, grants, and subsidies for AI-related projects can attract more participants to the field, further strengthening the AI freelancing ecosystem.

Implications to Researchers

Expanding Research Focus There is a need for more research focusing on AI freelancing in developing economies, particularly in Africa. Understanding regional differences and challenges can provide a more comprehensive view of the global AI freelancing market. Longitudinal studies tracking the growth and development of AI freelancing over time can offer valuable insights into trends, challenges, and opportunities in the market, informing both policy and practice.

Interdisciplinary Collaboration Encouraging interdisciplinary collaboration between researchers in AI, economics, and social sciences can lead to a holistic understanding of the impact of AI on job creation and economic development. Additionally, more research is needed to understand the gender dynamics in AI freelancing. Studies exploring barriers to entry, success factors, and support mechanisms for female freelancers can provide valuable insights for creating a more inclusive market.

Practical Applications and Innovations Researchers should focus on practical applications of AI that can benefit freelancers, such as developing new AI tools, improving existing ones, and creating frameworks for better integration of AI in various industries. Investigating the sustainability and scalability of AI freelancing as a career option can help identify best practices and strategies for long-term success in the gig economy. This research will provide valuable guidance for freelancers, businesses, and policymakers, fostering a vibrant and sustainable AI freelancing ecosystem.

Conclusion

The analysis of AI freelancing on platforms like Fiverr reveals significant opportunities and challenges for African freelancers. The rise of AI and digital transformation has democratized access to global markets, enabling freelancers from developing regions, particularly Africa, to offer a diverse range of AI services. This study highlights the dominant role of AI tools such as ChatGPT, Midjourney, and TensorFlow, which African freelancers widely use. However, the findings also underscore the need for continuous skill development and specialization to remain competitive in a rapidly evolving market (Turkina, 2018; Zwettler et al., 2023).

For practitioners, the emphasis on skill diversification and advanced training is crucial. Freelancers must stay abreast of emerging technologies and adapt to market demands to enhance their service offerings and command higher prices. Building a strong reputation through consistent quality delivery and client engagement is essential for advancing to higher seller levels and achieving long-term success (Barley, 2016; Kalleberg, 2011). Moreover, addressing gender disparities by encouraging more women to enter and thrive in the AI freelancing space can lead to a more inclusive and balanced market (Aroles et al., 2019).

Policymakers play a vital role in fostering the growth of the AI freelancing ecosystem. Investment in education and targeted training programs, particularly for in-demand AI skills, will equip the workforce to compete globally. Improving digital infrastructure and creating a supportive ecosystem with access to funding, co-working spaces, and networking opportunities are critical for nurturing innovation and entrepreneurship (Wennekers et al., 2010; Isenberg, 2010). Establishing clear regulatory frameworks and providing incentives for AI development will enhance market stability and attract more participants to the field (Drucker, 2014).

Researchers have a pivotal role in expanding the knowledge base around AI freelancing, particularly in developing economies. More studies focusing on regional differences, gender dynamics, and the sustainability of AI freelancing careers are needed (Malanski et al., 2021). Interdisciplinary collaboration can provide a holistic understanding of AI's impact on job creation and economic development (Battisti, 2022; Hernández-Sánchez, 2019). Practical research applications, such as developing new AI tools and frameworks, will benefit freelancers and contribute to the industry's overall growth.

In conclusion, AI freelancing presents a transformative opportunity for job creation and economic development in Africa. By addressing the challenges and leveraging the opportunities identified in this study, freelancers, policymakers, and researchers can collaboratively build a robust and inclusive AI freelancing ecosystem. This ecosystem can significantly contribute to reducing unemployment, promoting gender equality, and fostering innovation across the continent, ultimately enhancing Africa's position in the global digital economy (Agrawal et al., 2015; Muhindi, 2019).

Limitations of the Study

The methodology used in this study, while comprehensive, has limitations that may impact the generalizability and accuracy of the findings.

Data Source Limitation The study relies heavily on data from Fiverr, which may not fully capture the entire spectrum of AI freelance work in Africa. Other platforms such as Upwork, Freelancer, and regional freelance marketplaces might have different distributions and trends that were not considered in this analysis. Consequently, the findings may not represent the broader landscape of AI freelancing across different platforms.

Manual Data Scraping The manual data scraping method, while meticulous, is prone to human error and may result in incomplete or biased data collection. The reliance on Fiverr's platform filters to categorize and collect relevant gig data may miss out on nuances and variations in gig descriptions and categories that automated tools might capture more consistently.

Geographic and Demographic Focus The focus on selected African countries with significant numbers of AI-related gigs might overlook smaller markets or emerging regions where AI freelancing is beginning to take root. Furthermore, the demographic variables such as gender, while considered, may not provide a comprehensive view of the diversity and inclusion within the AI freelancing community.

Temporal Scope The data collection period from November 2023 to April 2024 is relatively short and may not capture longer-term trends or seasonal variations in the AI freelancing market. This limited timeframe might affect the ability to generalize the findings to other periods or to understand the dynamics of the market over time.

Qualitative Data Collection The interviews conducted provide valuable insights but are limited by the sample size and the subjective nature of qualitative data. The purposive sampling method, while ensuring relevance, may introduce bias as the selected freelancers might not fully represent the broader population of AI freelancers in Africa.

Recommendations for Future Studies

Broaden Data Sources Future research should include data from multiple freelancing platforms to provide a more comprehensive view of the AI freelancing market. Comparing data across different platforms can help identify unique trends and commonalities, enhancing the robustness of the findings.

Automate Data Collection Utilizing automated data scraping tools can improve the accuracy and consistency of data collection. Automated methods can handle larger data sets and capture more nuanced details in gig descriptions and categories, reducing the risk of human error.

Expand Geographic and Demographic Scope Incorporating a wider range of countries and regions, including those with emerging AI markets, will provide a more holistic view of the AI freelancing landscape in Africa. Additionally, future studies should delve deeper into demographic factors such as age, education level, and socio-economic background to understand better the diversity and inclusion within the AI freelancing community.

Longitudinal Studies Conducting longitudinal studies over extended periods will help capture long-term trends and seasonal variations in the AI freelancing market. This approach can provide deeper insights into market dynamics, the impact of technological advancements, and the evolution of freelancer skills and services.

Increase Sample Size for Qualitative Research Expanding the sample size for qualitative interviews and employing random sampling methods can enhance the representativeness of the findings. Including diverse voices and experiences will provide richer insights into the opportunities and challenges faced by AI freelancers.

By addressing these limitations and recommendations, future research can build on the insights gained from this study, contributing to a more comprehensive and nuanced understanding of AI freelancing in Africa and beyond.

References

Agrawal, A., Horton, J., Lacetera, N., & Lyons, E. (2015). Digitization and the contract labor market: A research agenda. In A. Goldfarb, S. M. Greenstein & C. Tucker (Eds.) *Economic analysis of the digital economy*. University of Chicago Press (pp. 219–250).

Alvarez De La Vega, J. C. (2022). *Understanding the impacts of gig economy platforms on freelancers' work practices* (Doctoral dissertation, Northumbria University).

Amershi, S., Weld, D., Vorvoreanu, M., Fourney, A., Nushi, B., Collisson, P., … & Horvitz, E. (2019). Guidelines for human-AI interaction. *In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (pp. 1–13). https://doi.org/10.1145/3290605.3300233

Anwar, M. A., & Graham, M. (2021). Between a rock and a hard place: Freedom, flexibility, precarity and vulnerability in the gig economy in Africa. *Competition & Change*, *25*(2), 237–258.

Aroles, J., Mitev, N., & de Vaujany, F. X. (2019). Mapping themes in the study of new work practices. *New Technology, Work and Employment*, *34*(3), 285–299.

Barley, S. R. (2016). 60th anniversary essay: Ruminations on how we became a mystery house and how we might get out. *Administrative Science Quarterly*, *61*(1), 1–8.

Battisti, S., Agarwal, N., & Brem, A. (2022). Creating new tech entrepreneurs with digital platforms: Meta-organizations for shared value in data-driven retail ecosystems. *Technological Forecasting and Social Change*, 175, 121392.

Benz, M. (2009). Entrepreneurship as a non-profit-seeking activity. *International Entrepreneurship and Management Journal*, *5*, 23–44.

Blank, S. (2013). Why the lean start-up changes everything. *Harvard Business Review*, *91*(5), 63–72.

Boateng, R. (2020). *Research Made Easy* - 2nd ed. Kindle Independent Publishing (an Amazon Company). https://amzn.to/39gMMXh

Boateng, S. L., Penu, O. K., Budu, J., Boateng, R., Marfo, J. S., Anning-Dorson, T., & Broni, F. E. (2024). Mapping the research on artificial intelligence and entrepreneurship: A bibliometric review from Scopus database. *International Journal of E-Entrepreneurship and Innovation (IJEEI)*, *14*(1), 1–24. https://doi.org/10.4018/IJEEI.343790

Doshi-Velez, F., & Kim, B. (2017). Towards a rigorous science of interpretable machine learning. arXiv *preprint arXiv:1702.08608*. https://doi.org/10.48550/arXiv.1702.08608

Drucker, P., & Maciariello, J. (2014). *Innovation and entrepreneurship* (1st ed.). Routledge.

Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press.

Guillick, J., & West, S. (2012). Uncovering the common ground in qualitative inquiry: Combining quality improvement and phenomenology in clinical

nursing research. *International Journal of Health Care Quality Assurance*, *25*, 532–548. https://doi.org/10.1108/09526861211246485

Gunning, D., & Aha, D. W. (2019). DARPA's Explainable Artificial Intelligence (XAI) program. *AI Magazine*, *40*(2), 44–58. https://doi.org/10.1609/aimag.v40i2.2850

Hernández-Sánchez, B. R., Sánchez-García, J. C., & Mayens, A. W. (2019). Impact of entrepreneurial education programs on total entrepreneurial activity: The case of Spain. *Administrative Sciences*, *9*(1), 1–16. https://doi.org/10.3390/admsci9010025

Isenberg, D. J. (2010). How to start an entrepreneurial revolution. *Harvard Business Review*, *88*(6), 40–50.

Kairouz, P., McMahan, H. B., Avent, B., Bellet, A., Bennis, M., Bhagoji, A. N., … & Zhao, S. (2019). Advances and open problems in federated learning. *arXiv preprint arXiv:1912.04977*. https://doi.org/10.48550/arXiv.1912.04977

Kalleberg, A. L. (2011). *Good jobs, bad jobs: The rise of polarized and precarious employment systems in the United States, 1970s-2000s*. Russell Sage Foundation.

Kibler, E., Kautonen, T., & Fink, M. (2017). Regional social legitimacy of entrepreneurship: Implications for entrepreneurial intention and start-up behaviour. In *Entrepreneurship in a Regional Context* (pp. 57–77). Routledge.

Joensuu-Salo, S., Viljamaa, A., & Varamäki, E. (2021). Understanding business takeover intentions—The role of theory of planned behavior and entrepreneurship competence. *Administrative Sciences*, *11*(3), 1–17.

Kozlinska, I., Mets, T., & Rõigas, K. (2020). Measuring learning outcomes of entrepreneurship education using structural equation modeling. *Administrative Sciences*, *10*(3), 1–17.

Malanski, P. D., Dedieu, B., & Schiavi, S. (2021). Mapping the research domains on work in agriculture. A bibliometric review from Scopus database. *Journal of Rural Studies*, *81*, 305–314.

Marres, N., & Weltevrede, E. (2013). Scraping the social? Issues in live social research. *Journal of Cultural Economy*, *6*, 313–335.

Mastercard Foundation. (2021). The Mastercard Foundation strategy to promote and expand employment opportunities for young people in Africa. *In Young Africa Works*. https://mastercardfdn.org/wp-content/uploads/2021/06/Young-Africa-Works-Strategy.pdf

Mettler, A., & Williams, A. D. (2011). The rise of the micro-multinational: How freelancers and technology-savvy start-ups are driving growth, jobs and innovation. *Lisbon Council Policy Brief*, *5*(3), 1–28.

Moustakas, C. (1994). *Phenomenological research methods*. Sage.

Muhindi, A. B. (2019). *Towards decent work on online labour platforms: Implications of working conditions in online freelance work on the well-being of youths in Nairobi County* (Doctoral dissertation, University of Nairobi).

Muller, S., & Korsgaard, S. (2018). Resources and bridging: The role of spatial context in rural entrepreneurship. *Entrepreneurship & Regional Development*, *30*(1–2), 224–255.

Project Management Institute (PMI). (2017). *A guide to the project management body of knowledge (PMBOK guide)* (6th ed.). Project Management Institute.

Sarawagi, S. (2007). Information extraction. *Foundations and Trends in Databases*, *1*(3), 261–377.

Schmidt, E., & Cohen, J. (2013). *The new digital age: Reshaping the future of people, nations and business*. Alfred A. Knopf.

Shane, S. A. (2003). *A general theory of entrepreneurship: The individual-opportunity nexus*. Edward Elgar Publishing.

Sundararajan, A. (2017). *The sharing economy: The end of employment and the rise of crowd-based capitalism*. MIT Press.

Turkina, E. (2018). The importance of networking to entrepreneurship: Montreal's artificial intelligence cluster and its born-global firm element AI. *Journal of Small Business & Entrepreneurship*, *30*(1), 1–8.

Vetter, T. R. (2017). Descriptive statistics: reporting the answers to the 5 basic questions of who, what, why, when, where, and a sixth, so what?. *Anesthesia & Analgesia*, *125*(5), 1797–1802.

Wennekers, S., Van Stel, A., Carree, M., & Thurik, R. (2010). The relationship between entrepreneurship and economic development: Is it U-shaped?. *Foundations and Trends® in Entrepreneurship*, *6*(3), 167–237.

Zhao, B. (2017). Web scraping. In Schintler, L., & McNeely, C. (Eds.), *Encyclopedia of big data*. Springer. https://doi.org/10.1007/978-3-319-32001-4_483-1

Zhiyi, R., Nan, Z., & Zhiyan, S. (2024). Construction of a model for college students' innovation and entrepreneurship quality based on artificial intelligence technology. *Informatica*, 47(10), https://doi.org/10.31449/inf.v47i10.5174

Zwettler, C., Straub, C., & Spurk, D. (2023). Kicking off a gig work career: Unfolding a career learning cycle of gig workers. *Journal of Career Assessment*. Advance online publication. https://doi.org/10.1177/1069072 7231212188

Chapter 2

Global AI Index: Comparably to Europe and the Americas, How Are Africa and Asia, Shining and Why?

Pasty Asamoah, Daniel Zokpe, Esther Ama Amoh, and Richard Boateng

Introduction

The Artificial Intelligence (AI) literature has gained substantial scholarly attention recently (Kim, 2023; Möller, 2023; Salinas-Navarro et al., 2024). AI is defined as the science and engineering of creating machines capable of perceiving, recognizing, learning, reacting, and solving problems in ways that would be considered intelligent if performed by humans (Tahiru, 2021; Zhai et al., 2021). Research in AI and its applications has extended to various fields, including education (Dai, Liu, and Ping, 2023; Chiu, 2024), agriculture (Bannerjee et al., 2018; Akintuyi, 2024), engineering (Lu et al., 2024; Wankhede et al., 2024), health (Bekbolatova et al., 2024; Ueda et al., 2024), and government (Pandey, 2024; Valle-Cruz, García-Contreras, and Gil-Garcia, 2024). It is suggested that the AI revolution will transform businesses, governments, and society (Mostrous, White, and Cesareo, 2023), leading to increased global AI investments, innovations, and implementations.

DOI: 10.4324/9781003507314-2

For instance, global private investment in AI increased from $9.7 billion in 2022 to $18 billion in 2023. Additionally, China is drafting AI laws, and the United States raised its AI research and development budget by 13% in 2022 compared to the previous year (Mostrous, White, and Cesareo, 2023).

Although the AI literature suggests its potential to transform various sectors, the state of AI development worldwide is often misunderstood. The Global AI Index ranks countries based on their capacity for AI (Mostrous, White, and Cesareo, 2023). This index, the first of its kind, ranks 62 countries based on three pillars of analysis: investment, innovation, and implementation. It is underpinned by 111 indicators, collected from 28 different public and private data sources, and 62 governments, divided across seven sub-pillars: talent, infrastructure, operating environment, research, development, government strategy, and commercial. The 4th update of the Global AI Index, released in 2023, highlights which countries are currently leading the global AI race and why.

This chapter contributes to the Global AI Index project by focusing on the progress and advancements of AI in Africa and Asia. It aims to analyze the Global AI Index as published by Tortoise Media, discussing which African and Asian countries are performing well in AI and how they compare with Europe and the Americas. The remaining sections of the chapter are organized as follows: an overview of the Global AI Index, methodology, data analysis, and a summary of key findings and conclusions.

Overview of the Global AI Index

The Global AI Index ranks countries based on their capacity for AI (Mostrous, White, and Cesareo, 2023). Currently, the index includes 62 countries across six continents: Africa (Egypt, Kenya, Morocco, Nigeria, South Africa, and Tunisia), Asia (Bahrain, China, Hong Kong, India, Indonesia, Israel, Japan, Malaysia, Pakistan, Qatar, Saudi Arabia, Singapore, South Korea, Sri Lanka, Taiwan, Turkey, UAE, and Vietnam), Australia (Australia and New Zealand), Europe (Armenia, Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, and the United Kingdom),

North America (Canada, Mexico, and the United States), and South America (Argentina, Brazil, Chile, Colombia, and Uruguay).

The Global AI Index consists of three main constructs: implementation, innovation, and investment.

Implementation is conceptualized as the operationalization of AI by practitioners, government, and communities. It includes three sub-pillars:

- **Talent:** Refers to practitioners' ability to deploy, manage, and implement AI technologies. It defines the level of capacity offered by a nation's human capital.
- **Infrastructure:** Refers to access to basic electricity, internet, computing capabilities, and databases required for the sustained operationalization of AI solutions and increased adoption.
- **Operating Environment:** Encompasses the political, social, legislative, economic, cultural, and natural environmental factors that significantly influence the implementation of AI technologies.

Innovation is conceptualized as technological and methodological breakthroughs indicative of greater capacity for AI in the future. It includes two sub-pillars:

- **Research:** Associated with the generation and propagation of new ideas in AI, measured by the number of papers, citations, impact according to the Computer Science H-Index, conference attendance, and contributions to IEEE journals.
- **Development:** Focuses on collaboration on open-source AI projects, ISO AI committee status, and indicators describing the level of patentable innovation.

Investment is conceptualized as the financial and procedural commitments of a nation to AI. It includes two sub-pillars:

- **Commercial Ventures:** Analyzes the industrial environment surrounding AI in a country, including the number, scale, and funding of businesses such as AI startups.
- **Government Strategy:** Focuses on digital transformation, innovation, and AI, assessing government plans through AI spending and targets.

The 2023 Global AI Index report shows that the United States is the leading country in AI implementation, innovation, and investment, followed by China,

Singapore, the United Kingdom, Canada, South Korea, Israel, and **Germany**. Insights from the report indicate that both the United States and China have maintained their ranks since 2020. Singapore has risen significantly, moving from tenth to sixth place in 2021 and then to third place in 2023.

This chapter compares the performance of Africa and Asia against other continents included in the Global AI Index. It investigates the trends, opportunities, and challenges in the AI landscape for these regions.

Methodology

The data for this study was sourced from the Tortoise Media website (see: The Global AI Index—tortoisemedia.com) and organized using ChatGPT. Initially, the data was copied from the Tortoise Media website and pasted into Microsoft Excel. The data was presented in a single column, necessitating data transformation. After removing null values, the data was transferred to ChatGPT with the prompt:

> Arrange the following data under eleven columns in a tabular form. The columns are: Country, Overall, Talent, Infrastructure, Operating Environment, Research, Development, Government Strategy, Commercial, Scale, Intensity. For each row, include one more column and label it Continent. Based on the Country, populate the continent name.

The transformed data was then copied and pasted into Microsoft Excel for further processing. Microsoft Power BI software was used for the data analysis. The study employed basic statistics to perform a comparative analysis of the Global AI Index. The AI implementation index was derived by computing the average of the talent, infrastructure, and operating environment indices. Similarly, the AI innovation index was derived by computing the average of the research and development indices. Finally, the investment index was derived by computing the average of commercial ventures and government strategy indices.

It is important to note that the Global AI Index is normalized (Tortoise, 2023), where lower values (approaching one) signify higher performance. The data collected included 62 countries from 6 continents. The global average index of the sub-pillars stood at 31.5, indicating that investment in AI is still on the rise.

Data Analysis

The data analysis was performed and presented based on the three main pillars of the Global AI Index: implementation, innovation, and investment.

Implementation

AI implementation focuses on the availability of skilled practitioners for developing, deploying, and maintaining AI solutions (talent), access to reliable infrastructure for AI implementation (infrastructure), and regulatory and public opinions on AI (operating environment). Analysis of the data revealed that North America (index=22), Europe (index=26), and Asia (index=31) have advanced in the implementation of AI solutions more than other continents, signifying the availability of talent, sustained AI implementation infrastructure, and a conducive operating environment (see: Figure 2.1). Unfortunately, Africa ranked last in AI implementation with an index of 53. This indicates a lack of skilled AI practitioners and reliable basic AI implementation infrastructure, such as electricity, internet, and supercomputing capabilities.

Further analysis revealed that while AI implementation is ranked lowest in Africa, the continent (index=50.33) outperformed Australia (index=54) in terms of the operating environment (see: Figure 2.2). This suggests that despite the lack of skilled AI practitioners and infrastructure, Africa's existing regulatory frameworks and operating environment present opportunities for AI implementation. This further indicates that investment in AI infrastructure and education may improve Africa's AI implementation capabilities. At the regional level, the eight lowest-ranked countries in AI

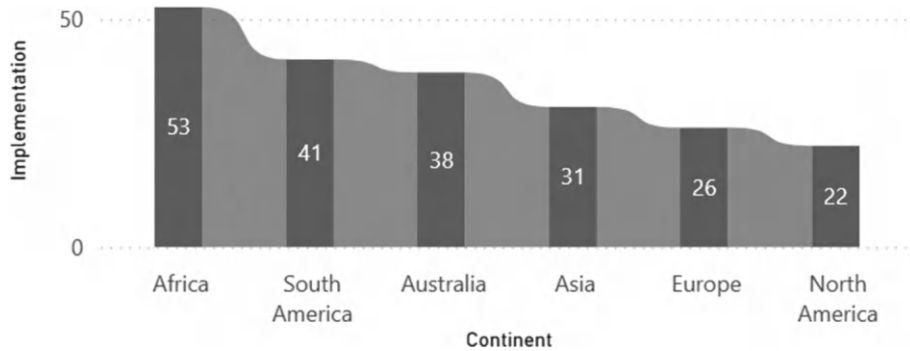


Figure 2.1 AI implementation index by continents.

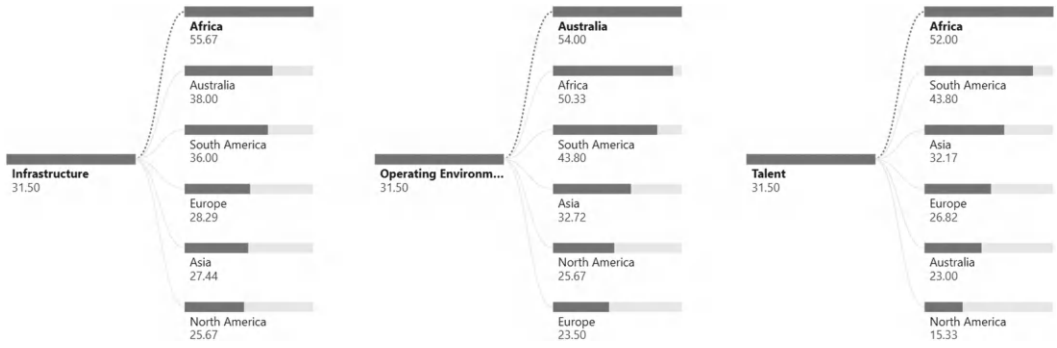


Figure 2.2 AI implementation index by continents based on infrastructure, operating environment, and talent.

implementation are Colombia (index=50), Tunisia (index=50.33), Egypt (index=51), Pakistan (index=51.67), Morocco (index=51), Nigeria (index=55.67), Sri Lanka (index=58), and Kenya (index=59.33).

Innovation

Innovation focuses on technological and methodological breakthroughs in AI solutions, encompassing research (e.g., numbers of publications and citations in credible academic journals) and the development of fundamental platforms and algorithms upon which innovative AI projects rely. The Global AI Index indicates that Australia (index=19), North America (index=19), and Europe (index=25) are the leading continents in AI innovation, suggesting their significant contributions to scholarly research, and the development of platforms and algorithms for sustained AI solutions (see: Figure 2.3).

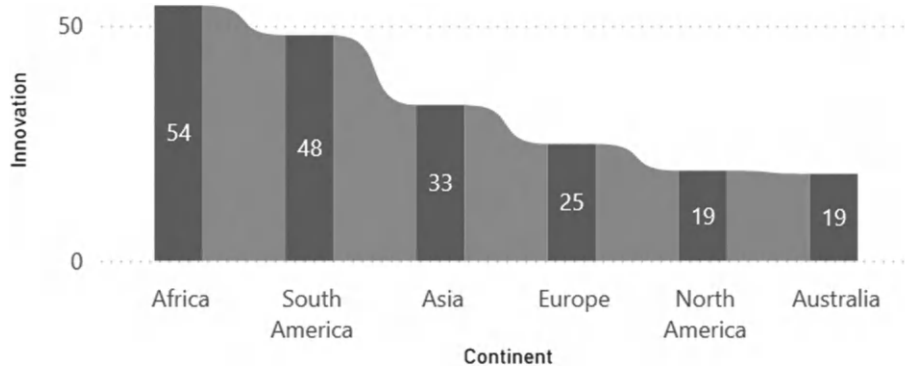


Figure 2.3 AI innovation index by continents.

Figure 2.4 AI innovation index by continents based on research and innovation.

Africa ranks the lowest in AI innovation (index=54), both in research (index=51.83) and development (index=56.83) (see: Figure 2.4). This suggests that Africa's contribution to AI research, platforms, and algorithms is minimal. The poor performance in AI innovation in Africa is likely due to the lack of skilled AI practitioners and reliable basic AI implementation infrastructure, such as electricity, internet, and supercomputing capabilities.

While Asia ranks third (index=31) in AI implementation, it ranks fourth (index=33) in innovation, in both the research (index=32.56) and development (index=33.72) sub-pillars. This may imply that Asia prioritizes AI implementation over scholarly publications.

At the regional level, the eight lowest-ranked countries in AI innovation are Tunisia (index=50), Egypt (index=51), Colombia (index=51), Pakistan (index=53), Nigeria (index=56), Morocco (index=57), Kenya (index=61), and Sri Lanka (index=62).

Investment

Investment focuses on the financial and procedural commitments of a nation to AI development, including the level of startup activity, investment, business initiatives based on AI, and the depth of commitment from national governments to AI developments. Analysis of the data showed that North America (index=20), Europe (index=27), and Australia (index=29) are

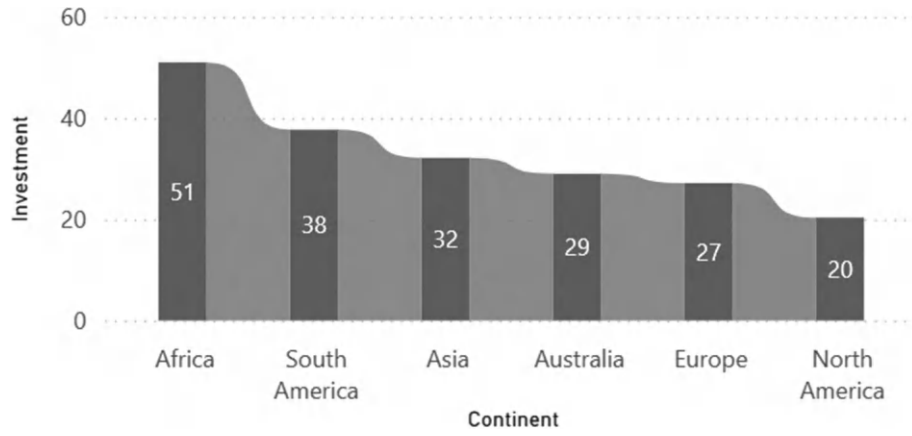


Figure 2.5 AI investment index by continents.

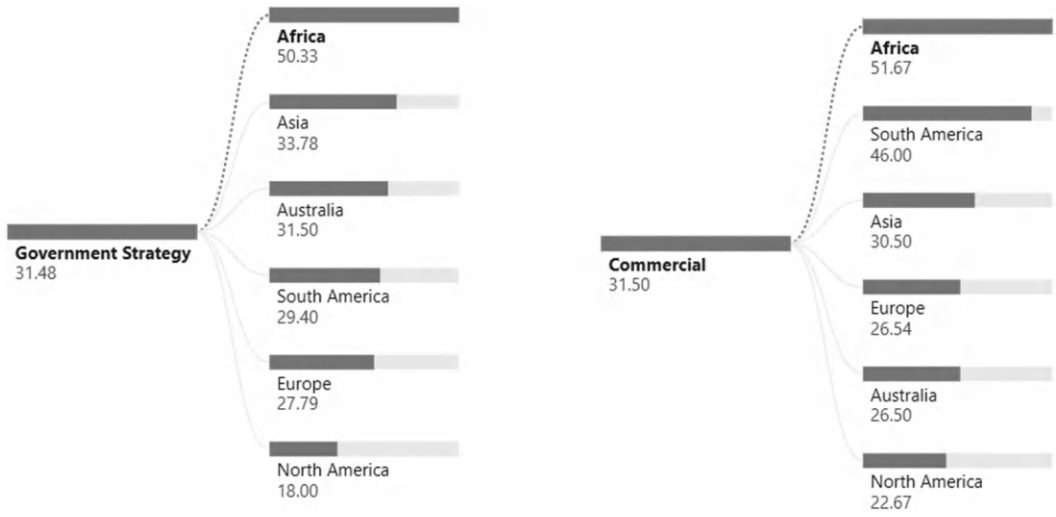


Figure 2.6 AI investment index by continents based on government strategy and commercial.

the leading continents in AI startup activities, investments, business initiatives, and government commitment to AI developments (see Figure 2.5).

Africa is ranked the lowest in AI investments (index=51), both in the government strategy (index=50.33) and commercial sub-pillars (index=51.67) (see Figure 2.6). This suggests low government commitment to AI development and limited funding opportunities for AI startup activities.

At the regional level, the eight lowest-ranked countries in AI investment are Colombia (index=34), Egypt (index=38), Kenya (index=52), Sri Lanka (index=56), Morocco (index=56), Pakistan (index=57), Nigeria (index=57), and Tunisia (index=60).

Summary of Key Findings

The study compares the performance of Africa and Asia and investigates the opportunities and challenges in the AI landscape for these regions. The global AI development race is dominated by North America (United States and Canada), Europe (United Kingdom, Germany, and Switzerland), and Australia. The analysis revealed that Egypt, South Africa, Tunisia, and Morocco are the top-performing African countries in the global AI race. Generally, Africa is ranked the lowest in AI implementation, innovation, and investment. This implies a lack of skilled AI practitioners and reliable basic AI implementation infrastructure such as electricity, internet, and supercomputing capabilities. Additionally, Africa's contribution to AI research, platforms, and algorithms is minimal. Moreover, there is low government commitment to AI development and limited funding opportunities for AI startup activities in Africa. Despite these challenges, the existing regulatory frameworks and operating environment in Africa present opportunities for the implementation of AI solutions. Investment in AI infrastructure, education, and government commitment to AI development could improve Africa's AI implementation capabilities and innovation.

In the case of Asia, China, Singapore, South Korea, Israel, Japan, and India are leading the AI race. Countries in Asia have demonstrated significant performance in AI implementation, innovation, and investments over the years. Although Asia has performed well across the three pillars of the Global AI Index, the findings indicate that Asia excels more in AI implementation than in innovation and investment. This suggests that Asia prioritizes AI implementation over publishing in scholarly journals. Specifically, in terms of implementation, Asia outperforms in infrastructure and operating environment but lags in talent. Finally, while there are relatively high levels of startup activities, investment, and business initiatives based on AI in Asia, the depth of commitment from national governments to AI and national strategies remains low.

Implications

Implications for Practice

African countries need to prioritize investment in AI infrastructure and talent development to improve their AI implementation capabilities. This includes enhancing access to reliable electricity, internet, and supercomputing capabilities, which are fundamental for the development and deployment of AI solutions. Practitioners should leverage the existing regulatory frameworks and conducive operating environments in Africa to implement AI solutions. This can help bridge the gap in AI implementation despite the current limitations in infrastructure and talent. Asian countries should continue to focus on AI implementation, leveraging their strong infrastructure and favorable operating environments. This will help maintain their competitive edge in AI while addressing the talent development gaps through targeted educational initiatives.

Implications for Policymakers

Policymakers in Africa should increase their commitment to AI development by creating policies that support AI research and development, providing funding opportunities for AI startups, and fostering public-private partnerships to drive AI innovation. There is a need for educational reforms to incorporate AI and related technologies into the curriculum at all levels of education. This will help build a pipeline of skilled AI practitioners in Africa, addressing the talent deficit that hinders AI implementation and innovation. Policymakers in Asia should develop comprehensive national AI strategies that include clear targets for AI research and development, talent cultivation, and government support for AI initiatives. This will ensure sustained growth and leadership in the global AI landscape.

Implications for Researchers

Researchers should focus on contextual AI research that addresses the specific challenges and opportunities within Africa and Asia. This includes developing AI solutions tailored to local needs and constraints, which can drive meaningful impact and adoption. There is a need for increased collaboration and knowledge sharing among researchers within and across continents. Establishing research networks and partnerships can help pool

resources, share best practices, and accelerate AI innovation globally. Researchers should engage in continuous monitoring and evaluation of AI implementation, innovation, and investment trends. This will provide valuable insights into the effectiveness of policies and practices, guiding future improvements and ensuring that AI developments align with societal needs and goals.

Conclusion

The study highlights the disparities in AI performance between Africa and Asia, with North America and Europe leading the global AI race. For Africa, addressing the gaps in infrastructure, talent, and government support is crucial for improving AI implementation and innovation. In Asia, despite strong performance in AI implementation, there is a need for greater emphasis on talent development and government commitment to sustain and enhance their position in the global AI landscape. Policymakers, practitioners, and researchers must collaborate to create an enabling environment for AI to thrive, ensuring that both regions can fully harness the transformative potential of AI.

Future Research Directions

Future research should focus on understanding the specific barriers and enablers of AI adoption in Africa and Asia. Studies could explore the socio-economic and cultural factors that influence AI implementation and innovation in these regions. There is also a need for research that examines the effectiveness of different policy interventions aimed at promoting AI development, including the impact of government incentives, regulatory frameworks, and public-private partnerships. Additionally, comparative studies between regions could provide insights into best practices and successful strategies for AI adoption. Another important area for future research is the development of AI solutions tailored to the unique challenges and opportunities within local contexts. This includes creating AI applications that address specific needs in sectors such as healthcare, agriculture, education, and governance. Finally, research should investigate the ethical implications of AI deployment in diverse socio-economic settings, ensuring that AI solutions are developed and implemented in a manner that is equitable, inclusive, and beneficial to all segments of society.

References

Akintuyi, O. B. (2024) 'AI in agriculture: A comparative review of developments in the USA and Africa', *Research Journal of Science and Engineering*, 2024(02), pp. 60–070. doi: 10.53022/oarjst.2024.10.2.0051

Bannerjee, G. et al. (2018) 'Artificial intelligence in agriculture: A literature survey', *International Journal of Scientific Research in computer Science applications and Management Studies*, 7(3). Available at: https://www.researchgate.net/profile/Gouravmoy-Banerjee/publication/326057794_Artificial_Intelligence_in_Agriculture_A_Literature_Survey/links/5b35ab970f7e9b0df5d83ec6/Artificial-Intelligence-in-Agriculture-A-Literature-Survey.pdf (Accessed: 7 July 2024).

Bekbolatova, M. et al. (2024) 'Transformative potential of AI in healthcare: Definitions, applications, and navigating the ethical landscape and public perspectives', *Healthcare (Switzerland)*, 12(2). doi: 10.3390/healthcare12020125

Chiu, T. K. F. (2024) 'Future research recommendations for transforming higher education with generative AI', *Computers and Education: Artificial Intelligence*, 6(December 2023), p. 100197. doi: 10.1016/j.caeai.2023.100197

Dai, Y., Liu, A. and Ping, C. (2023) 'ScienceDirect Reconceptualizing ChatGPT and generative AI as a student-driven innovation in higher education', *ScienceDirect Procedia*, 00, pp. 1–7. Available at: https://osf.io/nwqju/download

Kim, P. W. (2023) 'A framework to overcome the dark side of generative Artificial Intelligence (GAI) like ChatGPT in social media and education', *IEEE Transactions on Computational Social Systems*, pp. 1–9. doi: 10.1109/TCSS.2023.3315237

Lu, Q. et al. (2024) 'Responsible AI pattern catalogue: A collection of best practices for AI governance and engineering', *ACM Computing Surveys*, 56(7). doi: 10.1145/3626234

Möller, D. P. F. (2023) 'Machine Learning and Deep Learning', *Advances in Information Security*, 103, pp. 347–384. doi: 10.1007/978-3-031-26845-8_8

Mostrous, A., White, J. and Cesareo, S. (2023) *The Global Artificial Intelligence Index*. Available at: https://www.tortoisemedia.com/2023/06/28/the-global-artificial-intelligence-index/ (Accessed: 5 July 2024).

Pandey, J. K. (2024) 'Unlocking the power and future potential of generative AI in government transformation', *Transforming Government: People, Process and Policy*. doi: 10.1108/TG-01-2024-0006

Salinas-Navarro, D. E. et al. (2024) 'Using generative artificial intelligence tools to explain and enhance experiential learning for authentic assessment', *Education Sciences*, 14(1). doi: 10.3390/educsci14010083

Tahiru, F. (2021) 'AI in education: A systematic literature review', *Journal of Cases on Information Technology*, 23(1), pp. 1–20. doi: 10.4018/JCIT.2021010101

Tortoise (2023) 'The global AI index methodology report'. Available at: https://www.tortoisemedia.com/wp-content/uploads/sites/3/2023/06/AI-Methodology-2306.pdf

Ueda, D. et al. (2024) 'Fairness of artificial intelligence in healthcare: Review and recommendations', *Japanese Journal of Radiology*, 42(1), pp. 3–15. doi: 10.1007/s11604-023-01474-3

Valle-Cruz, D., García-Contreras, R. and Gil-Garcia, J. R. (2024) 'Exploring the negative impacts of artificial intelligence in government: The dark side of intelligent algorithms and cognitive machines', *International Review of Administrative Sciences*, 90(2), pp. 353–368. doi: 10.1177/00208523231187051

Wankhede, V. A. et al. (2024) 'Artificial intelligence an enabler for sustainable engineering decision-making in uncertain environment: A review and future propositions', *Journal of Global Operations and Strategic Sourcing*, 17(2), pp. 384–401. doi: 10.1108/JGOSS-06-2022-0057

Zhai, X., Chu, X., Chai, C. S., Jong, M. S. Y., Istenic, A., Spector, M., … & Li, Y. (2021). A review of artificial intelligence (AI) in education from 2010 to 2020. *Complexity*, 2021(1), 1–18.

Chapter 3

Thriving in the AI Freelancing Sphere: Insights and Strategies for Success in India and Asia

Swapnil Shivram Vyavahare, Richard Boateng,
Frederick Edem Broni Junior, and Acheampong Owusu

Introduction

Freelancing involves providing services to clients on a project or contract basis, rather than through full-time employment. This model extends to the field of artificial intelligence (AI), where AI freelancers engage in tasks such as data analysis, algorithm creation, machine learning (ML) model development, and projects in computer vision (CV) or natural language processing (NLP) (Malinsky, 2023). AI freelancers can collaborate with startups, multinational corporations (MNCs), or research institutions in domains like robotics, automation, or predictive analytics (Hagiwara, 2020). This flexibility allows AI freelancers to select projects aligning with their skills and background while keeping up-to-date in this continuously evolving field. Consequently, AI freelancing has become popular as organizations seek to leverage AI technologies without hiring full-time employees.

AI freelancing is gaining popularity in India and Asia due to the dynamic evolution of the gig economy, a promising tech landscape, and an entrepreneurial spirit. Businesses across various sectors seek AI solutions to enhance productivity, efficiency, and innovation, driving digital transformation. India, in particular, has emerged as a global hub for tech talent.

 DOI: 10.4324/9781003507314-3

Significant investments in AI research are also occurring in countries like China, Singapore, and South Korea, increasing the demand for AI freelancers. This trend is further supported by the rise of online platforms that connect AI freelancers with global clients. Thus, AI freelancing is an attractive career option, offering flexibility, cost-effectiveness, and diverse opportunities despite market competition and project variability challenges.

This chapter reflects on an interview with the first author on the challenge of being an AI freelancer in India (and Asia) and the skills needed to thrive in this burgeoning sector.

Personal Reflection

Introduction to Myself and my Career in AI Freelancing

My journey into AI freelancing began after accumulating valuable experience in both industry and academia. I gained insights into industrial processes and technological innovations during three years with a renowned automotive multinational. Subsequently, I spent four years in academia, culminating in a Ph.D. focused on AI and additive manufacturing (AM). This background equipped me with a comprehensive knowledge base and a desire to apply cutting-edge technologies. My industrial experience instilled a problem-solving approach, while my academic experience provided a strong foundation in AI technologies. This unique blend of industry and academic experience has been pivotal in my freelancing career, enabling me to develop innovative solutions for clients worldwide.

Initial Motivations and Aspirations

Witnessing the transformative potential of AM and AI during my industrial experience sparked a deep interest in exploring these techniques further. My Ph.D. research allowed me to delve into the intricacies of AI, fueling my passion for continuous learning and problem-solving. Freelancing offered the perfect platform to apply my skills across diverse domains, collaborate with various clients, and tackle unique challenges. I aspire to use my expertise to create impactful solutions, contribute to AI advancements, and establish myself as a reputed AI specialist. Additionally, freelancing allows me to balance my professional ambitions with personal goals.

The Current Landscape of AI Freelancing in India and Asia

Market Trends

Global startups and MNCs are investing heavily in AI technologies to gain a competitive advantage, increasing the demand for AI expertise (Nair, 2024). This demand spans conventional tech sectors and industries such as healthcare, finance, e-commerce, and manufacturing. The COVID-19 pandemic has further amplified the need for AI capabilities, making AI freelancing one of the top job categories on freelancing websites such as Upwork, Freelancer, Toptal, and Fiverr. The advantage of AI freelancing is its feasibility for remote work without a loss of efficiency. Therefore, AI freelancers must stay updated to remain competitive.

Opportunities

AI freelancers have vast opportunities across multiple sectors. In finance, experts are needed for fraud detection, risk management, and personalized financial services (Nepomuceno, 2023). In healthcare, AI can be used for predictive analytics, patient care, and medical imaging. E-commerce platforms employ AI for recommendation systems, customer service automation, and supply chain optimization. Government and educational institutions are also investing heavily in AI research.

Challenges

Despite numerous opportunities, AI freelancers face intense market competition, driving rates down and necessitating differentiation through unique skills (Nepomuceno, 2023). Another challenge is the inconsistency of work, leading to periods of high demand followed by dry spells. Limited opportunities for in-person networking make it crucial to build and maintain a robust professional network. AI freelancers must handle multiple roles, such as marketing, client management, and financial planning, which extend beyond their technical expertise. Additionally, navigating the legal and regulatory frameworks related to intellectual property and contract enforcement in different countries adds complexity. Overcoming these challenges requires resilience, continuous learning, and strategic planning for a sustainable AI freelancing career.

Essential Skills for AI Freelancers

Technical Skills

Proficiency in data analysis and visualization tools is essential for extracting insights and presenting data in an understandable manner. Expertise in programming languages such as Python, R, and Java is crucial for AI freelancers. Proficiency in machine learning and deep learning techniques, including model training, hyper-parameter tuning, and model deployment, is also necessary. Familiarity with popular frameworks like TensorFlow, PyTorch, Keras, and Scikit-learn is important for building and fine-tuning models. Knowledge of NLP tasks like sentiment analysis, chatbots, and language translation services is vital. AI freelancers should stay updated on developments in reinforcement learning, generative adversarial networks, and edge AI.

