
Editorial: A brief review on the development of artificial intelligence

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1 Introduction

The society's sustainable development has long been driven by innovation (Xiong et al., 2020; Wang et al., 2020). In the eve of the Fourth Industrial Revolution, the world witnesses the application of many emerging technological innovation. Artificial intelligence (AI) is one of the most significant innovative breakthrough. AI is the science and engineering of creating computer programs and hardware to learn and solve problems in ways that traditionally require human intelligence (Dorigo et al., 2006). PwC (2017) predicts that AI will boost the world economy by up to 14% by 2030, equivalent to \$15.7 trillion. By that time, the AI can bring greatest economic gains to two regions: China (26% boost to GDP) and North America (14.5% boost) (PwC, 2017). AI has been rapidly and profoundly shaping the world by creating a new wave of technological and business revolution. For instance, e-commerce industry uses AI to predict the demand changes of customers. The agriculture industry applies deep learning to facilitate yields. The financial industry adopts AI to improve the data analysis speed and quality to increase returns.

The radical changes brought by AI will further impact the whole structure of society, reshaping employment patterns and people's daily lives. While AI could work as a worker-replacement process and cause unemployment, there also exists a Pareto improvement to adjust societal structure and enhance welfare as well as entrepreneurship (Korinek and Stiglitz, 2017). In terms of social and ethical issues, such as security of data and privacy, AI can bring opportunities as well as challenges to today's society.

2 New competition and collaboration relationships

Emerging technologies such as AI bring new changes to the relationships between countries, as well as to firms. Emerging countries have gradually become important global developmental engines, while developed countries still hold advantages in many classic technological areas. But when it comes to emerging technologies, developed countries are usually good at the research side, while emerging countries have more

advantages in the commercialisation side. Therefore, emerging countries gain more bargaining power in the development of emerging technologies such as AI. The new patterns of competition and collaboration in developing emerging technologies between emerging and developed countries are an interesting topic. Similarly, new competition and collaboration relationships might occur between giants and new companies. At the same time, emerging technologies such as AI may bring new opportunities and challenges to the above collaboration and competition relationships.

Although AI is still in the very early stages of development, it will definitely create new winners and losers in firms, industries, and probably in countries (Daugherty et al., 2019). Naturally, many countries regard AI as a strategic enabler to help better position themselves for the future global competition. For instance, the USA, China and Japan have already launched industrial and national schemes to accelerate the development and application of AI technologies. In addition, firms in various sizes have strong interest in exploring new business opportunities in the context of AI. Therefore, significant financial, political, and human capitals across the world have been invested into the global competition for AI development. The following review will first discuss how to fund AI firms to improve their innovation performance, and then present the application of AI in two representative scenarios, and finally briefly discuss the relationship between AI and blockchain.

3 How to fund AI firms

To develop AI, firms need to get strong funding support. The possibility of getting funding is determined by many factors, and one of the most important factors is the innovation performance of firms, namely, the output of a firm's R&D activities. Governments' public funding agencies usually regard the innovation performance of firms as a key measurement of whether the firm deserves the investments. Naturally, many studies investigate how firms' previous innovation performance influences their opportunities of obtaining public funding. However, this question is under-explored about how can small and medium-sized enterprises (SMEs) and start-ups in AI market get public funding.

This special issue's first article (Li et al.) aims to explore how firms' innovation performance is related to their possibility of receiving public funding support (e.g., Innofund) in the Chinese AI market. Innofund is a Chinese central government program that was established in 1999 with a purpose of facilitating the R&D activities of technology-based SMEs and start-ups by helping them to secure other financing. Li et al. adopted the dataset of the applicants to the Innofund Programme in Beijing. The dataset was collected by the Beijing Municipal Science and Technology Commission. The data of 553 valid firms (years 2015 and 2016) was collected in this research.

This study finds an inverted U-shaped relationship between an AI firm's innovation performance and its probability of receiving public funding (e.g., Innofund). This study also finds that social investment can moderate the above relationship by flattening the effect of firms' innovation performance on their successful rate of receiving Innofund. Additionally, firms' ties to institutional intermediaries can help strengthen the above moderating effect of social investment. Social investment and institutional intermediaries act as important complementary signals to firms' innovation performance.

Li et al. seek to contribute to the literature in four aspects. First, they add to the literature on the relationship between innovation and policy, which mainly regards the selection issue as an endogeneity problem, and therefore, fails to pay enough attention to the selection process. Li et al. investigates how the signalling mechanisms by which firms are selected by the public funding via the perspective of firms' previous innovation performance. Second, Li et al. extend the existing research on the signalling effects of innovation performance by delineating the curvilinear effects of a firm's innovation performance on its probability of receiving public funding (e.g., Innofund). Both the benefits and costs/risks of the signalling effect are examined. Third, this study provides an explanation to the seemingly contrasting findings in extant literature, where both positive and negative effects of firms' innovation performance on the government's attitude to fund the firms were identified. Fourth, this research extends the innovation policy research into a new research context, i.e., the market of AI. AI is still in an early stage of its development (Daugherty et al., 2019), and therefore, its significant potential benefits come along with technical uncertainties, market risks and legal risks. This presents an excellent opportunity to analyse the co-evolution between government and industries' innovation policies and AI.

