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THE EVOLUTION OF DIGITAL TRANSFORMATION IN CHINESE MANUFACTURING: A REVIEW AMIDST THE DRIVE FOR HIGH-QUALITY DEVELOPMENT

Chen Huihong*, Amiya Bhaumik

Original Article

Lincoln University College, 47301 Petaling Jaya, Selangor D. E., Malaysia

Corresponding Author's Email: chenhuihong003@outlook.com

Abstract

Chinese businesses now have more chances than ever before to achieve high-quality development because of the rise of the digital economy. There are several issues that have arisen as a result of digital transformation in Chinese manufacturing enterprises. These include a severe lack of digital transformation talent, an incomplete pattern of collaborative innovation throughout the industrial chain, and a lack of a solid foundation for digital transformation in Chinese enterprises. Using findings from field investigations and literature reviews, this paper lays out a theoretical framework and process for digital transitions in enterprises. It then proposes a top-tier design that includes data resource accumulation, digital platform , and the construction of a benign collaborative ecological system. All of this will take place against the backdrop of developing high-quality digital transformation and the trajectory for the growth. The significance of digital transformation and its role in helping companies maintain market competitiveness of economies. However, environmental, social, and institutional factors are also affected by disruptive changes that happen at the corporate level. Because of this, a broad variety of issues related to digital transformation have been extensively studied in academic literature during the 20 years.

Keywords: Chinese Manufacturing; Digital Transformation; High-Quality Development; Industrial Innovation; Manufacturing Enterprises

Introduction

The "14th Five-Year Plan" aims to leverage extensive data and diverse application scenarios, facilitate the profound integration of digital technology with the real economy, support the transformation and enhancement of traditional industries, cultivate new industries, business forms, and models, and reinforce new drivers of economic development. The Notice from the Ministry of Industry and Information Technology regarding the Three-Year Action Plan for the Development of New Data Centres (2021–2023) explicitly stated that "within three years, a development model for new data centres characterised by a rational layout, advanced technology, environmental sustainability, and a computing power scale commensurate with the expansion of the digital economy will be fundamentally established." In recent years, despite the profound effects of COVID-19 on the worldwide financial system and the significant decline in certain economies, China's digital economy has defied the trend and demonstrated remarkable vitality [1]. The White Paper on The Development of China's Digital Economy published by the China Academy of Communication and Information

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Technology indicates that in 2020, China's digital economy reached a magnitude of 39.2 trillion yuan, positioning it as the second largest globally and constituting 38.6% of GDP. The digital economy has expanded at a rate at least thrice that of GDP, emerging as a crucial catalyst for sustained economic growth.

In recent decades, globalisation has exerted mounting pressure on firms to adapt. This necessitates that firms integrate efficiently to survive and prosper in competitive landscapes. Effective integration may alone be accomplished via digital procedures and collaboration instruments [2]. Consequently, the significance of digital transformation has escalated. Research underscores the necessity of integrating digital transformation into current business paradigms, as this subject encompasses far more than just technology changes and impacts numerous, if not all, facets of a company. Successful business transformation is realised by concurrently utilising and investigating its potential to attain organisational agility [3].

Disruptive changes are defined as alterations within a company and its operational context resulting from digitalisation, which may render the existing business model obsolete and instigate digital transformation across various environments due to swift or disruptive innovations in digital technologies. These alterations generate significant uncertainty, prompting sectors and firms to adjust to new conditions through various strategies, such as banks adopting e-banking to secure competitive advantages over rivals. Innovative agile enterprises include transformation mandates in their plans to sustain their standings in competitive marketplaces. In doing so, they address emerging opportunities and strive to enhance their resilience to risk [3]. This implementation demonstrates the value of digital transformation for maintaining competitiveness in a digital economy [3]. Digitisation yields enhancements in productivity, savings in costs, and innovations that also "affect" digital transformation [4]. Numerous scholars from various fields have participated in the assessment of digital transformation, along with its prospects and problems [4]. Furthermore, the digital revolution induces alterations inside an industry and affects society concurrently. Consequently, as the significance of digital transformation becomes increasingly evident, it is concurrently accompanied with elevated expectations.