Soft Skills

Effective communication is paramount for understanding client requirements, conveying complex concepts, and maintaining transparency in professional relationships. Strong problem-solving skills are crucial for addressing unique and challenging problems. Time management and project management skills help handle multiple projects, meet deadlines, and ensure quality work. Adaptability and resilience allow freelancers to navigate job fluctuations. Building and maintaining professional networks online and offline with clients is essential for maintaining trust. Finally, a continuous learning and self-improvement attitude ensures AI freelancers remain competitive.

Business Skills

Effective marketing skills are influential in promoting AI services and building a personal brand to attract potential clients. Networking through online platforms like LinkedIn and offline events helps establish professional connections. Financial skills, such as budgeting, setting competitive service rates, and handling taxes, are also important. Negotiation skills play a noteworthy role in securing fair contracts. Developing strong business intelligence enables AI freelancers to navigate the complexities of the freelancing market and maintain sustainable operations.

Building a Successful AI Freelancing Career

Starting Out

AI freelancers should develop a compelling portfolio showcasing a diverse range of projects highlighting their technical skills. This portfolio should include case studies, detailed project descriptions, and clear results or outcomes achieved. Certifications from platforms like Coursera, edX, Google, and IBM can enhance credibility and demonstrate continuous learning. Building a website and maintaining an active presence on social networks such as LinkedIn are also important. Clients can be obtained from freelancing platforms like Upwork or Freelancer.

Finding Clients

Freelancing platforms like Upwork, Toptal, and Freelancer provide immediate access to global markets. AI freelancers should create detailed profiles on these platforms, including client testimonials to attract future clients. Attending offline industry conferences can help build relationships and discover new prospects. Direct outreach with personalized proposals highlighting how one's skills can yield positive results is another effective way to find clients. Additionally, AI freelancers should remain active online through blogging, sharing insights on social media, and contributing to AI-related discussions. Offering free or low-cost webinars to showcase expertise and engage clients can also be beneficial. A combined approach of online platforms, networking, direct outreach, and content marketing is recommended.

Delivering Value

Building a strong reputation and long-term client relationships requires delivering exceptional value. AI freelancers should understand client requirements, ask the right questions, and listen carefully during consultations. Maintaining clear and transparent communication throughout the project lifecycle is essential. Setting realistic milestones and ensuring consistent quality of work are crucial. At the end of a project, a comprehensive report outlining actionable insights from AI implementation should be prepared. Being responsive even after project completion helps gain client trust.

Overcoming Challenges

Managing Uncertainty

Freelancing often involves variations in workload, income, and client management, which can be challenging for beginners. To manage these uncertainties, AI freelancers should save a portion of their peak period earnings as a buffer during dry spells. Diversifying income sources reduces the risk of sudden project cancellations. Effective client management and task prioritization can help manage multiple projects simultaneously without compromising quality. Developing a flexible mindset and remaining open to new opportunities and experiences are also important. Building a strong professional network can be beneficial during uncertain times.

Navigating Legal and Ethical Issues

AI freelancers must understand intellectual property laws to protect their work and avoid infringing on others' rights. Contracts should clearly specify ownership of codes, data, and developed models. Confidentiality agreements may be necessary to protect sensitive information. Ethical considerations should be kept in mind when developing and deploying AI solutions. AI freelancers should also be aware of varying data protection laws and AI governance standards across different countries in Asia. Seeking legal advice when necessary can help stay updated on legal standards.

Cultural and Regional Considerations

Asia's diverse and multifaceted culture necessitates understanding local business practices, communication styles, and cultural nuances to improve project outcomes. Building trust and establishing strong relationships are vital in many Asian countries before finalizing business deals. AI freelancers should be aware of regional holidays and preferred communication modes. Learning the client's language or hiring a translator can improve collaboration and tackle language barriers. Respecting local customs helps maintain fruitful client relationships.

Future Trends and the Way Forward

Emerging Technologies

AI freelancers should stay updated with advancements in AI to maintain a competitive edge (Ozdemir, 2024; Thomas, 2024). One notable advancement is edge AI, which processes data closer to the source rather than relying on centralized cloud computing, thus enhancing privacy and reducing latency. Revolutions in generative AI models like GPT-4 and beyond are transforming content creation and providing powerful tools for freelancers. Automation and robotics are expanding AI applications in manufacturing, logistics, and healthcare. The combination of AI and blockchain technology enhances transaction security. Quantum computing is another novel concept that can solve complex problems much faster than traditional techniques.

The Evolving Gig Economy

Digital platforms are becoming more sophisticated, offering improved tools for project management, skill showcasing, and client communication. Freelancers have ample opportunities to tap into the global market as remote work becomes normalized. This trend may lead to collaborations between freelancers and employees, resulting in hybrid work models. Additionally, the growth of the gig economy fosters an entrepreneurial mindset, encouraging freelancers to continually upgrade their expertise. Companies increasingly prefer flexible, on-demand talent to address technological challenges.

Continuous Learning

Continuous learning is essential for AI freelancers. This can be achieved through online courses, certifications, webinars, and workshops offered by experts. Participating in professional communities and conferences is also crucial. Other learning opportunities include hackathons and collaborations with peers. Staying informed about the latest research papers, case studies, and industry reports is important for keeping up with recent developments.

Implications

Implications for AI Freelancers

1. *Technical Skill Enhancement*: AI freelancers must continually update their technical skills to stay competitive. This includes proficiency in programming languages, data analysis tools, machine learning frameworks, and staying abreast of advancements in AI technologies like edge AI, generative AI, and quantum computing.
2. *Adaptability and Continuous Learning*: Freelancers need to adopt a proactive approach to learning through online courses, certifications, webinars, and participation in professional communities. Continuous learning will ensure they remain competitive and can tackle the latest challenges in the AI field.
3. *Building a Robust Portfolio*: Developing a compelling portfolio showcasing diverse projects, case studies, and outcomes is crucial for attracting clients. Including certifications and maintaining an active presence on professional networks can enhance credibility.
4. *Effective Client Management*: Clear communication, setting realistic milestones, and delivering consistent quality are essential for building strong client relationships. Freelancers should also be prepared to manage multiple roles, such as marketing, client management, and financial planning.
5. *Legal and Ethical Awareness*: Understanding intellectual property laws, data protection regulations, and ethical considerations in AI deployment is critical. Freelancers must ensure their contracts clearly define ownership and confidentiality to protect their work and their clients' interests.

Implications for Policymakers

1. *Investment in AI Infrastructure and Education*: Policymakers should focus on investing in AI infrastructure and education to build a skilled workforce capable of meeting the demands of the growing AI industry. This includes funding for AI research and development, as well as training programs to develop technical skills.
2. *Regulatory Frameworks*: Developing and implementing clear regulatory frameworks for AI, including data protection, intellectual property, and ethical guidelines, will help create a stable and secure environment for

AI development and deployment. This will also protect freelancers and their clients.
3. *Supporting the Gig Economy*: Policies that support the gig economy, such as providing access to healthcare, retirement benefits, and fair taxation for freelancers, can help create a more sustainable and attractive environment for AI freelancers.
4. *Promoting Innovation and Entrepreneurship*: Encouraging innovation and entrepreneurship through grants, incubators, and support for startups can stimulate the AI industry. Policymakers should also facilitate access to global markets for local AI freelancers.

Implications for Researchers

1. *Focus on Emerging Technologies*: Researchers should focus on exploring and developing emerging technologies like edge AI, generative AI, and quantum computing. This research will drive innovation and provide new tools and techniques for AI freelancers to use.
2. *Interdisciplinary Research*: Collaboration between different fields, such as AI, ethics, law, and business, can provide comprehensive solutions to the challenges faced by AI freelancers. Interdisciplinary research can also address the broader impacts of AI on society.
3. *Case Studies and Best Practices*: Conducting case studies on successful AI freelancing projects can provide valuable insights and best practices for other freelancers. This research can highlight effective strategies for project management, client communication, and overcoming challenges.
4. *AI in the Gig Economy*: Studying the role of AI in the gig economy can help understand the unique challenges and opportunities it presents. This research can inform policies and practices that support freelancers and promote sustainable growth in the AI industry.

Conclusion

In this chapter, we explored the opportunities and challenges faced by AI freelancers in Asia. We began by discussing the fundamentals of AI freelancing, followed by highlighting market trends that demonstrate the growing demand for AI freelancers across different sectors. We then dissected the essential skills for AI freelancers into technical, soft, and business skills. Successful strategies for AI freelancers were outlined, including portfolio development, client acquisition tactics, and delivering exceptional value.

Finally, we emphasized the importance of managing uncertainty, legal considerations, and cultural practices. Looking ahead, we highlighted the dominance of emerging AI technologies such as edge AI and quantum computing, coupled with the evolving gig economy. Therefore, as the global demand for AI expertise continues to grow, freelancers must equip themselves with cutting-edge technical skills, maintain adaptability through continuous learning, and develop effective client management strategies to navigate the competitive landscape successfully. Building a robust portfolio and staying informed about legal and ethical standards are also crucial for long-term success.

Policymakers play a vital role in creating a supportive environment for AI development by investing in infrastructure and education, establishing clear regulatory frameworks, and promoting innovation and entrepreneurship. By supporting the gig economy through fair taxation, access to benefits, and facilitating global market access, policymakers can help ensure that AI freelancers thrive and contribute significantly to the economy.

Researchers are instrumental in driving innovation by focusing on emerging technologies such as edge AI, generative AI, and quantum computing. Interdisciplinary research and case studies can provide valuable insights and best practices, helping to address the challenges faced by AI freelancers and inform supportive policies.

In essence, the collaboration between AI freelancers, policymakers, and researchers is essential to harness the full potential of AI. By working together, these stakeholders can foster an environment that encourages growth, innovation, and sustainable development in the AI industry. This approach will not only benefit individual freelancers but also contribute to the broader economic and social advancements in India, Asia, and beyond. Embracing a proactive approach to learning and professional development, alongside supportive policies and groundbreaking research, will ensure that AI freelancers can achieve professional fulfillment and drive meaningful advancements in the AI field.

References

Hagiwara, M. (2020). *My First Year as a Freelance AI Engineer*. https://Masatohagiwara.Net/202002-My-First-Year-as-a-Freelance-Ai-Engineer.Html

Malinsky, G. (2023, August 17). *4 In-demand Freelance A.I. Jobs—One Can Pay $100/hour: 'There's Incredible Demand for People Who Are Creative'*. https://Www.Cnbc.Com/2023/08/17/4-in-Demand-Freelance-Ai-Jobs-on-Fiverr.Html

Nair, P. (2024, March 26). *Freelancing from India - A Growing Opportunity*. https://Payglocal.in/Blog/Freelancer-India

Nepomuceno, E. (2023, April 17). *What Are Freelance Artificial Intelligence Jobs?* https://Freeup.Net/Blog/Freelance-Tips/What-Is-Freelance-Artificial-Intelligence-Jobs/

Ozdemir, G. S. (2024, February 5). *AI, Latest Trends and Future Prospects: What's the Way Forward?* https://Politicstoday.Org/Ai-Latest-Trends-and-Future-Prospects-Whats-the-Way-Forward/

Thomas, M. (2024, March 13). *The Future of AI: How Artificial Intelligence Will Change the World*. https://Builtin.Com/Artificial-Intelligence/Artificial-Intelligence-Future

Chapter 4

Navigating the French AI Landscape: A Journey from Freelance Beginnings to Corporate Opportunities

Edouard Sainflou, Richard Boateng, Jonathan Barnor, and Edward Entee

Introduction

The chapter focuses on the AI freelancing experience of the first author, Edouard Sainflou. Edouard is an AI Consultant, Writer, and Content Specialist with a proven track record in AI analysis for applications and video games, engaging article writing, and seamless translation services. Fluent in both French and English, Edouard provides in-depth analysis of AI-generated content, ensuring optimal user experiences and seamless integration. His diverse skills extend across various domains, allowing him to refine AI-generated content with precision and quality. He charges $35 per hour for translation services on Upwork and recently made $600 as an Expert Mobile Game AI editor, working for 20 hours.

Edouard's experience includes significant projects such as transcribing French audio for AI training with Speech Ocean, where he effectively managed tasks, met deadlines, and earned a five-star rating from the

DOI: 10.4324/9781003507314-4

company. His educational background from Université Paris Sorbonne (Paris IV), where he earned a Bachelor's degree in History and is currently pursuing a Master's degree in War History and International Relations, complements his professional capabilities. According to his Upwork profile, Edouard's clients consistently commend his reliability, attention to detail, and proactive communication. He is committed to elevating content strategies, enhancing AI applications, and creating impactful stories.

The co-authors of the chapter interviewed Edouard to gain insights into AI freelancing in France.

Developing Prominence in the AI Sector

Personal Journey and Freelance Opportunities

In 2016, Google released its Google Home intelligent assistant, sparking a craze reminiscent of sci-fi movies with AI at our fingertips. However, these intelligent assistants are the result of extensive training by thousands of entrepreneurs. My journey as an AI entrepreneur began in this context. My name is Edouard Sainflou, a French entrepreneur and corporate consultant in the AI sector, focusing primarily on translating AI works into French. In October 2022, I joined several companies seeking junior freelancers for their virtual assistant training programs. These tasks, though simple and repetitive, involved analyzing AI responses to various human requests, from locating a restaurant on a map to recommending a movie. Thus, my journey into the world of AI as a French entrepreneur began.

The AI sector in France is characterized by significant dynamism, with novel opportunities continuously emerging. Prominent multinational corporations such as Samsung, Microsoft, Meta, and Google have established their AI laboratories in France, thereby contributing to a vibrant entrepreneurial ecosystem. Since 2018, 590 small businesses have been established, bolstered by €1.5 billion in government funding. While the majority of French start-ups employ AI as a tool, only 20% are dedicated to AI creation, indicating substantial potential for entrepreneurs to specialize in this rapidly expanding field. Furthermore, according to a Statista report (2024), France's artificial intelligence market is projected to reach nearly 6.5 billion Euros by the end of 2025, reflecting a growth of almost 30% since 2023. The market is expected to sustain robust growth throughout the decade, surpassing 21 billion Euros by 2030.

Tools and Specialization

At the start of an AI entrepreneur's career, possibilities are limited due to the necessary knowledge to work with AI. I began my career on Upwork with some experience in virtual assistant training missions. Soon, I was contacted by Chinese companies seeking entrepreneurs to train and develop their virtual assistants. I collaborated with other French entrepreneurs on oral recording projects to provide AI with vocal material for language training. Later, I transcribed these recordings to create suitable training materials for AI. These tasks were repetitive but essential for understanding the sector.

A French AI entrepreneur faces the crucial choice of specialization to advance their career. Specializations can include translation, coding, editing, transcription, writing, proofreading, art, marketing, and many others. AI can be both the subject of work and a tool or colleague. Specializing is essential for obtaining better-paid positions. For instance, I obtained the European TOEFL IBT certification, which enabled me to specialize in translation and editing. AI assists in my work, from translation to proofreading and spelling correction, and PMTE (Post Machine Translation Editing) contracts involve correcting AI's work, thus training it further. Other specializations, like coding, also benefit from AI assistance in generating or correcting code.

Numerous AI tools, some developed by French entrepreneurs, aid in career development. For example, Jasper, promoted by Upwork, helps contractors with marketing. I use GPT APIs in PMTE contracts and Upwork Pro extension for brainstorming and repetitive tasks. Tools like Qonto, a financial management AI tool for entrepreneurs, assist in customer management. These tools lighten auxiliary work, allowing entrepreneurs to focus on customer contracts. As AI tools multiply, they become indispensable colleagues, supporting precise work and enabling long-term contracts, enhancing visibility and income.

Major AI Contracts and the Role of French Entrepreneurs

As my career advanced, I secured larger projects, mainly editing related to AI, lasting over six months with substantial remuneration. These contracts, by their duration and pay, enhance visibility and network opportunities, bringing together global entrepreneurs to perfect AI or work

alongside it as a colleague. Securing long-term contracts requires expertise and a deep understanding of AI. Learning on the job is crucial for continuous growth.

French AI entrepreneurship extends beyond freelancing and start-ups to a broader corporate environment. Companies seek AI consultants, often external contractors, offering significant remuneration and visibility. For instance, I interacted with a French entrepreneur working on AI in the military sector, a rapidly growing field. To remain independent, an entrepreneur must stay dynamic, actively seeking new customers and opportunities and avoiding dependency on a single company.

In precis, entrepreneurs in France have ample opportunities to develop AI-related businesses. The sector is evolving rapidly, supported by innovative tools that enhance entrepreneurial activities. For me, AI is both the subject of my work and a supportive colleague through various AI tools. However, entrepreneurship requires continuous learning to stay abreast of the growing AI sector. Each new opportunity demands new skills and knowledge.

Implications for Practitioners

1. **Leveraging AI Tools for Efficiency:** Practitioners can significantly enhance their productivity and efficiency by incorporating AI tools into their workflows. Tools like Jasper for marketing and GPT APIs for various tasks can streamline operations, allowing entrepreneurs to focus on more strategic aspects of their business.
2. **Specialization and Certification:** To stay competitive in the AI sector, practitioners should consider specializing in niche areas such as translation, coding, or editing. Obtaining relevant certifications, like the European TOEFL IBT, can further solidify their expertise and attract higher-paying clients.
3. **Adapting to Market Dynamics:** The AI field is rapidly evolving, with new opportunities and technologies emerging regularly. Practitioners need to stay informed about the latest trends and continuously adapt their skills to meet market demands. This proactive approach will help them seize new opportunities and remain relevant.
4. **Building a Diverse Client Base:** Relying on a single client can be risky. Practitioners should aim to diversify their client base to ensure

steady income and reduce dependency on any single source. Using platforms like Upwork to reach a global clientele can be beneficial.

5. **Utilizing AI for Business Management:** AI tools like Qonto can aid in managing financial and administrative tasks, allowing practitioners to focus on their core competencies. This can lead to better business management and growth.

Discussion and Conclusion

Edouard Sainflou's journey through the AI freelancing landscape in France exemplifies both the opportunities and challenges faced by micro-workers and freelancers in the AI sector. His experiences align with the findings of Tubaro and Casilli (2020), who highlight the significant yet often undervalued contributions of micro-workers in AI development. Like many micro-workers, Edouard began with repetitive tasks such as transcription and data labeling, essential for training AI systems. These tasks, while crucial, are typically low-paid and lack job security, reflecting the broader conditions of the micro-work sector.

The impact of AI on labor productivity, as explored by Damioli et al. (2021), underscores the dual nature of AI advancements. For freelancers like Edouard, AI presents both risks and opportunities. The automation of routine tasks may reduce demand for basic roles, but those who adapt and acquire new skills can access higher-paying, specialized opportunities. Edouard's progression from simple transcription tasks to more complex roles in translation and editing demonstrates how freelancers can navigate and thrive in this evolving landscape by continuously upgrading their skills and embracing AI tools.

Furthermore, Edwards' (2022) critique of the European AI Act highlights the need for robust regulatory frameworks to protect freelancers and micro-workers involved in AI. The current regulatory landscape often fails to address the complexities of AI systems and the rights of those who contribute to their development. Ensuring fair working conditions and recognizing the contributions of micro-workers are essential steps toward creating a more sustainable and ethical AI industry. For freelancers like Edouard, effective regulation would provide greater job security and acknowledgment of their critical role in the AI supply chain, ultimately fostering a more inclusive and fair AI ecosystem.

Future Research Directions for Researchers

1. **AI in Language Translation and Editing:** Further research is needed to explore the advancements in AI-driven language translation and editing. Understanding the nuances and limitations of current AI models can help in developing more sophisticated and accurate tools.
2. **Impact of AI Tools on Freelance Work:** Investigating the impact of AI tools on the productivity and job satisfaction of freelancers in the AI sector can provide insights into how these tools are reshaping the freelance landscape.
3. **AI Entrepreneurship Ecosystems:** Comparative studies of AI entrepreneurship ecosystems in different countries can reveal best practices and policies that support the growth of AI start-ups. Researchers can examine the role of government funding, corporate partnerships, and educational programs in fostering these ecosystems.
4. **Specialization and Career Development in AI:** Research can focus on the career trajectories of AI entrepreneurs who specialize in different niches. Understanding the factors that contribute to their success and the challenges they face can inform educational and training programs.
5. **Ethics and Fairness in AI Applications:** As AI tools become more integrated into business operations, it is crucial to study the ethical implications and ensure fairness in AI applications. Researchers should investigate how biases in AI models can be mitigated and develop frameworks for ethical AI usage.
6. **AI and Customer Relationship Management:** Exploring how AI tools can enhance customer relationship management (CRM) practices for freelancers and small businesses can provide valuable insights. This includes examining the effectiveness of AI in customer acquisition, retention, and satisfaction.
7. **Longitudinal Studies on AI Adoption:** Long-term studies on the adoption and impact of AI tools on businesses can shed light on the sustainability and long-term benefits of AI integration. Researchers can track the progress and outcomes of businesses that have adopted AI tools over several years.
8. **Optimization of Micro-Work Tasks:** Further research should investigate methods for automating repetitive tasks while maintaining human-in-the-loop systems to ensure quality and address complex scenarios. This can improve the efficiency and quality of micro-work tasks.

9. **Micro-Worker Motivation and Satisfaction:** Examining the psychological and economic drivers for micro-workers can identify strategies to enhance their working conditions and overall job satisfaction. Understanding these factors is crucial for improving the micro-work environment.
10. **Impact of Cultural and Linguistic Diversity:** Exploring the benefits and challenges of leveraging a diverse micro-worker base for AI training can lead to best practices for managing diversity in data annotation and training processes. Research should focus on how cultural and linguistic diversity among micro-workers affects AI training data sets and outcomes.
11. **AI's Role in Job Creation and Displacement:** Longitudinal studies tracking the net impact of AI on employment across different industries can reveal sectors where AI has created new job opportunities versus those where it has led to job losses. Understanding this dynamic is essential for anticipating and managing labor market changes.
12. **Skill Development and Training for AI Integration:** Investigating the types of training and education programs that best equip workers with the skills needed to thrive in an AI-driven economy is critical. Research should focus on identifying effective training programs and skill development initiatives for both technical and non-technical roles.
13. **Productivity Gains from AI Adoption:** Analyzing the factors that influence the extent of productivity improvements from AI adoption can provide insights into maximizing the benefits of AI. This includes examining company size, industry, and the nature of the tasks being automated.
14. **Effectiveness of Existing AI Regulations:** Evaluating the implementation and impact of current AI regulations can help identify gaps and areas for improvement in safeguarding worker rights and welfare. Research should focus on assessing the effectiveness of existing AI regulations in protecting the rights and interests of workers involved in AI development and deployment.
15. **Frameworks for Ethical AI Development:** Developing and proposing comprehensive regulatory frameworks that address ethical considerations, worker protections, and transparency in AI development processes is essential. Research should explore regulatory frameworks that ensure ethical AI development and fair treatment of workers throughout the AI lifecycle.

16. **Role of Labor Unions and Advocacy Groups:** Exploring the potential roles of labor unions and advocacy groups in shaping AI regulations, supporting workers, and advocating for fair labor practices in the AI industry can enhance protection and fairness. Research should examine how these entities can effectively contribute to the regulation and protection of AI workers.

References

Edwards, L. (2022). Regulating AI in Europe: Four problems and four solutions. *Ada Lovelace Institute*, 15. London, UK: Ada Lovelace Institute.

Damioli, G., Van Roy, V., & Vertesy, D. (2021). The impact of artificial intelligence on labor productivity. *Eurasian Business Review*, 11, 1–25.

Statista. (2024, April 17). Market size of AI in France from 2020-2030. https://www.statista.com/forecasts/1462147/ai-market-size-france

Tubaro, P., & Casilli, A. A. (2020, October). Portraits of micro-workers: The real people behind AI in France. 2nd Crowdworking Symposium 2020, Research program "Digital Future", Universities of Paderborn and Bielefeld, Oct 2020, Paderborn, Germany. ⟨hal-02960775⟩

Further Resources

Jasper (Formerly Jarvis) - #1 AI Writing Assistant. (2023). www.jarvis.ai. https://www.jasper.ai/

Intelligence artificielle en France: un écosystème d'excellence. (n.d.). Entreprises.gouv.fr. Retrieved June 13, 2024, from https://www.entreprises.gouv.fr/fr/numerique/enjeux/intelligence-artificielle-france-ecosysteme-excellence

Notre histoire • Qonto en quelques chiffres. (n.d.). Qonto. Retrieved June 13, 2024, from https://qonto.com/fr/about

Upwork Chat pro. (n.d.). Upwork Open Ai. Retrieved June 12, 2024, from https://www.upwork.com/apps/chatpro/details

Chapter 5

Unveiling Top-Rated Asian AI Freelancers on Upwork: Skills, Earnings, and Geographical Distribution

Richard Boateng, Sheena Lovia Boateng, Pranay Patodi, and Obed Kwame Adzaku Penu

Introduction

In recent years, freelance platforms like Upwork have revolutionized how AI professionals connect with global clients (Munoz et al., 2022; Winsor & Paik, 2024). This chapter delves into the profiles of top-rated and top-rated plus Asian AI freelancers on Upwork, comprehensively analyzing their skills, earnings, and market presence. The study aims to shed light on the diverse talents and contributions of AI freelancers from Asia, highlighting the leading countries and the specific AI services they offer.

By examining these freelancers' profiles, we aim to uncover insights into patterns and trends that define success in the AI freelance market, mainly focusing on the dominance of certain regions, gender disparities, and the types of AI skills in high demand. This analysis not only underscores the pivotal role of Asian freelancers in the global AI landscape but also provides insights into the opportunities and challenges they face in this dynamic and competitive field.

DOI: 10.4324/9781003507314-5

Methodology

To create a data set of top-rated and top-rated plus Asian AI freelancers on Upwork, specific criteria and a detailed search process were employed. The selection criteria required a minimum of 15 profiles for top-rated and top-rated plus categories, each earning at least $5,000 to ensure significant experience and credibility. The profiles had to be from Asia and include AI-related skills such as Machine Learning, Deep Learning, and Large Language Models (LLM) in their titles and skills. The earnings had to be primarily from AI-related jobs to maintain relevance. The search process involved using Upwork as the platform, setting filters for location (Asia), job success score (90% and above), minimum earnings ($5,000), and relevant skills.

Each profile was manually reviewed to confirm the rating, earnings threshold, relevance of skills and job history, and the source of earnings. The data collection included compiling profiles with key information (Billings, 1996) such as name, region, country, advertised services, rating, gender (if declared), year of joining Upwork, number of jobs completed, total AI earnings, AI skills, and a link to the Upwork profile. This methodology ensured a robust and scientifically collected data set of 30 profiles, providing valuable insights into the AI talent pool in Asia.

Data Description

The data set comprises information about ten top-rated and ten top-rated plus AI freelancers from Asia on Upwork. Each freelancer's profile is described by various variables: Name, Country, Type of AI Services Offered, Rating (top-rated or top-rated plus), Gender, Year of Joining Upwork, Number of Jobs Completed, Total AI Earnings to Date, and AI Skills. This analysis aims to extract insightful patterns and trends by examining each variable and their interrelationships.

Description of Variables

1. **Name:** The identifier of each freelancer.
2. **Country:** The country of residence of the freelancer.

3. **Type of AI Services Offered by Freelancer:** A description of the AI services provided by the freelancer.
4. **Rating:** Indicates whether the freelancer is Top-Rated or Top-Rated Plus.
5. **Gender:** The gender of the freelancer.
6. **Year of Joining Upwork:** The year when the freelancer joined the Upwork platform.
7. **Number of Jobs Completed:** Total number of jobs completed by the freelancer on Upwork.
8. **Total AI Earnings to Date:** The freelancer's total earnings from AI-related jobs.
9. **AI Skills of Freelancer:** A list of AI-related skills the freelancer possesses.

Descriptive Analysis by Country

The data set contains information on top AI freelancers from various Asian countries, highlighting the geographical distribution of AI talent on Upwork. As shown in Figure 5.1, the countries represented are as follows:

1. **India:**
   - India has the highest representation in the data set, with 15 freelancers. This dominance indicates that India is a significant hub for AI talent on Upwork, reflecting the country's growing emphasis on technology and digital skills. Indian freelancers offer a wide range of AI services, showcasing the depth and diversity of expertise available.
2. **Pakistan:**
   - Pakistan follows with six freelancers. This considerable presence indicates Pakistan's increasing involvement in the global AI market. Pakistani freelancers contribute notably to AI development, emphasizing their competitive skills in the industry.
3. **Thailand and Malaysia:**
   - Both Thailand and Malaysia have two freelancers each. These countries are emerging players in the AI domain, with professionals offering specialized services. The presence of freelancers from these countries highlights their potential growth in AI-related fields.

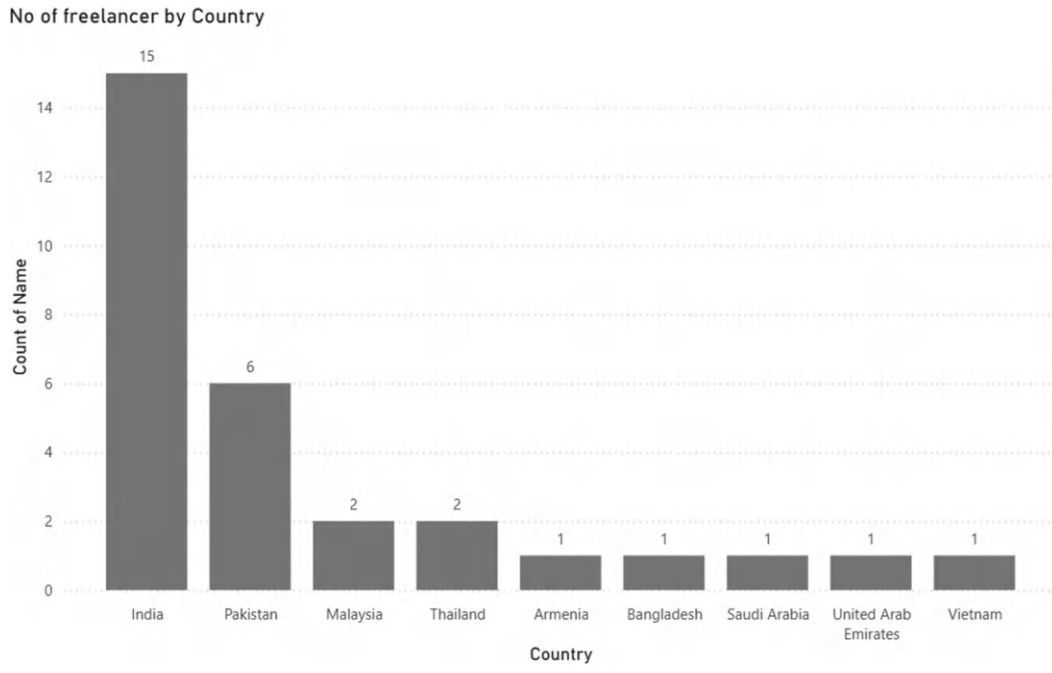


Figure 5.1 Distribution of Asian AI freelancers by country.

4. **Bangladesh, Saudi Arabia, Armenia, United Arab Emirates, and Vietnam:**
   - Each of these countries is represented by one freelancer. While their numbers are smaller, including these nations underscores the widespread distribution of AI talent across Asia. These freelancers bring unique skills and perspectives, contributing to the overall diversity of AI expertise on Upwork.

The data set reveals a concentration of AI freelancers from a few key countries, particularly India and Pakistan, which account for 21 of the 30 freelancers. This distribution reflects the prominence of these nations or South Asia in the AI freelancing landscape. Additionally, the presence of freelancers from various other Asian countries illustrates the broad reach of AI skills and the potential for growth in less-represented regions.

Descriptive Analysis by Types of AI Services Offered

The data set showcases various AI services offered by top-rated freelancers across Asia on Upwork. Each freelancer brings unique skills and specialties, contributing to a rich tapestry of AI expertise on the platform. The types of

AI services these freelancers provide cover a broad spectrum of AI and machine learning applications, including full-stack AI development, computer vision, natural language processing (NLP), and chatbot development.

Several freelancers specialize in Python development, highlighting the language's significance in AI. Expertise in generative AI and LLMs is also prevalent, with many freelancers offering services in these cutting-edge areas. Other notable specializations include deep learning, data science, AI-powered web and mobile app development, and AI solution architecture.

This variety in service offerings underscores the comprehensive capabilities of these freelancers, catering to a wide range of client needs from building AI software and developing custom models to integrating AI into existing systems and creating sophisticated AI-driven applications. This diversity reflects the evolving demands of the AI market and the multifaceted skill sets that these top freelancers possess, making them valuable assets for clients seeking advanced AI solutions.

Descriptive Analysis by Gender and Rating

By Gender

The data set shows a significant gender disparity among the top AI freelancers on Upwork from Asia, with a pronounced male dominance. Of the 30 freelancers, 29 are male, and only 1 is female. This stark difference highlights the gender gap in AI freelancing, suggesting that male professionals are far more represented in top-tier AI services on the platform.

By Rating

Freelancers in the data set are categorized into two ratings: top-rated and top-rated plus. Among the 30 freelancers, 17 are classified as top-rated plus, while the remaining 13 are top-rated. This distribution indicates a slight skew toward the top-rated plus category, suggesting a higher number of freelancers have achieved this premium status.

Comparison of Gender and Rating

When examining the intersection of gender and rating, the data reveals that the sole female freelancer in the data set holds a top-rated plus status, indicating exceptional performance and recognition. In contrast, the male

freelancers are distributed across both rating categories, with 13 identified as top-rated and 16 as top-rated plus. This comparison underscores two key insights: firstly, the male dominance in the field, and secondly, the high performance of the single female freelancer, who has managed to achieve the top-rated plus status despite the significant gender disparity. This may suggest that while fewer women are present in this domain, those who do engage tend to excel and achieve high ratings.

Descriptive Analysis by Year of Joining Upwork, Jobs Completed, and Earnings

Year of Joining Upwork

Freelancers on Upwork joined between 2010 and 2024, with an average joining year of 2020. Most freelancers joined recently, as indicated by the median joining year of 2021 and the third quartile of 2022. The distribution is relatively wide, showing that while some freelancers began their Upwork journey as early as 2010, others only joined as late as 2024.

Number of Jobs Completed

The number of jobs completed by freelancers ranges from 4 to 95, with an average of 33.33 jobs. The median number of jobs completed is 26.5, indicating that half of the freelancers completed fewer than 27 jobs. There is significant variability in this aspect, as shown by the standard deviation of 24.79 jobs, highlighting that some freelancers are much more active than others.

Total AI Earnings to Date

Earnings among freelancers range from $5,000 to $400,000, with an average of $88,900. The median earnings are $50,000, suggesting that half of the freelancers earned less than this. The high standard deviation of $102,395.56 underscores a significant disparity in earnings among freelancers, indicating that while some are making very high incomes, others are earning relatively modest amounts.

Comparative Analysis by Rating

Year of Joining Upwork: Top-Rated Plus freelancers typically joined Upwork more recently, with a higher concentration of joining years around 2021–2023. In contrast, Top-Rated freelancers have a wider

range of joining years, from as early as 2010 to as late as 2024. This suggests that Top-Rated Plus freelancers are likely newer to the platform but have quickly achieved a high rating.

Number of Jobs Completed: Top-Rated Plus freelancers generally complete more jobs, with several freelancers completing over 40 jobs. On the other hand, Top-Rated freelancers tend to have fewer completed jobs, although some outliers in this group have completed a high number of jobs. This indicates that Top-Rated Plus freelancers are more active and possibly more sought after for projects.

Total AI Earnings to Date: Top-Rated Plus freelancers typically have higher earnings, often exceeding $100,000. In comparison, Top-Rated freelancers show a broader range of earnings, with many earning below $50,000. This suggests that achieving a Top-Rated Plus status may correlate with access to higher-paying opportunities and clients. The highest earner among the Asian Upwork AI freelancers is Respondent 14 from India, with a top-rated Plus rating. This freelancer has completed 84 jobs since joining Upwork in June 2014 and has accumulated total AI earnings of $400,000. This substantial number of completed jobs and the high earnings demonstrate a consistent and highly successful engagement on the platform, highlighting the correlation between the Top-Rated Plus status, extensive job completion, and significant earnings.

Descriptive Analysis of AI Skills Of Freelancer

The word cloud in Figure 5.2 depicts various terms related to AI Skills. Words like "machine learning," "artificial intelligence," "deep learning," and "python" are prominently displayed, indicating their importance in this field. Other terms such as "TensorFlow," "PyTorch," "Scikit-learn," and "Django" are also visible, suggesting the software tools used in data science workflows.

The AI skills freelancers possess in this data set are diverse, reflecting the broad spectrum of services offered. Common skills include machine learning, NLP, computer vision, and deep learning. Specific technical proficiencies include Python, TensorFlow, Keras, and other programming languages and frameworks relevant to AI development (see Figure 5.3). This skill diversity indicates that freelancers can handle various AI-related tasks, catering to different client needs and project requirements.

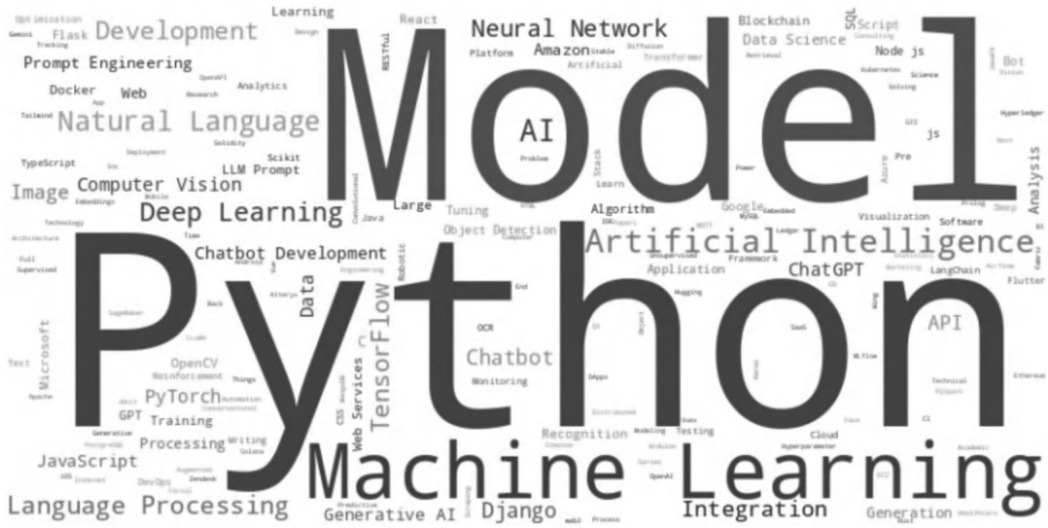


Figure 5.2 Word cloud of AI skills.

The top three earners among the Asian Upwork AI freelancers have notable AI skills and have completed a significant number of jobs, reflecting their expertise and high demand.

1. **Respondent 14** has the highest earnings, totaling $400,000. This freelancer has a diverse skill set, including artificial intelligence, API integration, and web development. They have completed 84 jobs, indicating high engagement and success on the platform.
2. **Respondent 15** has earned $300,000 and possesses Natural Language Processing, Machine Learning, and Deep Learning skills. This freelancer has completed 44 jobs, showcasing their capability and expertise in high-demand AI fields.
3. **Respondent 18** also has earnings of $300,000. Their skills include Artificial Neural Networks, Machine Learning, and Deep Learning. This freelancer has completed 67 jobs, highlighting their extensive experience and strong presence in the AI freelance market.

These top earners demonstrate a strong correlation between possessing advanced AI skills, completing numerous jobs, and achieving high earnings on Upwork. Their expertise in specialized areas such as machine learning, NLP, and neural networks significantly contributes to their success.

In precis, freelancers with a wide range of AI skills, particularly those with expertise in high-demand areas like machine learning and NLP, tend to

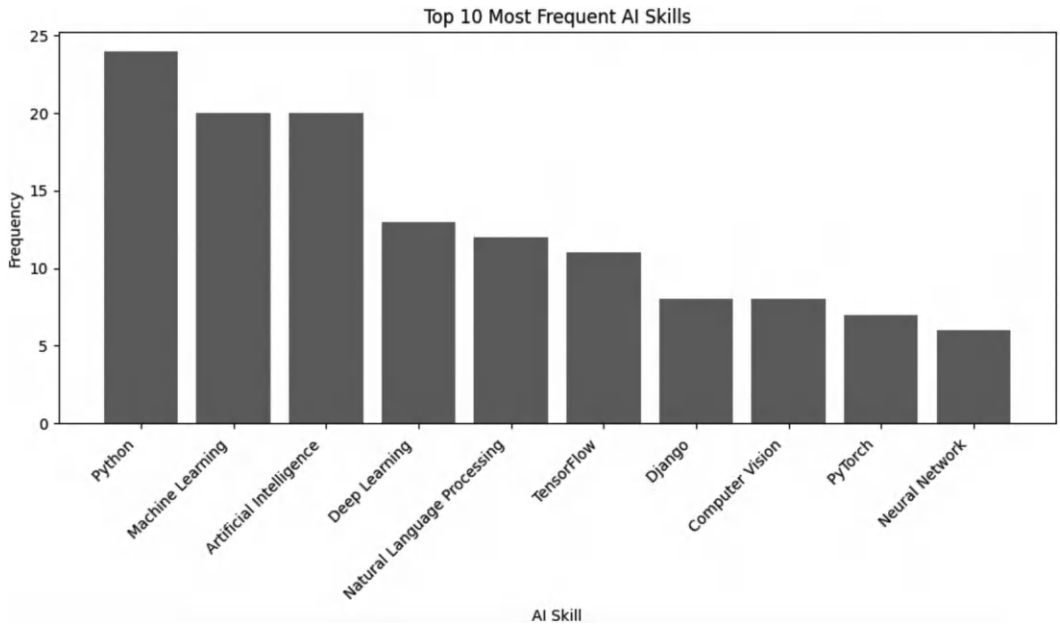


Figure 5.3 Most frequent AI skills.

have higher earnings and more completed jobs. The Top-Rated Plus freelancers, in particular, show a strong correlation between their rating, the number of jobs completed, and their total earnings. This suggests that a combination of diverse AI skills, high engagement, and a strong reputation significantly contributes to the success of freelancers on Upwork.

Spotlight on Indian Freelancers

Indian freelancers comprise a significant portion of the top-rated AI experts on Upwork. Their diverse skills, high levels of activity, and substantial earnings reflect the country's growing prominence in the global AI freelance market.

AI Skills

Indian freelancers showcase a broad range of AI skills, covering various aspects of artificial intelligence and related technologies. Commonly mentioned skills include:

- **Machine Learning:** Many Indian freelancers specialize in machine learning algorithms and applications, reflecting a deep understanding of predictive modeling and data-driven decision-making.

- **Natural Language Processing (NLP):** Skills in NLP indicate proficiency in developing chatbots, language models, and other applications that process human language.
- **Deep Learning:** Expertise in deep learning, including neural networks and related frameworks such as TensorFlow and Keras, is prevalent among Indian freelancers.
- **Programming Languages:** Proficiency in languages like Python, Java, and JavaScript is common, highlighting their ability to implement AI solutions effectively.
- **API Integration and Web Development:** Some freelancers also offer API integration and web development skills, providing end-to-end solutions that incorporate AI into broader systems.

Earnings and Jobs Completed

The combined total earnings of Indian freelancers on Upwork amount to $1,486,000. In terms of activity, these freelancers have collectively completed 583 jobs. This substantial level of earnings and job completion underscores the significant contribution and presence of Indian freelancers in the AI freelance market on Upwork. Their advanced skills and consistent engagement have enabled them to secure numerous projects and achieve notable financial success.

Comparison of Emerging Countries with India

Bangladesh

Freelancers from Bangladesh have combined total earnings of $20,000 and have completed 18 jobs. The skills offered typically include Python, AI, and computer vision. Compared to India, Bangladeshi freelancers have lower earnings and fewer completed jobs, indicating a smaller but growing presence in the AI freelance market.

Saudi Arabia

Saudi Arabian freelancers have earned $5,000 and have completed 7 jobs. Their skills focus on machine learning, deep learning, and NLP. The earnings and job completions are relatively modest, suggesting a nascent stage of AI freelancing compared to the more established Indian market.

Armenia

Armenian freelancers have a combined total earnings of $100,000 and have completed 4 jobs. They offer skills in AI development, data science, and neural networks. Despite fewer jobs, the high earnings indicate potentially higher-paying projects or specialized expertise in demand.