This research also made three practical recommendations: first, in the context of China, where the available resources are limited and the institutions are weak, policy makers should carefully and appropriately allocate public resources. This is particularly true for SMEs that have limited resources, in the meantime, weak ties with government. Second, governments' public funding should not limit themselves to the firms' performance as the only criteria when evaluating which firm to invest in, other complementary measurement criteria should also be considered. Third, SMEs could leverage both social investment and institutional intermediaries to influence the policy decision and to improve their chances of getting public funding.

4 The applications of AI

The applications of AI usually include the recognition and process of language, pattern and vision, as well as decision-making support (Karaboga et al., 2014). The recent years witnessed the wider and deeper application of AI across industries and countries. From self-driving vehicles, shopping platforms (e.g., Alibaba and Amazon), video sharing apps (e.g., Tiktok), to personal assistant (SIRI of Apple) and information search engine (e.g., Google and Baidu), AI encompasses almost every aspects of our society. It cannot only bring about emerging industries, but also help upgrade and transform traditional industries. Nevertheless, we still do not have much understanding of how to apply AI to different industries. More importantly, how to understand AI's characteristics to harness more benefits in different industries? This special issue pays a special attention to the application of AI in a few representative areas, including, strategic human resource management (SHRM), collaborative business ecosystem, and entrepreneurial social networks.

4.1 Entrepreneurial social networks

This special issue's second article (Chen et al.) explores how to exploit AI to dynamically optimise the governance and evolution of an entrepreneurial social network. Social

networks are regarded as important channels for start-ups to obtain resources (Xia et al., 2020; Jha et al., 2017). In the fast-changing environment where massive information is generated and spread, start-ups need to dynamically evolve their social networks to match their resources with the strategic objectives. In other words, the dynamic governance, as well as its optimisation, of social networks is extremely significant for companies. Unfortunately, many firms do not know when and how to evolve their social networks. In addition, very few previous research has investigated the dynamic optimisation subjects within the context of entrepreneurial social network.

AI is a powerful method to simulate, process, and reason the complex and dynamic human behaviour, and therefore, it is well-aligned with the dynamic and uncertain characteristics of entrepreneurial social networks. Chen et al. introduce a dynamic optimisation algorithm (DOA)-based AI system to explore when and how to optimise the dynamic evolution of start-ups' social network governance. To test the algorithm, this study obtained data from the Yuejia Cloud Service of Chongqing Ruiyun Technology Co. Ltd., which deployed distributed crawler-based engines to collect data. The DOA is verified to be effective to improve the evolution governance efficiency of social networks.

This study makes a number of contributions. First, it extends the application of AI to entrepreneurial social networks based on DOA. Second, this study adds insights to the literature on entrepreneurial social networks by proposing and testing a DOA-based AI system with empirical data. The DOA-based AI system is helpful to the measurement of the dynamic governance of social networks. It can also enable researchers achieve comprehensive understanding towards the governance effect of an entrepreneurial social network. Third, this study embeds two significant but under investigated elements, dynamism and uncertainty, into the research framework in the fields of entrepreneurship and social networks. In terms of the practical implications, start-ups can refer to this article's DOAs and AI system to better govern their entrepreneurial social networks.

4.2 Human resource management

AI has gradually been widely applied in human resource management system, such as performance measurement, KPI management, promotion and remuneration management and so on. Human resource department's client relationship management (HRDCRM) is a focus topic in the area of SHRM. This special issue's third article (Wang et al.) investigates how to improve firms' sustainable performance by improving HRDCRM as well as promoting the match between HRDCRM and relational capital. HRDCRM is a process of improving the HR department's management practices by continually strengthening the communication with customers, who in this study refer to interior staff members and exterior stakeholders. Relational capital refers to the relationship between the enterprise and employees, customers, suppliers, government, community, beyond, etc. (Sulistyo and Siyamtinah, 2016). Factors of HRDCRM include internal marketing mix, strategic countermeasure ability, organisational attractiveness and so forth.

Wang et al. build a theoretical model to investigate the mediator role of relational capital by which HRDCRM influences firms' sustainable performance in the Chinese context. This study randomly chooses 35 firms to carry out a two-phase questionnaire survey from five industrial parks in eastern and southern China. The data was collected through employee-manager paired samples. In total, 273 valid front-line employee questionnaires and 235 valid middle-senior managers' questionnaires were retrieved.

Wang et al. find that AI technology cannot only directly improve firms' sustainable performance, but also indirectly promote it through relational capital. Further, HR department's strategic countermeasure ability will effectively promote firms' sustainable performance through the mediating effect of relational capital. Wang et al. add insights to the human resource management by developing a theoretical model of the mechanism of HRDCRM on firms' sustainable performance. Second, they extend the research on SHRM by exploring how AI can be applied in different stages and tasks. This study recommends the HR departments to fulfil the new role of strategic business partner by applying AI technologies in multiple aspects.