Digital transformation has become an important tactic for businesses to stay ahead of the curve and adapt to new circumstances, thanks to the proliferation of digital technology. When digital technology slowly seeps into businesses, it entirely changes how those businesses operate and how they do business [5]. This process is known as digital transformation. Even more so for companies operating in the industrial sector, digital transformation is crucial. Not only does it boost output and quality, but it also pushes businesses towards smart manufacturing, which helps them keep their edge in the global market [5]. The foundation of China's national economy and the driving force behind innovation-driven development are manufacturing businesses. Making the most of digital transformation and attaining innovation-driven growth are pressing and realistic concerns for Chinese manufacturing firms. In light of digital transformation's growing significance and the ripple effects it has on businesses and communities, this paper surveys the most recent research on the topic. To achieve this, the authors ran a co-occurrence analysis using the terms they had chosen. In this qualitative literature study, they will look at digital transformation through the lens of digital business transformation, analysing 39 of the most important publications in the process. In this context, technology is considered a force propelling digital change, with ramifications for both society and institutions.

Multiple sections make up this document. The first part of the paper lays out the methodology, criteria, terminology, and software that were used to select the publications for the study. The second part presents the findings from the bibliometric co-occurrence analysis, which found three primary groups in the literature. This section also defines key terms related to digital transformation and discusses the increasing interest in the topic. The third portion tackles the three clusters that were identified: digital business transformation, technology as a driver of digital transformation, and institutional and social repercussions. The former is further divided into two areas of research: business processes and organisational implications. Lastly, the last section provides a summary and analysis of the results, discussing their limits and offering suggestions for further research.

This investigation may consider several areas as potential minor contributions to the current literature. One problem is that there isn't enough study on how digital transformation affects knowledge development in the current literature. By recasting knowledge production through the SECI model as an iterative process, our research fills that need. The ability to create new knowledge may be broken down into four parts: the ability to perceive new information, to externalise that information, to combine existing information, and to internalise that information. To examine the consequences of digital transformation experimentally, they quantify each dimension. The second part of this research looks at how digital transformation affects knowledge creation capacities and how these effects vary across businesses. It discusses how factors like company size, ownership type, industry affiliation, and location play a part in these effects. Lastly, this study adds to the current body of literature by investigating the influence of knowledge production capacities, including R&D investment, government subsidies, and innovation culture, and the interconnections between various knowledge creation skills.

The Background Story of Digital Transformation Trajectory

Digital Economy was initially published in 1995 by Canadian author Don Tapscott in his book Digital Economy: The main point is that, thanks to various technological advancements, the new economy stores all information digitally and allows for rapid sharing, unlike the previous economy where data was physically stored. A total of 34.54% of Chinese businesses have begun digital transformation initiatives; 15.9% are actively pushing digital transformation, while 18.64% are just implementing it in select areas or products. A digital transformation is something that 18.83% of businesses intend to begin [6]. An entirely new economic paradigm and structure have emerged with the advent of the digital economy. Accelerating digital industrialisation and industrial digitisation and promoting deep integration of the digital economy and the real economy are the only ways to achieve high-quality economic development in this era of the digital economy [6].

Enterprises in the modern knowledge economy rely heavily on knowledge production, which is the bedrock upon which they build their capacity for indigenous innovation. The way knowledge is generated inside organisations is being transformed as digital technology continues to progress and becomes more widely used. More and more businesses are incorporating it into their approaches to innovation [6]. According to research, the pace, distribution, and bearers of conventional knowledge have all been significantly impacted by digital technology. Digital technology is significantly influencing knowledge generation activities and gradually changing the operations of businesses. Knowledge absorption capacity, building knowledge, flow of knowledge, knowledge coupling, and knowledge search are some of the mediating factors that have been considered in previous research on the impact of digital technology on enterprise innovation performance [6]. Furthermore, note that several academics have provided theoretical elaboration on how digital technology might aid knowledge management.