United Arab Emirates

Freelancers from the UAE have significantly higher combined total earnings of $300,000 and have completed 67 jobs. Their skills include machine learning, AI integrations, and automation. This performance is comparable to that of Indian freelancers, suggesting a strong and competitive presence in the AI freelance market.

Vietnam

Vietnamese freelancers have earned a total of $10,000 and completed 9 jobs. Their expertise lies in deep learning, AI solutions, and software development. Like Bangladesh and Saudi Arabia, the earnings and job completions are on the lower side, indicating an emerging market with growth potential.

Summary

Indian freelancers have a combined total earnings of $1,486,000 and have completed 583 jobs, showcasing their dominance in the AI freelance market. In comparison, freelancers from the UAE show a strong presence with high earnings and many jobs completed, indicating a competitive edge. Freelancers from Armenia, despite fewer jobs, also display high earnings, suggesting expertise in specialized, high-value projects. Meanwhile, freelancers from Bangladesh, Saudi Arabia, and Vietnam are in the early stages of establishing their presence, with lower earnings and fewer completed jobs but the potential for growth as they gain more experience and visibility in the market.

In precis, Indian freelancers are prominent players in the AI freelance market (Kathuria et al., 2017) on Upwork, showcasing advanced skills, high earnings, and extensive job completion rates. Their success story highlights

India's growing influence in the global AI industry, driven by a pool of highly skilled and dedicated professionals.

Conclusion

This chapter presents a detailed exploration of the top-rated and top-rated plus AI freelancers from Asia on Upwork, highlighting the significant impact of this talent pool on the global AI market. Indian freelancers dominate the scene, showcasing exceptional skills and achieving substantial earnings, underscoring India's growing prominence in AI. Other countries like Pakistan, Thailand, Malaysia, and the UAE also demonstrate noteworthy contributions, reflecting AI talent's broad distribution and diverse capabilities across Asia. The analysis reveals a pronounced gender disparity (Bandaranayake et al., 2020), with male freelancers predominantly occupying top positions, although the few female freelancers in the field achieve high recognition and performance. The findings emphasize the importance of specialized AI skills, high engagement levels, and strong reputations in securing success on freelance platforms. Overall, this chapter underscores the critical role of Asian AI freelancers in shaping the future of AI development and highlights the need for ongoing support and recognition of their contributions to the global tech industry.

Implications for AI Freelancers

For AI freelancers, the findings of this chapter underscore the importance of building a diverse and specialized skill set to remain competitive in the global market. The analysis shows that top-rated freelancers often possess expertise in high-demand areas such as machine learning, natural language processing, and deep learning. These skills and proficiency in programming languages like Python and frameworks like TensorFlow and PyTorch are critical for securing high-paying and frequent job opportunities. Additionally, the study highlights the value of achieving high ratings and maintaining a strong reputation on platforms like Upwork. Freelancers who actively engage with clients, complete many projects, and consistently deliver high-quality work tend to earn more and gain better visibility. Therefore, investing in continuous learning and professional development,

seeking client feedback, and leveraging successful project completions to build a robust profile are crucial strategies for AI freelancers aiming to excel in this competitive landscape.

Implications for Researchers

For researchers, this chapter offers valuable insights into the dynamics of the AI freelance market and the distribution of AI talent across Asia. The dominance of Indian freelancers and the significant contributions from other Asian countries provide a rich area for further study on the socio-economic factors driving this trend. The pronounced gender disparity among top-rated freelancers also calls for more research into the barriers and opportunities for women in the AI freelancing industry. Understanding the factors contributing to top-rated freelancers' success, such as specific skill sets, engagement strategies, and market demand, can inform the development of training programs and policies to support emerging AI professionals. Furthermore, the diverse range of AI services freelancers offer reflects the evolving demands of the AI market, providing a basis for examining how these trends influence the broader tech industry. Researchers can also explore the implications of these findings for AI education and workforce development, aiming to bridge skill gaps and foster inclusive growth in the global AI economy.

Limitations and What Future Research Can Add

While the study provides valuable insights into the profiles of top-rated and top-rated plus Asian AI freelancers on Upwork, several limitations should be considered. The data set comprises only 30 profiles, which may not fully represent the entire population of AI freelancers on Upwork. This limited sample size could skew the findings and may not capture the full diversity and range of experiences within the broader freelancer community.

The selection criteria focused on freelancers with a minimum earning threshold of $5,000 and a job success score of 90% or above. While this ensures that only experienced and credible freelancers are included, it may exclude emerging talents who have yet to reach these milestones but possess significant potential and skills. Additionally, the study targets Asian freelancers, providing a regional perspective that might not apply to AI freelancers from other parts of the world. The unique socio-economic and

cultural factors influencing the Asian freelancing market may limit the generalizability of the findings to other regions.

The study relies on gender information as declared by freelancers on their profiles, which may not always be accurate or comprehensive. This reliance on self-reported data could introduce bias and affect the accuracy of the gender analysis. Moreover, the data collection is based on profiles available at a specific point in time. The rapidly evolving nature of the AI and freelancing industries means that the findings might quickly become outdated as new trends and shifts occur. The analysis is confined to Upwork, a single freelancing platform. While Upwork is a major player, the insights might differ on other platforms like Freelancer, Toptal, or Fiverr, where different dynamics and user bases might influence the outcomes. Furthermore, the manual review process for confirming ratings, earnings, and skills introduces a degree of subjectivity, which might affect the consistency and objectivity of the data collected.

Lastly, the study primarily focuses on quantitative data, such as earnings, job completions, and skill sets. Qualitative aspects, such as personal experiences, client relationships, and freelancer challenges, are not explored, which could provide a deeper understanding of the freelancing landscape. Acknowledging these limitations is crucial for interpreting the results accurately and guiding future research to address these gaps and build a more comprehensive understanding of the AI freelancing market.

References

Bandaranayake, R., Iqbal, T., Galpaya, H., Senanayake, L., & Perampalam, S. (2020, April). Now we are Independent': Female online Freelancers in India and Sri Lanka. In K. Jones, C. Collins, M. Davies, M. Della Giust, & G. James. *Proceedings of the 3rd International Conference on Gender Research* (pp. 40–47). Reading, UK: University of Reading. DOI: 10.34190/IGR.20.121

Billings, J. R. (1996). Investigating the process of community profile compilation. *NT Research*, *1*(4), 270–283.

Kathuria, R., Kedia, M., Varma, G., Bagchi, K., & Khullar, S. (2017). Future of work in a digital era: The potential and challenges for online freelancing and microwork in India. *Indian Council For Research On International Economic Relations* Core 6-A, 4th Floor, India Habitat Centre, Lodi Road, New Delhi 110 003. https://icrier.org/pdf/Online_Freelancing%20_ICRIER.pdf

Munoz, I., Sawyer, S., & Dunn, M. (2022, June). New futures of work or continued marginalization? The rise of online freelance work and digital platforms. In *Proceedings of the 1st Annual Meeting of the Symposium on Human-Computer Interaction for Work* (pp. 1–7).

Winsor, J., & Paik, J. H. (2024). *Open Talent: Leveraging the global workforce to solve your biggest challenges*. Harvard Business Press.

Chapter 6

The Journey of a Female Developer from Front-end to Full-stack: The Role of Generative AI

Sessah Sadicka Gyanwah, John Serbe Marfo, Richard Boateng, and Jefferson Seyanya Seneadza

Introduction

Technology has significantly reshaped our world, influencing how we communicate, learn, and work (Wang et al., 2020). The rapid adoption of digital devices among young children is a testament to this transformation. Nearly one-in-five parents of a child younger than 12 say their child has their own smartphone (Auxier et al., 2020). This early exposure to technology fosters familiarity and comfort with digital tools from a young age. Similarly, there is an increasing prevalence of smartphone usage among children, noting its impact on cognitive and social development (Fischer-Grote et al., 2021).

This reflective case study explores the transformative journey of the first author, from early encounters with discarded technology to becoming a proficient developer.

Growing up, I (the first author) didn't have the privileges many children have today. I had to make do with old, discarded phones from my parents. Despite their issues, I managed to make them work and used them

 DOI: 10.4324/9781003507314-6

enthusiastically, fueling my growing passion for technology. In university, I found myself at a crossroads in my third year while studying business administration. Recalling my fondness for tinkering with phones, I chose to major in Business Information Technology, marking the start of my programming journey. During an internship at a company co-founded by my lecturer, I was introduced to web development.

Under the mentorship of an exceptional web developer, I quickly fell in love with front-end development, learning HTML, CSS, and working with Material Design Bootstrap templates.

Recognizing my potential, my lecturer provided numerous opportunities to develop my skills. I contributed to projects like inventory and hospital management systems and was eventually employed as an information systems developer specializing in front-end development. The integration of generative AI, particularly tools like ChatGPT, has been instrumental in my transition from a front-end developer to a full-stack developer. AI-assisted coding, debugging, and learning new technologies have accelerated my development process. This chapter aims to share how integrating generative AI has been pivotal in my journey from front-end to full-stack development, highlighting its transformative power in bridging knowledge gaps and facilitating continuous learning.

Early Days in Front-end Development

My first significant projects in front-end development were a hospital management system and an inventory management system. Alongside these, I built portfolio websites, a hibiscus drink ("sobolo") selling website for my business, and various landing pages. These projects helped me grasp the basics of HTML, CSS, and JavaScript. I learned about different classes and their corresponding CSS properties, allowing me to understand how they worked together. However, I faced challenges, particularly with complex CSS and JavaScript. Despite understanding the functions, I struggled to memorize JavaScript syntax. I focused on mastering what I could and relied on programming communities and tutorial websites like Stack Overflow and W3Schools for the more challenging aspects.

Later in my front-end journey, I was introduced to generative AI tools like ChatGPT and Bard, now known as Gemini. I preferred ChatGPT for tackling front-end challenges because, unlike Stack Overflow, which had unpredictable response times, ChatGPT provided real-time feedback.

However, due to my limited domain knowledge as a beginner, I sometimes found myself spending long hours with ChatGPT, getting similar solutions that didn't solve my problems because I didn't know how to query it effectively or fully comprehend the problem I was facing. Despite these challenges, I found that ChatGPT could generate code and explain solutions, helping me understand why the code worked. This made it an invaluable resource, supplementing the guidance I received from senior developers and programming communities.

Generative AI in Front-end Development

Generative AI, particularly in software development, has revolutionized coding, debugging, and learning new technologies by providing real-time assistance and significantly enhancing productivity and efficiency (Peng et al., 2023). Adopting generative AI tools like ChatGPT and Gemini in front-end development marked a significant shift in my workflow. Initially, I used these AI tools primarily for coding assistance. The ability to generate code snippets and receive real-time feedback was revolutionary. Tasks such as layout design and debugging became significantly more efficient. The initial benefits were clear: increased productivity and reduced coding time. Projects that previously took hours to complete were now finished in minutes. This was a game-changer, especially when working under tight deadlines, as I could deliver results much faster without compromising quality. The following figures illustrate the impact of generative AI tools in my software development. I recall how transformative these tools were in my development process. For instance, I often used them to generate code snippets and receive immediate feedback, significantly enhancing my coding efficiency and productivity (see Figure 6.1). Additionally, they were invaluable in projects like creating a medical interface, where the AI provided crucial assistance in generating and integrating front-end code (see Figure 6.2).

However, integrating AI tools into my existing workflows was not without challenges. One of the main issues I faced was the difference in coding styles. I had developed a specific way of writing code, and the AI often generated solutions that, while correct, were structured differently from my usual approach. This discrepancy often left me torn between using the AI-generated code as-is, adapting it to fit my style, or modifying my code to align with the AI's logic. This challenge persists, as the logical approach

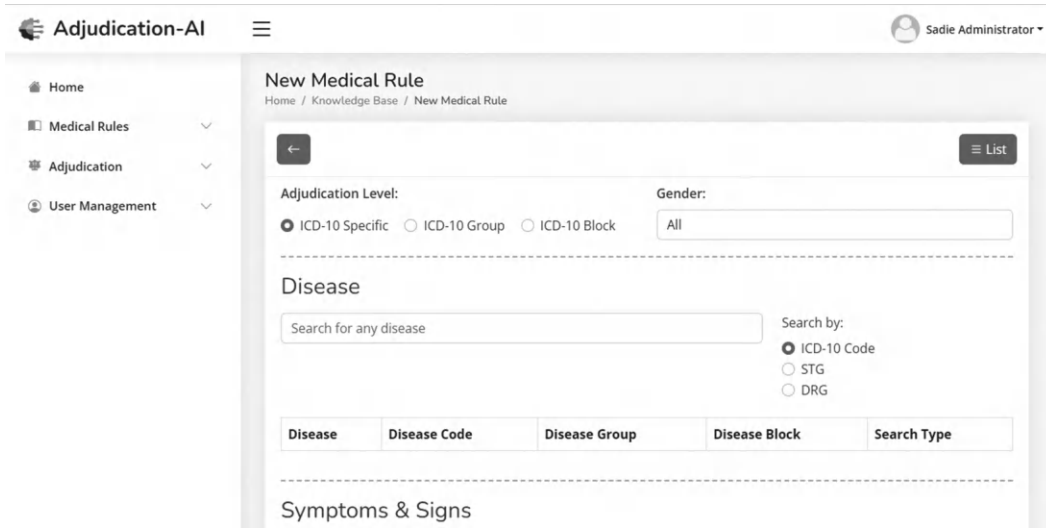


Figure 6.1 User Interface (UI) of code snippet assisted by generative AI.

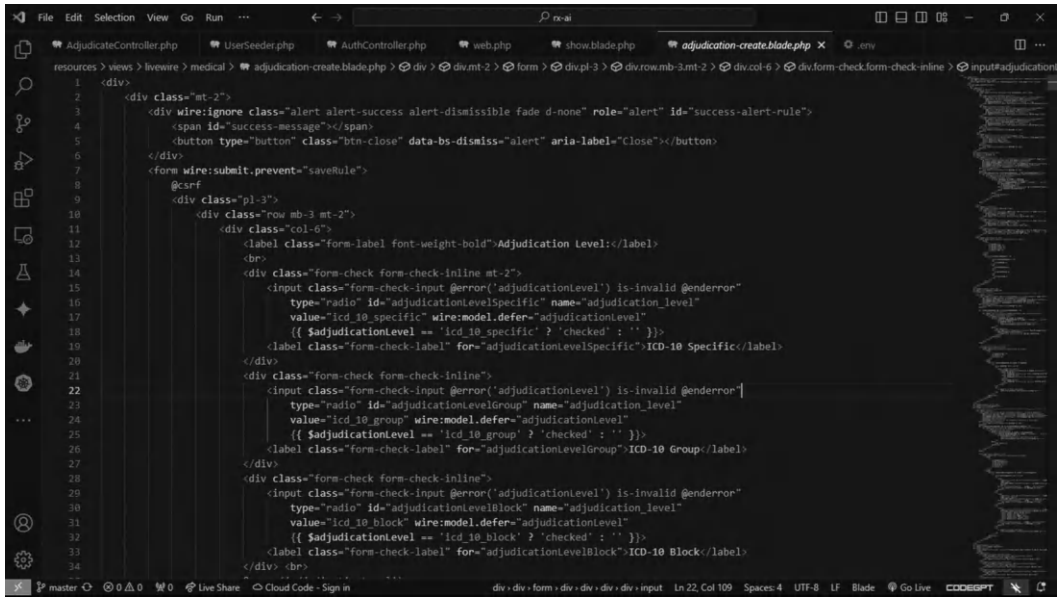


Figure 6.2 Code snippet of a front-end assisted by generative AI—Creation of a medical interface.

may be the same, but the execution varies. To overcome this, I adopted a strategy of balancing the AI's suggestions with my coding style. I would take the AI's code and adjust it to suit my established patterns or tweak my approach to incorporate the AI's more efficient methods.

Despite these challenges, the productivity gains from using AI tools are undeniable. AI has enabled me to focus less on rote coding tasks and more on problem-solving and innovation. Instead of spending hours figuring out solutions, I can now quickly get the answers I need and understand why they work. This has allowed me to handle more complex problems and deliver solutions faster, enhancing my overall efficiency and effectiveness as a developer. AI continues to play a crucial role in my development journey, providing both immediate solutions and long-term learning opportunities.

Motivation to Transition to Full-stack Development

While working as a front-end developer, a pressing need arose for additional backend support due to tight project deadlines. The project I was involved in required extra backend development, prompting me to learn this new skill. With no one to turn to, I relied on ChatGPT for coding assistance, marking the start of my backend journey. Eventually, I was assigned a full-stack project to handle independently, developing an AI system for adjudicating health insurance claims using expert systems and machine learning models. I created a knowledge base incorporating the Ghana Standard Treatment Guidelines and, with ChatGPT's help, successfully completed the system. Using Python, I developed the expert system to adjudicate claims based on predefined rules. This project, also my Master's thesis, remains my primary full-stack project.

Additionally, I use basic CSS and HTML for a Moodle project, with ChatGPT as an invaluable resource. The constant encouragement from my lecturer has significantly contributed to my growth. Inspired by market demand, peer success stories, and industry trends, I realized the limitations of being a front-end-only developer. This transition has broadened my skill set, enabling me to tackle complex projects more effectively.

Exploring Backend Development with Generative AI

Transitioning to full-stack development began with familiarizing myself with server-side languages. Starting with PHP and later Laravel, I relied heavily on ChatGPT for code assistance and explanations, which simplified the learning process. When I needed to expand my skills further, particularly for the health insurance claims adjudication system, I began using Python.

ChatGPT was instrumental in providing code snippets and solutions, making the transition smoother.

Understanding databases was another critical aspect of this journey. My MSc education introduced me to SQL and NoSQL databases, but my practical work primarily involved MySQL. ChatGPT helped me navigate MySQL complexities by generating detailed tutorials and sample queries. This support enhanced my ability to write efficient queries and manage data effectively, solidifying my database management skills.

My initial backend projects were developed with substantial AI support. Projects like the knowledge base for the adjudication system highlighted the practical benefits of AI. ChatGPT provided real-time feedback and precise code snippets, accelerating the development process (see Figure 6.3). These projects reinforced my backend skills and demonstrated how AI integration could streamline complex tasks.

However, integrating AI tools into my workflow presented challenges. Often, I spent long hours with ChatGPT, receiving similar solutions that didn't fully resolve my issues due to my inability to articulate problems accurately. Over time, I learned to ask better questions and refine my queries, improving the AI's effectiveness. This experience underscored the

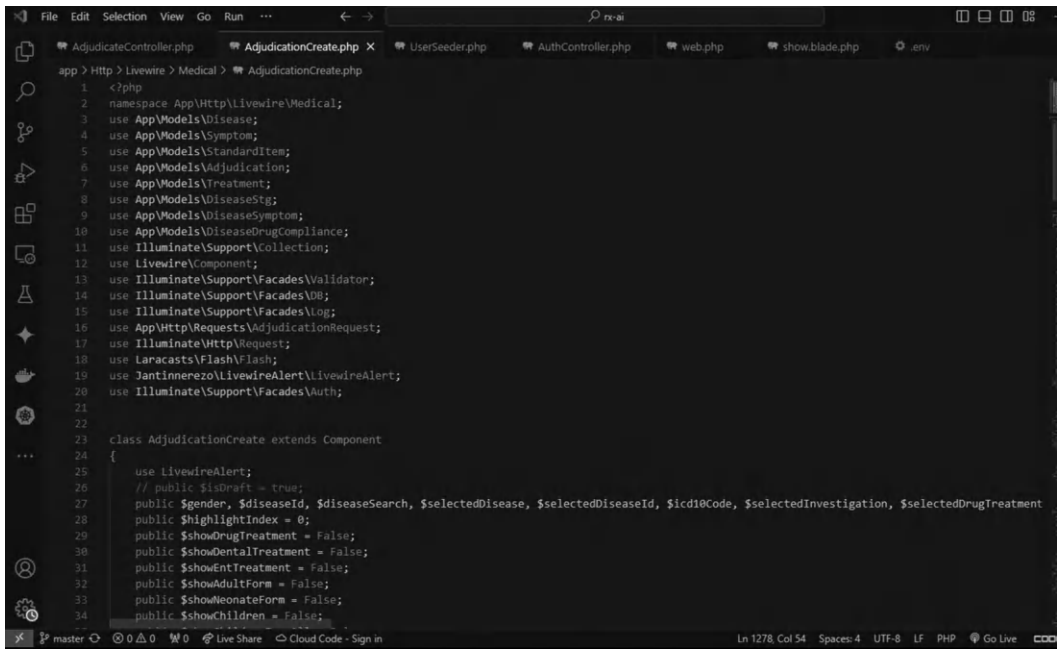


Figure 6.3 Code snippet assisted by generative AI—sample code for backend of creation of a rule.

importance of clear problem comprehension and effective communication. Despite the challenges, AI tools significantly boosted my productivity and learning, enabling me to tackle complex projects with greater efficiency.

Bridging the Gap: Integrating Front-end and Backend Skills

Integrating my front-end and backend skills allowed me to develop comprehensive full-stack applications. By combining my knowledge in both areas, I was able to build complete applications that seamlessly integrated user interfaces with server-side functionality. AI-guided learning played a crucial role in this transition, especially in understanding RESTful APIs and microservices, which are essential for modern web development. Tools like ChatGPT provided guidance on best practices and generated sample code that helped me grasp these concepts quickly.

One significant project developed with AI assistance was an AI system for adjudicating health insurance claims. This project involved creating a knowledge base with standard treatment guidelines and an expert system using Python to adjudicate claims based on these rules. Working on this project taught me valuable lessons in integrating AI tools for coding and debugging, significantly improving my efficiency and understanding of complex concepts. I remember how generative AI assisted me in such complex tasks; for instance, I integrated Python API codes into a Laravel framework, a process that was significantly streamlined by AI assistance (see Figure 6.4).

Figure 6.4 Code snippet assisted by generative AI—sample code integrating the python API codes into laravel.

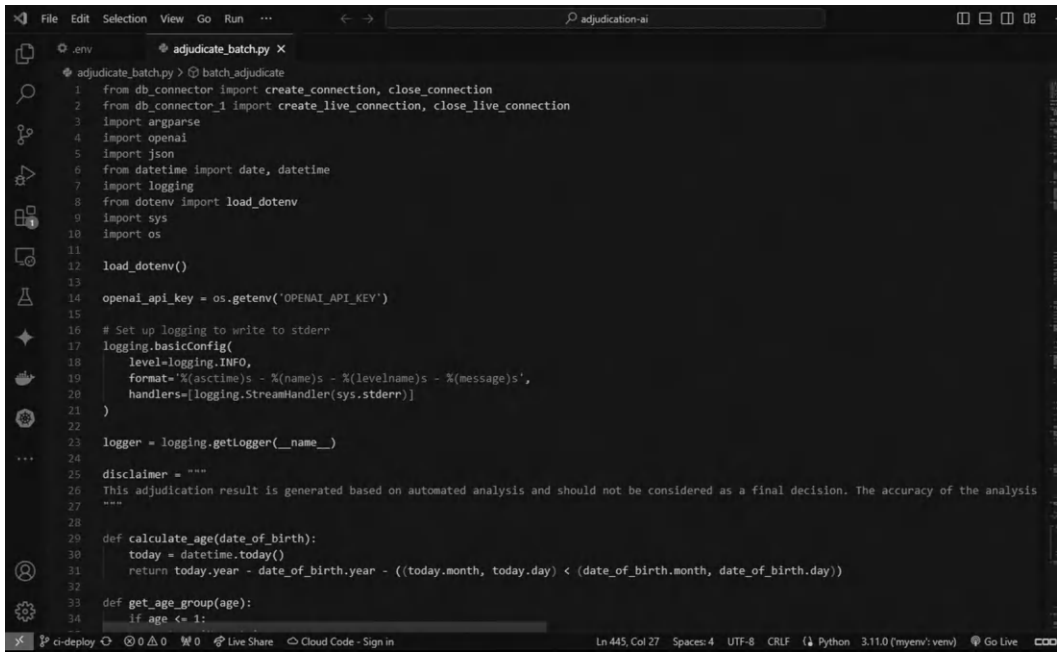


Figure 6.5 Code snippet assisted by generative AI—sample codes of the python API codes.

Advanced Use of Generative AI in Full-stack Development

Generative AI, particularly ChatGPT, has enhanced my productivity by streamlining coding, debugging, and learning new technologies. ChatGPT provided real-time code suggestions and solutions, which I incorporated into my full-stack projects, improving both efficiency and quality. The use of AI in these projects not only accelerated development but also ensured that the code was optimized and followed best practices. An example of this is shown in a code snippet where Python API codes were integrated into the project (see Figure 6.5). Additionally, using generative AI for generating adjudication reports with OpenAI's API demonstrated the practical benefits of AI integration in real-world applications (see Figure 6.6).

Findings and Discussion

Embracing Early Passion and Persistence

The journey of the developer emphasizes the critical role that an early passion for technology plays in shaping a successful career in software

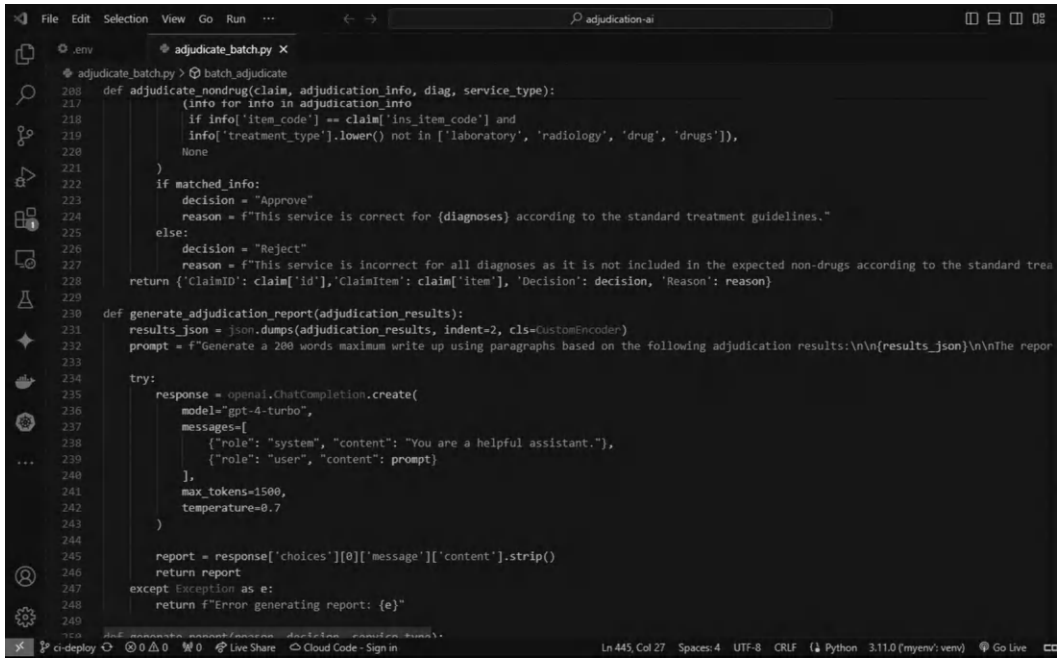


Figure 6.6 Code snippet assisted by generative AI—sample code for generating adjudication reports using openAI's API.

development. This passion, ignited by working with old, discarded phones, demonstrates that enthusiasm and a willingness to experiment can overcome resource limitations. The developer's early tinkering laid the groundwork for their technical skills and problem-solving abilities. This finding underscores the importance of fostering curiosity and persistence in young technologists, as these traits can lead to profound long-term benefits (Feraco et al., 2023). These early experiences also instilled comfort with exploring and adopting new tools, such as generative AI, which influenced the developer's openness to integrating emerging technologies in the future. The foundational passion and persistence developed early on continued to drive the developer's innovative use of AI tools as they evolved (Björklund et al., 2023).

Leveraging External Resources for Learning

In the early stages of the developer's journey, external resources such as programming communities and tutorial websites were pivotal. These resources provided solutions to complex problems and supported

continuous learning. The reliance on platforms like Stack Overflow and W3Schools highlights the value of community-driven knowledge sharing and the availability of educational content online. This illustrates that successful developers often build their skills by tapping into collective wisdom and seeking help from a broader community (Araos et al., 2023). This practice of leveraging external resources laid the groundwork for the developer's effective use of generative AI tools, which similarly rely on vast datasets and community input. Consequently, the developer's future use of AI will likely continue to benefit from this foundation of utilizing and contributing to collective knowledge.

Integration and Adaptation of AI Tools

A significant turning point in the developer's journey was the integration of generative AI tools like ChatGPT into their workflow. The real-time feedback and code generation capabilities of these tools revolutionized their development process, leading to enhanced productivity and efficiency. This finding highlights the transformative potential of AI in software development, particularly in reducing time spent on repetitive tasks and debugging. However, the need to balance AI-generated solutions with personal coding styles underscores that while AI can significantly aid development, it must be used judiciously to complement human creativity and expertise. This careful integration of AI tools has equipped the developer with the skills to adapt to and leverage future advancements in AI technology. As AI tools continue to evolve, the developer's experience with balancing AI assistance and personal coding preferences will ensure their effective and innovative use of these tools (Gupta et al., 2023; Qadir, 2023).

Continuous Learning and Adaptability

The transition from front-end to full-stack development was driven by practical needs and market demands. The developer's willingness to learn new backend technologies and database management showcases the importance of adaptability in the tech industry. This finding emphasizes that the ability to learn and adapt to new technologies is crucial for developers to stay relevant and meet the evolving demands of the industry. It also highlights that practical project needs can be powerful motivators for expanding one's skill set. This adaptability extends to the developer's use of

generative AI tools, as their capacity to continuously learn and integrate new technologies positions them well to capitalize on future advancements in AI. The developer's proactive approach to learning ensures they will effectively incorporate evolving AI tools to address emerging challenges and opportunities (Kumi et al., 2024; Majanoja et al., 2023).

Effective Communication with AI

The initial challenges the developer faced in articulating problems to AI tools reveal an important aspect of using such technologies: effective communication. Learning to ask the right questions and refine queries were essential for maximizing the utility of AI assistance. This highlights that while AI tools are powerful, their effectiveness is significantly enhanced by the user's ability to clearly define and communicate their problems and requirements (Qadir, 2023). This finding underscores the importance of clear and precise communication skills in the context of AI-assisted development. This experience has equipped the developer with a critical skill set that will be invaluable as AI tools become more sophisticated. As AI technology advances, the developer's ability to effectively communicate and interact with these tools will ensure they continue to leverage AI's full potential for innovative and efficient solutions (Gupta et al., 2023).

AI As a Catalyst for Efficiency and Innovation

Generative AI significantly enhanced the developer's productivity, allowing them to focus more on complex problem-solving and less on routine coding tasks. The real-time code suggestions and optimizations provided by AI tools acted as a catalyst for both efficiency and innovation (Yilmaz & Yilmaz, 2023). This finding highlights that AI can open new avenues for developers, enabling them to tackle more complex and innovative projects by streamlining the more mundane aspects of coding. It suggests that the adoption of AI tools can lead to greater creativity and innovation in software development. This enhancement in productivity and innovation will likely continue as the developer integrates future advancements in AI technology into their workflow. The developer's experience with AI as a powerful tool for efficiency positions them to remain at the forefront of technological innovation, continually pushing the boundaries of what is possible in software development (Dwivedi et al., 2023).

Reflecting On the Transformative Impact of AI

Reflections on the developer's journey reveal the profound impact of generative AI on their professional development. The integration of AI tools into their workflow not only boosted productivity but also enhanced problem-solving skills and overall development proficiency (Yilmaz & Yilmaz, 2023). This finding encourages the broader adoption of AI tools in the development community, suggesting that AI can bridge knowledge gaps, accelerate learning processes, and foster innovation. It highlights that AI is not just a tool for efficiency but also a catalyst for personal and professional growth in the tech industry (Qadir, 2023). Moreover, the transformative impact of AI extends to entrepreneurship by enabling developers to innovate and launch new ventures more effectively. The enhanced problem-solving skills and increased productivity facilitated by AI tools empower developers to create, test, and iterate on new business ideas swiftly and efficiently (Dwivedi et al., 2023). The developer's experience with AI underscores its potential to continually drive their professional evolution, ensuring they remain agile and innovative in the face of rapidly advancing technologies. As AI tools evolve, the developer's proven adaptability and openness to these technologies will keep them at the cutting edge of the industry, further bolstering their entrepreneurial capabilities and success.

Lessons and Questions for Practice and Research

Lessons for Female Developers

1. **Embrace Early Passion and Persistence:**
   - **Lesson:** Cultivate an early passion for technology and maintain persistence in pursuing your interests, even when resources are limited. This foundational passion can drive long-term success and innovation in your career.
   - **Example:** The developer's initial interest in technology was sparked by working with old, discarded phones, which laid the groundwork for her technical skills and problem-solving abilities.
2. **Leverage External Resources:**
   - **Lesson:** Utilize online communities, tutorials, and other educational resources to supplement your learning and overcome challenges. Engaging with a broader community can provide valuable insights and support.

- **Example:** The developer relied on platforms like Stack Overflow and W3Schools to navigate complex problems and enhance her skills.

3. **Integrate and Adapt AI Tools:**
   - **Lesson:** Embrace generative AI tools to boost productivity, efficiency, and learning. However, balance AI-generated solutions with your personal coding style to ensure the integration complements your creativity and expertise.
   - **Example:** The developer used AI tools like ChatGPT to generate code snippets and receive real-time feedback, significantly enhancing her development process.
4. **Focus on Continuous Learning and Adaptability:**
   - **Lesson:** Stay adaptable and continuously seek to expand your skill set to meet evolving industry demands. Practical project needs and market trends can be powerful motivators for learning new technologies.
   - **Example:** The developer transitioned from front-end to full-stack development by learning backend technologies and database management with the help of AI tools.
5. **Effective Communication with AI:**
   - **Lesson:** Develop clear and precise communication skills to maximize the utility of AI tools. Learning to ask the right questions and refine queries is essential for effective AI-assisted development.
   - **Example:** The developer initially faced challenges in articulating problems to AI tools but improved over time, enhancing the AI's effectiveness in providing solutions.
6. **AI as a Catalyst for Efficiency and Innovation:**
   - **Lesson:** Use AI tools to streamline routine tasks, allowing more time for complex problem-solving and innovation. AI can significantly enhance productivity and open new avenues for creativity.
   - **Example:** The developer's use of AI tools enabled her to focus on innovative projects and handle complex problems more efficiently.
7. **Reflect on the Transformative Impact of AI:**
   - **Lesson:** Recognize the profound impact that AI tools can have on professional development. Embrace AI as a catalyst for continuous learning, efficiency, and entrepreneurial success.
   - **Example:** The developer's journey highlights how AI tools transformed her development practices, fostering both personal and professional growth.

8. **Seek Mentorship and Support:**
   - **Lesson:** Find mentors and supportive networks to guide and encourage your development journey. Mentorship can provide valuable opportunities and insights that accelerate your career growth.
   - **Example:** The developer benefited from the mentorship of an exceptional web developer and constant encouragement from her lecturer.
9. **Balance Personal and Professional Goals:**
   - **Lesson:** Balance your professional ambitions with personal goals and interests. Leveraging AI tools can help manage time and enhance productivity, making it easier to achieve a fulfilling work-life balance.
   - **Example:** The developer successfully managed her transition to full-stack development while working on significant projects and pursuing academic goals.

These lessons underscore the importance of passion, continuous learning, effective use of technology, and the support of mentors and communities in the career development of female developers.

Questions for Discussion with Practitioners

1. **Adoption of Generative AI:**
   - How has the adoption of generative AI tools like ChatGPT influenced your daily workflow and productivity?
   - What specific challenges have you encountered when integrating AI tools into your existing development practices?
2. **Transition and Learning:**
   - Can you describe your journey transitioning from one area of expertise to another (e.g., from front-end to full-stack development)? How did generative AI tools facilitate this transition?
   - How do you stay updated with the latest advancements in AI and integrate them into your development practices?
3. **Efficiency and Innovation:**
   - In what ways have AI tools helped you improve the efficiency and quality of your code?
   - Can you share an example where AI significantly contributed to a project's success or innovation?

4. **Balancing AI and Personal Coding Style:**
   - How do you balance the use of AI-generated code with your personal coding style and standards?
   - Have you faced any conflicts between AI-generated solutions and your coding preferences? How did you resolve them?
5. **Learning and Adaptability:**
   - How has continuous learning and adaptability played a role in your career development, particularly with the integration of AI tools?
   - What strategies do you use to effectively communicate problems and requirements to AI tools?

Questions for Researchers

1. **Impact of Generative AI:**
   - What are the key factors that influence the effectiveness of generative AI tools in software development?
   - How do AI tools impact the learning curve for developers transitioning between different areas of expertise (e.g., front-end to full-stack development)?
2. **Behavior and Motivation:**
   - What motivational factors drive developers to adopt generative AI tools in their workflow?
   - How do generative AI tools influence developers' problem-solving skills and overall cognitive processes?
3. **Challenges and Solutions:**
   - What common challenges do developers face when integrating AI tools into their workflows, and what solutions have been identified to mitigate these challenges?
   - How do developers' backgrounds and prior experiences affect their ability to effectively use AI tools?
4. **Efficiency and Innovation:**
   - How do AI tools contribute to efficiency and innovation in software development projects?
   - What are the long-term impacts of using AI tools on developers' career growth and skill development?
5. **Future Trends:**
   - What future trends do you foresee in the integration of AI tools in software development?
   - How can educational institutions better prepare future developers to effectively use AI tools in their professional careers?

These questions aim to explore the practical applications, challenges, and impacts of generative AI tools from both practitioner and researcher perspectives.

Conclusion

Generative AI has been instrumental in the developer's transition from front-end to full-stack, significantly boosting productivity and fostering entrepreneurial success. Early experiences with technology ignited a passion that laid the foundation for technical skills. AI tools like ChatGPT revolutionized coding practices by providing real-time feedback, streamlining tasks, and enabling the developer to tackle complex problems efficiently.

The integration of AI tools facilitated the seamless combination of front-end and backend skills, essential for developing comprehensive applications. This capability has proven particularly beneficial in entrepreneurial projects, where rapid development and iteration are crucial. AI has acted as a catalyst for innovation, allowing the developer to focus on problem-solving and swiftly create, test, and refine new business ideas. AI's transformative impact extends beyond efficiency, fostering continuous learning and entrepreneurial agility. The enhanced problem-solving skills and productivity provided by AI empower the developer to launch and scale ventures effectively. As AI technologies advance, the developer's experience ensures they remain at the forefront of technological and entrepreneurial innovation.

In conclusion, AI has been a game-changer, driving efficiency, innovation, and professional growth. Developers and entrepreneurs alike are encouraged to embrace AI tools to accelerate growth and achieve success in the tech industry.

References

Auxier, B., Anderson, M., Perrin, A., & Turner, E. (2020). *Children's engagement with digital devices and screen time*. Pew Research Center. https://www.pewresearch.org/internet/2020/07/28/childrens-engagement-with-digital-devices-screen-time/

Araos, A., Damşa, C., & Gašević, D. (2023). Browsing to learn: How computer and software engineering students use online platforms in learning activities. *Journal of Computer Assisted Learning*, *39*(2), 304–320. https://doi.org/10.1111/jcal.12774

Björklund, T. A., Gilmartin, S. K., & Dempsey, S. (2023). The dynamics of innovation efforts in the early career. *Creativity and Innovation Management*, *32*(1), 12–25. https://doi.org/10.1111/caim.12534

Dwivedi, Y. K., Kshetri, N., Hughes, D. L., Slade, E. L., Baabdullah, A. M., Ribeiro-Navarrete, S., … & Wright, R. T. (2023). Opinion Paper: "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. *International Journal of Information Management*, *67*, 102642. https://doi.org/10.1016/j.ijinfomgt.2023.102642

Feraco, T., Sella, E., Meneghetti, C., & Cona, G. (2023). Adapt, explore, or keep going? The role of adaptability, curiosity, and perseverance in a network of study-related factors and scholastic success. *Journal of Intelligence*, *11*(2), 34. https://doi.org/10.3390/jintelligence11020034

Fischer-Grote, L., Kothgassner, O. D., & Felnhofer, A. (2021). The impact of problematic smartphone use on children's and adolescents' quality of life: A systematic review. *Acta Paediatrica*, *110*(5), 1417–1424.

Gupta, M., Akiri, C. K., Aryal, K., Parker, E., & Praharaj, L. (2023). From chatgpt to threatgpt: Impact of generative AI in cybersecurity and privacy. *IEEE Access*, *11*, 80218–80245. https://doi.org/10.1109/ACCESS.2023.3300381

Kumi, E., Osei, H. V., Asumah, S., & Yeboah, A. (2024). The impact of technology readiness and adapting behaviours in the workplace: a mediating effect of career adaptability. *Future Business Journal*, *10*(1), 12–25. https://doi.org/10.1186/s43093-023-00123-7

Majanoja, A. M., Hakkala, A., & Virtanen, S. (2023). Motivation for continuous software engineering expertise development through lifelong learning. In *Proceedings of the 19th CDIO International Conference* (pp. 345–358). Ghent, Belgium: CDIO.

Peng, S., Kalliamvakou, E., Cihon, P., & Demirer, M. (2023). The impact of AI on developer productivity: Evidence from GitHub Copilot (arXiv:2302.06590). arXiv. https://doi.org/10.48550/arXiv.2302.06590

Qadir, J. (2023). Engineering education in the era of ChatGPT: Promise and pitfalls of generative AI for education. In *2023 IEEE Global Engineering Education Conference (EDUCON)* (pp. 1234–1240). Vienna, Austria: IEEE.

Wang, B., Liu, Y., & Parker, S. K. (2020). How does the use of information communication technology affect individuals? A work design perspective. *Academy of Management Annals*, *14*(2), 695–725.

Yilmaz, R., & Yilmaz, F. G. K. (2023). The effect of generative artificial intelligence (AI)-based tool use on students' computational thinking skills, programming self-efficacy and motivation. *Computers and Education: Artificial Intelligence*, *5*(1), 100058.

Chapter 7

Enhancing Entrepreneurial Opportunities through AI-Driven Strategies and Techniques

Sulemana Bankuoru Egala, Samuel Nii Odoi Devine, Andrew Asante, and Emmanuel Awuni Kolog

Introduction

In today's dynamic and technology-driven business landscape, the intersection of entrepreneurship and artificial intelligence (AI) presents unprecedented opportunities. As a purpose-driven technology, AI has taken center stage in most circular economy sectors (Agrawal et al., 2022). As AI continues to evolve and permeate various industries, entrepreneurs increasingly leverage its power to innovate, streamline processes, and gain a competitive edge in the marketplace (Daraojimba et al., 2023; Edilia & Larasati, 2023). According to Kanbach et al. (2023), exploring entrepreneurial opportunities through AI-driven strategies and techniques signifies a paradigm shift in how businesses operate, strategize, and thrive in the digital age. Thus, entrepreneurs can use AI-driven analytics to make informed decisions regarding product ideation, development, marketing strategies, and resource allocation (Farayola et al., 2023). The fusion of entrepreneurship and AI heralds a new era of creativity, efficiency, and scalability of digital

DOI: 10.4324/9781003507314-7

entrepreneurship (Kolog et al., 2022; Ndagi & Salihu, 2019). Scholars attest that, entrepreneurs, whether seasoned veterans or budding visionaries, recognize AI as a transformative tool capable of revolutionizing traditional business models, uncovering untapped markets, and unlocking novel revenue streams (Edilia & Larasati, 2023).

Furthermore, by harnessing AI-driven strategies and techniques, entrepreneurs can navigate complex market landscapes, anticipate consumer demands, and craft personalized experiences that resonate with target audiences (Allil, 2024). Again, with AI techniques such as predictive modeling and data mining, entrepreneurs can gain valuable insights into market dynamics and customer behavior, leading to more effective business strategies (Schmitt, 2023). From predictive analytics and natural language processing to machine learning algorithms and robotic process automation, an arsenal of AI-driven technologies equips entrepreneurs with invaluable insights and capabilities to navigate uncertainties and capitalize on emerging trends (Shepherd & Majchrzak, 2022). Moşteanu (2023) furthered that, the proliferation of AI-powered tools and platforms empowers entrepreneurs to enhance decision-making, optimize resource allocation, and mitigate risks effectively.