5 Blockchain and AI

Gartner (2019) predicts that blockchain can support the movement and tracking of up to \$2 trillion worth of global goods and services annually by 2023. A blockchain is an open, decentralised, distributed and immutable ledger that records data in a verifiable and permanent way (Dinh et al., 2018). Blockchain enables reliable transactions/exchanges even if the participants do not know each other.

Some experts describe AI as the brain, while blockchain is the body (Kranz, 2017). In other words, AI enables the analytics and decision making based on the data collected, shared and stored by blockchain. The match between AI and blockchain gradually proves to be successful and effective in online social networks (OSNs), such as Facebook, WeChat and Twitter. OSNs have significantly transformed people's way of socialising. In the ecosystem of OSNs, the users are free to join, engage with the online community, which constantly generates data. The data can be commercially developed by OSNs to provide better focused service to users. Meanwhile, the user-generated data can be sold and exchanged among OSNs. The long lasting limitations in the traditional centralised OSNs are concerned with the data transfer quality, security and safety. To overcome those limitations, a growing number of OSNs have now start to embed blockchain technologies.

This special issue's fourth article (Duan et al.) investigate to how to address the security challenges and limitations of current OSNs by using blockchain. In particular, Duan et al. investigate how to exploit the blockchain technology to design a new photo-sharing social network (PSSN), in which users' social behaviour data are stored in the blockchain in the form of transactions. The blockchain improves the authenticity and credibility of data and help preclude data tampering. Further, this study proposes a new blockchain consensus algorithm, which can help the efficiency of the proposed PSSN exceeds that of the existing blockchain system. Finally, a creative incentive model is designed in the PSSN to encourage users to share more social activities (e.g., sharing and forwarding photos), which is good for the whole value-creation of the OSNs.

The above articles are helpful to extend our understanding of the development of AI via a management perspective. There are many promising areas for future research. For instance, the integration of AI with big data, cloud computing and blockchain. Another aspect would be the design of policy and regulation to guide the development of AI. Further, cross-country comparison on the evolution pattern of AI could be interesting. We look forward to seeing more research on the management and application of AI as well as other strategic emerging technologies. Finally, we would like to thank Editor-in-Chief,

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References

- Daugherty, P.R., Wilson, H.J. and Chowdhury, R. (2019) 'Using artificial intelligence to promote diversity', *MIT Sloan Management Review*, Vol. 60, No. 2, p.1.
- Dinh, T.T.A. et al. (2018) 'Untangling blockchain: a data processing view of blockchain systems', *IEEE Transactions on Knowledge and Data Engineering*, Vol. 30, No. 7, pp.1366–1385.
- Dorigo, M., Birattari, M. and Stutzle, T. (2006) 'Ant colony optimization – artificial ants as a computational intelligence technique', *IEEE Computational Intelligence Magazine*, Vol. 1, No. 4, pp.28–39.
- Gartner (2019) *Blockchain: What's Ahead?* [online] <https://www.gartner.com/en/information-technology/insights/blockchain> (accessed 3 October 2020).
- Jha, A., Fernandes, K., Xiong, Y., Nie, J., Agarwal, N. and Tiwari, M.K. (2017) 'Effects of demand forecast and resource sharing on collaborative new product development in supply chain', *International Journal of Production Economics*, Vol. 193, pp.207–221.
- Karaboga, D., Gorkemli, B., Ozturk, C. and Karaboga, N. (2014) 'A comprehensive survey: artificial bee colony (ABC) algorithm and applications', *Artificial Intelligence Review*, Vol. 42, No. 1, pp.21–57.
- Korinek, A. and Stiglitz, J.E. (2017) *Artificial Intelligence and its Implications for Income Distribution and Unemployment*, National Bureau of Economic Research.
- Kranz, M. (2017) *AI is the Brain, IoT is the Body* [online] https://aibusiness.com/document.asp?doc_id=760259 (accessed 3 October 2020).
- PwC (2017) *Global Artificial Intelligence Study: Exploiting the AI Revolution* [online] <https://www.pwc.com/gx/en/issues/analytics/assets/pwc-ai-analysis-sizing-the-prize-report.pdf> (accessed 3 October 2020).
- Sulistyo, H. and Siyaminah. (2016) 'Innovation capability of SMEs through entrepreneurship, marketing capability, relational capital and empowerment', *Asia Pacific Management Review*, Vol. 21, No. 4, pp.196–203.
- Wang, Z., He, Q., Xia, S., Sarpong, D., Xiong, A. and Maas, G. (2020) 'Capacities of business incubator and regional innovation performance', *Technological Forecasting and Social Change*, Vol. 158, p.120125.
- Xia, S., Xiong, Y., Zhang, M., Cornford, J., Liu, Y., Lim, M.K., Cao, D. and Chen, F. (2020) 'Reducing the resource acquisition costs for returnee entrepreneurs: role of Chinese national science parks', *International Journal of Entrepreneurial Behavior & Research*, Vol. 26, No. 7, pp.1627–1657.
- Xiong, A., Xia, S., Ye, Z.P., Cao, D., Jing, Y. and Li, H. (2020) 'Can innovation really bring economic growth? The role of social filter in China', *Structural Change and Economic Dynamics*, Vol. 53, pp.50–61.