Literature Review

About the Concept of Digital Transformation

Digital technology, from a technical standpoint, is the means by which many forms of information, including images, texts, music, and video, are transformed into a set of numbers that computers can understand and work with, known as binary digits "0" and "1" [7]. The term "digitisation" refers to the methods, procedures, and development of using digital technologies. When businesses undergo a digital transformation, they undergo a period of intense change in which they use a combination of IT, computing, communication, and connection technologies to reimagine their structure, behaviour, and operational systems [8]. The G20 Digital Economy Development and Teamwork Initiative, adopted at the 2016 G20 Hangzhou Summit, defines the digital economy as a set of interrelated economic activities that rely on digital knowledge and information as primary inputs; modern information networks as transport mechanisms; and the efficient application of ICT as a catalyst for structural and operational optimisation.

In the Digital Transformation of Enterprise Development

Now more than ever, digital transformation is the key to industrial organisations achieving innovation. To boost their performance in new product creation, increase their new development space, and promote demand-centred

organisational ideas, models, and formats, manufacturing businesses will benefit from digital transformation [8]. The key to coping with environmental unpredictability is encouraging organisational innovation, which has recently become the standard for organisation development. Innovation output is positively impacted by big data's capabilities. Business shifts to data-driven product R&D from experience-based product R&D. The enhancement of three external driving factors—a technological breakthrough, a dramatic shift in the competitive landscape, and the empowerment of consumers—is intimately tied to this [8]. There is a fundamental conflict in China's conventional manufacturing sector between the "serious excess" of low-end manufacturing capacity and the "insufficient supply" of high-end, customised production capabilities. Businesses can better understand their customers' wants and needs in real time and connect with them on a more personal level through digital empowerment. Such an approach allows for more precise data input during product research and development and design, which in turn leads to better life-cycle services for users [9]. Four types of digital transformation—the provision of digital strategies, the sharing of digital strategies, the provision of digital business strategies, and the realisation of digital business strategies—support enterprise change [9]. Enterprises in our country are undergoing digital transformation, but the transformation ratio is low, and there are unbalanced development issues like insufficient [10]. This process is dynamic and depends on digital components, infrastructure, and platforms. Enterprise management decision-makers should develop a profound understanding of personnel characteristics and essential demands for digital transformation. They should view digital transition as an iterative upgrade of enterprise strategy, promoting enterprise materials, business facilities, and digital elements through digital and systematic thinking.

In Terms of Methods and Paths of Enterprise Digital Transformation

The digital transformation of manufacturing companies is being influenced by both internal and external factors. The former two lines represent the "technology push," which includes both the vertical and transverse technological driving forces, and the latter two lines represent the "value drivers," which include factors like process optimisation and the importance of customer experience. Utilise both internal and external factors to create a rational framework for the digital transformation of manufacturing businesses. Enterprise digital transformation in the age of the digital economy means achieving intelligent transformation via the use of network technologies, big data, and 5G. Building an intelligent enterprise strategy and culture is the next step after bolstering the advancement of technological innovation and business applications, creating a digitally connotational business process, realising digital innovation of core business products and services, transitioning to a control mode with highly coupled components, and finally, establishing a digital service system. Enterprise digital transformation can only be successful if two things are in place: first, the ability to offer the necessary financial backing for digital transformation and second, effective technological assistance conditions [10].

Basic Connotation of Enterprise Digital Transformation

Anything that is either integrated with or facilitated by information and communication technologies (ICTs) is considered digital technology [11]. This classification includes digital components, digital platforms, and digital infrastructure. The term "digital transformation" describes how businesses adapt to new circumstances by reimagining value generation via the application of digital technology. In the process of going digital, there are three distinct phases. All things digital, including digital upgrading, digital transformation, A dynamic digital business model may be created through digital transformation, which is a high-level change that focuses on establishing digital technologies and supporting capabilities through digitisation. To construct a new model of business and encourage the new fundamental competitiveness of companies, the three differentiate themselves by highlighting digitalisation in information, process, and business [11]. Many companies have decided to implement digital transformation and management strategies to keep up with the rapid changes of the information age. These initiatives allow the inventive use of data technology to radically alter the way organisations are run. When businesses use digital technology to revamp their essential goods, services, and operations, it's known as enterprise digital transformation [12]. This shift occurs from the perspective of organisational change. When businesses innovate via the use of digital technology, they undergo a process known as digital transformation. This involves restructuring the company's vision, strategy, organisational structure, processes, capabilities, and culture to adapt to the rapidly evolving digital environment.