Streams of literature suggest that exploring entrepreneurial opportunities through AI-driven strategies and techniques is not merely confined to established enterprises (Dwivedi et al., 2021). Startups and small businesses, fueled by innovation and agility, stand to gain immensely from adopting AI as a cornerstone of their growth trajectory. With AI democratizing access automation and predictive modeling, entrepreneurs at every stage of their journey can leverage AI-driven solutions to amplify productivity, drive efficiencies, and accelerate their path to success. Amid the promise and potential of AI-driven entrepreneurship, literature predicts that some challenges and ethical considerations loom large (Chaturvedi & Verma, 2023). Again, as entrepreneurs integrate AI into their business operations, they must navigate data privacy issues, algorithmic bias, and the ethical implications of AI-driven decision-making. Moreover, fostering a culture of responsible AI adoption and ensuring equitable access to AI-driven opportunities are imperative for fostering inclusive and sustainable entrepreneurial ecosystems.

This study aims to delve into the multifaceted landscape of entrepreneurial opportunities through AI-driven strategies and techniques in Africa. By examining this, industry trends, and academic research, this endeavor seeks to illuminate the transformative power of AI in reshaping entrepreneurial

endeavors across diverse sectors and geographies. Given the transformative nature of AI, we seek to leverage the current trend of frugality in digital innovations and embark on this scholarly journey to elucidate the provenance of AI in entrepreneurship. This study contributes significantly to the current discussions on AI and its affordance to entrepreneurship particularly in the global south. Again, we contribute to acknowledging and setting the pace for practitioners to draw insight for informed decisions on the appropriate strategies to adopt and implement AI into entrepreneurship. While synthesizing scholarly and industry perspectives, this review endeavors to proffer a holistic understanding of the evolving intersection between entrepreneurship and AI.

Entrepreneurship Development in Africa

Entrepreneurship has emerged as a critical driver of economic growth, job creation, and social development in Africa (Peprah & Adekoya, 2020). In recent years, the continent has witnessed a surge in entrepreneurial activities driven by factors such as demographic shifts, technological advancements, and increasing access to education and finance (Ojo & Oluwatayo, 2015; Ogunmokun, 2018). Corresponding scholarly studies have highlighted a growing recognition of entrepreneurship as a catalyst for sustainable development across Africa (Ajide & Ojeyinka, 2022; Ning, 2021). Additionally, the continent has seen a rise in the number of startups, SMEs, and social enterprises, particularly in sectors such as technology, agriculture, and renewable energy. Moreover, there is a notable shift toward innovative and impact-driven entrepreneurship, focusing on addressing socio-economic and technological challenges while generating economic value (Ning, 2021).

Furthermore, there are significant opportunities for entrepreneurship development in Africa. These opportunities are fueled by market dynamics, technological advancements, and supportive ecosystems (Nkontwana & Stam, 2023; Kansheba, 2020). Besides harnessing these opportunities and addressing key challenges, African entrepreneurs can drive inclusive growth, foster innovation, and contribute to sustainable development across the continent. Kansheba (2020) emphasized the importance of fostering entrepreneurial ecosystems characterized by supportive policies, access to finance, infrastructure development, and entrepreneurship education. According to Mafimisebi and Ogunsade (2022), the rise of digital technologies has created new pathways for entrepreneurial growth, enabling

startups to access markets, connect with customers, and scale their operations more efficiently.

Conversely, social entrepreneurship has gained traction as a promising approach to addressing pressing social and environmental issues in Africa (Rivera-Santos et al., 2015). Farhoud et al. (2023) highlight the role of social enterprises in delivering innovative solutions, empowering marginalized communities, and promoting inclusive growth. Moreover, the emergence of innovation hubs, incubators, and accelerators has created fertile ground for nurturing entrepreneurial talent and fostering collaboration across sectors.

Despite its potential, entrepreneurship in Africa faces numerous challenges that hinder its growth and impact (Kansheba, 2020; Peprah & Adekoya, 2020). Succinctly, entrepreneurship development in Africa faces unique challenges and opportunities. While the continent possesses abundant natural resources, a burgeoning youth population, and increasing access to technology, it also grapples with issues such as limited access to finance, inadequate infrastructure, bureaucratic hurdles, and political instability (Igwe et al., 2018). Additionally, limited access to finance, inadequate infrastructure, regulatory barriers, and skills gaps as significant impediments to entrepreneurial development. Moreover, political instability, corruption, and market inefficiencies pose additional hurdles for aspiring entrepreneurs, particularly in fragile or conflict-affected contexts (Atiase et al., 2018). This makes promoting entrepreneurship in Africa daunting, requiring a concerted effort to enhance education and skill development initiatives. Thus, investing in entrepreneurship development and innovations can equip aspiring entrepreneurs (Youssef et al., 2018).

As a remedy, Ajide (2020) suggests that, governments play a crucial role in fostering entrepreneurship by creating a supportive policy environment that encourages innovation, protects intellectual property rights, and promotes market competition. Policy reforms aimed at reducing bureaucratic red tape, streamlining business registration procedures, and providing tax incentives can stimulate entrepreneurial activity and attract investment in key sectors of the economy. Relative to financial constraints, African entrepreneurs often struggle to secure loans, venture capital, and other forms of funding due to stringent lending policies, high-interest rates, and a lack of collateral (Ajide & Ojeyinka, 2022). Addressing this challenge requires innovative financing mechanisms, such as microfinance initiatives, angel investor networks, and crowdfunding platforms tailored to the African context (Atiase et al., 2018). Most importantly, technology serves as a powerful enabler for solving entrepreneurial problems. Emerging technologies

such as AI provide innovative solutions that address challenges related to market access, finance, operations, marketing, product development, and supply chain management (Pustovrh et al., 2020). By embracing technology and leveraging its capabilities, entrepreneurs can overcome barriers to success, drive business growth, and achieve their entrepreneurial goals more effectively in today's dynamic and competitive business environment (Indrawati, 2020).

Entrepreneurship Development on National Economies

Entrepreneurship development has a profound impact on national economies across the globe. The impact of entrepreneurship development on national economies is non-exhaustive. Entrepreneurship, a consistent process of being inspired, adventurous, and prepared, plays a vital role in economic development, contributing significantly to national economies (Çelikkol et al., 2019). Studies show that entrepreneurship has a multifaceted impact on economic, social, and environmental welfare, driving innovation, job creation, and economic growth. It fosters job creation, stimulates innovation, and drives economic growth (Dvouletý et al., 2018). Moreover, entrepreneurship positively impacts economic, social, and environmental welfare, contributing to sustainable development (Bruce et al., 2022; Zhakupov et al., 2023).

Regarding job creation, literature reviews emphasize entrepreneurship as a key driver of economic growth, highlighting entrepreneurial intention as a critical factor. For instance, Çelikkol et al. (2019) assert that, job creation and employment are among the main impacts of entrepreneurship development in most emerging economies. In the global south for instance, entrepreneurship is a significant driver of job creation and employment opportunities within national economies. Amoah et al. (2023) submit that, small and medium-sized enterprises (SMEs), often founded by entrepreneurs, are responsible for a substantial portion of total employment in many countries (Zhakupov et al., 2023). Furthermore, entrepreneurship creates wealth by generating income for individuals, families, and communities. According to Dvouletý et al. (2018) and Egala et al. (2024), entrepreneurs generate wealth that contributes to poverty alleviation and socio-economic development by creating new businesses and expanding existing ones. Entrepreneurship, therefore brings about wealth creation and poverty alleviation among the local people in national economies.

Also, because entrepreneurs strive to make a difference in the score of competitive advantage, a significant amount of innovation and economic growth has been championed through entrepreneurship. Businesses often try to find innovative ways of improving and growing their business products and/or services. That is, entrepreneurs play a crucial role in fostering innovation, a key driver of economic growth and competitiveness (Dvouletý et al., 2018; Egala et al., 2024; Zhakupov et al., 2023). Entrepreneurial ventures introduce new products, services, processes, and business models that drive productivity gains, stimulate demand, and enhance overall economic performance (Zhakupov et al., 2023). Entrepreneurship development significantly influences national economies across various dimensions. Entrepreneurial conditions, such as regulatory frameworks and access to resources, play a crucial role in shaping economic outcomes (Vatavu et al., 2022). Notably, entrepreneurship contributes to public sector governance, enhancing economic development in large economies (Çelikkol et al., 2019). Entrepreneurial behavior, attitudes, and framework conditions influence economic development, affecting market processes and outcomes.

Studies indicate that entrepreneurial activity is strongly linked to national economic performance, especially in high-developed economies, shifting toward an "entrepreneurial economy" model (Bruce et al., 2022; Zhakupov et al., 2023). Overall, entrepreneurship serves as a catalyst for job creation, economic prosperity, and social change. Entrepreneurship fosters regional development and economic diversification by promoting the growth of diverse industries and sectors. By encouraging entrepreneurial activity outside of traditional economic hubs, national economies can reduce regional disparities and foster more inclusive growth (Vatavu et al., 2022). While entrepreneurship impacts global competitiveness and trade, entrepreneurial ventures contribute to national competitiveness by driving innovation, productivity, and efficiency gains. Successful entrepreneurs often expand their businesses internationally, contributing to export growth, foreign direct investment, and global trade integration (Abor & Quartey, 2010).

Research Approach

This research adopts a scoping review approach toward exploring entrepreneurial opportunities through AI-driven strategies and techniques. As a qualitative content approach, the study used thematic analysis to generate insight into the phenomenon under study. The objective is to discover

patterns, trends, and relationships in literature (Park & Peters, 2022). It also focused on developing AI-driven approaches to scouting entrepreneurial opportunities. With the daily generation and propagation of digital data which occurs in large volumes and varieties, the scoping review enabled the extraction of meaningful insight and identify recurring themes and patterns concerning the research. Thus, researchers following guidelines, protocols, and standards for data collection ensures integrity, transparency, and rigor in the research process (Hasan, 2023).

Data Sources and Credibility

Data collected for this study were from various academic journal databases such as Scopus, web of science, and JSTOR. Other institutional repositories such as KPMG, World Bank, International Monetary Fund (IMF), United Nations Development Programme (UNDP), Global Entrepreneurship and Development Institute (GEDI) among others that publish periodic reports linked to the theme of this research were also used. The retrieved data included peer-reviewed articles, reports, commentaries, patents, interviews, and erratum relating to AI and entrepreneurial activities, particularly those centered on the global south. While Mellinger and Hanson (2022) have emphasized that the quality of research results highly depends on the availability of data, its relevance and credibility cannot be overemphasized (Creswell, 2021). The extensive triangulation approach was to harness a significant amount of data from the sources to inform the strategic alignment of AI for the common good of entrepreneurial activities in the global south. The choice of the data source was a key consideration to ensure that data and information retrieved were of the highest credibility and reliability for the analysis. The source credibility of these reports significantly strengthens the reliability and conclusion to the inferences made on entrepreneurship activities toward economic growth and development of Africa.

To gain valuable insight from data in the context of exploring entrepreneurial opportunities through deploying AI-technology-driven strategies and techniques, leveraging data from these reputable journals and institutional repositories gives a wider density of representation and comprehensive understanding of the scope of entrepreneurship. Insights gained from these reports provides a comprehensive understanding of best practices, policy frameworks and formations, macroeconomic dynamics, and perspective of various business landscape that inform strategic decisions in entrepreneurship.

AI Strategies and Techniques for Exploring Entrepreneurship Opportunities

Machine Learning (ML) and Natural Language Processing (NLP) capabilities appear to be the two broad facets of AI applications, which are propelling innovations within the entire domain of businesses (Sharma & Garg, 2021). NLP in particular deals with data that is usually classified as unstructured rather than structured data (Zong et al., 2021). Unstructured data often does not have a predefined model and organization. Examples include social media posts or comments, blogs, emails, articles, and conversations in a natural language text. The techniques of NLP extract, understand, and provide meaningful insight into such data that entrepreneurs can utilize for the survival of their businesses. Most companies in the developed world are now leveraging this opportunity to gain valuable insight from human language data and use the outcome to automate their routine task. Concepts such as sentiment analysis, topic modeling, named entity recognition, trend analysis, event detection, and others are techniques that leverage NLP tool strategies (William et al., 2023). These strategies offer a wide range of opportunities for innovations, business growth, policy frameworks, and formations that propel better decision-making for business survival. That notwithstanding there are challenges toward the use of all these techniques. For instance, entrepreneurs need to acquire tons of knowledge or hire people with such expertise to expedite some of these procedures into business strategies for overall turnaround effect.

NLP for Social Media Analysis

The pipeline for NLP social media analysis involves several stages such as data creation and collection, data preprocessing, feature engineering, model training, evaluation, deployment, and maintenance (Brownlee, 2020; Chapman et al., 2020; Hou et al., 2020).

a. *Data Creation and Collection* is the preliminary stage of NLP social media analysis, and it entails data accessibility and gathering from the platforms for research (Hou et al., 2020). Whereas some media platforms have imposed strong proprietary rights and restrictions on how data is collected and used from their platforms, others with permission have made their data available and accessible through application programming interfaces (API). For instance, X, hitherto called Twitter,

is one of such platforms with less proprietary restriction on information accessibility and as a result, data is readily and publicly available on a topically structured basis, accessible via X APIs, free tweet-collection apps, Python tweet collection software, and the possibility of custom-built-in crawlers (Chapman et al., 2020). Moreover, X platform supports and facilitates public discourse for a larger group of users on specific topical issues (by hashtags) in real time and even with anonymous identity. Thus, the concentration of the web scrapping must be timely and relevant to the subject of interest. Overall, data gathered from social media that may have entrepreneurial value and opportunities includes user comments, likes, engagement metrics, user profiles, and (#)hashtags. Several structured formats such as CSV, JSON, XML, and more are used to store these gathered data which appears unstructured.

b. *Data Preprocessing* involves the transformation and preparation of raw data text into suitable data for the required NLP task. In NLP, data preprocessing stage involves an integration of data selecting, cleaning, normalizing, transforming, and selecting features (Brownlee, 2020; Chapman et al., 2020). The essence of these steps is to improve on the quality by reducing the "noise" to enable a machine to adjudicate and make sense of human-written languages. The outcome of this stage is a new useful data set needed to boost the classification performance (Rahman, 2019). The steps below detail the data preprocessing phase;
   i. ***Data Cleaning—***involves the transformation of raw or "noisy" data into a well-structured form of text instances which aid efficient analysis. Thus, data obtained from sources containing unwanted features such as duplicates, incorrect words, hyphens, whitespaces, abbreviations, web addresses, and special characters can be cleaned during this phase of the text cleaning using for instance, scripted lines of Python codes.
   ii. ***Corpus Annotation—***is a group of textual instances from a large collection of natural human language in the form of texts, posts, or comments (Kim et al., 2008). Manually or automatically, text instances in a corpus can be given tags with some predefined choice categorization by experts who are knowledgeable in the subject domain to facilitate text annotation processes after receiving training from the researcher. A corpus is organized in forms ranging from words and sentences to documents that are machine-readable. While a well-formed corpus shows a structured and balanced

representation of texts in its natural context, a poorly formed corpus annotation affects the performance of the supervised learning algorithm. Thus, a good corpus annotation positively impacts the training data to create a reliable classifier model. Figure 7.1 is a flowchart illustration of how the process of annotation can be undertaken.

iii. ***Tokenization—***this process computationally breaks down streams of textual data into relevant word parts, phrases, or symbols called tokens (Vijayarani & Janani, 2016). For instance, *Tokenizer*, a Natural Language Toolkit (NLTK) in Python helps split text into smaller units called tokens. These broken fragments of text input serve as a list of tokens for the lexical parser in text mining. Tokenization is essential in text preprocessing as it helps convert raw text into structured format that can be analysed more efficiently (Welbers, 2017). In the

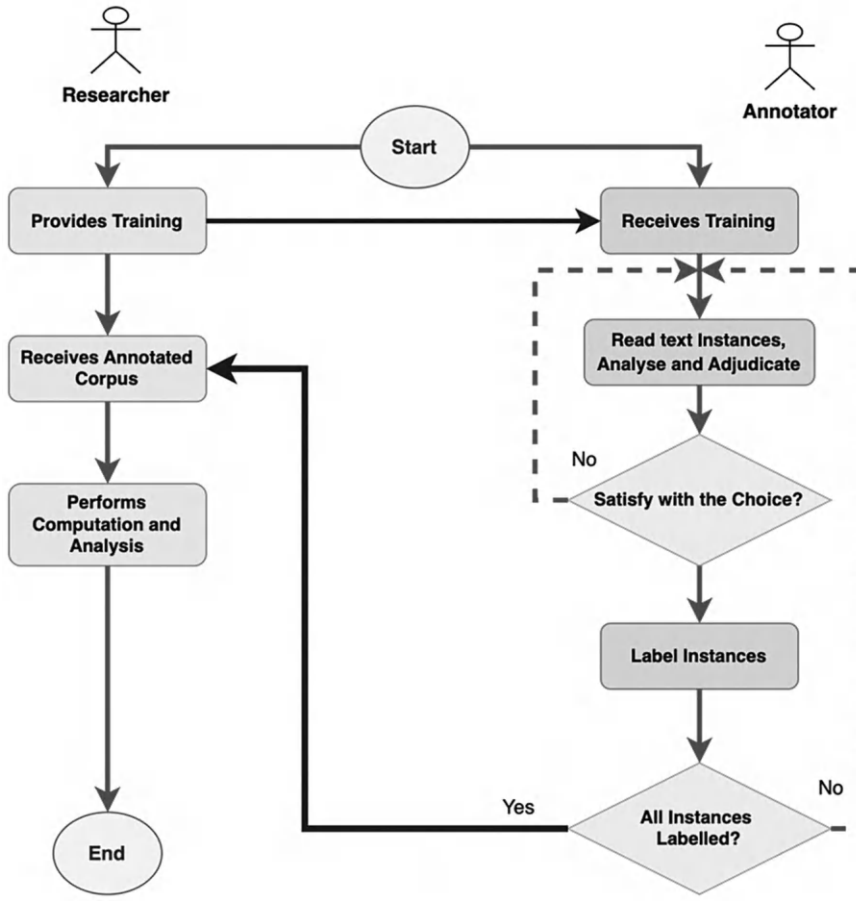


Figure 7.1 The annotation process (Kolog & Montero, 2018).

process of tokenization, all uppercase letters are converted into lowercase format to ensure consistency and normalization that improves model performance.

iv. ***Stop Words Removal—***improves both the quality and relevance of textual data in NLP task when words which do not have distinctive meaning and context are removed from the tokens (Brownlee, 2020). Such tokens do not appear to be stemmed or lemmatized; hence their inclusion will only add noise or errors to the data. Examples of stop words in any tweet collections during information retrieval include *they, of, is, are, were, also, although*, and many others.

v. **Lemmatization/Stemming—**are both linguistic computational techniques that reduce words to their canonical base or root word and subsequently contribute to the semantic analysis of data based on a specific task or goal (Welbers, 2017). While the lemmatization method removes affixes and inflection on a word to return a word form that appears to be a dictionary word, the stemming process returns the stem of a word after truncating part of the word. For example, words such as *connection, produced*, and *classification* would be replaced with their lemma words such as connect*, produce*, and *class*, respectively, but for stemming, words such as "*changes, changing, and changer*" are returned as "*chang*" which represents a complete loss in meaning and context of the words. For instance, in the context of entrepreneurial opportunities driven by AI strategies, gaining insight from larger data set is paramount. Hence, lemmatization procedure is preferred over stemming to create a grammatically semantic connection between related words.

vi. **Part-of-Speech Tagging** is another fundamental task of understanding the syntactical role, logics, and relationship of words in a sentence. This provides a valuable insight into grammatical structure textual data and aid in extracting entities, action, and attributes (Brownlee, 2020).

c. *Feature Engineering*—is an important process in NLP involving the conversion of raw word-tokens into a vector representation for selection based on feature engineering methods such as bag-of-words (bow), term frequency-inverse document frequency (TF-IDF). Feature extraction technique combined with dimensionality reduction methods such as Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), or t-Distributed Stochastic Neighbour Embedding

(t-SNE) can help in reducing noise in modeling. Comparatively, the TF-IDF is the most widely used feature extraction technique in text analysis and information retrieval (Liu et al., 2022).

d. *Model Training and Evaluation*—ends the NLP pipeline for social media analysis. A chosen model is trained with the feature-engineered data at this stage to produce state-of-the-art results. Several evaluation metrics are combined to ascertain the model performance, including the accuracy score, harmonic mean (F1-measure), precision, and recall. Other performance evaluations can be performed to augment these criteria such as the confusion matrix report, miscalculation ratio, receiver operating characteristics (roc-auc). To improve the model usability, a K-fold-cross-validation method of evaluation can be considered to reduce the possibility of the model overfitting or underfitting the data set. This involved randomly splitting the data set into equal folds unlike the test-train to verify the learning algorithm's performance (King et al., 2021). Maintenance on the model becomes a continuous process after deployment.

Figure 7.2 provides a summary demonstration of the various stages in data preprocessing, feature extraction, and selection that aid in text classification problem. The process or pipeline is initiated with collecting data from several social media platforms to extracting features and further to the ML algorithm for model predictions.

Machine Learning Technique

Machine learning techniques are useful in identifying meaning patterns in data (Devine et al., 2022) and have been applied in several studies for problem identification, trend analysis, prediction and forecasting, anomaly detection, and recommendation. Machine learning can enable individuals and companies to explore trends and patterns in an existing market space to provide tailor-made solutions in the form of products or services for their intended customers.

Machine Learning Process for Entrepreneurial Opportunities Discovery

Supervised and unsupervised ML approaches, through classification and clustering, as a hybrid approach, can be applied in diverse contexts

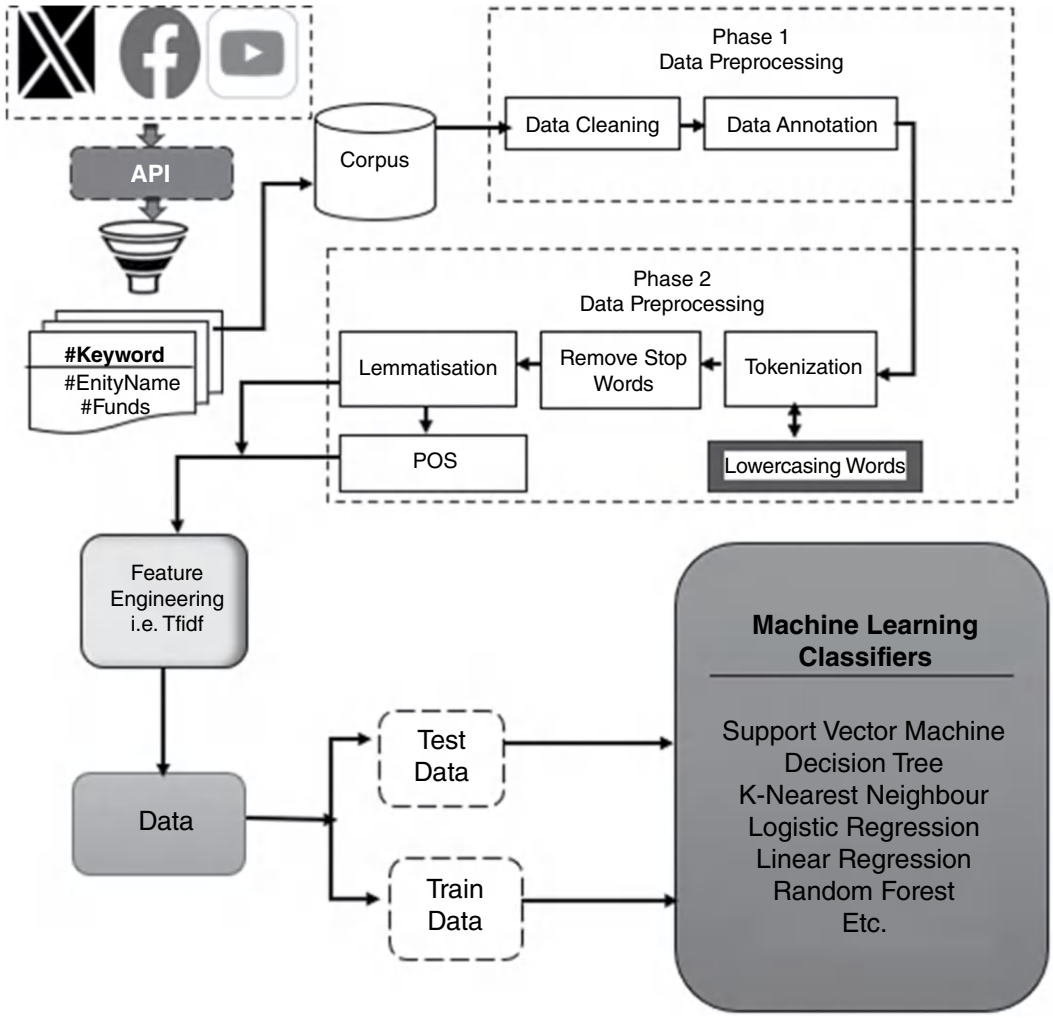


Figure 7.2 NLP pipeline for social media text analysis (author's own creation).

(Kolog et al., 2020; Yafooz et al., 2020) to promote exploration and discovery (Azevedo, Rocha, & Pereira, 2024) of new business opportunities and trends, analyse current patterns and recommend target-oriented solutions for specific markets and demographics. Figure 7.3 is the hybrid ML two-stage approach.

1. *Data source*—With the massive generation and proliferation of data by individuals and organizations (both internally and externally) in the form of text, image, audio, and video across different platforms (Yafooz et al., 2020), ML can be leveraged to analyse the data and provide strategic areas of viable interest for entrepreneurial pursuits. Thus, the

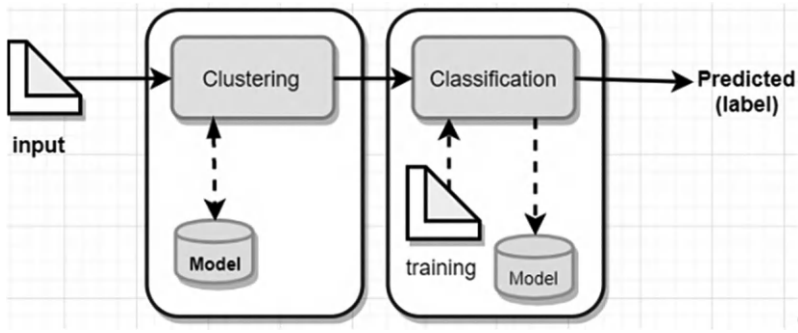


Figure 7.3 The hybrid two-stage machine learning process (Kolog et al., 2020).

data sources can be from operational databases, data warehouses, social media, or other web sources (Kolog et al., 2020; Yafooz et al., 2020). For such data, the extract, transform, and load (ETL) approach can be applied where relevant (Kolog et al., 2020).

2. *Data preprocessing and feature selection*—The data needs to be taken through the initial preprocessing stage since such data is often unstructured, must be cleaned, and transformed into structured data (Yafooz et al., 2020) for additional processing and feature extraction. After the data has been cleaned and relevant features extracted, the data is then fed to a ML classifier (Kolog & Montero, 2018; Kolog et al., 2020). Typically, features including demographics, consumer feedback, consumer preferences, and consumer's purchasing behavior are selected.
3. *Clustering and classification process*—At this stage a clear definition of variables that represent entrepreneurship opportunities is defined to determine how the opportunities are to be classified. The opportunities classification can be binary, multi-classes, or by the measure of their potential. The appropriate method or algorithms for clustering and classification are chosen based on the type of data and the nature of the problem. The K-means and hierarchical clustering approaches are suited due to the nature of the task (Kolog et al., 2020) and the data and problem to be addressed. The purpose of the clustering stage is to automatically label the data, by identifying data patterns and grouping them into segments. The labeled data is then fed to the classification algorithm for training to develop the model for classification or prediction. Classification algorithms such as the support vector machine (SVM) and logistic regression can be applied as they are suitable for the problem and task (Gu & Han, 2013; Li et al., 2016). The model is then tested with the test data.

4. *Prediction, presentation, and interpretation*—After clustering and classification, the model is then deployed with actual data that is pipelined to the classifier for prediction data. As earlier indicated, the prediction would then be based on the defined entrepreneurship opportunities variables. The output is then presented through visualization for interpretation by managers or entrepreneurs to make appropriate decisions based on the nature of their business and the expected opportunities or knowledge to be explored.

Machine Learning for Problem Discovery and Anomaly Detection

Data from credible sources such as World Bank and historical data of consumers are explored to identify areas with prevailing or critical problems and needs (Bharadiya, 2023). As entrepreneurs are deemed to be problem solvers, problems, challenges, or issues relating to persons or groups must be identified and addressed. These niche areas when carefully observed may tend to be potential markets for entrepreneurial opportunities. Additionally, issues or challenges faced by existing customers of organizations can be exploited as viable areas of opportunity which when addressed may provide these organizations the possible new markets to explore. Similarly, the application of anomaly detection strategies can be applied in identifying outliers and/or unusual patterns in consumer data that may indicate potential prospects or interesting patterns in unexplored or untapped market segments and trends or niche areas that were hitherto given less attention for viable entrepreneurship opportunities (Bharadiya, 2023; Yafooz et al., 2020). Figure 7.4 illustrates the application of ML techniques in discovering and exploring potential entrepreneurial opportunities.

Machine Learning for Entrepreneurial Knowledge Management and Discovery

Organizations can invest in building business innovation–oriented knowledgebase that collates and harnesses data on business strategies, prospects, and their resulting solutions and target markets and customers (Yafooz et al., 2020). This approach will enable maintenance and monitoring of institutional memory and industry-based practices that may be re-examined to identify areas explored to yield new markets and learn which markets have already been explored using a particular approach. It will also serve as a

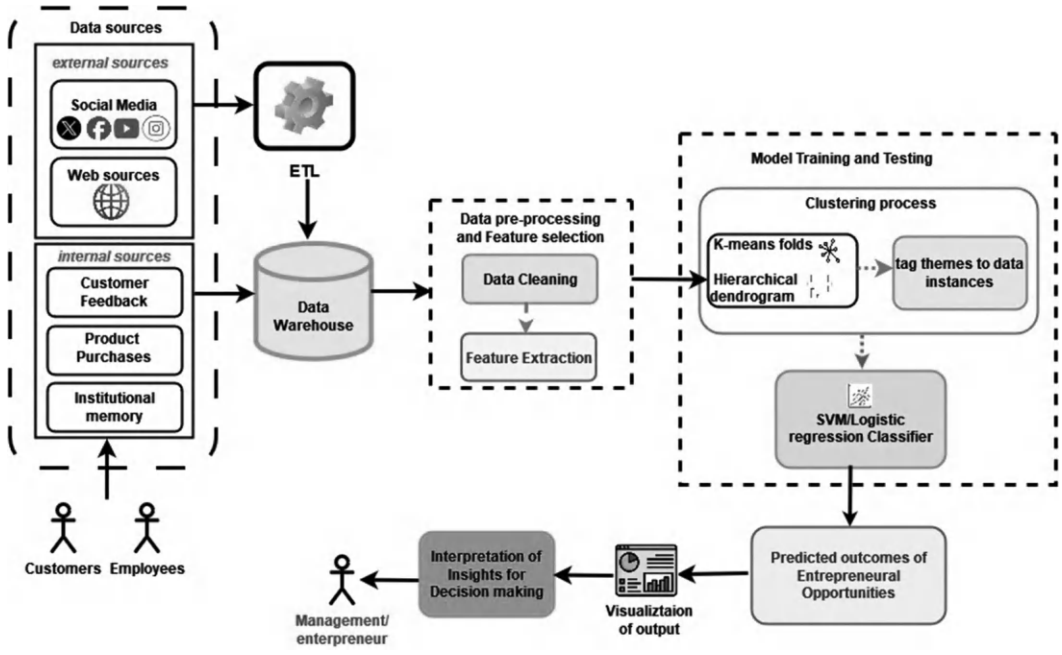


Figure 7.4 Proposed machine learning affinity analysis approach for exploring entrepreneurial opportunities (author's own creation).

platform for knowledge sharing on market dynamics and effective discovery of unexplored opportunities. This approach may require the application of classification and ontology-based approaches similar to the hybrid approach proposed by Devine et al. (2019) to manage entrepreneurial knowledge.

Machine Learning in Exploring Trends and Consumer Dynamics

Entrepreneurs explore trends within their market space and environment to identify business opportunities (Hunt, 2018). These trends may span the areas of emerging technology, political terrain, economy conditions, social setting, and industry indicators (Hunt, 2018). Organizations can leverage on the demographics and transactions of consumers and apply in the context of the prevailing environment to provide unique products and services to address the needs of their consumers by analysing their purchasing behavior, preferences (Yafooz et al., 2020). Classification and clustering approaches can be employed on the customer data to perform behavioral, gender issues and characteristics-based segmentation to provide tailored solutions to existing clientele or identify unexplored segments.

Machine Learning in Audio, Image, and Video Analysis

Many organizations today have an online presence in building, marketing, promoting, and managing their brands, products, and services. Social media is a notable and well-utilized approach deployed by several organizations (Saleh, 2021; Yafooz et al., 2020) to ensure they maintain an online presence. Organizations actively engage their customers on social media (Saleh, 2021) platforms such as X (Twitter), Facebook, YouTube, and Instagram. These platforms are well noted to generate massive data in varying forms including text, audio, images, and videos (Yang et al., 2020). Interestingly, individuals who engage in some informal trading or commerce presently employ social media as a major tool to advertise and/or sell their products and services (Saleh, 2021). Using clustering techniques, ML can be leveraged to identify image and video posts of brands, products, services, or concepts that are receiving more or less attention to determine what or where to shift attention. Similarly, by analysing and detecting reactions in audio and video posts through classification and regression (Kolog et al., 2020), entrepreneurs can gauge consumer satisfaction on products and services, and predict the likelihood of interests with potential reception and sale in offers and promotions when new products and services are advertised.

Machine Learning in Recommendation Systems and Forecasting

Entrepreneurs require timely information to explore potentially lucrative areas to invest in. One possible avenue is to analyse current market trends and forecast future events (Bharadiya, 2023). Machine learning techniques for forecasting and time series analysis can be applied against historical data (Zhang et al., 2021) or credible data sources, for instance, financial and economic data from the IMF and World Bank, to monitor and predict market volatility while envisaging sales trends areas with prevailing markets, capitalizing on investment avenues, and maximizing growth. Additionally, recommendation systems can be implemented using ML approaches to recommend targeted products and services for specific demographics based on their history relating to behaviors, interests, responses, and preferences. By applying collaborative filtering and/or content-based filtering algorithms to analyse customers' interactions and their similarities or interrelations, entrepreneurs can identify niche markets to offer existing and potential customers, tailor-made products and

services. Recommendation systems are useful for increasing customer engagement, behavior analysis, personalization and enhancing user experience, especially in the travel and hospitality, media and entertainment, and e-commerce sectors, leading to the discovery of potential entrepreneurship opportunities to deliver new products and services (Shankar et al., 2024; Zhang et al., 2021).

Affinity Analysis

Affinity analysis is a data mining and ML technique that is also referred to as associative rules mining or market basket analysis. Originally, the technique was designed for application on historical data of customers to find their most frequent purchasing patterns (Atsa'am et al., 2023). Affinity analysis is employed to explore data sets in order to identify frequent patterns, interesting relationships, correlation, co-occurrences, and causal structures between variables, observing factors that may influence or drive the occurrence of another (Diaz-Garcia et al., 2023; Atsa'am et al., 2023). There are factors that drive entrepreneurs to venture into new markets or explore opportunities in existing markets or promote the start of new businesses.

Affinity analysis can be applied in any domain and help identify the association between these factors that may drive new business opportunities. Affinity analysis falls under the umbrella of unsupervised learning which posits that if an item X occurs, then it is possible that item Y is (less or very) likely to occur (Atsa'am et al., 2023). The association rule has two parts: the antecedent (if) and the consequent (then). By definition, association rules are represented as X⇒ Y, where X and Yare items that are more or less frequent to occur together in a given data set, and $X \cap Y = \emptyset$ (Zhou & Yau, 2007). Thus, the antecedent, X, is the item(s) on the left-hand side (LHS) and the consequent is Y on the right-hand side (RHS). A combination of the LHS and the RHS is an itemset (Atsa'am et al., 2023; Zhou & Yau, 2007). For instance, if item "quantity-purchase-100-or-above" occurs in a given transaction for a product and "product-rating-4-or-above," then the item "opportunity" is likely to exist for further entrepreneurial exploration on similar type of product. Algorithms including A priori and FP-Growth can enable identification of frequently occurring itemsets and the association rules by analysing an organization's transactional data.

Affinity Analysis Process for Entrepreneurial Opportunities Discovery

Data source—Data generated by an organization stored in their databases or data warehouse is most suitable to explore for this kind of task. However, external sources including data from social networking platforms associated with an organization, product, or service can be leveraged to identify and explore possible opportunities for entrepreneurship. Thus, some studies have applied the technique on social media data (Diaz-Garcia et al., 2023).

Data preprocessing—Data extracted operational database, data warehouse, or social media must be presented in an appropriate format such as Microsoft Excel file, ARFF file, or CSV file. The data must be cleaned to remove duplicates, unwanted values, and outliers (Diaz-Garcia et al., 2023). The data is then prepared for processing by presenting it in a transactional format consisting of the relevant set of items associated with the customer, product, or service. This could be in the form of a binary matrix with rows representing transactions and columns representing the item(s).

Rules mining—Where interest is toward generating all possible rules, A priori is deemed better. However, FP-Growth is more efficient in handling Big Data due to its divide and conquer approach, and uses less memory (Diaz-Garcia et al., 2023) as proposed by Han et al. (2000). A priori or FP-Growth algorithm is used on the preprocessed data. A priori technique is applied specifying the appropriate support and confidence minimum thresholds. The thresholds should be able to effectively streamline the rules generated. The support threshold is to ensure all rules extracted had similar pattern of occurrence in the itemset. Equally, the confidence threshold is to guarantee that an extracted rule had the same consequence of the occurrences at the minimum threshold consisting of the same antecedents. From the resulting rules generated, repetitive, weak, and redundant rules are then removed or eliminated (Diaz-Garcia et al., 2023). FP-Growth algorithm applies a frequent pattern tree (FP-tree) structure based on a minimum support threshold being specified. Through an FP-tree, the algorithm is able to generate frequent itemsets by storing crucial, compressed information about frequently occurring patterns and uses the FP-growth to determine which frequent patterns to mine in order to achieve a complete set of patterns. The pattern fragment growth approach assists in avoiding repeated scans which are costly and significantly reduces the search space. This is done via a 3-stage approach (Han et al., 2000). Firstly, the dataset is

compressed to a smaller, highly condensed structure. Secondly, an FP-tree-based mining approach is applied to generate multiple candidate sets, and lastly, through a divide-and-conquer strategy, the rules mining task is partitioned into smaller tasks for mining confined patterns. This approach ensures scalability and improves search of frequent pattern mining.

The result is the possible set of outcomes on the association of conditions (rules) with the estimated level of confidence (Atsa'am et al., 2023) that would determine whether potential entrepreneurial opportunities exists. To communicate the results, visualization using graphs is appropriate (Heer et al., 2008), based on the thresholds defined, for comparative analysis, interpretation, and decision-making. This will enable management and entrepreneurs to identify meaningful patterns and relevant associations that suggest viable opportunities for the creation of new products or services or the development of tailored offers based on identified preferences and customer experiences. An illustration of the application of affinity analysis in exploring entrepreneurial opportunities is presented in Figure 7.5. This AI strategy is well suited for exploring entrepreneurship possibilities in the e-commerce, retail, entertainment, agricultural, and transport service

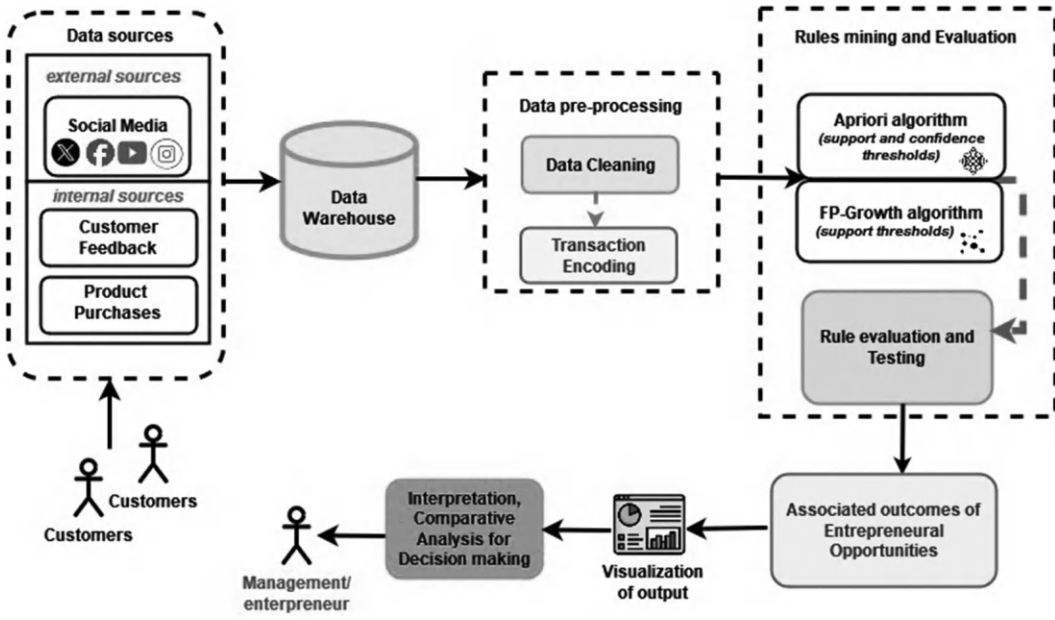


Figure 7.5 Proposed affinity analysis approach for exploring entrepreneurial opportunities (author's own creation).

sectors (Elavarasan et al., 2018; Javaid et al., 2023; Nautiyal et al., 2023; Torre-Bastida et al., 2018), as discussed in the sections that follow.

Organizations operating in the retail and e-commerce domain can leverage on identifying likely patterns or association rules (if any) in consumer purchases, and determine possible outcomes of consumer behavior when new products and services are rolled out (Hartmann et al., 2016; Yafooz et al., 2020). Based on historical data, organizations can determine which type of services or products are driven by demographics, cost, season, weather conditions, location, and other services or products. Similarly, agri-business entrepreneurs can capitalize on the associations between seasons and preference for particular foods (Javaid et al., 2023; Elavarasan et al., 2018), which then may drive the focus on which type of farm produce to invest in and derive more profit from. Further, this may spawn new markets in seed marketing, tailored to address the needs of farmers and individuals who may want to venture into the cultivation of specific crops (Javaid et al., 2023) for niche markets.

On the entertainment front, the hidden insights between content and consumers of such content can be useful to discover new approaches to content development and also identify demographics that prefer specific types of content (Nautiyal et al., 2023). Affinity analysis has been applied in the social media domain for collaborative recommendation systems, community analysis, influence studies, opinion mining (Diaz-Garcia et al., 2023) on products and services. The application is beneficial and strategic to content creators on social media platforms such as TikTok, Instagram, and YouTube, who generate income based on the nature of the content they churn out and the associated views and likes they receive (Kopf, 2020). This will enable such entertainment-based entrepreneurs to target and generate new content for specific audiences based on their associated preferences and the genre that addresses or best appeals to a targeted-audience grounded on market- or consumer-specific consumption data (Kasera et al., 2023; Nautiyal et al., 2023). This is also applicable to other mass media organizations offering television content seeking to identify content that will appeal to existing or new viewers to increase their viewership, thus generating more income and higher ratings.

The transport sector is experiencing rapid adoption of diverse ubiquitous technologies that support generation of big data and smart city technologies (Torre-Bastida et al., 2018). This is potentially an avenue that transport-driven entrepreneurs can leverage on the big data being created from the

various activities involving consumers of transport services and the products being offered (Torre-Bastida et al., 2018). With the changing dynamics of preferences of consumers within the transport service space, tailored services can be provided to customers (Okrepilov et al., 2022) that are driven toward the provision of safe and low-level emissions transport in relation to their location, and preferred pricing schemes (Iyer, 2021) can be a potential area to explore. Transport service providers can tap into these associations between preferences (Iyer, 2021) and offer unique packages that would either increase their customer base or profit margins, while meeting sales targets and creating new markets (Vishnoi et al., 2018). Thus, with this AI-driven marketing strategy, vehicle manufacturers can determine which brands appeal to which demographics in specific regions and develop strategies that would yield positive reception and purchase on types of vehicles, in addition to which market-driven features to include (Kim, Hall & Chung, 2024; Vishnoi et al., 2018).