In manufacturing, operations, and service processes, "digital transformation" occurs when organisations use digital technology to either replace older technologies with more sophisticated ones or to cut down on repetitive labour. An organisation or business undergoes digital transformation when its structure or development plan is re-evaluated in light of digital technologies. As a result, digital technology becomes an organisation's or business's primary engine for change and improvement.

As a whole, the manufacturing sector is undergoing a digital transformation as a result of the "technology-economy" paradigm shift, which is having a profound impact on the industry's factor structure, mode of production, organisational structure, and value source. A new level of cluster innovation, including the deep integration of current information technology into the manufacturing industry, has been achieved with the digital transformation of the manufacturing sector. A data-driven revolution is underway in the manufacturing sector, permeating every facet of the business from research and development to design to production to manufacturing to storage and logistics to sales and support.

Core Features of Digital Transformation of Manufacturing Enterprises

When businesses undergo digital transformation, they are compelled to continuously improve their resources, capacities, and models, ultimately leading to the development of new forms of stiffness [13]. Both internal value and external technology form the basis of digital transformation's precursors. Inputs from digital transformation (I) include both internal and external aspects of an enterprise, such as digital awareness, technical resources, organisational resources, human resources, learning ability, capital investment, as well as market competition, consumer demand, financial incentives, technological distance, and external cooperation. The five pillars of digital transformation (P) include digital product innovation, digital process innovation, digital service innovation, digital organisation innovation, process optimisation, customer experience upgrade, a collaborative symbiotic ecology system, output efficiency promotion through digital transformation (O), enterprise value promotion, and sustainable competitive advantage. Enterprise digital transformation aims to boost customer value, realise innovation and development, improve production efficiency, and close the gap between consumers' demands and manufacturing firms [14].

The Pattern of Collaborative Innovation in the Industrial

The chain is still in its early stages Production relations in China are lagging and hindering the growth of productive forces, creating a significant paradox in the country's digital economy. To achieve their digital transformation goals, Chinese businesses must engage in collaborative innovation across a wide range of domains, including partnerships between businesses and academic institutions. Such collaboration will allow for the optimal use of each party's superior resources. In today's business world, most companies put more emphasis on believing in themselves than on collaborating with academic institutions like colleges and universities. As a result, many partnerships between businesses and universities end up being more of a formality than anything else. As a result, universities and colleges often fail to adequately transform their students' academic achievements into marketable innovations, and companies often struggle to find effective solutions for digital transformation as a whole.

The Foundation of Digital Transformation is Weak

Small and medium-sized enterprises in our country generally have a low level of digital transformation. Statistics show that over half of the companies have never made the transition, and nearly a quarter of those businesses don't know much about digital transformation. Nearly a third of enterprises have a vague idea of what digital transformation is, and some are willing to start but haven't gotten around to it yet. Out of all businesses, just 4.39 percent have fully embraced digital transformation. It is clear that the foundation of digital transformation is rather poor, even if it may deliver value appreciation and increase competitive advantages for organisations.

The Integration of Industrialization and It Needs to Be Further Deepened

Essentially, informatisation impacts industrial innovation efficiency because information technology permeates the entire value chain of industrial innovation, boosting innovation efficiency at every stage. This leads to an overall improvement in industrial innovation efficiency, which is what they mean when they talk about the integration of informatisation and industrialisation, or AI and IR. Nevertheless, there are several issues plaguing China's innovation output, including poor quality, an imbalanced structure, low transfer efficiency generally, a large but weak industry

overall, an excess of low-end products, an inadequate supply of high-end products, products that require improvement in quality, and a dearth of influential leading enterprises on a global scale. Because of the increased importance of both information infrastructure and industrial innovation, the government should speed up the construction of infrastructure related to artificial intelligence, big data, the Internet industry, 5G base stations, smart upgrades, and digital transformation to facilitate the merging of the two processes [14].