Business Intelligence Approach

Business intelligence (BI) is a key strategy and aspect of modern information systems of organizations targeted at improving business operations to obtain value from their vast data resources for competitive advantage (Raj et al., 2016; Sharda et al., 2018; Yafooz et al., 2020). BI seeks to present the overall performance of an organization to derive valuable insights relating to an organization's business strategies and processes through visualization in the form of dashboarding (Khalid et al., 2020; Khatuwal & Puri, 2022). By applying analytics and data mining strategy, an organization can identify possible opportunities to venture into new markets and/or explore existing markets by analysing demographics of their customers to identify niches that would lead to the start of new businesses, provision of new products and services, enhance consumer experiences, and/or improve business processes to maximize profit (Sharda et al., 2018; Yafooz et al., 2020). BI has been employed by large organizations and also small-to-medium scale companies (Guarda et al., 2013) for strategic planning and decision-making (Khalid et al., 2020). Popular BI tools such as Microsoft Power BI and Tableau can be employed to support decision-making (Raj et al., 2016; Khatuwal & Puri, 2022). BI can be used in any sector or business for business diversification, strategy, continuity, and expansion.

Business Intelligence Process for Entrepreneurial Opportunities Discovery

Raj et al. (2012) posit that the key BI consists of four main components: *(1) Data source, (2) ETL process, (3) Data mart/warehouse* and *(4) Presentation/Analytics*.

1. *Data source*—A variety of sources including internal data from organizations that capture operational data (El-Adaileh & Foster, 2019; Raj et al., 2012) such as sales, supplier data and customer demographics, and externally (El-Adaileh & Foster, 2019; Gangadharan & Swami, 2004) from social media interaction and, industry and competitor-based reports (Yang et al., 2020; Surbakti & Ta'a, 2018) can be leveraged to identify potential opportunities for entrepreneurship.
2. *ETL process and Data mart/warehouse*—The extracted data is then integrated and consolidated from different sources into a data mart or data warehouse (Surbakti & Ta'a, 2018). The data is cleaned, transformed, restructured, standardized, validated where necessary (Khalid et al., 2020) in their appropriate format for consistency, accuracy, and quality. This stage is critical and must be carefully implemented with the appropriate filtering applied to get the data required for analysis (El-Adaileh & Foster, 2019).
3. *Presentation/Analytics*—The transformed data is then analysed using online analytical processing (OLAP) tools and techniques applied through a BI tool or data analysis tool. Descriptive and predictive analytics are applied to identify possible entrepreneurial opportunities available. The results are presented through dashboards as graphs and statistics, and also through reports (Khatuwal & Puri, 2022; Sharda et al., 2018).

The application of BI to explore entrepreneurial opportunities is discussed below and illustrated in Figure 7.6.

BI for Customer Profiling/Analysis

Customers are often driven to purchase or subscribe for a product or service based on their preferences. Entrepreneurs can leverage on BI tools to identify the dynamics for specific needs of customers and profile them based on their preferences. The identification and analysis of these

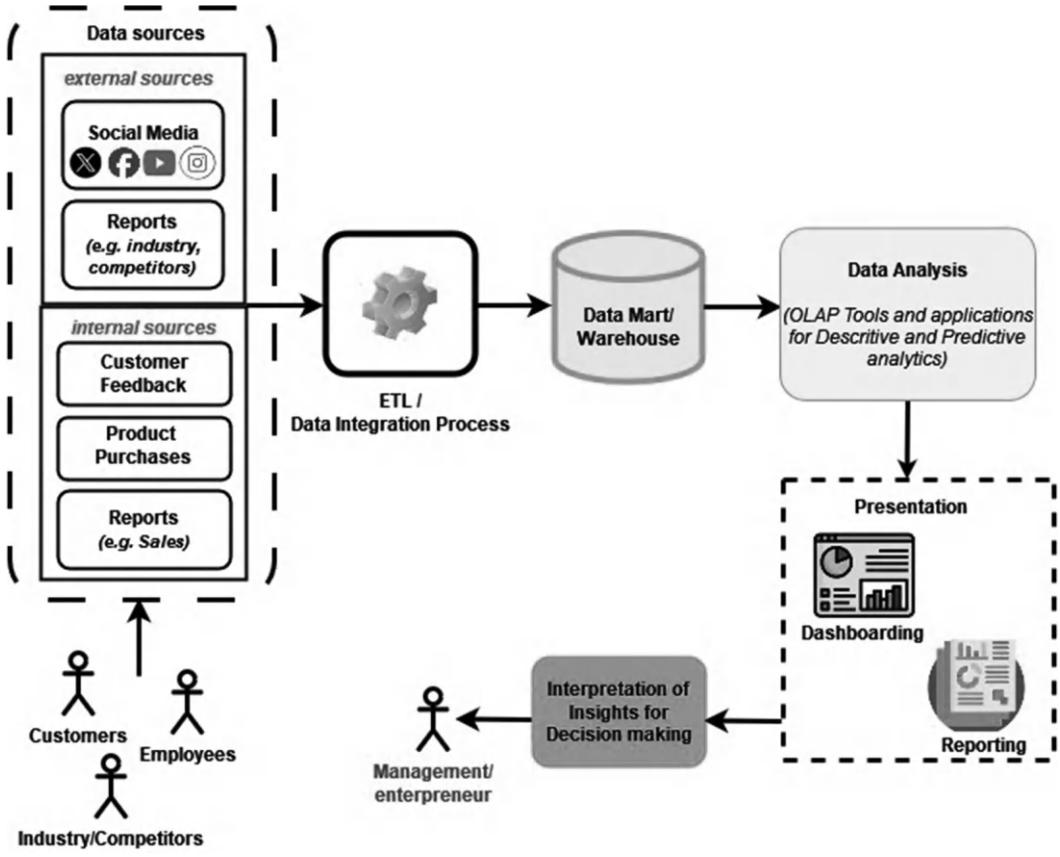


Figure 7.6 Proposed BI approach for exploring entrepreneurial opportunities (author's own creation).

preferences will enable organizations to better understand their customer-base in order to develop personalized solutions (products or services) by evaluating their purchasing behaviors, rationale for product or service selection or choice, and their pain points. Additionally, the understanding obtained based on the market segmentation can yield strategic areas to explore entrepreneurial opportunities (Zhang et al., 2020).

BI for Feedback and Performance Monitoring

Through the monitoring of feedback from consumers and the performance of products and services, entrepreneurs can effectively predict the likelihood of customers' behavior, enabling them to strategize on which service or product to provide—at this period, to which market, location or region, and at the best price to maximize profit. This can be easily done by

applying BI strategies to review the response of consumers on specific or similar services and products, and the possibility of the same effect and benefits being derived when similar services or products are introduced (Bharadiya, 2023; Sharda et al., 2018).

BI for Trend and Competitor Analysis

BI strategies such as dashboards can be applied to observe market trends and dynamics in product and service performance concerning customers' preferences and demographics within an organization (Bharadiya, 2023). New and existing entrepreneurial opportunities can be discovered based on emerging trends and current market dynamics that are identified, leading to new business, or development of new products or services for existing organizations (Khatuwal & Puri, 2022; Khalid et al., 2020). Similarly, by analysing competitors' operations, organizations can explore existing markets that may be providing specific products and services to some targeted market segment. These may reveal new insights into areas that underserved, or relatively unexplored, creating openings of viable entrepreneurial opportunities (Khalid et al., 2020; Khatuwal & Puri, 2022; Zhang et al., 2020).

BI for Market Research

As a business strategy, organizations explore new opportunities for entrepreneurship by allocating resources to investigate into strategies of their competitors, preferences of consumers, industry trends and dynamics, and prevailing market trends (Yafooz et al., 2020). BI approaches can be leveraged for performing market research analysis to discover dynamics of consumers based on their demographics, market segment, product or service choices, purchasing history and power, and geographical distribution. The objective is to predict consumer behavior, market fluxes, economic trends, demand patterns in order to identify opportunities to explore and develop tailor-made products and services for niche markets (Yafooz et al., 2020; Zhang et al., 2020).

Conclusion

This chapter has presented a comprehensive exploration of entrepreneurial opportunities through the lens of AI-driven strategies and techniques.

Employing a scoping review approach, the study has delved deep into the phenomenon, aiming to understand and leverage AI-driven approaches for data scraping, analysis, and exploration of entrepreneurial opportunities. The exponential growth of digital data generation and propagation has posed both challenges and opportunities for entrepreneurs. With vast volumes and varieties of data available, the scoping review methodology employed in this study has proven invaluable in how insight could be extracted from data toward identifying recurring themes and patterns toward entrepreneurial opportunities. The relevance of this chapter in the context of identifying entrepreneurial opportunities cannot be overstated. By bridging the gap between entrepreneurship and AI, this research contributes to the advancement of knowledge in both fields. The insights gained from this study offer practical implications for entrepreneurs, policymakers, and scholars alike. Entrepreneurs can harness AI-driven strategies and techniques to enhance their decision-making processes, identify emerging trends, and capitalize on untapped opportunities. Policymakers can utilize these insights to formulate policies that foster innovation and entrepreneurship in the digital age. Scholars can build upon this research to further explore the intersection of entrepreneurship and AI, paving the way for continued advancements in both fields.

References

Abor, J., & Quartey, P. (2010). Issues in SME development in Ghana and South Africa. *International Research Journal of Finance and Economics*, *39*(6), 215–228.

Agrawal, R., Wankhede, V. A., Kumar, A., Luthra, S., Majumdar, A., & Kazancoglu, Y. (2022). An exploratory state-of-the-art review of artificial intelligence applications in circular economy using structural topic modeling. *Operations Management Research*, *15*(3), 609–626.

Ajide, F. M., & Ojeyinka, T. A. (2022). Financial development and entrepreneurship: insights from Africa. *Journal of Financial Regulation and Compliance*, *30*(5), 596–617.

Ajide, F. M. (2020). Infrastructure and entrepreneurship: Evidence from Africa. *Journal of Developmental Entrepreneurship*, *25*(03), 2050015.

Allil, K. (2024). Integrating AI-driven marketing analytics techniques into the classroom: pedagogical strategies for enhancing student engagement and future business success. *Journal of Marketing Analytics*, 12 6, 1–27.

Amoah, J., Bruce, E., Shurong, Z., Bankuoru Egala, S., & Kwarteng, K. (2023). Social media adoption in SMEs sustainability: evidence from an emerging economy. *Cogent Business & Management*, *10*(1), 2183573.

Atiase, V. Y., Mahmood, S., Wang, Y., & Botchie, D. (2018). Developing entrepreneurship in Africa: investigating critical resource challenges. *Journal of Small Business and Enterprise Development*, *25*(4), 644–666.

Atsa'am, D. D., Omotehinwa, T. O., Devine, S. N. O., Kolog, E. A., & Dada, O. A. (2023). Extracting the frequent sequential patterns among the factors associated with neonatal birthweight. *Journal of Neonatal Nursing*, *29*(4), 639–644.

Azevedo, B. F., Rocha, A. M. A., & Pereira, A. I. (2024). Hybrid approaches to optimization and machine learning methods: a systematic literature review. *Machine Learning*, 113(7), 1–43.

Bharadiya, J. P. (2023). Machine learning and AI in business intelligence: trends and opportunities. *International Journal of Computer (IJC)*, *48*(1), 123–134.

Brownlee, J. (2020). Data cleaning, feature selection, and data transforms in python. *Machine Learning Mastery*.

Bruce, E., Shurong, Z., Egala, S. B., Amoah, J., Ying, D., Rui, H., & Lyu, T. (2022). Social media usage and SME firms' sustainability: An introspective analysis from Ghana. *Sustainability*, *14*, 9433.

Çelikkol, M., Kitapçi, H., & Döven, G. (2019). Culture's impact on entrepreneurship and interaction effect of economic development level: an 81 country study. *Journal of Business Economics and Management*, *20*(4), 777–797.

Chaturvedi, R., & Verma, S. (2023). Opportunities and challenges of AI-driven customer service. In: Sheth, J.N., Jain, V., Mogaji, E., Ambika, A. (eds) Artificial Intelligence in Customer Service: The Next Frontier for Personalized Engagement (pp. 33–71), https://doi.org/10.1007/978-3-031-33898-4_3

Chapman, A., Missier, P., Simonelli, G., & Torlone, R. (2020). Capturing and querying fine-grained provenance of preprocessing pipelines in data science. *Proceedings of the VLDB Endowment*, *14*(4), 507–520.

Creswell, J. W. (2021). *A concise introduction to mixed methods research*. SAGE publications.

Daraojimba, C., Abioye, K. M., Bakare, A. D., Mhlongo, N. Z., Onunka, O., & Daraojimba, D. O. (2023). Technology and innovation to growth of entrepreneurship and financial boost: a decade in review (2013-2023). *International Journal of Management & Entrepreneurship Research*, *5*(10), 769–792.

Devine, S. N. O., Kolog, E. A., & Atinga, R. (2022). Toward a knowledge-based system for African traditional herbal medicine: a design science research approach. *Frontiers in Artificial Intelligence*, *5*, 856705.

Devine, S. N. O., Kolog, E. A., Sutinen, E., & Sääksjärvi, I. (2019). Knowledge-based Service for African Traditional Herbal Medicine: A Hybrid Approach. *Proceedings of 11th International Conference on Knowledge Management and Information System* (Vienna). 10.5220/0007946400450055

Diaz-Garcia, J. A., Ruiz, M. D., & Martin-Bautista, M. J. (2023). A survey on the use of association rules mining techniques in textual social media. *Artificial Intelligence Review*, *56*(2), 1175–1200.

Dwivedi, Y. K., Hughes, L., Ismagilova, E., Aarts, G., Coombs, C., Crick, T., … & Williams, M. D. (2021). Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research,

practice and policy. *International Journal of Information Management*, *57*, 101994.

Dvouletý, O., Gordievskaya, A., & Procházka, D. A. (2018). Investigating the relationship between entrepreneurship and regional development: case of developing countries. *Journal of Global Entrepreneurship Research*, *8*, 1–9.

Edilia, S., & Larasati, N. D. (2023). Innovative approaches in business development strategies through artificial intelligence technology. *IAIC Transactions on Sustainable Digital Innovation (ITSDI)*, *5*(1), 84–90.

Egala, S. B., Amoah, J., Bashiru Jibril, A., Opoku, R., & Bruce, E. (2024). Digital transformation in an emerging economy: exploring organizational drivers. *Cogent Social Sciences*, *10*(1), 2302217.

El-Adaileh, N. A., & Foster, S. (2019). Successful business intelligence implementation: a systematic literature review. *Journal of Work-Applied Management*, *11*(2), 121–132.

Elavarasan, D., Vincent, D. R., Sharma, V., Zomaya, A. Y., & Srinivasan, K. (2018). Forecasting yield by integrating agrarian factors and machine learning models: A survey. *Computers and electronics in agriculture*, *155*, 257–282.

Farayola, O. A., Abdul, A. A., Irabor, B. O., & Okeleke, E. C. (2023). Innovative business models driven by ai technologies: a review. *Computer Science & IT Research Journal*, *4*(2), 85–110.

Farhoud, M., Bignotti, A., Hamann, R., Kauami, N. C., Kiconco, M., Ghalwash, S., … & Kgaphola, M. (2023). African perspectives on researching social entrepreneurship. *Social Enterprise Journal*, *19*(5), 421–434.

Gangadharan, G. R., & Swami, S. N. (2004, June). Business intelligence systems: design and implementation strategies. In *26th International Conference on Information Technology Interfaces, 2004* (pp. 139–144). IEEE.

Gu, Q., & Han, J. (2013, April). Clustered support vector machines. In *Artificial Intelligence and Statistics* (pp. 307–315). PMLR.

Guarda, T., Santos, M., Pinto, F., Augusto, M., & Silva, C. (2013). Business intelligence as a competitive advantage for SMEs. *International Journal of Trade, Economics and Finance*, *4*(4), 187.

Han, J., Pei, J., & Yin, Y. (2000). Mining frequent patterns without candidate generation. *ACM sigmod record*, *29*(2), 1–12.

Hartmann, P. M., Zaki, M., Feldmann, N., & Neely, A. (2016). Capturing value from big data–a taxonomy of data-driven business models used by start-up firms. *International Journal of Operations & Production Management*, *36*(10), 1382–1406.

Hasan, A. (2023). Ethical Considerations in Mixed Methods Research Design. In *Mixed Methods Research Design for the Built Environment* (pp. 30–43). Routledge.

Heer, J., Mackinlay, J., Stolte, C., & Agrawala, M. (2008). Graphical histories for visualization: Supporting analysis, communication, and evaluation. *IEEE Transactions on Visualization and Computer Graphics*, *14*(6), 1189–1196.

Hou, Q., Han, M., & Cai, Z. (2020). Survey on data analysis in social media: A practical application aspect. *Big Data Mining and Analytics*, *3*(4), 259–279.

Hunt, R. A. (2018). An opportunity space odyssey: historical exploration of demand-driven entrepreneurial innovation. *European Journal of Innovation Management*, *21*(2), 250–273.

Igwe, P. A., Onjewu, A. E., & Nwibo, S. U. (2018). Entrepreneurship and SMEs' productivity challenges in sub-Saharan Africa. In: Dana, L. P., Ratten, V., Honyenuga, B. (eds) African Entrepreneurship. Palgrave Studies of Entrepreneurship in Africa. Palgrave Macmillan, Cham, 189–221. https://doi.org/10.1007/978-3-319-73700-3_9

Indrawati, H. (2020). Barriers to technological innovations of SMEs: how to solve them?. *International Journal of Innovation Science*, *12*(5), 545–564.

Iyer, L. S. (2021). AI-enabled applications towards intelligent transportation. *Transportation Engineering*, *5* (9), 1–11.

Javaid, M., Haleem, A., Khan, I. H., & Suman, R. (2023). Understanding the potential applications of artificial intelligence in agriculture sector. *Advanced Agrochem*, *2*(1), 15–30.

Kanbach, D. K., Heiduk, L., Blueher, G., Schreiter, M., & Lahmann, A. (2023). The GenAI is out of the bottle: generative artificial intelligence from a business model innovation perspective. *Review of Managerial Science*, 18(4), 1–32.

Kansheba, J. M. P. (2020). Small business and entrepreneurship in Africa: the nexus of entrepreneurial ecosystems and productive entrepreneurship. *Small Enterprise Research*, *27*(2), 110–124.

Kasera, S., Gehlot, A., Uniyal, V., Pandey, S., Chhabra, G., & Joshi, K. (2023, March). Right to digital privacy: a technological intervention of blockchain and big data analytics. In *2023 International Conference on Innovative Data Communication Technologies and Application (ICIDCA)* (pp. 1122–1127). IEEE.

Khalid, A. S., Hassan, N. H., Razak, N. A. A. B., & Baharuden, A. F. (2020, January). Business intelligence dashboard for driver performance in fleet management. In *Proceedings of the 2020 11th International Conference on E-Education, E-Business, E-Management, and E-Learning* (pp. 347–351).

Khatuwal, V. S., & Puri, D. (2022, April). Business intelligence tools for dashboard development. In *2022 3rd International Conference on Intelligent Engineering and Management (ICIEM)* (pp. 128–131). IEEE.

Kim, J. D., Ohta, T., & Tsujii, J. I. (2008). Corpus annotation for mining biomedical events from literature. *BMC Bioinformatics*, *9*, 1–25.

Kim, M. J., Hall, C. M., & Chung, N. (2024). The influence of AI and smart apps on tourist public transport use: applying mixed methods. *Information Technology & Tourism*, *26*(1), 1–24.

King, R. D., Orhobor, O. I., & Taylor, C. C. (2021). Cross-validation is safe to use. *Nature Machine Intelligence*, *3*(4), 276–276.

Kolog, E. A., & Montero, C. S. (2018). Towards automated e-counselling system based on counsellors emotion perception. *Education and information technologies*, 23, 911–933.

Kolog, E. A., Devine, S. N. O., Egala, S. B., Amponsah, R., Budu, J., & Farinloye, T. (2022). Rethinking the implementation of artificial intelligence for a sustainable education in Africa: Challenges and solutions. In *Management and Information Technology in the Digital Era*, 29, 27–46. Emerald Publishing Limited.

Kolog, E. A., Owusu, A., Devine, S. N. O., & Entee, E. (2020). Data avalanche: Harnessing for mobile payment fraud detection using machine learning. In *Handbook of Research on Managing Information Systems in Developing Economies* (pp. 28–49). IGI Global.

Kopf, S. (2020). "Rewarding good creators": corporate social media discourse on monetization schemes for content creators. *Social Media + Society*, *6*(4), 2056305120969877.

Li, J., Weng, J., Shao, C., & Guo, H. (2016). Cluster-based logistic regression model for holiday travel mode choice. *Procedia Engineering*, *137*, 729–737.

Liu, H., Chen, X., & Liu, X. (2022). A study of the application of weight distributing method combining sentiment dictionary and TF-IDF for text sentiment analysis. *IEEE Access*, *10*, 32280–32289.

Mellinger, C. D., & Hanson, T. A. (2022). Research data. In *The Routledge Handbook of Translation and Methodology* (pp. 307–323). Routledge.

Mafimisebi, O. P., & Ogunsade, A. I. (2022). Unlocking a continent of opportunity: Entrepreneurship and digital ecosystems for value creation in Africa. *FIIB Business Review*, *11*(1), 11–22.

Moşteanu, N. R. (2023). Navigating the intersection of sustainability and intelligent automation: Opportunities and challenges for entrepreneurs. *Human Resources Management and Services*, *5*(1), pp. 1–11.

Nautiyal, R., Jha, R. S., Kathuria, S., Chanti, Y., Rathor, N., & Gupta, M. (2023, September). Intersection of Artificial Intelligence (AI) in Entertainment Sector. In *2023 4th International Conference on Smart Electronics and Communication (ICOSEC)* (pp. 1273–1278). IEEE.

Ndagi, A., & Salihu, A. A. (2019). Technology entrepreneurship and fourth industrial revolution era. *LAPAI International Journal of Management and Social Sciences*, *11*(1), 142–153.

Nkontwana, P., & Stam, E. (2023). Entrepreneurial ecosystems for the Africa we want. *USE Working Papers Series*, *23*(05), 1–28.

Ning, E. N. (2021). Entrepreneurship and economic development in Africa: a Paradox. In *Enterprise and Economic Development in Africa* (pp. 15–37). Emerald Publishing Limited.

Ogunmokun, A. E. (2018). Entrepreneurship: driving force to sustainable development in developing regions. *International Journal of Business Marketing and Management*, *3*(11), 40–48.

Ojo, A. O., & Oluwatayo, I. B. (2015). Entrepreneurship as Drivers of Growth, Wealth Creation and Sustainable Development in Nigeria. *Socioeconomica*, *4*(8), pp. 325–332.

Okrepilov, V. V., Kovalenko, B. B., Getmanova, G. V., & Turovskaj, M. S. (2022). Modern trends in artificial intelligence in the transport system. *Transportation Research Procedia*, *61*, 229–233.

Park, L. S. C., & Peter, S. (2022). Qualitative research: Application of critical realism in social work research: Methodological considerations. *Aotearoa New Zealand Social Work*, *34(*2), 55–66.

Peprah, A. A., & Adekoya, A. F. (2020). Entrepreneurship and economic growth in developing countries: Evidence from Africa. *Business Strategy & Development*, *3*(3), 388–394.

Pustovrh, A., Rangus, K., & Drnovšek, M. (2020). The role of open innovation in developing an entrepreneurial support ecosystem. *Technological forecasting and social change*, *152*, 119892.

Rahman, A. (2019). Statistics-based data preprocessing methods and machine learning algorithms for big data analysis. *International Journal of Artificial Intelligence*, *17*(2), 44–65.

Raj, R., Wong, S. H., & Beaumont, A. J. (2016, November). Business Intelligence Solution for an SME: A Case Study. In *8th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management, IC3K 2016* (pp. 41–50). SciTePress.

Rivera-Santos, M., Holt, D., Littlewood, D., & Kolk, A. (2015). Social entrepreneurship in sub-Saharan Africa. *Academy of Management Perspectives*, *29*(1), 72–91.

Saleh, Y. (2021). ICT, social media and COVID-19: evidence from informal home-based business community in Kuwait City. *Journal of Enterprising Communities: People and Places in the Global Economy*, *15*(3), 395–413.

Schmitt, M. (2023). Automated machine learning: AI-driven decision making in business analytics. *Intelligent Systems with Applications*, *18*, 200188.

Shankar, A., Perumal, P., Subramanian, M., Ramu, N., Natesan, D., Kulkarni, V. R., & Stephan, T. (2024). An intelligent recommendation system in e-commerce using ensemble learning. *Multimedia Tools and Applications*, *83*(16), 48521–48537.

Sharda, R., Delen, D., & Turban, E. (2018). *Business Intelligence, Analytics, and Data Science: A Managerial Perspective*. Pearson.

Sharma, L., & Garg, P. K. (Eds.). (2021). *Artificial Intelligence: Technologies, Applications, and Challenges*. CRC Press.

Shepherd, D. A., & Majchrzak, A. (2022). Machines augmenting entrepreneurs: opportunities (and threats) at the Nexus of artificial intelligence and entrepreneurship. *Journal of Business Venturing*, *37*(4), 106227.

Surbakti, H. E. R. I. S. O. N., & Ta'a, A. (2018). Tacit knowledge for business intelligence framework: A part of unstructured data?. *Journal of Theoretical and Applied Information Technology*, *96*(3), 616–625.

Torre-Bastida, A. I., Del Ser, J., Laña, I., Ilardia, M., Bilbao, M. N., & Campos-Cordobés, S. (2018). Big Data for transportation and mobility: recent advances, trends and challenges. *IET Intelligent Transport Systems*, *12*(8), 742–755.

Vatavu, S., Dogaru, M., Moldovan, N. C., & Lobont, O. (2022). The impact of entrepreneurship on economic development through government policies and citizens' attitudes. *Economic research-Ekonomska istraživanja*, *35*(1), 1604–1617.

Vijayarani, S., & Janani, R. (2016). Text mining: open source tokenization tools-an analysis. Advanced Computational Intelligence. *An International Journal (ACII)*, *3*(1), 37–47.

Vishnoi, S. K., Bagga, T. E. E. N. A., Sharma, A. A. R. U. S. H. I., & Wani, S. N. (2018). Artificial intelligence enabled marketing solutions: A review. *Indian Journal of Economics & Business*, *17*(4), 167–177.

Welbers, K., Van Atteveldt, W., & Benoit, K. (2017). Text analysis in R. *Communication Methods and Measures*, *11*(4), 245–265.

William, P., Shrivastava, A., Chauhan, P. S., Raja, M., Ojha, S. B., & Kumar, K. (2023). Natural Language processing implementation for sentiment analysis on tweets. In *Mobile Radio Communications and 5G Networks: Proceedings of Third MRCN 2022* (pp. 317–327). Singapore: Springer Nature Singapore.

Yafooz, W. M., Bakar, Z. B. A., Fahad, S. A., & M Mithun, A. (2020). Business intelligence through big data analytics, data mining and machine learning. In *Data Management, Analytics and Innovation: Proceedings of ICDMAI 2019*, Volume 2 (pp. 217–230). Springer Singapore.

Yang, Y., See-To, E. W., & Papagiannidis, S. (2020). You have not been archiving emails for no reason! Using big data analytics to cluster B2B interest in products and services and link clusters to financial performance. *Industrial Marketing Management*, *86*, 16–29.

Youssef, A. B., Boubaker, S., & Omri, A. (2018). Entrepreneurship and sustainability: The need for innovative and institutional solutions. *Technological Forecasting and Social Change*, *129*, 232–241.

Zhakupov, Y. K., Berzhanova, A. M., Mukhanova, G. K., Baimbetova, A. B., & Mamutova, K. K. (2023). The impact of entrepreneurship on the socio-economic development of regions. *Business Strategy & Development*, *6*(1), 13–19.

Zhang, C., Wang, X., Cui, A. P., & Han, S. (2020). Linking big data analytical intelligence to customer relationship management performance. *Industrial Marketing Management*, *91*, 483–494.

Zhang, Q., Lu, J., & Jin, Y. (2021). Artificial intelligence in recommender systems. *Complex & Intelligent Systems*, *7*(1), 439–457.

Zhou, L., & Yau, S. (2007). Efficient association rule mining among both frequent and infrequent items. *Computers & Mathematics with Applications*, *54*(6), 737–749.

Zong, C., Xia, R., & Zhang, J. (2021). *Text Data Mining*, 711, 712. Springer.

Chapter 8

Adaptive Entrepreneurship: Leveraging Artificial Intelligence (AI) for Competitive Advantage among Digital Startups

Sulemana Bankuoru Egala, Yaw Afriyie, and Ishaque Mahama

Introduction

The use of Artificial Intelligence (AI) is not new, but recent years have seen a significant increase in its use (Ransbotham et al., 2018). The use of AI spans several spheres of the circular economy, including health, education, supply chain, and transportation, among others (Kiron et al., 2018). As a purpose-driven technology, AI has transcended the traditional economic sectors into other commercial ventures. For instance, entrepreneurship, a key purpose-driven economic driver, has witnessed some significant use of AI to augment entrepreneurial initiatives due to the changing dynamics in emerging businesses (McMullen & Shepherd, 2006). This trajectory has birthed the term *adaptive entrepreneurship* (Han et al., 2021). Adaptive entrepreneurship encompasses the ability of startups to swiftly respond to changes in the market, technology, and consumer preferences (Wang et al., 2020).

DOI: 10.4324/9781003507314-8

It involves continuous learning, experimentation, and adaptation to navigate uncertainties and capitalize on emerging opportunities (Bogachov et al., 2020).

AI technologies, such as machine learning, natural language processing, and predictive analytics, hold immense potential for digital startups. These technologies enable startups to automate tasks, personalize interactions with customers, and extract valuable insights from data to make informed decisions (Dadzie et al., 2024; Ehrenhard et al., 2017). It has been argued that AI is disruptive to a wide range of industries worldwide (Davenport & Ronanki, 2018). Given the changing dynamics of the market and clients' behavior, businesses are forced to adopt adaptive strategies to augment the ideation and implementation of their business ideas. As modern technology advances rapidly, adaptive capabilities are a requirement to keep up with the exponential pace of growth and also serve as a foundation for change in firms, as well as digital transformation (Zhou & Li, 2021).

However, startups that form the core of the business ecosystem, particularly in most developing countries, still lack strategic guidelines to stay on top of the changes and keep up with the exponential pace of change. While AI is becoming increasingly popular, many businesses are still struggling to realize its potential (Fountaine, McCarthy, & Saleh, 2019). Businesses are rapidly reshaping their models and processes using AI and its technologies (machine learning, deep learning, chatbots, neural networks, virtual assistants, etc.) (Pwc, 2019). Organizations and their relationships with their environment have already been transformed by AI. For organizations, AI has created a new way of managing information, and this represents a challenge and an enormous opportunity; but to take advantage of this opportunity, organizations must change their mentality, culture, and skills (Di Francescomarino & Maggi, 2020). Despite these affordances, literature on how digital startups adapt to changing dynamics in the digital business ecosystem is limited. Yet, investments on AI in other segments of the digital business ecosystems, like health, are on the rise given the provenance of the technology toward a competitive edge (Bruce et al., 2022; Frishammar & Parida, 2021). Unfortunately, this trajectory is elusive among digital startups in developing economies.

Coupled with the fact that AI has occasioned a new business perspicuity, the fluidity of innovation in the current business ecosystems seems to be elusive. That is to say, an empirical understanding of adaptive entrepreneurship and how it transforms digital businesses is underexplored. For instance, studies such as (Huikkola et al., 2022; Kaggwa et al., 2023) have

underscored the relevance of AI to businesses with a limited focus on the agility, flexibility, and orientation of emerging businesses. This presents several gaps in the existing literature demanding further exploration. Whereas AI offers promising opportunities for startups, it also presents challenges, including data privacy concerns, ethical considerations, and the need for skilled talent (Brynjolfsson & McAfee, 2017). These factors can be harnessed with effective learning attitudes. Hence this study seeks to explore how organizations leverage AI for their competitive advantage. This study does so by leveraging the dynamic capability theory to understand the phenomenon.

In the rapidly evolving landscape of digital entrepreneurship, startups face multifaceted challenges in navigating competitive markets, adapting to technological advancements, and meeting evolving consumer demands (Bolton et al., 2020). While adaptive entrepreneurship emphasizes the importance of flexibility and innovation, digital startups are increasingly turning to AI as a strategic tool to gain a competitive advantage (Kaggwa et al., 2023). Despite the growing interest in leveraging AI, the question of how digital startups can effectively integrate AI technologies into their operations to enhance their adaptive capabilities and drive sustainable growth remains unanswered. Thus, this study investigates the intersection of adaptive entrepreneurship and AI integration among digital startups in Ghana. This study contributes to exploring best practices and providing actionable insights for startups seeking to thrive in the digital age. The study provides a comprehensive understanding of the strategies, challenges, and implications of adaptive entrepreneurship in the context of AI for competitive advantage among digital startups.

Theoretical Foundation and Hypothesis Development

Dynamic Capability Theory

The dynamic capabilities theory (DCT) is a theory of competitive advantage. It explains how firms can adapt to changing environments and create value from their resources and capabilities (Teece et al., 1997). The theory was birthed upon the shortcomings of the resource-based view theory. The DCT focuses on a firm's ability to adapt and innovate in response to high-velocity environments where the advantages of the innovations have become inherently unpredictable (Marco-Lajara et al.,

2021). Anchored on four dimensions: sensing, seizing, reconfiguring, and learning, the DCT emphasizes the organizational processes and routines that enable firms to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments (Teece, 2014). The DCT has been used extensively in IS research to explore the cultural dimensions in healthcare services (Sermontyte-Baniule et al., 2022), supply chain (Gupta et al., 2020), business intelligence and firm performance (Božič & Dimovski, 2019; Singh & Del Giudice, 2019). Relative to firms' competitive advantage, these studies synthesized the DCT to explore its provenance in driving the competitive advantage of firms (Brink, 2019; Fainshmidt et al., 2019).

This study uses the DCT to unearth how digital startups could derive some competitive advantage from leveraging AI. The adoption of the DCT lies in its ability to provide a framework for understanding how organizations can effectively leverage AI technologies to adapt, innovate, and compete in rapidly changing digital environments. Beyond organizational learning, a key factor in the DCT, this study modifies the theory to include innovation agility, strategic flexibility, and market orientation to provide an understanding of dynamic entrepreneurship. According to Fainshmidt et al. (2019), these factors help examine how variations in AI integration among digital startups influence the competitive advantage of entrepreneurial startups. The theory also helps explain the mechanisms underlying the adaptive entrepreneurial ecosystems in the digital age. Figure 8.1 presents the conceptual framework of the study.

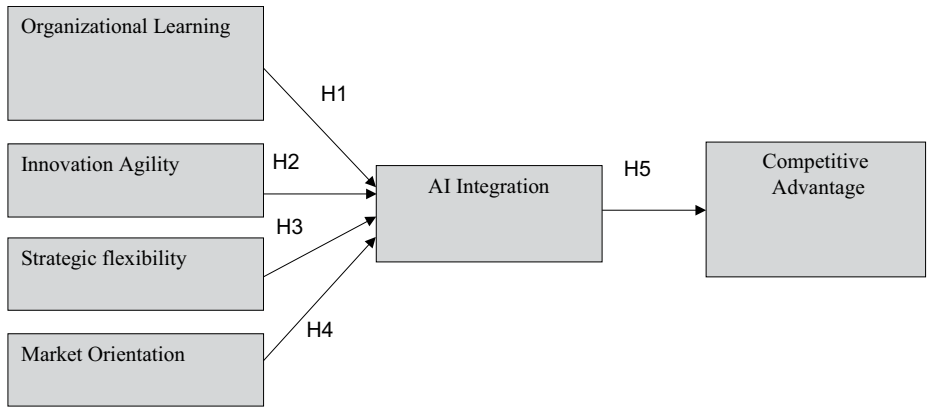


Figure 8.1 Conceptual framework.

Organizational Learning and AI Integration

Organizational learning refers to the process through which firms acquire, assimilate, and apply new knowledge and capabilities (Teece et al., 1997). Organizational learning pertains to how organizations acquire, interpret, and apply knowledge to adapt to changing environments (Giniuniene & Jurksiene, 2015). Relative to AI and entrepreneurship, organizational learning captures the capacity of entrepreneurs to learn about innovation, experiment with new applications, and adapt their strategies based on insights gained from AI-driven analytics and decision-making processes (Fainshmidt et al., 2019). Alet (2023) submits that organizational learning plays a crucial role in integrating AI into business, enabling effective business strategies. Perifanis and Kitsios (2023) add that integrating AI requires a focus on knowledge acquisition, performance improvement, and managing uncertainty and ambiguity. AI's self-learning capabilities can be harnessed through organizational learning, creating a competitive advantage (Jarrahi et al., 2023). Based on the above discussion, the study hypothesizes that:

> *H1: Organizational learning will significantly influence AI integration in digital startups*

Innovation Agility and AI Integration

Innovation agility refers to the ability of an organization to rapidly and effectively adapt to changes, experiment with new ideas, and innovate in response to market dynamics, technological advancements, and customer needs (Denning, 2017). Innovation agility reflects the ability of entrepreneurs to respond rapidly and effectively to emerging opportunities and challenges in the market (Brand et al., 2021; Lichtenthaler, 2020). It encompasses factors such as the speed of innovation, flexibility in adapting to changing customer needs, and the capacity to pivot strategies based on feedback and market dynamics (Upadhyay et al., 2023). Innovation agility can be viewed as a dynamic capability that enables startups to identify and seize opportunities for leveraging emerging technologies, such as AI, to drive innovation and enhance competitiveness. Lichtenthaler's (2020) study elucidated how the fluidity of design influences firms' competitiveness. A recent study by Perifanis and Kitsios (2023) also emphasized that innovative agility has the propensity to influence the rate at which businesses

automate their business processes. Following from the above, we hypothesize that:

H2: Innovation Agility of digital startups will significantly influence their AI integration

Strategic Flexibility and AI Integration

Strategic flexibility refers to the ability of entrepreneurs to adjust their business models, resource allocation, and competitive positioning in response to external threats and opportunities (Muneeb et al., 2023). In the context of AI adoption, strategic flexibility captures how entrepreneurs can dynamically reallocate resources, reconfigure organizational structures, and explore new strategic options enabled by AI technologies (Borges et al., 2021). According to Verdú-Jover et al. (2014), the strategic flexibility of digital startups significantly influences their AI integration, enabling them to adapt and respond to the dynamic digital environment. When done strategically, this integration can create business value through decision support, customer and employee engagement, automation, and new products and services (Borges et al., 2021). Perifanis and Kitsios (2023), however, contend that the successful utilization of AI in business strategies requires the development of AI capabilities and the integration of AI into business and IT strategies. Thus, the study hypothesizes that:

H3: Strategic flexibility of digital startups will significantly influence their AI integration

Market Orientation and AI Integration

Market orientation represents the degree to which entrepreneurs focus on understanding and satisfying customer needs and preferences (Kachouie et al., 2018). It includes factors such as customer responsiveness, market intelligence gathering, and the ability to anticipate and capitalize on market trends. In AI adoption, market orientation reflects how entrepreneurs leverage AI-driven insights to enhance customer engagement, personalize products and services, and identify new market opportunities (Baldegger et al., 2020; Li et al., 2023). Baldegger et al. (2020) for instance found firm orientation to influence the adoption of AI. A prior study by

Renko et al. (2009) intimated that market-oriented digital startups are inherently agile and responsive to changes in the external environment, including shifts in customer preferences, competitive dynamics, and technological advancements. Almansour (2023) affirms that by being attuned to market signals, market-oriented startups can identify the potential benefits of AI integration. This addresses customer needs more effectively, optimizing operations, and staying ahead of competitors. Hence, we hypothesize that:

H4: Market orientation of digital startups will significantly influence their AI integration

AI Integration and Competitive Advantage

AI integration represents the extent to which entrepreneurs incorporate the technology into their business processes and strategies (Upadhyay et al., 2022). It includes factors such as the scope of the applications deployment, level of sophistication, and the integration AI across different functional areas of the venture (Burström et al., 2021). Studies suggest that the use of AI in startups results in more precise, faster, and cost-effective business processes, enabling greater operational efficiency and agility (Burström et al., 2021; Giuggioli & Pellegrini, 2022). Perifanis and Kitsios (2023) mentioned that organizations that leverage AI are able to develop new business models and gain competitive advantages by streamlining operations, improving decision-making processes, and enhancing customer experiences. In effect, AI has profound implications for entrepreneurship, positively impacting entrepreneurs by providing tools and capabilities to drive innovation, optimize resource allocation, and identify market opportunities. Upadhyay et al. (2022) found the integrating of AI technologies into business operations to enhance decision support capabilities to outperform competitors. Similarly, Giuggioli and Pellegrini (2022) found that AI adoption in digital marketing enables organizations to integrate AI into their strategies, leveraging big data analytics and personalized marketing approaches to gain a competitive edge in the market. Based on the above discussions, we hypothesize that:

H5: AI Integration will positively influence the competitive advantage of digital startups

Methodology

Ghana's digital ecosystem has been spurred by the value proposition of digital startups. It is instructive to mention that, digital startups in Ghana have become the beacon of the economy given the government's efforts at digitalizing every facet of the economy (Ansong & Boateng, 2019). Given that, there has been a scale-up of digital startups in the country, the advent of AI and the capabilities it presents to businesses are driving the innovative strategies of startups toward competitiveness. To ascertain this, the current study investigates how leveraging AI by digital startups drives their competitive advantage.

The study sampled digital startups across the country. Doing this, the study designed a structured questionnaire to elicit their responses. The questionnaire was structured in two folds. While the first part focuses on the demographic and psychographic information of the respondents, the second part uses structured questions based on the conceptual framework to investigate the digital entrepreneurs in Ghana's view on how AI could drive their competitive advantages. The measurement constructs, as shown in the Figure 8.1, were organizational learning which involves adapting to changing market conditions through information acquisition, interpretation, and knowledge sharing (Giniuniene & Jurksiene, 2015). While innovation agility measures the startup's ability to rapidly develop and launch new products or services (Brand et al., 2021; Denning, 2017), strategic flexibility measures a startup's ability to pivot their strategies to capitalize on emerging opportunities or mitigate threats (Muneeb et al., 2023). Market orientation on the other hand measures startup's understanding of customer needs, competitor actions, and market trends (Kachouie et al., 2018). Whereas AI integration measures the startups' adoption of AI technologies to enhance efficiency and innovation (Upadhyay et al., 2022), competitive advantage measures a startup's market share, profitability, and customer satisfaction (Giuggioli & Pellegrini, 2022; Burström et al., 2021).

A five-point Likert scale (1-strongly disagree to 5-strongly agree) was used and respondents were required to indicate their level of agreement or disagreement with the statements. Using a non-probability snowballing sampling approach, the online questionnaire was administered across the country through the mail and their social media platforms. This approach was deemed appropriate given that the study sought to gather information

from only managers of digital startups across the country. To conform with the ethical protocols, the participants were asked to sign a consent form as an indication of assuring them of their anonymity. The data collection process took place between December 2023 and February 2024. Before that, a pilot study was conducted to validate all the questions formulated under each construct. All the questions were found to be valid based on the allowable threshold. In the end, 304 valid responses were received and used for the statistical analysis.

While the SPSS was used to analyse the demographic data, SMART-PLS software (Version 4) was used to conduct structural equation modeling (SEM) analysis. Specifically, the study employed the partial least square (PLS-SEM). According to Hair et al. (2019), PLS-SEM is well-suited for analysing complex models with multiple latent variables and observed variables. It can handle models with small sample sizes, non-normal data distributions, and a large number of variables more effectively compared to covariance-based SEM (CB-SEM) (Akuetteh et al., 2023). PLS-SEM integrates the measurement and structural models into a single analysis, allowing researchers to examine both the measurement validity of constructs and the structural relationships among them simultaneously (Egala et al., 2021).

Results

Table 8.1 presents the results of the demographic characteristics of the respondents. Out of the 304 respondents, 49.34% were males and 50.66% females. Among these the majority were in the age groups between 25 and 34 years (39.47%), 35–44 (26.32%), followed by 18–24 (22.37%). It can be concluded that the majority of the managers of startups are within their youthful ages. Relative to their educational level, the majority 64.14% were Bachelor's degree holders followed by Master's degree (21.05%) and 3.16% diploma and professional certificate holders. Again, most of them have been in the business for more than 1 year, specifically between 1 and 3 years (42.76%) and 3 to 5 years 38.49%. Concerning the business models, software as a service was (29.93%), platform and marketplace providers (25.66%), content creators (23.36%) and e-commerce (16.12%). The least were business incubators formed (3.93%) of the total respondents as shown in Table 8.1.