Serious Shortage of Talents in Digital Transformation

A major cause of digital transformation problems or failures in manufacturing companies is a lack of complete understanding of its importance. Inadequate investment in talent development and an organization's professional reserves is at the heart of this issue. There aren't many experts in digital transformation or digital economy in China, and the idea of digital economy has been around for a while, coming from outside the country. It is not possible to produce highly skilled workers in a short period of time, even if digital economy majors and schools have been popping up in Chinese universities and colleges recently. There are still many businesses that aren't well-versed in digital transformation and the digital economy. As a result, they have poor talent training capabilities and don't have the right people to back their digital transformation efforts. This lack of skilled personnel affects all aspects of their digital transformation.

Discussion

Although it is subjective, policy support is an external component of digital transformation that the government should enhance to better guide and assist industrial firms. Governments in the modern digital age should push for more labour division, help businesses become more economically efficient, and actively advise and aid them as they undergo digital transformation [15]. The national new infrastructure plan aims to speed up the adoption and deployment of 5G and Wi-Fi 6, as well as to increase investment in digital economy infrastructure. Efforts to construct new digital economy infrastructure in China are still woefully inadequate. Infrastructure supporting the digital economy will get less than 20% of 2020's new 900 billion local special bonds [16]. For current industries and businesses to undergo a more robust digital transformation, the government may diversify its usage of new infrastructure while expanding investment in digital infrastructure.

Investment in research and development (R&D) is crucial to the growth of any business, whether it's a technological firm or a typical manufacturing company [17]. Increased investment in R&D, data mining around goods and customer service, promotion of digital transformation, and the creation of new, unique products are the only ways to succeed in today's cutthroat business environment [18]. Not only can businesses gain objective corporate benefits from research and development and the production of new, highly valuable products, but they can also increase their investor base, diversify their financing sources, promote digital transformation even further, and strengthen their competitive advantages on a global scale [19].

Competition among nations is a competition of skills, and talents are more important to an enterprise's development and growth than any other factor. The effectiveness of advertising new Internet technologies, data, the IoT, and other building components relies heavily on skill. A company's ability to attract and retain digital talent is crucial to its success during the present digital transformation phase; thus, it must find ways to address the talent gap through both internal talent development and external talent acquisition [20].

Organisational cultural background, system structure, business approach, and operational division of labour are all aspects of an organisation's management style and structure that must be transformed to put digital strategy into action [21]. This transformation spans from the top of the company to the frontline workers, and it begins with ideological awareness and ends with practical action. A digital transformation is one that affects the entire system and all links in the supply chain. The digital transformation of a business is a company-wide effort that involves every employee [22].

Through digital transformation, businesses can fully utilise the research capacities of academic institutions, as well as the resource advantages of complementary businesses upstream and downstream, or businesses in related industries [23]. Collaboration between businesses in today's digital economy has evolved from a traditional upstream and downstream "chain" to a more modern "network" [24]. Running a business in isolation is no longer an option in today's highly developed commodities economy if the goal is to satisfy consumers [25]. A digital ecological system that is beneficial to all parties involved (suppliers, consumers, partners, etc.) must be actively constructed. Businesses that were born and raised in the digital age, along with others that are more conventional, may work together to reshape production relations, create personalised goods, and offer consumers better value [25].

Conclusion

To develop a powerful nation, China must first strengthen its manufacturing sector, which constitutes the backbone of the economy. As a result of its significant position and rapid expansion, China's manufacturing sector saw its added value rise from 16.98 trillion yuan in 2012 to 26.6 trillion yuan in 2020, or over 30% of the world total. With the global digital economy booming and China's finances settling into a new normal, digital transformation, industrialisation and informatisation integration, and coordinated growth of industrial chains present both possibilities and problems for China's manufacturing firms. The country's high attention and urgent requirement for the technological advancement of manufacturing enterprises are fully reflected in the "14th Five-Year Plan", which prominently proposes "to accelerate the digital industrialisation and promote the coordinated modification of the whole technological chain of data empowerment" and "to promote a complete integration of technological innovations and the real economy, thereby enabling the improvement and transformation of traditional industries." They are certain that with the help of policies, they will keep investing more in research and development and educating our employees, improving the way businesses are structured, and working to create an ecological system that works in harmony with the institutions upstream and downstream. If businesses are able to successfully undergo digital transformation, it will undoubtedly spur even more high-quality development in the sector.

Conflict of Interests

The authors declare that they have no conflict of interests.

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