Table 8.1 Demographic Information of Respondents

Demographic		*Frequency (N=304)*	*Percentage (%)*
Gender	Male	150	49.34
	Female	154	50.66
Age Group	18–24 years	68	22.37
	25–34 years	120	39.47
	35–44 years	80	26.32
	45+ years	36	11.84
Education Level	Diploma/Professional certificates	40	13.16
	Bachelor's	195	64.14
	Master's	64	21.05
	Doctorate	5	1.64
Years in Business	Less than 1 year	55	18.09
	1–3 years	110	42.76
	3–5 years	117	38.49
Business Model	E-commerce	49	16.12
	Software as a Service	91	29.93
	Platform and Marketplace	78	25.66
	Content Creators	71	23.36
	Business Incubators	15	4.93

Source: Authors own from demographic information

Assessment of the Measurement Model

The structural model assessment first measured the indicator loadings of the items. Indicators loading as recommended by Hair et al. (2017) must be above 0.7. As presented in Table 8.2, and the corresponding Figure 8.2, all indicators were above the 0.7 value indicating a strong relationship between the observed variables and the latent construct. The internal consistency of the constructs was measured using the composite reliability (CR) and Cronbach's alpha metric. Similar to the factor's loadings, all the factors were above the 0.7 value threshold (Hair et al., 2017). Often, CR values above 0.95 are considered problematic which indicates the measurement items are

Table 8.2 Factors Loadings, Construct Reliability, and Validity

Constructs	*Indicators*	*Loadings*	*Cronbach's alpha*	*Composite Reliability (CR)*	*Average Variance Extracted (AVE)*	*VIF*
Organizational Learning	OL1	0.913	0.882	0.927	0.811	2.498
	OL2	0.965				1.162
	OL3	0.817				1.161
Innovative Agility	IA1	0.879	0.779	0.856	0.666	1.248
	IA2	0.773				2.228
	IA3	0.792				2.149
Strategic Flexibility	SF1	0.955	0.898	0.932	0.821	2.876
	SF2	0.976				1.983
	SF3	0.774				1.325
Market Orientation	MO1	0.984	0.889	0.931	0.820	2.070
	MO2	0.749				2.201
	MO3	0.964				1.754
AI Integration	AII1	0.868	0.935	0.954	0.837	1.897
	AII2	0.897				1.005
	AII3	0.954				4.037
	AII4	0.939				1.117
Competitive Advantage	CA1	0.833	0.862	0.907	0.709	2.294
	CA2	0.855				1.293
	CA3	0.932				1.803
	CA4	0.737				2.436

larger than the computational power of the construct (Egala et al., 2024; Kolog et al., 2024). The AVE which measures the convergence of the latent constructs resulting in values above 0.5 recommended by Hair et al. (2017) also indicates a good convergent validity.

To determine the uniqueness between constructs in SEM, discriminant validity is proposed as a determined metric (Hair et al., 2017). To do this, the Heterotrait-Monotrait (HTMT) cross-loading and the Fornell and Larcker approaches have been suggested. Nonetheless, the HTMT approach is favored due to its ability to effectively establish the uniqueness between constructs (Henseler et al., 2015). Thus, the HTMT approach was utilized in

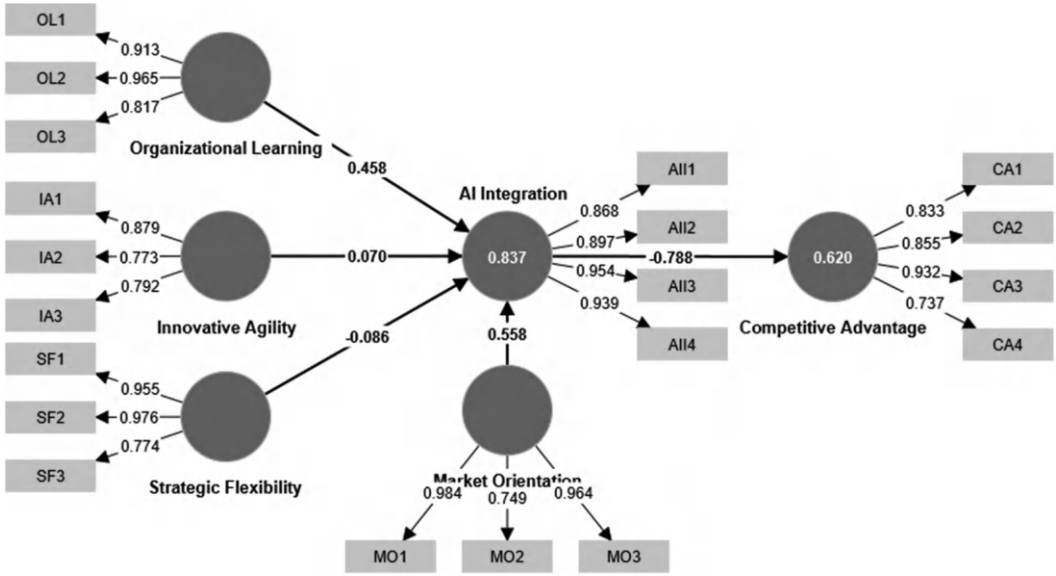


Figure 8.2 Factor loading.

Table 8.3 Discriminant Validity—Heterotrait-Monotrait Ratio (HTMT) – Matrix

Construct	*AII*	*CA*	*IA*	*MO*	*OL*
Competitive Advantage	0.845				
Innovative Agility	0.757	0.664			
Market Orientation	0.873	0.830	0.828		
Organizational Learning	0.880	0.753	0.733	0.756	
Strategic Flexibility	0.687	0.705	0.712	0.844	0.671

Key: OL – Organizational Learning; IA – Innovative Agility; SF – Strategic Flexibility; MO – Market Orientation; AII – Artificial Intelligent Integration; CA – Competitive Advantage

this study. As proposed by Henseler et al. (2015), discriminant validity values should not be above 0.9. As evident in Table 8.3, the values span between 0.6 and 0.88 an indication that all the constructs are conceptually distinct. Hence, there is no discriminant validity problem between each pair of the constructs.

Assessment of the Structural Model and Hypothesis Testing

Following the model assessment, we measured the structural model and tested the formulated hypotheses (see Table 8.4). To do so, the model fit

Table 8.4 Result of Hypothesis Testing

Hypothesis	*Original Sample (O)*	*Mean Value*	*Stand. Deviation*	*T-Value*	*P-Value*	*Interpretation*
H1: OL -> AII	0.458	0.458	0.034	13.642	0.000	Accepted
H2: IA -> AII	0.070	0.070	0.030	2.302	0.021	Accepted
H3: SF -> AII	–0.086	–0.084	0.056	1.526	0.127	Rejected
H4: MO -> AII	0.558	0.556	0.051	10.895	0.000	Accepted
H5: AII -> CA	–0.788	–0.789	0.023	33.808	0.000	Accepted

was determined using the coefficient of determination (R^2) value. From Table 8.5, R^2 value of 0.72 was derived implying the model showed a 72% variation in the dependent variable. Literature affirms that R^2 values of 0.75, 0.50, and 0.25 represent substantial, moderate, and weak predictive accuracy (Hair et al., 2017). Given the 0.72 value derived in this study, it can be deduced that the model was sufficiently substantial, which implies AI integration substantially drives the competitive advantage of digital startup firms in Ghana. Finally, the formulated hypotheses were tested and interpreted using the (t-values >1.645 and *P*-values of 0.05) as the basis for accepting or rejecting the hypothesis.

The effect size of each path was also evaluated using the Cohen's F^2 metric to determine the relative importance of the predictor construct in explaining the variance in the dependent construct. Hair et al. (2017) recommend constructs' F^2 values of 0.02, 0.15, and 0.35 to represent small, medium, and large effect sizes, respectively. These values indicate the magnitude of the relationship between variables (Hair et al., 2019). From the Table 8.6, AI integration has a stronger effect on competitive advantage. While market orientation and organizational learning have strong effect on AI integration, innovative agility and strategic flexibility have moderate

Table 8.5 Goodness of Fit and Predictive Relevance Q-Square (Q^2)

Variables	*Coefficient of determination (R^2)*	*Adjusted R^2*	*Q^2 Predict*	*RMSE*	*MAE*
AI Integration	0.837	0.834	0.533	0.598	0.398
Competitive Advantage	0.720	0.719	0.407	0.639	0.481

Table 8.6 Effect Size (F^2)

Constructs	*AI Integration*	*Competitive Advantage*
AI Integration		1.633
Competitive Advantage		
Innovative Agility	0.151	
Market Orientation	0.384	
Organizational Learning	0.629	
Strategic Flexibility	0.154	

effect on AI integration. Lastly, the predictive relevance (Q^2), which measures the model's ability to accurately predict endogenous constructs based on the exogenous variables, was measured. Consistent with Hair et al. (2017), all the values (column 4, 5, and 6 of Table 8.5) were above 0 which indicates that the indicators have higher predictive relevance. As recommended by Hair et al. (2019), Q^2 values above 0 show that the model has a predictive relevance.

Discussion

The study sought to determine the affordances of AI for digital entrepreneurs. Given that AI is fast revolutionizing several economic spheres, the transformative nature of the technology makes its affordance speculative (Boateng et al., 2022). To ascertain this, this study investigates how digital entrepreneurs in Ghana derive some competitive advantage from the use of AI. Following this, five hypotheses were formulated.

First, the study hypothesizes that *(H1) organizational learning will have a positive relationship with AI integration of digital startups* which was supported. In line with extant studies, organizational learning is a continuum process and when internalized becomes a norm (Nimmi et al., 2022; Salim & Sulaiman, 2013). Nimmi et al. (2022) specifically emphasized that the complexities that confound AI for small businesses require a learning process that has a positive influence on the integration of AI technologies and product innovation. Perifanis and Kitsios (2023) further emphasize the potential for AI to enhance business value, while Hamburg et al. (2019) highlight the positive impact of AI strategy on knowledge-sharing quality

and organizational performance. These findings collectively suggest that organizational learning can indeed have a positive relationship with AI integration in digital startups.

The second hypothesis (H2), *innovation agility of digital startups will positively influence their AI integration*, was also supported and consistent with extant research (Lichtenthaler, 2020; Upadhyay et al., 2022, 2023). For instance, Upadhyay et al. (2023) highlight the positive impact of factors such as performance expectancy, openness, social influence, and generativity on the intention to accept AI in digital entrepreneurship. This intention is further influenced by business innovativeness, which partially mediates the relationship between various factors and AI adoption intention in family businesses (Upadhyay et al., 2023). The importance of agility in innovation processes was emphasized by Lichtenthaler (2020), who suggests that the combination of design thinking and lean startup approaches can enhance the benefits of agile innovation. Perifanis and Kitsios (2023) underscore the potential for AI to enhance business value, particularly in the digital era, but also highlight the complexity of resource orchestration and governance in this context.

Relative to strategic flexibility and AI integration, the study hypothesized that (H3) *strategic flexibility positively influences AI integration in digital startups*. This proposition was not supported. Contrary to the findings, the literature (Borges et al., 2021; Perifanis & Kitsios, 2023) highlights the potential benefits of AI integration in business strategies to foster a culture of flexibility and experimentation with different AI technologies. Upadhyay (2022) and Borges et al. (2021) emphasize the importance of factors such as business innovativeness, entrepreneurial orientation, and AI acceptance intention in the context of digital entrepreneurship. While the literature provides valuable insights into strategic factors influencing AI integration in digital startups, the study found no direct support for the hypothesis.

Again, the study hypothesized that (H4) *market orientation will have a positive influence on the integration of AI* by digital entrepreneurs. As expected, market orientation of digital startups was found to positively influence AI integration into the operations of digital startups. Consistent with extant literature, Upadhyay et al. (2023) and Li et al. (2023) studies affirmed this proposition. Li et al. (2023) for instance concluded that AI technologies enable entrepreneurs to gather and analyse vast amounts of data from various sources, providing deeper insights into customer segments, purchasing patterns, and market trends. Baldegger et al. (2020)

further supported this, showing a correlation between entrepreneurial orientation and the introduction of AI in firms' operations. In line with Upadhyay et al. (2022) conceptualization of AI integration and digital entrepreneurship, the study highlights the positive impact of performance expectancy, openness, social influence, hedonic motivations, and generativity on AI acceptance intention.

To ascertain how AI integration significantly influences the competitive advantage of digital firms, the study posited that (H5) integration of AI in digital startups will generate a positive outcome. The study result showed integrating AI in the operations of digital firms has a significant and positive influence on their competitive advantage. Consistent with recent studies (e.g., Perifanis & Kitsios, 2023; Giuggioli & Pellegrini, 2022; Burström et al., 2021), this hypothesis was supported. Given the manifold advantages AI integration offers, the literature consents that it has the propensity to stimulate productivity and efficiency in the business ecosystem. For instance, AI-powered innovations automate repetitive tasks helping businesses to optimize resource allocations (Upadhyay et al., 2022). Giuggioli and Pellegrini (2022) add that, by leveraging AI technologies for tasks such as product design, prototyping, and testing, startups can accelerate the innovation process, bring new products to market faster, and stay ahead of competitors. The impact of AI on entrepreneurship is further underscored by its role as an enabler for entrepreneurs, particularly in the areas of opportunity, decision-making, performance, and education and research (Giuggioli & Pellegrini, 2022).

Implications

This study has several implications for both research and practice. It must be emphasized that AI is still evolving in most developing economies like Ghana where the technology's capabilities are manifold. Given the rate at which digital entrepreneurs are constantly evolving, integrating competition among these firms has also heightened. Hence, there is a need to employ cutting-edge technology to stem the tide of the dynamism in the digital business ecosystem toward a competitive drive.

First, the study comes with several theoretical implications given that studies on AI and how it is transforming the business ecosystem exist. Yet, limited literature has explored how technology is fast transforming digital startups because of the changing and competitive business ecosystem.

Existing studies have centered on the value proposition and the commercialization of AI. This study is situated in Ghana where AI is still in its formative stage. In response to the call for adaptive entrepreneurship, this study contributes to the literature on adaptive entrepreneurship by exploring how digital startups leverage AI for competitive advantage in dynamic and uncertain environments. Specifically, the study provides an in-depth introspection of how AI drives the competitiveness of digital startups. Through the dynamic capability theory, the study explicates how the capabilities of firms augment their AI integration strategies toward their competitive strategy. This trajectory has seen a limited exploration in literature. Hence, this study contributes significantly to the existing literature on how AI is fast transforming startups in most developing economies. Significantly, the study provides insight into how AI is taking center stage as the fulcrum of entrepreneurship competitiveness. Theoretically, reanimating the dynamic capability theory into the realm of AI and digital entrepreneurship serves as a key contribution. The study contributes to the literature on DCT by examining how digital startups leverage AI to create and sustain competitive advantage in rapidly changing environments.

That is to say, this study's conceptualization of how AI could transform the digital business ecosystem toward a competitive advantage is novel. The study proposes a conceptual framework of adaptive entrepreneurship, which consists of four dimensions: organizational learning, innovation agility, strategic flexibility, and market orientation in transforming AI opportunities. These dimensions extend while reflecting the core processes of DCT and its application to AI innovation. The extension of the DCT to the context of AI-enabled entrepreneurship provides insights into the sources and consequences of adaptive behavior among entrepreneurs in most developing economies.

Practically this study comes with myriads of implications for the entrepreneurial ecosystem. The findings of the study unearth the antecedents and outcomes of adaptive entrepreneurship, such as the role of entrepreneurial orientation, agility, flexibility, and organizational learning. The study offers a novel perspective on the interplay between AI and entrepreneurship, and how AI can be an opportunity for digital startups. This study provides valuable insights for digital startups in developing economies that aim to leverage AI for competitive advantage in the dynamic and uncertain market environment. The study findings suggest that digital startups need to develop adaptive mechanisms, which involve sensing, seizing, and

transforming AI opportunities, as well as overcoming the challenges and barriers associated with AI adoption and integration. Furthermore, considering that there is no framework for the deployment of AI in Ghana, this study offers guidance for policymakers and educators in Ghana on how to foster and support adaptive entrepreneurship in the AI era. The study recommends that policymakers should create a conducive ecosystem for AI innovation, such as providing access to data, infrastructure, funding, and talent, as well as addressing the ethical and legal issues related to AI. The study also suggests that educators should design and deliver relevant and effective curricula and programs that equip digital startups with the necessary skills and knowledge to leverage AI for competitive advantage.

Conclusion

This study sought to investigate the integration of adaptive entrepreneurship in AI toward the competitiveness of digital firms. Set in Ghana, the study draws on the dynamic capability theory to explore how managers of digital firms leverage AI for their adaptive competitive edge. Through an extensive literature review, the study formulated hypotheses through a conceptual framework. Using PLS-SEM, data was collected from 304 managers of digital firms across Ghana through a non-probability snowballing technique. The study found that organizational learning, innovative agility, and market orientation have a positive relationship with AI integration. Even though there was no positive relationship between strategic flexibility and AI integration, it emerged that AI integration significantly influences the competitive advantage of digital entrepreneurs. This study comes with several implications for knowledge and practice.

Limitations

Given the relevance of the study, it came with some limitations. First, the focus of the study was on digital entrepreneurs, which limits the scope even though the inclusion of all other forms of entrepreneurs would have opened up the scope. Furthermore, the study centered on leveraging AI toward the competitive drive of digital startups. Perhaps, future studies could explicate further nuances and fill the above gaps amid other methodologies and theoretical perspectives. Nonetheless, the findings of the study are relevant with several empirical and practical contributions.

References

Akuetteh, A. P., Kolog, E. A., Boateng, R., & Egala, S. B. (2023). Fit and Viable Determinants of Gamification in Christian Religious Studies in Developing Economy Context. *Journal of religion, media and digital culture*, *12*(2–3), 160–184.

Alet, J. (2023). Effective integration of artificial intelligence: key axes for business strategy. *Journal of Business Strategy*, 45(2), 107–114.

Almansour, M. (2023). Artificial intelligence and resource optimization: A study of Fintech start-ups. *Resources Policy*, *80*, 103250.

Ansong, E., & Boateng, R. (2019). Surviving in the digital era–business models of digital enterprises in a developing economy. *Digital Policy, Regulation and Governance*, *21*(2), 164–178.

Baldegger, R., Caon, M., & Sadiku, K. (2020). Correlation between Entrepreneurial Orientation and Implementation of AI in Human Resource Management (HRM). *Technology Innovation Management Review*, *10*(4), 72–79.

Boateng, R., Boateng, S. L., Anning-Dorson, T., & Babatope, L. O. (2022). *Digital Innovations, Business and Society in Africa*. Springer International Publishing, 1st ed, 1–448

Bogachov, S., Kwilinski, A., Miethlich, B., Bartosova, V., & Gurnak, A. (2020). Artificial intelligence components and fuzzy regulators in entrepreneurship development. *Entrepreneurship and Sustainability Issues*, *8*(2), 487.

Bolton, R., Gustafsson, A., McColl-Kennedy, J., Sirianni, N., & Tse, D. K. (2020). Small data for big impact: A review of emerging research using small samples in service research and a call for action. *Journal of Service Research*, 23(4), 397–417.

Borges, A. F., Laurindo, F. J., Spínola, M. M., Gonçalves, R. F., & Mattos, C. A. (2021). The strategic use of artificial intelligence in the digital era: Systematic literature review and future research directions. *International Journal of Information Management*, *57*, 102225.

Božič, K., & Dimovski, V. (2019). Business intelligence and analytics use, innovation ambidexterity, and firm performance: A dynamic capabilities perspective. *The Journal of Strategic Information Systems*, *28*(4), 101578.

Brand, M., Tiberius, V., Bican, P. M., & Brem, A. (2021). Agility as an innovation driver: towards an agile front end of innovation framework. *Review of Managerial Science*, *15*(1), 157–187.

Brink, T. (2019). Orchestration of dynamic capabilities for competitive advantage. *International Journal of Energy Sector Management*, *13*(4), 960–976.

Bruce, E., Shurong, Z., Egala, S. B., Amoah, J., Ying, D., Rui, H., & Lyu, T. (2022). Social media usage and SME firms' sustainability: An introspective analysis from Ghana. *Sustainability*, *14*(15), 9433.

Brynjolfsson, E., & McAfee, A. (2017). The business of artificial intelligence, *Harvard Business Review*, 95(1), 52–59.

Burström, T., Parida, V., Lahti, T., & Wincent, J. (2021). AI-enabled business-model innovation and transformation in industrial ecosystems: A framework, model and outline for further research. *Journal of Business Research*, *127*, 85–95.

Dadzie, E. B., Amoah, J., Egala, S. B., Keelson, S. A., & Bashrisu, A. J. (2024). The impact of procurement training on procurement process efficiency and organizational performance: a PLS-SEM analysis. *International Journal of Entrepreneurial Knowledge*, *12*(1), 24–42.

Davenport, T. H., & Ronanki, R. (2018). Artificial intelligence for the real world. *Harvard Business Review*, *96*(1), 108–116.

Denning, S. (2017). Strategic agility: Using agile teams to explore opportunities for market-creating innovation. *Strategy & Leadership*, *45*(3), 3–9.

Di Francescomarino, C., & Maggi, F. M. (2020). Preface to the Special Issue on Artificial Intelligence for Business Process Management. *Journal on Data Semantics*, *9*(1), 1.

Egala, S. B., Amoah, J., Bashiru Jibril, A., Opoku, R., & Bruce, E. (2024). Digital transformation in an emerging economy: exploring organizational drivers. *Cogent Social Sciences*, *10*(1), 2302217.

Egala, S. B., Boateng, D., & Mensah, S. A. (2021). To leave or retain? An interplay between quality digital banking services and customer satisfaction. *International Journal of Bank Marketing*, *39*(7), 1420–1445.

Ehrenhard, M., Wijnhoven, F., van den Broek, T., & Stagno, M. Z. (2017). Unlocking how start-ups create business value with mobile applications: Development of an App-enabled Business Innovation Cycle. *Technological Forecasting and Social Change*, *115*, 26–36.

Fainshmidt, S., Wenger, L., Pezeshkan, A., & Mallon, M. R. (2019). When do dynamic capabilities lead to competitive advantage? The importance of strategic fit, *Journal of Management Studies*, *56*(4), 758–787.

Fountaine, T., McCarthy, B., & Saleh, T. (2019). Building the AI-powered organization. *Harvard Business Review*, *97*(4), 62–73.

Frishammar, J., & Parida, V. (2021). The four fatal mistakes holding back circular business models. *MIT Sloan Manag. Rev.* 62 (3), 68–72.

Giniuniene, J., & Jurksiene, L. (2015). Dynamic capabilities, innovation and organizational learning: Interrelations and impact on firm performance. *Procedia-Social and Behavioral Sciences*, *213*, 985–991.

Giuggioli, G., & Pellegrini, M. M. (2022). Artificial intelligence as an enabler for entrepreneurs: a systematic literature review and an agenda for future research, *International Journal of Entrepreneurial Behavior & Research*, *29*(4), 816–837.

Gupta, S., Modgil, S., Gunasekaran, A., & Bag, S. (2020, July). Dynamic capabilities and institutional theories for Industry 4.0 and digital supply chain. In *Supply Chain Forum: An International Journal*, 21(3), 139–157. Taylor & Francis.

Hair, J., Hollingsworth, C. L., Randolph, A. B., & Chong, A. Y. L. (2017). An updated and expanded assessment of PLS-SEM in information systems research. *Industrial management & data systems*, *117*(3), 442–458.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, *31*(1), 2–24.

Hamburg, I., O'brien, E., & Vladut, G. (2019, October). Entrepreneurial learning and AI literacy to support digital entrepreneurship. *In Balkan Region Conference on Engineering and Business Education*, *3*(1), 132–144.

Han, J., Ruan, Y., Wang, Y., & Zhou, H. (2021). Toward a complex adaptive system: The case of the Zhongguancun entrepreneurship ecosystem. *Journal of business research*, *128*, 537–550.

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the academy of marketing science*, *43*, 115–135.

Huikkola, T., Kohtamaki, M., Ylimaki, J. (2022). Becoming a smart solution provider: reconfiguring a product manufacturer's strategic capabilities and processes to facilitate business model innovation. *Technovation 118* (December), 1–13.

Jarrahi, M. H., Kenyon, S., Brown, A., Donahue, C., & Wicher, C. (2023). Artificial intelligence: A strategy to harness its power through organizational learning. *Journal of Business Strategy*, *44*(3), 126–135.

Kachouie, R., Mavondo, F., & Sands, S. (2018). Dynamic marketing capabilities view on creating market change. *European Journal of Marketing*, *52*(5/6), 1007–1036.

Kaggwa, S., Akinoso, A., Dawodu, S. O., Uwaoma, P. U., Akindote, O. J., & Osawaru, S. E. (2023). Entrepreneurial strategies for AI startups: navigating market and investment challenges. *International Journal of Management & Entrepreneurship Research*, *5*(12), 1085–1108.

Kiron, D., Prentice, P. K., & Henderson, J. (2018). MIT Sloan Management Review Research Report.

Kolog, E. A., Mensah, I., & Egala, S. B. (2024). Cyberloafing deterrence in the public sector of Ghana. *The Electronic Journal of Information Systems in Developing Countries*, e12316.

Li, D., Pan, Z., Wang, D., & Zhang, L. (2023). A study on artificial intelligence orientation and new venture performance. *Asia Pacific Business Review*, *29*(4), 967–989.

Lichtenthaler, U. (2020). Agile innovation: The complementarity of design thinking and lean start-up. *International Journal of Service Science, Management, Engineering, and Technology (IJSSMET)*, *11*(1), 157–167.

Marco-Lajara, B., Ruiz-Fernández, L., & Seva-Larrosa, P. (2021). Dynamic Capabilities View within the Field of Strategic Management Field: A Bibliometric Analysis. *Contemporary Management Research*, *17*(4), 333–350.

McMullen, J. S., & Shepherd, D. A. (2006). Entrepreneurial action and the role of uncertainty in the theory of the entrepreneur. *Academy of Management Review*, 31(1), 132–152.

Muneeb, D., Khattak, A., Wahba, K., Abdalla, S., & Ahmad, S. Z. (2023). Dynamic capabilities as a strategic flexibility enabler: organizational responsiveness to COVID-19. *Journal of Asia Business Studies*, *17*(4), 824–849.

Nimmi, P. M., Vilone, G., & Jagathyraj, V. P. (2022). Impact of AI technologies on organisational learning: proposing an organisation cognition schema. *Development and Learning in Organizations: An International Journal*, *36*(5), 7–9.

Perifanis, N. A., & Kitsios, F. (2023). Investigating the Influence of Artificial Intelligence on Business Value in the Digital Era of Strategy: A Literature Review. *Information (Switzerland)*, *14* (2), 1–42.

Pwc. (2019). Sizing the prize: Exploiting the AI Revolution, What's the real value of AI for your business and how can you capitalise? PwC's Global Artificial Intelligence Study. https://www.pwc.com/gx/en/issues/data-and-analytics/publications/artificial-intelligence-study.html

Ransbotham, S., Gerbert, P., Reeves, M., Kiron, D., & Spira, M. (2018). Artificial intelligence in business gets real. *MIT Sloan Management Review*. https://sloanreview.mit.edu/projects/artificial-intelligence-in-business-gets-real/

Renko, M., Carsrud, A., & Brännback, M. (2009). The effect of a market orientation, entrepreneurial orientation, and technological capability on innovativeness: A study of young biotechnology ventures in the United States and in Scandinavia. *Journal of small business management*, *47*(3), 331–369.

Salim, I. M., & Sulaiman, M. (2013). Examination of the relationship between organisational learning and firm's product innovation. *International Journal of Innovation and Learning*, *13*(3), 254–267.

Sermontyte-Baniule, R., Pundziene, A., Giménez, V., & Narbón-Perpiñá, I. (2022). Role of cultural dimensions and dynamic capabilities in the value-based performance of digital healthcare services. *Technological Forecasting and Social Change*, *176*, 121490.

Singh, S. K., & Del Giudice, M. (2019). Big data analytics, dynamic capabilities and firm performance. *Management Decision*, *57*(8), 1729–1733.

Teece, D. J. (2014). A dynamic capabilities-based entrepreneurial theory of the multinational enterprise. *Journal of International Business Studies*, *45*, 8–37.

Teece, D. J., G. Pisano, and A. Shuen (1997). Dynamic capabilities and strategic management, *Strategic Management Journal 18*(7), 509–533.

Upadhyay, N., Upadhyay, S., Al-Debei, M. M., Baabdullah, A. M., & Dwivedi, Y. K. (2023). The influence of digital entrepreneurship and entrepreneurial orientation on intention of family businesses to adopt artificial intelligence: examining the mediating role of business innovativeness. *International Journal of Entrepreneurial Behavior & Research*, *29*(1), 80–115.

Upadhyay, N., Upadhyay, S., & Dwivedi, Y. K. (2022). Theorizing artificial intelligence acceptance and digital entrepreneurship model. *International Journal of Entrepreneurial Behavior & Research*, *28*(5), 1138–1166.

Verdú-Jover, A. J., Alós-Simó, L., & Gómez-Gras, J. M. (2014). Strategic flexibility in e-business adapters and e-business start-ups. Progress in IS, in: Francisco J. Martínez-López (ed.), *Handbook of Strategic e-Business Management*, edition 127, 139–155, Springer.

Wang, Y., Liu, C., Liu, L., & Ding, X. (2020). *Journal of Physics: Conference Series*, *1552*(1), 012130.

Zhou, K.Z., & Li, C. B. (2021). How strategic orientations influence the building of dynamic capability in emerging economies. *Journal of Business. Research. Agement Perspective. Intell. Syst. Account. Financ. Manag.*, *28*, 224–231. https://doi.org/10.1002/isaf.1503

Chapter 9

Digital Transformation and Remote Work: A Review of the Role of AI in Shaping the Future of Entrepreneurship

Divine Q. Agozie, Abeeku S. Edu, Jerry Owusu Sarfo, Edem K. Lagble, Makija John, and John P. Adjadeh

Introduction

The contemporary business and employment landscape has been significantly influenced by the symbiotic relationship between entrepreneurship, artificial intelligence (AI), and remote working paradigm (Bonfanti et al., 2024). Entrepreneurship in the context of remote work has emerged as a transformative force, reshaping the landscape of modern business and employment. This evolution is underscored by the symbiotic relationship between entrepreneurial endeavors and the flexibility inherent in remote work structures (Salkenov et al., 2022). A notable surge in remote entrepreneurs is evident, as highlighted by the Global Entrepreneurship Monitor (GEM) report, capitalizing on technological advancements that facilitate seamless virtual collaboration (Zahari et al., 2024).

The transformative shift in work, catalyzed by the intersection of entrepreneurship and digital technologies, is evident in recent developments and trends (Battisti et al., 2022). Innovative digital tools, including robust communication platforms, cloud-based collaboration tools, advanced project

DOI: 10.4324/9781003507314-9

management applications, and AI, have empowered businesses to transcend geographical constraints, ushering in an era of increasing remote work (Zahari et al., 2024). Remote working has become increasingly popular, with approximately 70% of global professionals working remotely at least once a week, according to a survey by Switzerland-based IWG. The recent global pandemic, geopolitical tensions, and environmental challenges have further disrupted economic and entrepreneurial ecosystems, compelling businesses to respond via innovative production paradigms like remote working schemes to manage unprecedented challenges (Ratten, 2023).

Amid these disruptions, and changing work paradigms, many businesses and entrepreneurs have primarily turned to digital technologies to innovate and particularly adapt to new business models. This shift, accelerated by factors such as the COVID-19 pandemic, has also led to a surge in the use of artificial intelligence (AI) tools, making artificial intelligence the "new normal" (Zeuge et al., 2023; Corvello et al., 2022). Entrepreneurs are capitalizing on this trend to minimize operational costs and offer employees a better work-life balance. The integration of AI with remote work is not merely a response to global pressures but a strategic alignment that amplifies innovation, contributing to economic resilience (Zeuge et al., 2023). Thus, AI tools today play a crucial role in organizational transformation, enabling businesses and entrepreneurs alike to be at the forefront of innovation (Matytsin et al., 2023). AI processes automate routine tasks, freeing up time and human capital, thus re-humanizing work and fostering creativity.

Despite these positive shifts, the nuanced role of AI tools in entrepreneurship and remote work is still underexplored (Giuggioli & Pellegrini, 2023; Matytsin et al., 2023). For instance, research on remote work has brought attention to the impact of diverse factors and home conditions on employee productivity, and not necessarily AI (Aleem et al., 2023; Ratten, 2023). Additionally, the theoretical frameworks employed in the remote work context vary, reflecting different perspectives (Adisa et al., 2023). One frequently utilized theory for examining individual performance in remote work is self-efficacy theory, which elucidates anticipated employee behavior in task execution (Staples et al., 1999). This theory becomes especially pertinent in situations where employees are granted autonomy in their work processes. In the context of the post-pandemic era, research on remote work and workers' well-being highlight multiple theories to comprehend the elements contributing to the success of remote work (Wheatley et al., 2021). These include determination theory, dialogical self-theory, communication theory, and others, all directed toward scrutinizing the

impact and effectiveness of remote work. Notably, some studies have embraced a grounded theory approach to capture the dynamics of employees' experiences and challenges in the context of remote work (Wang et al., 2021).

Furthermore, investigations into remote work have predominantly highlighted the correlation between self-efficacy and remote work. Notably, findings suggest that heightened self-efficacy among SME entrepreneurs correlates with enhanced creativity in their business practices (Giuggioli & Pellegrini, 2023). The examination of knowledge and technology's impact on self-efficacy reveals a direct influence on the potential adoption of remote work by entrepreneurs (Giuggioli & Pellegrini, 2023). Additionally, studies exploring the role of technological tools, such as mobile technologies, in remote work indicate that technology positively influences performance in remote work. These inquiries collectively underscore the importance of technology for self-efficacy in shaping entrepreneurs' ability to adapt to and thrive in different work scenarios (Donnelly & Johns, 2021; Sahut & Lissillour, 2023). However, the role of technology like AI tools has little amplification.

Thus, the significance of this review study lies in scrutinizing how AI influence entrepreneurship in the remote work context. Specifically, this review aims to offer insights into what role AI plays in driving the adoption of remote work in entrepreneurial activities, and how the integration of AI impacts the nature of entrepreneurial ventures in remote settings. Three broad categorizations in line with Giuggioli and Pellegrini (2023) representing the impact of AI on entrepreneurship have been identified: "productivity," "entrepreneurial decision-making," "performance and future research and education trends." These themes will form the basis for reviewing the literal contributions within the "AI-enabled entrepreneurial era." The goal of this is to create a framework for amplifying the impact of AI on entrepreneurship in remote work environments. The framework is expected to offer valuable insights for future research, proving useful for researchers, entrepreneurs, and aspiring entrepreneurs. The remaining sections of this study will be organized to explore the relationship between AI and entrepreneurship, present the methodology, analyse cluster results, synthesize a framework, and conclude with limitations and implications for future research.

Overall, this study makes relevant theoretical contributions to synthesizing existing literature on entrepreneurship and AI within the remote work context, highlighting the role of AI in entrepreneurship in terms of productivity, decision-making, performance, and future trends.

Concept Explanation

Definition of AI and entrepreneurship

Entrepreneurship, a pivotal subject in business management research, extends its influence to other domains such as science, arts, and engineering (Kirzner, 2009). The extensive body of literature, comprising numerous articles and books, attests to the field's academic validation (Apostolopoulos et al., 2021). Typically, entrepreneurship is conceptualized as a process that generates value, thereby exerting a positive societal impact (Jones et al., 2020). One of the most renowned definitions, provided by Shane and Venkataraman (2000: 218), describes entrepreneurship as the exploration, evaluation, and exploitation of opportunities to create future goods and services. This definition underscores opportunity recognition as a fundamental aspect of entrepreneurship, although it can be framed in various ways (Lounsbury & Glynn, 2001), such as focusing on emerging markets or technological innovations (Phan et al., 2009).

Artificial intelligence (AI) encompasses machines designed to execute tasks that typically require human intelligence, interpret and learn from external data, and adapt their operations based on this learning to achieve specific objectives. The prevalent form of AI, machine learning, predominantly involves supervised learning, where the AI system is trained using human-labeled data.

Both AI and entrepreneurship serve as tools whose combined application and utilization can significantly influence humanity. Although research on entrepreneurship and AI has advanced independently, these areas have largely developed in isolation. AI, a groundbreaking technological advancement, has the potential to transform markets and societies, contingent upon its deployment by entrepreneurs. Entrepreneurs can leverage AI to enhance their decision-making and actions, thereby pursuing opportunities for substantial gains.

Artificial Intelligence in Entrepreneurship

The emergence of new entrepreneurial models like personalized e-commerce, chatbots, Industry 4.0, and IOTs mark a turning point in merging the virtual and real worlds, emphasizing engineering applications like robotics and digitalization. However, the emergence of

technologies like intelligence (AI) has garnered significant attention. Recent advancements in techno-driven production paradigms like the Industry 4.0 further underscores this viewpoint and have also catapulted AI to the forefront, making it a dominant research area with wide-ranging applications across diverse domains requiring human intelligence (Blanco-González-Tejero et al., 2023). AI's central role unfolds prominently in smart production environments, like fully connected manufacturing systems designed for minimal human intervention. From data generation to analysis, AI governs the entire system, managing tasks such as scheduling interventions, designing workflows, ensuring quality control, and autonomously handling programming and maintenance activities (Gupta et al., 2023; Wuisan et al., 2023).

The integration of AI with the Internet of Things (IoT) is equally significant, influencing an extended network of physical devices capable of remote interaction and communication (Sjödin et al., 2021). In the IoT context, AI processes extensive data volumes, producing valuable outcomes and facilitating seamless communication across diverse software languages enforced by IoT devices (Putri et al., 2023). The impact of AI extends further into augmented reality (AR), where real and virtual 3D objects seamlessly blend in real-time. In this domain, AI enhances image processing accuracy and robustness, as seen in the AR paradigm (Liu et al., 2022). Additionally, AI's integration with blockchain, a distributed ledger ensuring secure and transparent record-keeping of digital assets (Townsend & Hunt, 2019), further solidifies its role in operating on trusted, digitally signed, and securely shared data, ultimately enhancing trust and credibility (Shiyal et al., 2019).

Relative to technological entrepreneurship, AI becomes a linchpin in new venture creation processes (Short & Short, 2023). Its influence permeates how entrepreneurs develop, design, and scale their companies throughout the entrepreneurial journey, presenting AI as a radical innovation empowering entrepreneur to explore new opportunities and introduce innovative products or services through entrepreneurial avenues (Wang et al., 2023b). Moreover, AI's impact on decision-making systems adopted by entrepreneurs enhances decision quality in terms of effectiveness and efficiency, subsequently driving operational performance (Wang et al., 2023b). AI tools not only boost the performance of AI-driven business but also encourage the integration of AI-based solutions into traditional business processes and models (Cao et al., 2021).

Method

The systematic literature review methodology constitutes the systematic process of gathering, organizing, and evaluating existing literature to comprehensively review established concepts. This approach, exemplified in works such as Ali (2019) and embraced by various authors including Ribeiro-Navarrete et al. (2021) and Nyagadza (2022), is widely employed to categorize topics, establish theoretical frameworks, and analyse bibliometric elements. To conduct a precise examination of entrepreneurship and AI within the remote working context, and to consolidate relevant studies, this study employs an iterative search method outlined by Tranfield et al. (2003). According to Tranfield et al. (2003), the iterative search method for conducting a systematic review involves three main stages. The first stage, planning the review, begins with identifying the need for a review (Phase 0), preparing a proposal (Phase 1), and developing a review protocol (Phase 2). The second stage, conducting the review, encompasses identifying relevant research (Phase 3), selecting appropriate studies (Phase 4), and assessing the quality of these studies (Phase 5). This stage also includes data extraction and monitoring progress (Phase 6), followed by data synthesis (Phase 7). The final stage, reporting and dissemination, involves compiling the report and formulating recommendations (Phase 8) and ensuring the evidence is put into practice (Phase 9).

To identify articles for this review, the authors defined query terms related to "entrepreneurship" and "artificial intelligence," encompassing various forms of entrepreneurship like "entrepreneur*" and "venture creation," and AI-related terms such as "AI," "A.I.," "IOTs," and "Machine learning." The final query formed was: ("entrepreneur*" OR "venture* creation") AND ("artificial intelligence" OR "AI" OR "A.I."). These query terms were carefully chosen in line with prior examinations (Giuggioli & Pellegrini, 2023). This review focuses on English peer-reviewed journal articles published between January 1, 2020, up to January 30, 2024, across Google Scholar and Web of Science searching for terms in the title, abstract, and keywords of articles only. The choice of Google Scholar and Web of Science databases for this study is motivated by accessibility constraints. In addition, the period used, marks the COVID into post-COVID era, which has been a time of exponential adoption and utilization of digital technologies in entrepreneurship (Modgil et al., 2022). Further, the time frame selected for retrieving the publication highlights the period of heightened adoption of the remote work paradigm in recent times, as a result of the COVID-19

global pandemic. In line with Paul et al. (2021), this study adheres to the Scientific Procedures and Rationales for Systematic Literature Review (SPAR-4-SLR) protocol, designed for transparency, rigor, exhaustiveness, and robustness. The SPAR-4-SLR protocol involves defining clear research objectives, devising a comprehensive search strategy, screening articles based on predetermined criteria, extracting data using standardized forms, assessing study quality, synthesizing data to identify patterns and gaps, interpreting results, critically appraising literature, writing a structured report, and subjecting it to peer review.

Thus, in this study, the SPAR-4-SLR is condensed into three broad stages: assembling, which defined and identified the type of publications using a predetermined search strategy, such as, setting the review's period and search keywords. Next stage is arranging, which encompassed the organization, standardizing, and filtering of the literature with inclusion and exclusion criteria. The final stage, assessing, focuses on analysing and synthesizing the collected literature to generate insights, identify gaps, and research opportunities, while also visualizing results and evaluating study limitations. These stages are expressed in a flow chart Figure 9.1.

Initially, a search on Google Scholar yielded 457 papers, while 255 were found on the Web of Science databases. To refine the search to focus on remote working, titles were adjusted to reduce the initial results significantly and duplicate studies (202) were removed, resulting in 255 papers. Subsequently, abstracts were reviewed, leading to the exclusion of 83 technical AI studies, and 49 lacked AI relevance, 44 did not address entrepreneurship, 13 were not related to remote working, and 8 did not necessarily connect the three topics. This process left 58 articles: 31 theoretical, 5 qualitative empirical, and 22 quantitative empirical studies.

Results of Literature Search and Review

The systematic literature review encompassed 58 papers categorized into three broad categories, each shedding light on different facets of AI's influence on entrepreneurship within remote working context. These three categories, although distinct, acknowledge the potential overlap of papers across multiple groups based on their thematic focus. The first category, "entrepreneurial opportunity," comprised 11 papers that delved into AI's role in generating new entrepreneurial prospects. The second category, "decision-making," encompassed 24 papers that investigated how AI

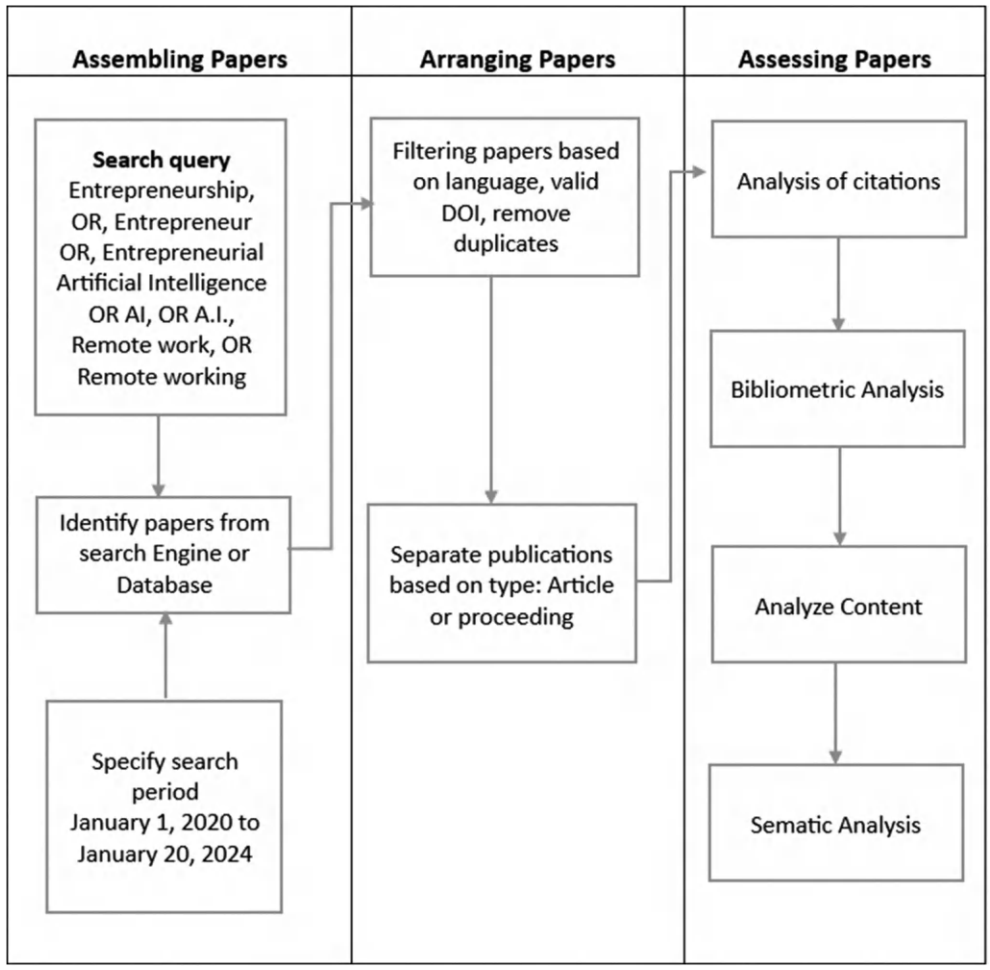


Figure 9.1 Systematic review protocol (SPAR-4-SLR) adapted from Blanco-González-Tejero et al. (2023).

enhances entrepreneurs' predictive capabilities and decision-making skills. The third category, "performance and future trends," included 23 papers examining AI's potential to elevate firm performance and what future trends and research implications exist for the future of entrepreneurship and AI.

These categorizations collectively illustrate stages in the AI-enabled entrepreneurial process in remote working. Within this framework, the sequential phases of "opportunity," "decision-making," and "performance" signify key stages in the entrepreneurial journey empowered by AI. Additionally, the future trend dimension serves as an accelerant, positively influencing the entire process by facilitating continuous learning and knowledge dissemination.

Entrepreneurial Opportunities

The analysis herein categorizes entrepreneurs engaging in digital transformation through AI as part of the "opportunity" group. Table 9.1 outlines research included in this "entpreneurial opportunities" category. The research show that these entrepreneurs encounter various business opportunities and are tasked with developing new strategic options to reshape their business models in response. AI tools are examined to enhance traditional approaches, resulting in positive outcomes such as the introduction of new products/services and business models. This trend underscores the role of AI and big data as external enablers of entrepreneurial activities, facilitating the introduction of new economic activities and products/services through entrepreneurial means (Modgil et al., 2022).

The emergence of the AI revolution is anticipated to have a profound impact, surpassing both the Industrial and Digital revolutions combined. This technological shift is expected to create significant opportunities for growth and profitability, albeit accompanied by challenges and increased competition from startups. The simplicity of venture capital and crowdsourcing processes will facilitate the development of breakthrough ideas from diverse sources (Chatterjee et al., 2022).

Moreover, AI's potential to address specific problems through applications and verticals like messaging bots and intelligent virtual assistants presents new opportunities for entrepreneurs. However, the effective design of business models is crucial for successfully bringing useful technologies to the market (Polas & Raju, 2021).

Another stream of studies highlights AI tools in conjunction with other technologies, e.g., Internet of Things, Big data utilization. Big data, IOTs combined with AI technology, is reshaping entrepreneurship. An emerging subcategory that derives products or services from sensor-collected data. This evolution in digital entrepreneurship underscores the innovation potential inherent in both large organizations and dispersed individuals from diverse backgrounds participating in entrepreneurial activities (Bickley et al., 2021).

Furthermore, the IoT's ability to generate vast amounts of data transforms how entrepreneurs interact with employees, clients and deal with entrepreneurial challenges, necessitating adjustments in business models to address new opportunities and threats. Big data analytics, particularly when applied to entrepreneurial work, promises to enhance digital technologies such as AI and the IoT, leading to the development of effective digital business models supporting innovation in products, processes, and business models (Dubey et al., 2020).

Table 9.1 Papers Included in the "Entrepreneurial Opportunities" Category

Study	*Purpose*
Usman et al. (2024)	Explores the role of AI in market analysis, highlighting how advanced data analytics and predictive modeling contribute to informed decision-making and market forecasting. How AI-driven innovations in product development emphasize the acceleration of ideation, prototyping, and customization through machine learning algorithms. The paper scrutinizes the influence of AI on customer engagement and relationship management.
Suraji & Ali (2024)	This research analyses the impact of AI adoption in businesses, focusing on the Indonesian business context.
Obschonka & Audretsch (2020).	This paper presents some reflections and a collection of papers on the role of AI and big data for this emerging area in the study and application of entrepreneurship research.
Modgil et al. (2022)	This study focuses on understanding emerging areas and technologies for digital entrepreneurship.
Coombs (2020)	This article reviews arguments in favor of COVID-19 increasing the level of IA adoption and possible counter-arguments.
Sjödin et al. (2021)	This paper explores how manufacturing firms can develop AI capabilities and innovate their business models to scale AI in digital servitization. It presents empirical insights from a case study of six leading ventures engaged in AI.
Wamba-Taguimdje et al. (2020)	The main purpose of our study is to analyse the influence of Artificial Intelligence (AI) on firm performance, notably by building on the business value of AI-based transformation projects.
Di Vaio et al. (2022)	The aim of the paper is to investigate the artificial intelligence (AI) function in agri-food industry, as well as the role of stakeholders in its supply chain.
Chatterjee et al. (2022)	The study also investigates the moderating role that adopting artificial intelligence (AI)-customer relationship management (CRM) capability and strategic planning have in corporate digital entrepreneurship.
Polas & Raju (2021)	The prime concern of this study is to explore how technology influences entrepreneurial marketing decisions during the world pandemic (COVID-19).
Enholm et al. (2022)	This study provides a systematic literature review that attempts to explain how organizations can leverage AI technologies in their operations and elucidate the value-generating mechanisms.

Decision-Making Category

In the discussion of the "decision-making" category within this review framework, the research outlined in Table 9.2 highlight the transformative role of AI in leveraging available data to facilitate accurate predictions. The collaborative strengths of humans and machines are emphasized, with humans excelling in scenarios with limited data while machines demonstrate superior efficacy in analysing extensive data sets. This synergy empowers entrepreneurs with AI capabilities to make informed decisions, marking a significant advancement in decision-making processes (Amoako et al., 2021).

This category's analysis underscores the increasing significance of datafication in entrepreneurship, particularly in predictive analytics, as firms amass large volumes of data. This trend emphasizes the growing importance of leveraging modern AI-driven and data science methodologies to enhance decision-making processes and provide valuable decision support to entrepreneurs (Bickley et al., 2021). Notably, the application of deep learning techniques emerges as a promising avenue for improving decision support within core business operations.

Moreover, the papers shed light on the role of data-driven approaches in elucidating crucial entrepreneurial decisions and external factors influencing entrepreneurs, such as investment decisions. Advancements in social signal processing enabled by AI technologies offer valuable insights into innovation, entrepreneurship analysis, trend prediction, and decision support. This underscores the necessity of integrating big data into entrepreneurship practices to foster innovation and facilitate informed decision-making (Rajagopal et al., 2022).

Furthermore, our analysis underscores the critical role of data in validating business models, particularly for startups. The integration of a hybrid intelligence decision support system, which combines social interactions with stakeholders and data analysis, enables entrepreneurs to iteratively validate business models amid uncertainty. This approach mitigates uncertainties inherent in entrepreneurial endeavors, enabling decision-makers to assess potential opportunities and allocate resources efficiently during the pre-startup phase (Neirotti et al., 2021).

Additionally, this category amplifies the challenges faced by entrepreneurs in navigating evolving business environments, including the integration of AI and IoT technologies. While these technologies offer potential benefits, the decision to adopt them requires careful consideration of associated challenges and costs (Shiyal et al., 2019). Entrepreneurs must

Table 9.2 Papers Included in the "Decision-making" Category

Study	*Purpose*
Amoako et al. (2021)	The objective of this paper is to explore the possible effects that Artificial intelligence systems have on entrepreneurs' decision-making, through the mediation of customer preference and industry benchmark.
Bickley et al. (2021)	This paper investigates sustainable entrepreneurship (SE) through the lens of Big Data (BD) and artificial intelligence (AI) tools for entrepreneurial decision-making process. To address the need for empirical guidance at every point of decision-making, while also charting pathways to achieve desired outcomes.
Shepherd & Majchrzak (2022)	This paper briefly explains AI and looks into the future to highlight some of AI's broader and longer-term decision-making implications.
Unhelkar & Gonsalves (2020)	This article discusses enhancing the AI's deep learning engine (DLE) as a tool that learns from past decisions and subsequent consequences with human experience resulting in a business disruption prediction framework.
Stone et al. (2020)	The purpose of this paper is to review literature about the applications of artificial intelligence (AI) in strategic situations and identify the research that is needed in the area of applying AI to strategic marketing decisions.
Rajagopal et al. (2022)	This paper investigates the prospective implications of artificial intelligence systems from an entrepreneurship standpoint on businesses' outcomes. It also examines the impact of the introduction of AI-based decision-making technologies on organizational policymaking?
Kudyba et al. (2020)	This paper provides a conceptual research model enabling organizations to better understand the integration of worker/team attributes with collaboration modes, information resources and augmented technologies (AI) that yield effective collective intelligence for decision-making.
Cao et al. (2021)	This study develops an integrated AI acceptance-avoidance model (IAAAM) to consider both the positive and negative factors that collectively influence managers' attitudes and behavioral intentions toward using AI for decision-making.
Bag et al. (2021)	This study examines the effect of big data powered artificial intelligence on customer knowledge creation, user knowledge creation and external market knowledge creation to better understand its impact on B2B marketing rational decision-making to influence firm performance.

(*Continued*)

Table 9.2 (Continued) Papers Included in the "Decision-making" Category

Study	*Purpose*
Jabeur et al. (2022)	Based on eclectic entrepreneurship theory, this study presents an original work that uses artificial intelligence to forecast the macro-level determinants of entrepreneurial opportunity.
Neirotti et al. (2021)	This article presents the findings of a case study on the way algorithms can be exploited in the electrical sector to develop a framework to theorize how the organizational mechanisms associated with absorptive capacity influence the way AI algorithms can be exploited to convert data into relevant knowledge for entrepreneurial and operational decision-making.
Di Vaio et al. (2022)	This study investigates the literary corpus of the role and potential of data intelligence and analytics through the lenses of artificial intelligence (AI), big data, and the human–AI interface to improve overall decision-making processes.
Al-Surmi et al. (2022)	This study investigates the strategic alignment between marketing and information technology (IT) strategies and provides production and operations decision-makers a model for improving operational performance.
Dubey et al. (2020)	This study draws on the dynamic capabilities view of firms and on contingency theory to develop and test a model that describes the role of entrepreneurial orientation (EO) on the adoption of big data analytics powered by artificial intelligence (BDA-AI) and operational performance (OP).
Allioui & Mourdi (2023)	This paper strives to contribute to the knowledge gap by facilitating the successful assimilation of AI into entrepreneurial planning and decision-making.
Barnea (2020)	
Prüfer & Prüfer (2020)	This paper describes the most prominent AI, data science tools, and methods suitable for entrepreneurship and provides links to literature and internet resources for self-starters.
Roundy (2022)	This study explores how entrepreneurs' adoption of AI influences their inter- and meta-organizational relationships.
Townsend & Hunt (2019)	This study explores how advancing AI systems provide novel solutions for resolving the fundamental challenges of modal uncertainty in entrepreneurial decision environments.
Liu et al. (2022)	This study explores how AI and big data contribute to a productive transformation of the smart entrepreneurship and what ethical issues as well as challenges are around the potential contradiction between entrepreneurial uncertainty and rule-driven AI rationality.

(*Continued*)

Table 9.2 (Continued) Papers Included in the "Decision-making" Category

Study	*Purpose*
Hannigan et al. (2022)	This study develops a comparative typology of the cultural and material dimension of an Emerging Entrepreneurial Ecosystem and applies it to an emerging regional ecosystem around artificial intelligence (AI).
Shiyal et al. (2019)	This study uses various mixed responses, inexplicit arguments, and opinions on the effectiveness of entrepreneurship using traditional techniques of decision-making and artificial intelligence from the entrepreneur's perspective in the Bangalore city.
Li et al. (2022)	This study explores the impact of artificial intelligence (AI) on user entrepreneurs, driving factors, and user entrepreneurship process combined with its characteristics and development trends.
Wamba-Taguimdje et al. (2020)	The main purpose of our study is to analyse the influence of Artificial Intelligence (AI) on firm performance, notably by building on the business value of AI-based transformation projects.
Rane, N. (2023)	Assist businesses in interpreting data, enabling data-driven decision-making and precise financial planning. The study explores the challenges faced by businesses when integrating ChatGPT and LLMs into different areas of business management.

evaluate the feasibility of integration within their organizational contexts and weigh the risks against potential benefits to make informed decisions tailored to their specific business needs.

The afore-discussed unfolds distinct streams, each exploring different facets of AI's impact on entrepreneurial decision-making within the remote work paradigm. The first stream delves into market analysis, wherein machine learning algorithms prove invaluable in analysing and predicting entrepreneurial decisions. Predictive techniques applied to organizational data aid in forecasting events for both new and existing decision, facilitating informed decisions regarding process discontinuation and introduction.

Another stream focuses on financial decisions, which is a vital avenue for entrepreneurial ventures or startups to raise capital. AI and deep learning techniques enable the prediction of financial outcomes, benefiting entrepreneurs, investors, and clients alike. By predicting factors that enhance financing success rates, entrepreneurs can optimize their strategies to improve financial performance. Investors, armed with predictions, can allocate funds judiciously, avoiding high-risk projects and maximizing returns. Crowdfunding platforms stand to benefit from improved project success rates, enhancing their profitability.

Furthermore, machine learning techniques offer insights into productivity aspects influencing entrepreneurial success. Productivity of entrepreneurs and personnel, measured through machine learning-based feature-based techniques, emerges as a significant factor impacting entrepreneurial success. Additionally, sentiment analysis of textual descriptions and review analysis contribute to predicting productivity outcomes, highlighting the importance of textual content work productivity assessment.

Lastly, machine learning algorithms are employed to evaluate market reactions for startups across platforms, aiding in predicting venture capital performance. Decision tree and random forest algorithms are utilized to forecast market reactions, providing startups with insights into critical features to focus on before logging into equity crowdfunding platforms (Unhelkar & Gonsalves, 2020). These insights not only streamline the entrepreneurial decision-making process but also enhance the efficiency of venture capital performance predictions, benefiting startups.

Performance and Future Trends

In the domain of performance evaluation within the entrepreneurial landscape, AI integration emerges as a pivotal strategy for augmenting operational efficiency and overall efficacy, particularly in the context of remote work. Entrepreneurs strategically harness AI technologies to synergize human capital with machine learning capabilities, thereby optimizing outcomes across various entrepreneurial pursuits. Our analysis reveals a burgeoning field of inquiry accentuating the transformative role of AI across entrepreneurial endeavors. Recent strides in machine learning have precipitated a swift automation trajectory, prompting entrepreneurs to judiciously substitute human labor with cost-effective machine alternatives. This paradigm shift resonates deeply within the economic landscape, catalyzing shifts in labor dynamics, price structures, productivity enhancements, and industry reconfigurations (Wang et al., 2023a).

Furthermore, the efficacy of deep learning networks in enhancing operational performance surpasses conventional models in terms of predictive accuracy and operational efficiency (Unhelkar & Gonsalves, 2020). Providers of AI solutions facilitate productivity enhancements and resource optimization among technology adopters by enabling streamlined upgrading processes, thereby contributing to growth and diversification (Bickley et al., 2021). Through the analysis of extensive data sets, AI-driven

technologies proffer swift resolutions and strategic guidance to entrepreneurs, thereby revolutionizing business operations and paving the way for optimized production scales and innovative processes (Sjödin et al., 2021).

Another pertinent avenue of inquiry explores the impact of AI on marketing and sales strategies, elucidating notable enhancements in business performance. Machine learning algorithms empower entrepreneurs to make data-informed decisions, thereby fostering enhanced sales figures, refined planning methodologies, and more efficient inventory management systems (Chatterjee et al., 2022). Predictive algorithms further facilitate the discernment of customer behavioral patterns, directly influencing revenue generation and product success metrics (Corvello et al., 2022).

Amid considerations of future trajectories for AI integration within the entrepreneurial realm, studies delineating prospective trends and research imperatives serve as catalysts for subsequent inquiry phases (Al-Surmi et al., 2022). AI emerges as a potent instrument with tangible implications in educational and research milieus, offering avenues for specialized training and equipping entrepreneurs with requisite AI-related competencies to navigate emerging challenges within remote work environments. This symbiotic exchange between theoretical entrepreneurial scholarship and pragmatic business applications holds promise for bridging extant knowledge lacunae.

The global pivot toward remote and hybrid work modalities post-COVID-19 has engendered a marked upsurge in digital technology utilization. However, the translation of theoretical constructs into practical, real-world manifestations remains a formidable challenge, particularly within the domain of remote entrepreneurial research. Augmented reality and AI assume critical roles in crafting simulated environments, thereby fostering a community-centric approach to entrepreneurial inquiry and praxis (Hasan et al., 2022). Digitalization affords avenues for the integration of automated digital tools within entrepreneurial solutions, with AI showcasing scalability and broad applicability, as evidenced during the exigencies of the COVID-19 crisis. Innovations in research and development methodologies within the entrepreneurial sphere hold promise for catalyzing greater entrepreneurial aspirations (Arunprasad et al., 2022). Notably, AI integration exerts a positive influence on entrepreneurial orientation, with entrepreneurs displaying heightened interest in entrepreneurial pursuits within AI-enabled environments, thereby fostering entrepreneurial endeavors irrespective of contextual constraints (Ge & Zhao, 2022).

Additionally, the integration of AI and big data unveils unprecedented avenues for enriching entrepreneurship research. As algorithms

progressively assume entrepreneurial tasks, these intelligent systems themselves undergo an evolutionary trajectory within the entrepreneurial landscape. Thus, the incorporation of AI and big data methodologies becomes imperative to adequately equip future entrepreneurs (Bosman et al., 2023). In an era characterized by perpetual disruption, the trajectory of AI adoption is outstripping historical rates. Nurturing an innovative mindset and fostering adaptability, particularly in the realm of disruptive innovation through digital transformation, emerges as imperative for cultivating a new cadre of entrepreneurs (Bosman et al., 2023). These insights resonate with examinations of Industry 4.0's catalytic role in fostering innovation and entrepreneurship through systemic research and modifications (Kumar et al., 2023). Embedding AI modules throughout entrepreneurial trajectories has the potential to cultivate a technologically adept workforce, fueling enthusiasm for innovation and AI-driven entrepreneurship (Amoako et al., 2021).

Furthermore, AI technologies assume a pivotal role in propelling digital transformation, necessitating decision-makers' comprehensive grasp of its strategic implications for business success (Bickley et al., 2021). However, the digital modernization of entrepreneurship may engender diminished demand for conventional employment, potentially exacerbating unemployment rates. Thus, entrepreneurial paradigm embracing digital modernization, grounded in Industry 4.0 technologies, can also offer new entrepreneurial opportunities such as AI entrepreneurship training and education, thus, fostering more entrepreneurship and creating startup opportunities (Shepherd & Majchrzak, 2022).

The second aspect pertains to research. The data revolution presents both opportunities and challenges for entrepreneurship research and practice. AI and big data not only enrich future entrepreneurship research but also shape research methodologies within the entrepreneurship domain (Obschonka & Audretsch, 2020). The ongoing datafication, coupled with significant advancements in AI, permeates all aspects of our lives, including the research domain, supported by developments in data science (Prüfer & Prüfer, 2020). Entrepreneurship research can draw insights from AI disciplines like genetic algorithms, which specialize in addressing complex, unstructured, and non-analytical problems (Zhang & Van Burg, 2020).

While AI serves as a potent tool to enhance entrepreneurship research by detecting entrepreneurial potential more effectively than human experts, it also presents methodological challenges. Collaboration between entrepreneurship researchers and experts in AI and related fields is essential to

navigate these challenges effectively (Lévesque et al., 2020). Ultimately, AI complements traditional research methods, offering opportunities to advance entrepreneurship research and enhance its relevance.

Discussion

The discourse surrounding the potential for intelligent computers to displace human labor is a prominent topic within the AI-entrepreneurship domain. While this concern holds validity in certain industries, it is crucial to recognize that computers primarily enhance human capabilities rather than replace them entirely. Humans possess unique skills such as creativity, critical thinking, decision-making, and interpersonal acumen that remain beyond the reach of computers. Conversely, computers excel in performing tasks swiftly, accurately, and repetitively.

This discourse extends into entrepreneurship, where individuals identify and capitalize on emerging opportunities. A specialized framework, building on previous studies (e.g., Flamini et al., 2022; Pellegrini et al., 2020), underpins this review's examination, specifically designed to elucidate the intersection of AI and entrepreneurship (Chalmers et al., 2021). This framework comprises five components, detailing how computers can aid the entrepreneurial process. The first component focuses on decision-making, where computers assist individuals in evaluating the feasibility of entrepreneurial ventures. Additionally, computers contribute to generating innovative business ideas, streamlining organizational design, accelerating business growth, and optimizing entrepreneurial rewards. Analysing these components and their implications provides insights into the evolving dynamic between humans and computers in entrepreneurship, prompting further inquiry into optimizing this collaboration for more effective business creation and development. The exploration of "education and research" regarding the "antecedents of venture creation" offers a compelling perspective on the evolving landscape of entrepreneurial education. The integration of AI into digital learning is emerging as a potent tool for deepening our understanding of entrepreneurial intentions and orientations, thereby fostering innovative ventures. The disruptive impact of the COVID-19 pandemic accelerated the digitization of education, presenting unprecedented opportunities in this sphere. Innovations in entrepreneurship education, bolstered by AI-supported pedagogical approaches, hold the potential to revolutionize learning experiences by fostering active engagement and reflective

thought processes (Mavlutova et al., 2020). Heightened student engagement, facilitated by AI, plays a crucial role in shaping entrepreneurial aspirations and orientations (Khalid, 2020). Thus, the role of business education in nurturing graduates with an innovative and digitally adept mindset is vital. By integrating AI technologies into classrooms and adapting teaching methodologies to embrace the AI revolution, we can cultivate a workforce proficient in technology utilization and passionate about driving innovation and entrepreneurship (Rath et al., 2019).

Moreover, the fusion of AI and neuroscience presents a promising avenue for unraveling the intricacies of entrepreneurial cognitive processes, particularly in opportunity identification, evaluation, and exploitation. Neuroscience research suggests that the interaction between cerebral hemispheres significantly influences entrepreneurial behaviors, with the left hemisphere facilitating conventional knowledge accumulation and the right hemisphere driving innovative thinking (Goodwin, 2013). Leveraging AI enables scientists to delve into these latent cognitive processes, illuminating the nuanced role of intuition, emotions, insights, and implicit attitudes in entrepreneurship (Nicolaou et al., 2019). Deep learning techniques offer a promising pathway for modeling cerebral processes, providing valuable insights into memory, visual processing, and motor control (Macpherson et al., 2021). AI's capacity to analyse extensive data sets holds promise for developing interpretative models of creative and intuitive processes pivotal to entrepreneurial success (Hisrich & Soltanifar, 2021). This enhanced understanding could pave the way for AI-driven interventions aimed at bolstering entrepreneurial decision-making and providing comprehensive support throughout the venture creation process.

AI also has the potential to enhance entrepreneurial decision-making, particularly in organizational design and entrepreneurial finance. AI-powered communication tools can aid entrepreneurs in making informed decisions and optimizing organizational performance. In conclusion, the integration of AI into entrepreneurship education and research presents numerous opportunities and challenges. Future research should explore ways to enhance educators' digital competencies, secure funding for AI integration in education, and delve deeper into the synergies between AI and neuroscience to unravel entrepreneurial cognitive processes. Additionally, AI applications in entrepreneurial decision-making and organizational design warrant further investigation to unlock the full potential of AI in fostering innovation and entrepreneurship. The success of entrepreneurs in engaging investors significantly depends on their ability to

effectively communicate their potential and project visions (Clark, 2008; Mason & Harrison, 2003). Recognizing this, there has been growing interest in leveraging AI to analyse entrepreneurs' communication behaviors, especially within startup presentations and crowdfunding projects. Drawing on psychological theories such as impression management theory (Goffman, 1959), recent studies have demonstrated a positive correlation between self-presentation techniques and crowdfunding success (Korzynski et al., 2021). Additionally, research highlights the importance of body language and non-verbal cues in encouraging investor participation in crowdfunding projects (Duan et al., 2020; Raab et al., 2020).

Despite these advancements, prior research has predominantly focused on crowdfunding platforms, neglecting other avenues of entrepreneurial finance like video pitches for startup accelerator programs. AI holds considerable potential in assessing the impact of communication on various funding decisions, offering valuable insights for both entrepreneurs and investors. Armed with this understanding, entrepreneurs can refine their communication strategies to enhance their prospects of securing financial backing, while investors can make more informed investment choices. Consequently, future research should prioritize the development of AI-driven solutions tailored to entrepreneurial finance. Expanding beyond communication, attention to "performance" should center on the specific "exploiting" process of opportunity. In this context, the fusion of AI with blockchain technology emerges as a transformative force, particularly within the realm of Industry 4.0. Blockchain's robust security and data validation capabilities make it instrumental in enhancing production processes and ensuring data integrity across the product lifecycle (Aoun et al., 2021). Furthermore, the integration of blockchain with AI has the potential to revolutionize financial accounting, legal compliance, and auditing processes, offering more efficient and secure alternatives (Susskind and Susskind, 2015; Zemanekova, 2019).

However, the widespread adoption of blockchain technology faces challenges related to uncertainty and volatility. Addressing these challenges requires future research efforts aimed at devising incentive mechanisms to foster collaborative data sharing and mitigating associated risks. Moreover, the ethical implications of AI's broad applications necessitate careful consideration. While AI holds promise in enhancing productivity and work-life balance, it also raises concerns regarding inequality and unemployment (Chalmers et al., 2021; Whittaker et al., 2018). Ethical education within AI-related curricula can play a pivotal role in navigating these challenges and fostering responsible AI governance. Thus, entrepreneurs must critically

assess the implications of AI adoption and governance in shaping their strategies. Future research should explore the symbiotic relationship between entrepreneurs and AI throughout the "AI-enabled entrepreneurial process," while addressing ethical, economic, and social considerations. Ultimately, this raises the thought-provoking question of whether AI might eventually replace entrepreneurs or if they will coexist symbiotically.

Conclusion

In conclusion, this study is among the few reviews that explore the intersection of AI, entrepreneurship, and remote work. It analyses 58 articles to examine the role of AI in assisting entrepreneurs. This review identifies four primary ways AI contributes to entrepreneurship: discovering new business opportunities, enhancing decision-making, improving operational efficiency, and integrating academic knowledge with practical applications.

The findings herein provide insights into the impact of AI on entrepreneurial activities, offering valuable perspectives for students, business professionals, and aspiring entrepreneurs. Although this review has limitations, such as the selection of articles and the nascent nature of this research area, it establishes a strong foundation for future investigations.

For future research, scholars should conduct longitudinal studies to assess the long-term effects of AI on entrepreneurial success and investigate sector-specific applications of AI in entrepreneurship. Additionally, exploring the ethical implications of AI use in business and its impact on employee well-being and job satisfaction would provide a more comprehensive understanding of AI's role in the entrepreneurial ecosystem.

We anticipate that our work will stimulate further exploration into the multifaceted ways AI influences entrepreneurship. As we stand on the brink of a significant transformation in business practices, it is crucial to harness AI's potential while fostering human creativity and decision-making. Rather than viewing AI as a threat, we should embrace it as a powerful tool that can drive innovation and efficiency in the entrepreneurial landscape.

References

Adisa, T. A., Ogbonnaya, C., & Adekoya, O. D. (2023). Remote working and employee engagement: A qualitative study of British workers during the pandemic. *Information Technology & People*, 36(5), 1835–1850.

Aleem, M., Sufyan, M., Ameer, I., & Mustak, M. (2023). Remote work and the COVID-19 pandemic: An artificial intelligence-based topic modeling and a future agenda. *Journal of Business Research*, 154, 113303.

Ali, M. B. (2019). Multiple perspective of cloud computing adoption determinants in higher education: A systematic review. *International Journal of Cloud Applications and Computing (IJCAC)*, 9(3), 89–109.

Allioui, H., & Mourdi, Y. (2023). Unleashing the potential of AI: Investigating cutting-edge technologies that are transforming businesses. *International Journal of Computer Engineering and Data Science (IJCEDS)*, 3(2), 1–12.

Al-Surmi, A., Bashiri, M., & Koliousis, I. (2022). AI based decision making: Combining strategies to improve operational performance. *International Journal of Production Research*, 60(14), 4464–4486.

Amoako, G., Omari, P., Kumi, D. K., Agbemabiase, G. C., & Asamoah, G. (2021). Conceptual framework—Artificial intelligence and better entrepreneurial decision-making: The influence of customer preference, industry benchmark, and employee involvement in an emerging market. *Journal of Risk and Financial Management*, 14(12), 604.

Aoun, A., Ilinca, A., Ghandour, M., & Ibrahim, H. (2021). A review of Industry 4.0 characteristics and challenges, with potential improvements using blockchain technology. *Computers & Industrial Engineering*, 162, 107746.

Apostolopoulos, N., Ratten, V., Petropoulos, D., Liargovas, P., & Anastasopoulou, E. (2021). Agri-food sector and entrepreneurship during the COVID-19 crisis: A systematic literature review and research agenda. *Strategic Change*, 30(2), 159–167.

Arunprasad, P., Dey, C., Jebli, F., Manimuthu, A., & El Hathat, Z. (2022). Exploring the remote work challenges in the era of COVID-19 pandemic: Review and application model. *Benchmarking: An International Journal*, 29(10), 3333–3355.

Bag, S., Gupta, S., Kumar, A., & Sivarajah, U. (2021). An integrated artificial intelligence framework for knowledge creation and B2B marketing rational decision making for improving firm performance. *Industrial Marketing Management*, 92, 178–189.

Barnea, A. (2020). How will AI change intelligence and decision-making? *Journal of Intelligence Studies in Business*, 10(1), 75–80.

Battisti, E., Alfiero, S., & Leonidou, E. (2022). Remote working and digital transformation during the COVID-19 pandemic: Economic–financial impacts and psychological drivers for employees. *Journal of Business Research*, 150, 38–50.

Bickley, S. J., Macintyre, A., & Torgler, B. (2021). Artificial intelligence and big data in sustainable entrepreneurship. *Journal of Economic Surveys*. https://doi.org/10.1111/joes.12611

Blanco-González-Tejero, C., Ribeiro-Navarrete, B., Cano-Marin, E., & McDowell, W. C. (2023). A systematic literature review on the role of artificial intelligence in entrepreneurial activity. *International Journal on Semantic Web and Information Systems (IJSWIS)*, 19(1), 1–16.

Bonfanti, A., De Crescenzo, V., Simeoni, F., & Adaui, C. R. L. (2024). Convergences and divergences in sustainable entrepreneurship and social entrepreneurship research: A systematic review and research agenda. *Journal of Business Research*, 170, 114336.

Bosman, L., Kotla, B., Madamanchi, A., Bartholomew, S., & Byrd, V. (2023). Preparing the future entrepreneurial engineering workforce using web-based AI-enabled tools. *European Journal of Engineering Education*, 48(5), 972–989.

Cao, G., Duan, Y., Edwards, J. S., & Dwivedi, Y. K. (2021). Understanding managers' attitudes and behavioral intentions towards using artificial intelligence for organizational decision-making. *Technovation*, *106*, 102312.

Chalmers, D., MacKenzie, N. G., & Carter, S. (2021). Artificial intelligence and entrepreneurship: Implications for venture creation in the fourth industrial revolution. *Entrepreneurship Theory and Practice*, 45(5), 1028–1053.

Chatterjee, S., Chaudhuri, R., & Vrontis, D. (2022). Does remote work flexibility enhance organization performance? Moderating role of organization policy and top management support. *Journal of Business Research*, *139*, 1501–1512.

Clark, C. (2008). The impact of entrepreneurs' oral 'pitch' presentation skills on business angels'initial screening investment decisions. *Venture Capital*, 10(3), 257–279.

Coombs, C. (2020). Will COVID-19 be the tipping point for the intelligent automation of work? A review of the debate and implications for research. *International journal of information management*, *55*, 102182.

Corvello, V., De Carolis, M., Verteramo, S., & Steiber, A. (2022). The digital transformation of entrepreneurial work. *International Journal of Entrepreneurial Behavior & Research*, *28*(5), 1167–1183.

Di Vaio, A., Hassan, R., & Alavoine, C. (2022). Data intelligence and analytics: A bibliometric analysis of human–Artificial intelligence in public sector decision-making effectiveness. *Technological Forecasting and Social Change*, *174*, 121201.

Donnelly, R., & Johns, J. (2021). Recontextualising remote working and its HRM in the digital economy: An integrated framework for theory and practice. *The International Journal of Human Resource Management*, 32(1), 84–105.

Duan, Y., Hsieh, T., Wang, R. R., & Wang, Z. (2020). Entrepreneurs' facial trustworthiness, gender, and crowdfunding success. *Journal of Corporate Finance*, *64*(10), 1–24. https://doi.org/10.1016/j.jcorpfin.2020.101693

Dubey, R., Gunasekaran, A., Childe, S. J., Bryde, D. J., Giannakis, M., Foropon, C., … & Hazen, B. T. (2020). Big data analytics and artificial intelligence pathway to operational performance under the effects of entrepreneurial orientation and environmental dynamism: A study of manufacturing organisations. *International journal of production economics*, *226*, 107599.

Enholm, I. M., Papagiannidis, E., Mikalef, P., & Krogstie, J. (2022). Artificial intelligence and business value: A literature review. *Information Systems Frontiers*, *24*(5), 1709–1734.

Flamini, G., Pellegrini, M. M., Fakhar Manesh, M., & Caputo, A. (2022). Entrepreneurial approach for open innovation: Opening new opportunities, mapping knowledge and highlighting gaps. *International Journal of Entrepreneurial Behavior & Research*, 28(5), 1347–1368.

Ge, B., & Zhao, L. (2022). The impact of the integration of opportunity and resources of new ventures on entrepreneurial performance: The moderating role of BDAC-AI. *Systems Research and Behavioral Science*, *39*(3), 440–461.

Giuggioli, G., & Pellegrini, M. M. (2023). Artificial intelligence as an enabler for entrepreneurs:a systematic literature review and an agenda for future research. *International Journal of Entrepreneurial Behavior & Research*, *29*(4), 816–837.

Goffman, E. (1959). *The presentation of self in everyday life*. Doubleday: Garden City, New York.

Goodwin, C. (2013). The co-operative, transformative organization of human action and knowledge. *Journal of Pragmatics*, *46*(1), 8–23.

Gupta, B. B., Gaurav, A., Panigrahi, P. K., & Arya, V. (2023). Analysis of artificial intelligence-based technologies and approaches on sustainable entrepreneurship. *Technological Forecasting and Social Change*, *186*, 122152.

Hannigan, T. R., Briggs, A. R., Valadao, R., Seidel, M. D. L., & Jennings, P. D. (2022). A new tool for policymakers: Mapping cultural possibilities in an emerging AI entrepreneurial ecosystem. *Research Policy*, *51*(9), 104315.

Hasan, F., Durga, S., Verma, V., & Podile, V. (2022, April). Strategic Evaluation of Implementing Artificial Intelligence Towards Shaping Entrepreneurial Development During Covid-19 Outbreaks. In *2022 2nd International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE)* (pp. 2570–2573). IEEE.

Hisrich, R.D., Soltanifar, M. (2021). Unleashing the Creativity of Entrepreneurs with Digital Technologies. In: Soltanifar, M., Hughes, M., Göcke, L. (eds) *Digital Entrepreneurship. Future of Business and Finance*. Springer, Cham. https://doi.org/10.1007/978-3-030-53914-6_2

Jabeur, S. B., Ballouk, H., Mefteh-Wali, S., & Omri, A. (2022). Forecasting the macro-level determinants of entrepreneurial opportunities using artificial intelligence models. *Technological Forecasting and Social Change*, *175*, 121353.

Jones, P., Ratten, V., & Hayduk, T. (2020). Sport, fitness, and lifestyle entrepreneurship. *International Entrepreneurship and Management Journal*, 16, 783–793.

Khalid, N. (2020). Artificial intelligence learning and entrepreneurial performance among university students: evidence from malaysian higher educational institutions. *Journal of Intelligent & Fuzzy Systems*, *39*(4), 5417–5435.

Kirzner, I. M. (2009). The alert and creative entrepreneur: A clarification. *Small Business Economics*, *32*, 145–152.

Korzynski, P., Haenlein, M., & Rautiainen, M. (2021). Impression management techniques in crowdfunding: An analysis of Kickstarter videos using artificial intelligence. *European Management Journal*, 39(5), 675–684.

Kudyba, S., Fjermestad, J., & Davenport, T. (2020). A research model for identifying factors that drive effective decision-making and the future of work. *Journal of Intellectual Capital*, *21*(6), 835–851.

Kumar, R., Kaur, S., Erceg, Ž., & Mirović, I. (2023). Industry 4.0 and its impact on entrepreneurial ecosystems: An examination of trends and key implications. *Journal of Organization Technology and Entrepreneurship*, 1(1), 12–34.

Lévesque, C., Fairbrother, P., & Roby, N. (2020). Digitalization and regulation of work and employment: Introduction. *Relations Industrielles/Industrial Relations*, 75(4), 647–659.

Li, X., Zhang, X., Liu, Y., Mi, Y., & Chen, Y. (2022). The impact of artificial intelligence on users' entrepreneurial activities. *Systems Research and Behavioral Science*, 39(3), 597–608.

Liu, X., Li, H., & Li, H. (2022). Analyzing Relationship between Financing Constraints, Entrepreneurship, and Agricultural Company Using AI-Based Decision Support System. *Scientific Programming*, *2022*, 1–9.

Lounsbury, M., & Glynn, M. A. (2001). Cultural entrepreneurship: Stories, legitimacy, and the acquisition of resources. *Strategic Management Journal*, 22(6–7), 545–564.

Macpherson, T., Churchland, A., Sejnowski, T., DiCarlo, J., Kamitani, Y., Takahashi, H., & Hikida, T. (2021). Natural and artificial intelligence: A brief introduction to the interplay between AI and neuroscience research. *Neural Networks*, 144, 603–613.

Mason, C. M., & Harrison, R. T. (2003). Auditioning for money: What do technology investors look for at the initial screening stage? *Journal of Private Equity*, *6*, 29–42.

Matytsin, D. E., Dzedik, V. A., Markeeva, G. A., & Boldyreva, S. B. (2023). "Smart" outsourcing in support of the humanization of entrepreneurship in the artificial intelligence economy. *Humanities and Social Sciences Communications*, *10*(1), 1–8.

Mavlutova, I., Lesinskis, K., Liogys, M., & Hermanis, J. (2020). Innovative teaching techniques for entrepreneurship education in the era of digitalisation. *WSEAS Transactions on Environment and Development*, 16(1), 725–733.

Modgil, S., Dwivedi, Y. K., Rana, N. P., Gupta, S., & Kamble, S. (2022). Has Covid-19 accelerated opportunities for digital entrepreneurship? An Indian perspective. *Technological Forecasting and Social Change*, 175, 121415.

Neirotti, P., Pesce, D., & Battaglia, D. (2021). Algorithms for operational decision-making: An absorptive capacity perspective on the process of converting data into relevant knowledge. *Technological Forecasting and Social Change*, 173, 121088.

Nicolaou, N., Lockett, A., Ucbasaran, D., & Rees, G. (2019). Exploring the potential and limits of a neuroscientific approach to entrepreneurship. *International Small Business Journal*, 37(6), 557–580.

Nyagadza, B. (2022). Sustainable digital transformation for ambidextrous digital firms:Systematic literature review, meta-analysis and agenda for future research directions. *Sustainable Technology and Entrepreneurship*, *1*(3), 100020.

Obschonka, M., & Audretsch, D. B. (2020). Artificial intelligence and big data in entrepreneurship: a new era has begun. *Small Business Economics*, 55, 529–539.

Paul, J., Lim, W. M., O'Cass, A., Hao, A. W., & Bresciani, S. (2021). Scientific procedures and rationales for systematic literature reviews (SPAR-4-SLR). *International Journal of Consumer Studies*, *45*(4), O1–O16.

Pellegrini, M. M., Ciampi, F., Marzi, G., & Orlando, B. (2020). The relationship between knowledge management and leadership: Mapping the field and providing future research avenues. *Journal of Knowledge Management*, *24*(6), 1445–1492.

Phan, P. H., Wright, M., Ucbasaran, D., & Tan, W. L. (2009). Corporate entrepreneurship: Current research and future directions. *Journal of Business Venturing*, 24(3), 197–205.

Polas, M. R. H., & Raju, V. (2021). Technology and entrepreneurial marketing decisions during COVID-19. *Global Journal of Flexible Systems Management*, *22*(2), 95–112.

Prüfer, J., & Prüfer, P. (2020). Data science for entrepreneurship research: Studying demand dynamics for entrepreneurial skills in the Netherlands. *Small Business Economics*, 55, 651–672.

Putri, S. I. E., Irawan, M. C. S., Ardianov, H. R., Purnomo, A., & Rosyidah, E. (2023, April). Artificial Intelligence in the Entrepreneurship: Patent Landscape Analysis. In *2023 International Conference on Inventive Computation Technologies (ICICT)* (pp. 441–447). IEEE.

Raab, M., Schlauderer, S., Overhage, S., & Friedrich, T. (2020). More than a feeling:Investigating the contagious effect of facial emotional expressions on investment decisions in reward-based crowdfunding. *Decision Support Systems*, *135* (8), 1–11. https://doi.org/10.1016/j.dss.2020.113326

Rajagopal, N. K., Qureshi, N. I., Durga, S., Ramirez Asis, E. H., Huerta Soto, R. M., Gupta, S.K., & Deepak, S. (2022). Future of business culture: an artificial intelligence-driven digital framework for organization decision-making process. *Complexity*, *2022*, 1–14.

Rane, N. (2023). Role and challenges of ChatGPT and similar generative artificial intelligence in business management. *Available at SSRN 4603227*.

Rath, D., Satpathy, I., & Patnaik, B. C. M. (2019). Industry 4.0–a new futuristic technological revolution a catalyst of innovation & entrepreneurship in creation of enterprises. *International Journal of Innovative Technology and Exploring Engineering*, 9(1), 4384–4390.

Ratten, V. (2023). Digital platforms and transformational entrepreneurship during the COVID-19 crisis. *International Journal of Information Management*, *72*, 102534.

Ribeiro-Navarrete, S., Piñeiro-Chousa, J., López-Cabarcos, M. Á., & Palacios-Marqués, D. (2021). Crowdlending: mapping the core literature and research frontiers. *Review of Managerial Science*, 16(11), 1–31.

Roundy, P. T. (2022). Artificial intelligence and entrepreneurial ecosystems: understanding the implications of algorithmic decision-making for startup communities. *Journal of Ethics in Entrepreneurship and Technology*, *2*(1), 23–38.

Sahut, J. M., & Lissillour, R. (2023). The adoption of remote work platforms after the Covid-19 lockdown: New approach, new evidence. *Journal of Business Research*, *154*, 113345.

Salkenov, A., Salkenova, A., Demeugazyyev, D., & Aitmukhanbetova, E. (2022, April). Impact of Digital Transformation on the Employees' Remote Working Performance: A Higher Institution Case Study. In *2022 International Conference on Smart Information Systems and Technologies (SIST)* (pp. 1–5). IEEE.

Shane, S., & Venkataraman, S. (2000). The promise of entrepreneurship as a field of research. *Academy of Management Review*, 25(1), 217–226.

Shepherd, D. A., & Majchrzak, A. (2022). Machines augmenting entrepreneurs: Opportunities(and threats) at the Nexus of artificial intelligence and entrepreneurship. *Journal of Business Venturing*, *37*(4), 106227.

Shiyal, S. M., Garg, A., & Rohini, R. (2019). Usage and implementation of artificial intelligence in entrepreneurship: An empirical study. *Seshadripuram Journal of Social Sciences (SJSS)*, 4, Special Issue (March), 4–19.

Short, C. E., & Short, J. C. (2023). The artificially intelligent entrepreneur: ChatGPT, prompt engineering, and entrepreneurial rhetoric creation. *Journal of Business Venturing Insights*, *19*, e00388.

Sjödin, D., Parida, V., Palmié, M., & Wincent, J. (2021). How AI capabilities enable business model innovation: Scaling AI through co-evolutionary processes and feedback loops. *Journal of Business Research*, 134, 574–587.

Staples, D. S., Hulland, J. S., & Higgins, C. A. (1999). A self-efficacy theory explanation for the management of remote workers in virtual organizations. *Organization Science*, 10(6), 758–776.

Stone, M., Aravopoulou, E., Ekinci, Y., Evans, G., Hobbs, M., Labib, A., … & Machtynger, L. (2020). Artificial intelligence (AI) in strategic marketing decision-making: a research agenda. *The Bottom Line*, *33*(2), 183–200.

Susskind, R. E., & Susskind, D. (2015). *The future of the professions: How technology will transform the work of human experts*. Oxford University Press.

Suraji, R., & Ali, H. (2024). Catalyzing change: unleashing the power of artificial intelligence in indonesian business. *International Journal of Advanced Multidisciplinary*, *2*(4), 952–961.

Townsend, D. M., & Hunt, R. A. (2019). Entrepreneurial action, creativity, & judgment in the age of artificial intelligence. *Journal of Business Venturing Insights*, *11*, e00126.

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British journal of management*, *14*(3), 207–222.

Unhelkar, B., & Gonsalves, T. (2020). Enhancing artificial intelligence decision making frameworks to support leadership during business disruptions. *IT Professional*, *22*(6), 59–66.

Usman, F. O., Eyo-Udo, N. L., Etukudoh, E. A., Odonkor, B., Ibeh, C. V., & Adegbola, A. (2024). A critical review of AI-driven strategies for entrepreneurial success. *International Journal of Management & Entrepreneurship Research*, *6*(1), 200–215.

Wamba-Taguimdje, S. L., Fosso Wamba, S., Kala Kamdjoug, J. R., & Tchatchouang Wanko, C.E. (2020). Influence of artificial intelligence (AI) on firm

performance: the business value of AI-based transformation projects. *Business Process Management Journal*, *26*(7), 1893–1924.

Wang, B., Liu, Y., Qian, J., & Parker, S. K. (2021). Achieving effective remote working during the COVID-19 pandemic: A work design perspective. *Applied Psychology*, 70(1), 16–59.

Wang, R., Guo, L. M., Cao, C., & Chen, Y. S. (2023b). The key success factors of the AI industry entrepreneurial process in China Great Bay Area: A systematic approach study. *Technological Forecasting and Social Change*, *186*, 122170.

Wang, Z., Deng, Y., Zhou, S., & Wu, Z. (2023a). Achieving sustainable development goal 9: A study of enterprise resource optimization based on artificial intelligence algorithms. *Resources Policy*, *80*, 103212.

Wheatley, D., Hardill, I., & Buglass, S. (Eds.). (2021). *Handbook of research on remote work and worker well-being in the post-COVID-19 era*. IGI Global.

Whittaker, M., Crawford, K., Dobbe, R., Fried, G., Kaziunas, E., Mathur, V., … & Schwartz, O. (2018). *AI now report 2018* (pp. 1–62). New York: AI Now Institute at New York University.

Wuisan, D. S. S., Sunardjo, R. A., Aini, Q., Yusuf, N. A., & Rahardja, U. (2023). Integrating Artificial Intelligence in human resource management: A SmartPLS approach for entrepreneurial success. *Aptisi Transactions on Technopreneurship (ATT)*, *5*(3), 334–345.

Zahari, A. I., Manan, D. I. A., Razali, F. M., Zolkaflil, S., & Said, J. (2024). Exploring the viability of remote work for SME. *Journal of Open Innovation: Technology, Market, and Complexity*, *10*(1), 100182.

Zemankova, A. (2019). Artificial intelligence and blockchain in audit and accounting: Literature review. *WSEAS Transactions on Business and Economics*, *16*(64), 568–581.

Zeuge, A., Schaefer, C., Weigel, A., Eckhardt, A., & Niehaves, B. (2023). Crisis-driven digital transformation as a trigger for process virtualization: Fulfilling knowledge work process requirements for remote work. *International Journal of Information Management*, *70*, 102636.

Zhang, S. X., & Van Burg, E. (2020). Advancing entrepreneurship as a design science:Developing additional design principles for effectuation. *Small Business Economics*, *55*(3), 607–626.

Chapter 10

Harnessing AI and ChatGPT-4.0 Technologies for Entrepreneurial Innovation

Divine Q. Agozie, Richard Boateng, Acheampong Owusu, Muesser C. Nat, and Ransford Pinto

Introduction

Entrepreneurship, a key driver of economic growth and job creation, has evolved significantly with the advent of digital technologies. The rise of Web 3.0 and artificial intelligence has revolutionized entrepreneurial activities, enabling entrepreneurs to reach global markets. Digital entrepreneurship, which involves developing, marketing, negotiating, and selling products and services online, has become a cornerstone of the modern economy (Sitaridis & Kitsios, 2024). These technologies have reshaped business ecosystems, moving marketplaces online and creating tailored opportunities that attract both novice and experienced entrepreneurs (Yáñez-Valdé & Guerrero, 2024). Understanding these digital opportunities is essential for fostering viable entrepreneurship to stimulate economic development (Alhajri & Aloud, 2024).

The Generative Pretrained Transformer (GPT) technology represents a significant advancement in artificial intelligence (AI). GPT technology can generate natural language text, images, sounds, and videos, offering new possibilities and challenges for entrepreneurial engagement (Abaddi, 2024; Gupta & Yang, 2024). Recently, OpenAI introduced ChatGPT-4,

DOI: 10.4324/9781003507314-10

a multimodal large language model with enhanced capabilities, including improved problem-solving, data analytics, and image analysis. This innovation is driving competition and fostering innovation across industries, providing entrepreneurs with new tools to enhance their ventures.

Entrepreneurs can leverage ChatGPT-4 to navigate the rapidly evolving technological landscape, improving decision-making and operational efficiency (George & George, 2023). Studies have shown a positive correlation between the use of ChatGPT and increased productivity, with benefits including cost reduction and support for business model innovation (Su & Liu, 2023). For entrepreneurs, especially those with limited resources, ChatGPT-4 can act as a valuable knowledge partner, generating insights that drive business innovation (Ausat et al., 2023). The challenge lies not in adopting this technology, but in deploying it efficiently and effectively. Understanding where ChatGPT-4 can be most useful and investing appropriately in its capabilities is crucial (George & George, 2023).

An approach to optimizing the use of ChatGPT-4 involves leveraging the "wisdom of the crowds." Social networking platforms like LinkedIn, Facebook, and Twitter (X) have transformed how people communicate, seek information, and share knowledge online (Tian et al., 2023). These platforms enable researchers to harness collective intelligence through large-scale observations and social sensing techniques (Moghadas et al., 2023). LinkedIn, in particular, stands out for its professional focus, widely utilized by users driven by career and business interests. The network's structure provides a unique and valuable data source, promoting content analysis for professional trends and dynamics (Burton et al., 2024).

By leveraging social networking data, particularly from LinkedIn, we can capture and analyse the collective intelligence of professionals and experts. This study aims to explore online interactions about ChatGPT-4 on a social media platform like LinkedIn. By analysing posts from March 14, 2023, to May 25, 2024, we seek to identify underlying themes and opportunities related to ChatGPT-4. This examination will provide actionable recommendations for entrepreneurs looking to harness ChatGPT-4's capabilities. Through textual mining, sentiment analysis, and topic modeling using the Bidirectional Encoder Representations from Transformers (BERT) Latent Dirichlet Allocation (LDA), this study will uncover key topics and sentiments in these online discussions, offering valuable insights for entrepreneurial strategy and operations to gain competitive advantages in the evolving digital landscape.

Understanding the opportunities and affordances of ChatGPT-4 technology is crucial for entrepreneurial engagements. This comprehension enables entrepreneurs to make informed decisions about where to focus their efforts, investments, and whether to adopt the technology. For instance, entrepreneurs must assess whether their working environment and available resources align with the requirements for effectively leveraging and adopting ChatGPT-4. These insights also guide startups in deciding whether to implement small-scale, incremental experiments as a foundation for relying on such AI technology. By designing ventures based on ChatGPT-4's affordances, entrepreneurs can accurately identify performance criteria for these venture experiments.

Moreover, the insights from these discussions are valuable for various stakeholders, including entrepreneurs, policymakers, technology providers, researchers, and institutions that support entrepreneurs, such as academia, incubators, accelerators, university libraries, public libraries, chambers of commerce, and foreign embassies. These stakeholders can use the research findings to enhance their understanding of the extensive determinants and capabilities of ChatGPT-4, improving their decision-making regarding service innovations and ultimately fostering a more favorable environment for entrepreneurship.

The lack of research on ChatGPT-4's usefulness, usability, and affordances in the context of entrepreneurship, especially from the perspective of technology professionals, highlights the urgent need for a comprehensive investigation (Sallam, 2023). Identifying the variables underlying the usefulness of this technological revolution to entrepreneurship is critical, as ChatGPT-4 operates in nearly boundless contexts with minimal constraints. This study aims to equip entrepreneurs with essential insights to make rational decisions, mitigate technology-related risks impacting their businesses, and foster continuous innovation in their entrepreneurial environments. To achieve this aim, the study pursues the following questions: (a) What are the key topics underlying expert discussions about ChatGPT-4 and entrepreneurship? and (b) What are the sentiments underlying these conversations about ChatGPT-4? As the AI field continues to develop, more advanced and innovative generative AI technologies and applications will emerge. Insights into these issues, based on the questions pursued in this study, will enable entrepreneurs, users, and other stakeholders to gain new perspectives and better leverage advancements in GPT technologies and the AI innovation landscape.

Study Context and Justification

LinkedIn stands as the premier social media platform for professionals, boasting a penetration rate of 89% (Daniels et al., 2023). Its widespread popularity stems from its effectiveness in identifying decision-makers and buyers, generating leads, building customer relationships, and maintaining a strong professional reputation (e.g., Purnomo et al., 2023; Smith & Watkins, 2023). LinkedIn provides industry-specific professionals with the capability to create accounts and engage with nearly 700 million active users through posts (Tsironis et al., 2023). Previous research highlights that the content of a post can significantly affect the efficacy of social media usage (Smith & Watkins, 2023), underscoring the importance of analysing post content for a deeper understanding of any given phenomenon.

ChatGPT is a state-of-the-art natural language processing model, pre-trained on a vast dataset, which enables it to generate text that is coherent, contextually appropriate, and often indistinguishable from human writing (Abaddi, 2024). Utilizing a transformer architecture, ChatGPT combines the strengths of generative models with scalability, employing a self-attention mechanism that helps it understand the context and deliver more precise responses. ChatGPT can produce text on any topic and in any language from a given prompt. Its versatile architecture supports various tasks, including question-answering, machine translation, and language modeling (Gupta & Yang, 2024). Additionally, it can be used to create virtual assistants and chatbots, facilitating human-like interactions. ChatGPT's design and algorithms allow it to generate detailed and extensive content, making it a valuable tool across multiple industries, such as healthcare, education, and commerce.

OpenAI recently launched GPT-4, the latest iteration of ChatGPT, on March 14, 2023. GPT-4 is a large-scale, multimodal model capable of processing both images and text inputs to generate text outputs. While it is currently less capable than humans in many real-world scenarios, it excels in passing certain tests and performing various professional and academic tasks at a human level. GPT-4 surpasses its predecessors and most advanced systems in several traditional NLP benchmarks. Despite its advanced capabilities, GPT-4 shares limitations with earlier GPT models, such as occasional unreliability, a limited context window, and an inability to learn from past experiences. Therefore, further research is essential to fully explore GPT-4's potential and mitigate its limitations.

Method

The research began with data collection, focusing on English posts related to "ChatGPT" and "Entrepreneurship" or "Digital entrepreneurship" and "ChatGPT-4" from March 14, 2023, to May 25, 2024. Using the "Xpath Helper" plugin and "Octoparse 8" software, both original posts and follower reactions were gathered. This data collection involved 191 professional accounts, including those of CEOs, Founders, and Co-founders of technology service organizations, resulting in a comprehensive data set of 1,714 posts. The "Clay" sales prospecting App used to check most recent posts of the accounts on LinkedIn to determine active accounts. All accounts identified were active during the period determined for the data collection.

The collected data set then underwent a rigorous preprocessing phase to ensure the quality of the analysis. Initially, unusable posts were removed, followed by tokenization, where the text was broken down into individual words or tokens. Commonly used words that do not carry significant meaning, known as stop words, were eliminated, and all text was converted to lowercase to maintain uniformity. To avoid skewing the analysis, words such as "ChatGPT-4," "ChatGPT," "OpenAI," and "AI" were removed. Further preprocessing steps included lemmatization and stemming, which reduced words to their base or root forms. Words that appeared in less than 0.1% of the posts were also removed to reduce noise, with a sparsity threshold set at 0.999, leaving a total of 1,327 words for topic modeling. The final data set consisted of 1,713 posts.

BERT-LDA algorithms were employed to extract latent themes from the posts. To determine the optimal number of topics, BERT model tuning algorithms were applied to derive the best possible topic structure with the top keywords for each topic and their respective weights (Mandal et al., 2023). Likewise, the topic weight and size were also evaluated. Subsequent thematic analysis was conducted on posts that strongly represented each topic, identified by a gamma value of 0.9 or higher, indicating a high probability of belonging to a particular topic. These high-probability posts were used to define and interpret the underlying concept within each topic. Further, an analysis of the sentiments and discussion trend of underlying issues in the identified topics is performed. To perform the trend analysis, the timeline of post was decomposed into two broad periods, specifically pre- and post- the release of ChatGPT-4o. This analysis offers a greater

understanding of the possible shifts in conversations about ChatGPT-4o in the entrepreneurial space.

Results and Analysis

Descriptives

The data for this analysis was sourced from a wide range of profiles of professionals and experts who employ artificial intelligence tools like ChatGPT-4 and other GPT technologies. These profiles include chief executives, application development analysts, data scientists, software engineers, and developers. The majority of these professionals are identified from India, the United States, the United Kingdom, Canada, and Africa, as illustrated in Figure 10.1. The distribution of the roles of the profiles used for this study is detailed in Table 10.1. By drawing on a diverse set of professionals across various geographic regions, the analysis aims to provide a comprehensive understanding of the use and perception of ChatGPT-4 and other AI tools in entrepreneurial and professional contexts. This diverse data set helps ensure that the insights and conclusions derived from the analysis are broadly applicable and relevant to a global audience.

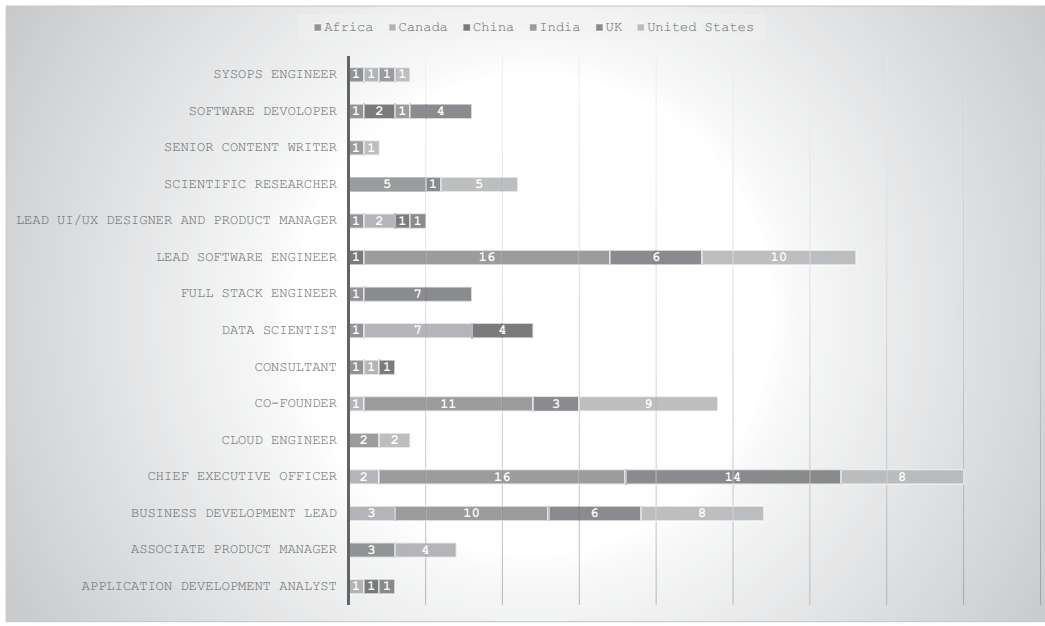


Figure 10.1 Profile and region distribution.

Table 10.1 Role Demographics of User Profiles

Role	#	%
Application Development Analyst	10	5%
Associate Product Manager	16	8%
Business Development Lead	21	11%
Chief Executive Officer	31	16%
Cloud Engineer	2	1%
Co-Founder	17	9%
Consultant	10	5%
Data Scientist	14	7%
Full Stack Engineer	10	5%
Lead Software Engineer	17	9%
Lead UI/UX Designer and Product Manager	12	6%
Scientific Researcher	6	3%
Senior Content Writer	1	1%
Software Developer	12	6%
SysOps Engineer	12	6%
Locations		
Africa	10	5%
UK	43	22.5%
USA	44	23%
China	10	5.2%
Canada	22	11.5%
India	62	32.5%
Total	**191**	**100%**

Topic Modeling Analysis

The primary objective of this study was to examine the discourse on OpenAI's ChatGPT-4 and entrepreneurial opportunities reflected in LinkedIn posts. Through refined data collection and exploratory analysis, the analysis assessed unique words, average reactions per post, and

follower distributions. Notably, the selected accounts posted at an average rate of 38.8% during the assessment period, with an average reaction rate of 47.62%. These metrics suggest that the accounts are active and influential among their followers.

By applying Term Frequency-Inverse Document Frequency (TF-IDF) technique, we identified the top ten words per topic and their importance. Additionally, we utilized Non-Negative Matrix Factorization (NMF) to create a document-term matrix, decomposing it into topic weight and coefficient matrices. To enhance topic generation, we combined the LDA and BERT techniques, followed by auto-encoding the data. From these, word frequency analysis revealed prevalent terms such as "intelligent," "opportunity," "innovate," "data," "impact," "communicate," "decide" indicating that ChatGPT-4 is frequently discussed as an intelligent innovation driving communication, data usage, and innovation to impact entrepreneurial decisions and engagements.

Drawing on the BERT-LDA algorithms with sentence transformers, we performed up to fifteen model runs, to evaluate model coherence and perplexity. The best model run, identified as run 5, achieved the highest coherence score of 0.495 and perplexity of 1469 (see Table 10.2). From the best model run, the five topics identified were qualitatively examined and compared with the posts constituting these topics.

The first topic, identified as "Information Generation" and carrying the highest topic weight of 0.2332, revolves around discussions on idea generation using large language models (LLMs) like ChatGPT-4. Posts and keywords under this topic, such as "*using ChatGPT-4 AI, innovators can move beyond conventional thinking and access new information and unusual ideas*" and "*ChatGPT came up with 200 new product ideas in about 15 minutes, completing the task faster, cheaper, and more efficiently than Wharton*

Table 10.2 Model Evaluation and Rank

Topic run	*Coherence*	*Perplexity*	*Rank*
Num Topics: 3	0.3812	895	3
Num Topics: 5	0.4959	1469	1
Num Topics: 10	0.3943	1487	4
Num Topics: 12	0.4393	1219	2
Num Topics: 15	0.3803	1512	5
Best Model - Topic: 5 Coherence Score: 0.49585			

MBA students," highlight the strong inclination to leveraging advanced AI technologies to spur innovation and creativity. Entrepreneurs and professionals recognize the potential of LLMs like ChatGPT-4 to drive the generation of new ideas, enhance brainstorming sessions, and facilitate creative problem-solving.

The second topic, with a weight of 0.1635, is labeled as "Precision Search." This topic emerges from conversations about using ChatGPT-4 for precise searches related to solutions, opportunities, and innovative models. Examples include "*ChatGPT has been a good search assistant worldwide so far"* and *"with ChatGPT-4, you can create prompts with precision and artistry. Use Specific Details; ChatGPT-4 thrives when given specific instructions and details*." This topic underscores the value of AI in improving the accuracy and efficiency of information retrieval, which is critical for identifying market gaps, exploring new business opportunities, and staying ahead of industry trends. Professionals and entrepreneurs view ChatGPT-4 as a powerful tool for conducting in-depth research and gaining actionable insights.

The third topic, weighted at 0.2019, is identified as "Innovation." This topic captures ChatGPT-4's ability to drive innovation by reconfiguring business models, enhancing professional communication, and providing ideas for deploying new systems to boost productivity. Posts like "*AI is already playing a pivotal role in the advancement of innovation, contributing to the introduction of new methodologies while building on old ones to create newer and more improved solutions*" and "*One of the most exciting roles of ChatGPT4 AI is driving innovation*" reflect ChatGPT-4's multifaceted applications in transforming traditional business practices and fostering continuous improvement. Entrepreneurs are particularly interested in how ChatGPT-4 can streamline operations, facilitate professional interactions, and support the development of cutting-edge solutions.

The fourth topic, with a weight of 0.1872, is described as "Entrepreneurial Insights." This topic links to discussions about the entrepreneurial applications of ChatGPT-4. Posts such as "*Products built using AI technology can, among many other benefits, enhance customer service, improve revenue forecasting capabilities, speed up decision-making, and raise productivity*" or "*what ChatGPT Will Mean for Entrepreneurs*" suggest that ChatGPT-4 is seen as a valuable asset for exploring new markets, understanding market trends, and sustaining client expectations and productivity through advanced innovations. Entrepreneurs appreciate ChatGPT-4's ability to provide entrepreneurial insights, identify emerging trends, and offer strategic guidance for entering and thriving in competitive markets.

The fifth topic, with a weight of 0.2140, is identified as "Data-Driven Decision-Making." This topic emerges from posts like "*With ChatGPT-4 AI tools, innovators can process vast amounts of data with incredible speed and accuracy*" and "*According to research, nearly 60% of healthcare companies depend on predictive analytics to help develop new services and products for their customers*." These posts highlight ChatGPT-4's prowess in data analysis, emphasizing its usefulness in performing complex analyses and offering insights for data-driven decision-making. Professionals and entrepreneurs recognize the importance of data in today's business environment and view ChatGPT-4 as an essential tool for making informed decisions, optimizing processes, and gaining a competitive edge.

Broadly, the identified topics illustrate ChatGPT-4's significant role in idea generation, precise searching, innovation, entrepreneurship, and data analysis. These insights highlight ChatGPT-4's potential to drive business strategies, enhance professional productivity, and support entrepreneurial ventures. Entrepreneurs and professionals can leverage these findings to explore new opportunities, refine their business models, and make data-driven decisions, ultimately contributing to their success in a rapidly evolving digital landscape. The identified topics, their top ten keywords, weights, and the number of posts constituting each topic (size) are detailed in Table 10.3. Model perplexity and coherence score, which are key metrics used to assess the performance of topic models, are reported in Figure 10.2. A good topic model should have a balance between low perplexity and high coherence scores. While perplexity focuses on the model's predictive performance, coherence ensures that the topics make sense to human users. Generally, lower perplexity values suggest better model performance in terms of predictive accuracy, while higher coherence scores indicate that the topics are more interpretable and meaningful. Inferring from Table 10.2, the best model run with 5 topics shows the best combination between perplexity and coherence.

Furthermore, the study analyses sentiments expressed about the release and use of ChatGPT-4 within the entrepreneurial context. The analysis revealed that 47.51% of posts expressed positive sentiments toward ChatGPT-4 and its implications for digital entrepreneurship, 41.33% were neutral, and 11.15% were negative. This indicates that the majority of professionals have a favorable view of ChatGPT-4 and its potential for driving significant gains in entrepreneurship. The high positive sentiment suggests a growing need for the adoption of this technology in entrepreneurial endeavors. The sentiment distribution is illustrated in Figure 10.3.

Table 10.3 Topics, Keywords, Weight, and Size

Topic	*Top Ten Keywords*	*Topic Weight*	*Topic Size*
Topic 1	generate (0.1503), altman (0.1168), model (0.109), business (0.1059), intelligence (0.0972), help (0.0956), use (0.0953), prompt (0.0812), new (0.0777), language (0.0711)	0.2332	234
Topic 2	search (0.1376), opportunity (0.1361), solve (0.111), human (0.1054), problem (0.088), innovate (0.0874), capability (0.0857), share (0.0852), train (0.0816), company (0.0815)	0.1635	164
Topic 3	innovate (0.1695), model (0.1211), communicate (0.1039), idea (0.0970), business (0.0921), image (0.0909), public (0.0880), deploy (0.0819), work (0.0783), product (0.0773)	0.2019	202
Topic 4	entrepreneur (0.1539), market (0.1149), innovate (0.1097), technology (0.0976), understand (0.0967), trend (0.0961), model (0.0900), data (0.0845), custom (0.0788), sustain (0.0778)	0.1872	188
Topic 5	data (0.2196), analyze (0.1365), business (0.1045), advance (0.0959), language (0.0857), predict (0.0834), process (0.0730), efficient (0.0713), automate (0.0669), perform (0.0632)	0.2141	214

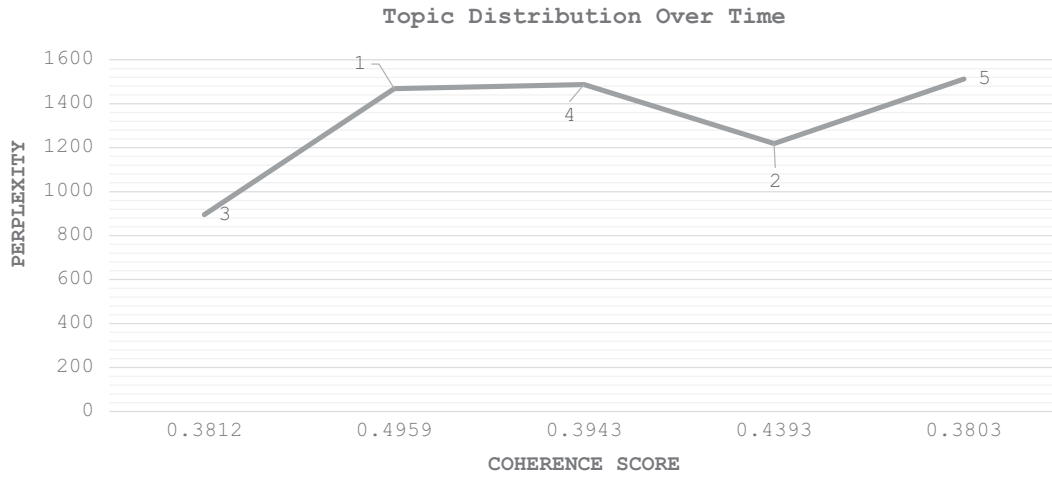


Figure 10.2 Model coherence, perplexity, and rank.

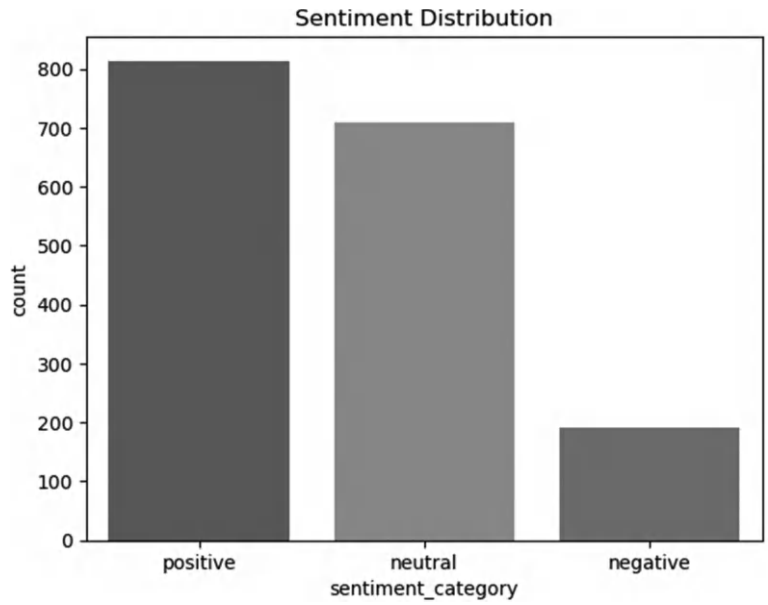


Figure 10.3 Sentiment distribution of posts.

Discussion

LinkedIn has become an essential platform for professionals to grow their networks, advance their careers, and shape industry trends and knowledge. It is a powerful tool for promoting innovation. According to Nagaraj et al. (2024), the creation, communication, and delivery of value are key drivers of user engagement on social networking platforms. Akkol et al. (2023) further note that these networks enable users to connect, share insights, and showcase achievements, thereby sparking interest in new skills and innovations that boost productivity.

In this study, we analysed the discourse on ChatGPT4.0 among professionals from diverse backgrounds to understand its relationship with entrepreneurship. The findings of this study are categorized into three levels: elements of ChatGPT4.0, key operating factors, and benefits, which reflect themes from previous research (Kim & Han, 2023; Tafesse & Wien, 2024). We observed that discussions frequently emphasize ChatGPT4.0's role in entrepreneurial processes, its impact on entrepreneurship, and its wide-ranging capabilities.

Prominent discussions about ChatGPT4.0 focus on its generative and enhancement values, which were identified in five main topics. These topics align with value perspectives such as value creation, value proposition, and

value creation processes identified in prior studies like Ali et al. (2023). Frequent word terms like intelligence, opportunity, and innovation can be considered macrometric indicators of ChatGPT4.0's impact, while terms like impact, communicate, and decision are critical micrometric indicators, showing direct influences on entrepreneurial activities.

Using the optimal K criteria and BERT-LDA algorithms, we identified five core topics in LinkedIn posts containing keywords "ChatGPT4.0 and Entrepreneurship" and "OpenAI and Entrepreneurship": information generation, precision search, innovation, entrepreneurial insights, and data-driven decision-making. These topics reflect the most frequent words associated with ChatGPT4.0's value creation in entrepreneurship. The relationship between ChatGPT4.0 and entrepreneurship is summarized in the framework shown in Figure 10.4, which can guide entrepreneurs on leveraging ChatGPT4.0 to drive innovation.

Figure 10.4 illustrates how ChatGPT4.0 supports entrepreneurship across three dimensions: elements, key underlying affordances, and value benefits. The elements (level 1) include information generation, innovation, entrepreneurial insights, and precision search. These capabilities are crucial for digital and social entrepreneurs, offering robust problem-solving abilities and facilitating strategic thinking. Several posts, such as Generative AI tools

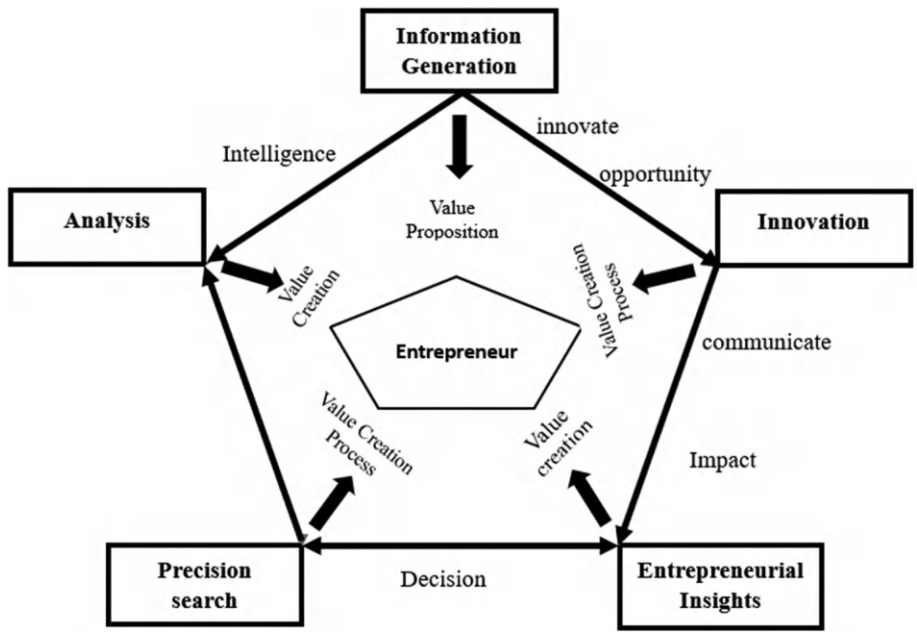


Figure 10.4 Synthesized model of findings.

like ChatGPT and TensorFlow have already revolutionized the generation of new ideas, while other AI technologies such as machine learning algorithms and neural networks continue to push the boundaries of what's possible across various fields, such as sales, marketing, and customer service, highlight the source of the "elements" dimension. Similarly, posts like this "ChatGPT AI can assist by recommending preferable services and products to users, analyzing customer demands, and improving delivery and production" highlight the analysis and entrepreneurial insight capability deposited in ChatGPT4.0.

The key operating factors (level 2) encompass six indexes: innovate, communicate, impact, decisions, opportunity, and intelligence. These factors highlight the importance of strategic thinking in leveraging both macro- and micrometric innovation capabilities as opportunities to foster social impact through developing effective communication, and making intelligent, data-driven decisions toward entrepreneurial outcomes. A post such as "*ChatGPT can assist entrepreneurs in various tasks, including composing proposals, market research questions, and social media posts*" largely underscores this argument.

The benefits and assessments (level 3) emphasize value creation and the delivery of value networks that ChatGPT4.0 presents. Entrepreneurs must effectively convey and broadcast their value with a well-thought-out strategy formation, being crucial for growth, online visibility, and enhanced business models.

The sentiment analysis of the posts on ChatGPT-4 and entrepreneurship revealed the majority (47.51%) of posts are positive, 41.33% are neutral, and 11.15% are negative. This indicates a generally favorable view of ChatGPT-4 among professionals, emphasizing its perceived value in enhancing entrepreneurial activities. In line with Kuzior et al. (2023), who established general optimism about AI use for innovation, the findings from this study also corroborate the notion that the high positive sentiment implies that many professionals see ChatGPT-4 as a valuable tool for idea generation, productivity enhancement, and data-driven decision-making. The significant neutral sentiment points to cautious optimism, where users recognize the potential but are still assessing its long-term impact. Similarly asserted by Kelley et al. (2021), the lower percentage of negative sentiment highlights some concerns regarding reliability, risks, or integration. For entrepreneurs and professionals, these findings suggest that leveraging ChatGPT-4 can offer considerable benefits. However, addressing potential drawbacks and

ensuring effective deployment are crucial to maximize its positive impact on business operations and innovation.

These findings offer insights from a vast and diverse pool of professional content that entrepreneurs can leverage. While analysing unstructured online posts is challenging, this study's examination of LinkedIn posts related to ChatGPT4.0 and entrepreneurship is essential, as it highlights ChatGPT4.0's core relevance in driving entrepreneurial ventures, providing valuable insights for entrepreneurs aiming to harness this technology for innovation and growth.

Conclusion

This study investigates the key topics related to ChatGPT4.0 and entrepreneurship, identifying five core themes. The findings underscore the essential elements, operating factors, and benefits of GPT-4.0 AI innovation in entrepreneurial contexts. The research confirms that AI innovations, like ChatGPT4.0, play a crucial role in sustaining business models and enhancing operational excellence. These innovations are particularly significant for digital entrepreneurship, driven by key operating factors and value-based benefits.

Key factors such as opportunity, innovation, communication, impact assessment, intelligence, and decision-making highlight ChatGPT4.0's potential to foster entrepreneurial success. The enduring application of ChatGPT-4.0 is vital for leveraging its extensive value offerings, which can drive significant advancements in entrepreneurial ventures.

The text analysis techniques used in this study demonstrate their effectiveness in extracting insights from large corpora of both long and short texts, including social media content such as posts and tweets. This research applies these techniques to analyse topics related to ChatGPT4.0 and entrepreneurship, providing a foundation for future studies.

Implications for Practice

The study on ChatGPT-4 and its impact on entrepreneurship reveals significant implications for practitioners. Entrepreneurs and business leaders can leverage ChatGPT-4 to enhance various aspects of their operations. The technology's ability to generate innovative ideas and provide precise search

capabilities enables entrepreneurs to discover new opportunities and streamline their decision-making processes. ChatGPT-4's applications in professional communication and data-driven decision-making are particularly valuable, allowing businesses to improve efficiency, productivity, and strategic planning. Additionally, the positive sentiment expressed by professionals toward ChatGPT-4 suggests a growing acceptance and enthusiasm for integrating advanced AI tools into entrepreneurial ventures. Practitioners and entrepreneurs must focus on deploying this technology effectively to maximize its benefits while addressing potential challenges such as reliability and integration into existing systems. By harnessing ChatGPT-4, businesses can stay competitive in the rapidly evolving digital landscape, drive innovation, and achieve sustainable growth.

Future Research Directions

1. **Time-Based Analysis of Discussions:**
   - Future research could expand on the scope of ChatGPT-4 and entrepreneurship by incorporating time-based analyses of trending discussions across various social media and news platforms. This approach would help contextualize insights within specific time periods, offering a clearer understanding of the evolving discourse around AI and entrepreneurship.
2. **Exploring Long-Term Impacts:**
   - Researchers should investigate the long-term impacts of ChatGPT-4 on entrepreneurial activities. This includes studying how sustained use of the technology influences business models, operational efficiency, and overall market competitiveness.
3. **Sector-Specific Applications:**
   - Detailed studies focusing on sector-specific applications of ChatGPT-4 can provide deeper insights into its effectiveness across different industries. By understanding how ChatGPT-4 can be tailored to meet the unique needs of various sectors, researchers can offer more targeted recommendations for practitioners and entrepreneurs.
4. **Addressing Potential Drawbacks:**
   - Further research is needed to address the potential drawbacks and challenges associated with the deployment of ChatGPT-4. This includes exploring issues of reliability, integration, and the ethical implications of using advanced AI technologies in business settings.

By leveraging these recommendations, practitioners, and entrepreneurs can harness the full potential of ChatGPT-4 to drive innovation and achieve growth in their ventures while researchers can continue to explore the vast possibilities and implications of this advanced AI technology.

References

Abaddi, S. (2024). GPT revolution and digital entrepreneurial intentions. *Journal of Entrepreneurship in Emerging Economies*, *16*(6), 1903–1930. https://doi.org/10.1108/JEEE-07-2023-0260

Akkol, E., Olucoglu, M., Dogan, O. (2023). Topic Modeling for Skill Extraction from Job Postings. In: Ortiz-Rodriguez, F., Villazón-Terrazas, B., Tiwari, S., Bobed, C. (eds) Knowledge Graphs and Semantic Web. KGSWC 2023. Lecture Notes in Computer Science, vol 14382. Springer, Cham. https://doi.org/10.1007/978-3-031-47745-4_20

Alhajri, A., & Aloud, M. (2024). Female digital entrepreneurship: A structured literature review. *International Journal of Entrepreneurial Behavior & Research*, *30*(2/3), 369–397.

Ali, O., Murray, P., Momin, M., & Al-Anzi, F. S. (2023). The knowledge and innovation challenges of CHATGPT: A scoping review. *Technology in Society*, 75 No. 11, 1–16.

Ausat, A. M. A., Rachman, A., Rijal, S., Suherlan, S., & Azzaakiyyah, H. K. (2023). Application of ChatGPT in Improving Operational Efficiency in the Context of Entrepreneurship. *Jurnal Minfo Polgan*, *12*(1), 1220–1228.

Burton, J. W., Almaatouq, A., Rahimian, M. A., & Hahn, U. (2024). Algorithmically mediating communication to enhance collective decision-making in online socialnetworks. *Collective Intelligence*, *3*(2), 26339137241241307.

Daniels, R. A., Pemble, S. D., Allen, D., Lain, G., & Miller, L. A. (2023). LinkedIn blunders: A mixed method study of college students' profiles. *Community College Journal of Research and Practice*, *47*(2), 90–105.

George, A. S., & George, A. H. (2023). A review of ChatGPT AI's impact on several business sectors. *Partners Universal International Innovation Journal*, *1*(1), 9–23.

Gupta, V., & Yang, H. (2024). Study protocol for factors influencing the adoption of ChatGPT technology by startups: Perceptions and attitudes of entrepreneurs. *PLoS One*, *19*(2), e0298427.

Kelley, P. G., Yang, Y., Heldreth, C., Moessner, C., Sedley, A., Kramm, A., … & Woodruff, A. (2021, July). Exciting, useful, worrying, futuristic: Public perception of artificial intelligence in 8 countries. In *Proceedings of the 2021 AAAI/ACM Conference on AI, Ethics, and Society* (pp. 627–637).

Kim, T., & Han, S. (2023). An exploratory study on social issues related to ChatGPT: focusing on news big data-based topic modeling analysis. *Journal Digital Contents Society*, 24(6), 1209–1220.

Kuzior, A., Sira, M., & Brożek, P. (2023). Use of artificial intelligence in terms of open innovation process and management. *Sustainability*, *15*(9), 7205.

Mandal, R., Chen, J., Becken, S., & Stantic, B. (2023). Tweets topic classification and sentiment analysis based on transformer-based language models. *Vietnam Journal of Computer Science*, *10*(02), 117–134.

Moghadas, M., Fekete, A., Rajabifard, A., & Kötter, T. (2023). The wisdom of crowds for improved disaster resilience: A near-real-time analysis of crowd-sourced social media data on the 2021 flood in Germany. *GeoJournal*, *88*(4), 4215–4241.

Nagaraj, R., Rohith Adithya, C. R., Sakalabathula Sri Chakra, T., & Deepika, T. (2024). Identifying the Influences Behind the LinkedIn Posts using Topic Modeling and Sentiment Analysis. *Proceedings of the 1st International Conference on Artificial Intelligence, Communication, IoT, Data Engineering and Security, IACIDS 2023*, 23–25 November 2023, Lavasa, Pune, India. (pp. 1–6) http://dx.doi.org/10.4108/eai.23-11-2023.2343215

Purnomo, A., Septianto, A., Taufiq, M., Anam, F., & Sano, A. V. D. (2023, August). LinkedIn: An academic study mapping using scientometric application during two decades. In *AIP Conference Proceedings* (Vol. 2431, No. 1). AIP Publishing.

Sallam, M. (2023, March). ChatGPT utility in healthcare education, research, and practice: A systematic review of the promising perspectives and valid concerns. In *Healthcare* (Vol. 11, No. 6, p. 887). MDPI.

Sitaridis, I., & Kitsios, F. (2024). Digital entrepreneurship and entrepreneurship education: A review of the literature. *International Journal of Entrepreneurial Behavior & Research*, *30*(2/3), 277–304.

Smith, S. A., & Watkins, B. (2023). Millennials' uses and gratifications on LinkedIn: Implications for recruitment and retention. *International Journal of Business Communication*, *60*(2), 560–586.

Su, Y., & Liu, Z. (2023). A study of ChatGPT empowering college students' innovation and entrepreneurship education in the context of China. *International Journal of New Developments in Education*, *5*(13), 1–7.

Tafesse, W. and Wien, A. (2024). ChatGPT's applications in marketing: a topic modeling approach, *Marketing Intelligence & Planning*, *42*(4), 666–683. https://doi.org/10.1108/MIP-10-2023-0526

Tian, Y., Wang, L., & Bullo, F. (2023). How social influence affects the wisdom of crowds in influence networks. *SIAM Journal on Control and Optimization*, *61*(4), 2334–2357.

Tsironis, G., Karagkouni, A., Dimitriou, D., & Tsagarakis, K. P. (2023). Mapping sustainable practices and concepts in the transportation ecosystem for the EU-27 countries, based on LinkedIn company profiles. *Frontiers in Sustainability*, *4*, 1268575.

Yáñez-Valdés, C., & Guerrero, M. (2024). Determinants and impacts of digital entrepreneurship: A pre- and post-COVID-19 perspective. *Technovation*, *132*, 102983.

Index

Pages in *italics* refer to figures and pages in **bold** refer to tables.

B

C

D

E

F

G

P

Q

R

S

T

U

V

W