

Firm Digital Transformation and Business Model Innovation: Antecedents, Present, and Future

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Abstract: With the deep integration of digital technology and traditional industries, the boundaries of firms become fuzzy and dynamic, communication mechanism between firms becomes more diversified and open. The application and penetration of digital technology facilities and digital technology in various scenarios have innovated new ways of working communication and cooperation, and spawned new higher consumption demands. To deal with such opportunities and challenges, more and more firms have begun digital transformation. Existing studies have also found that firms can use the advantages of digital technology to maintain competitiveness and respond to new challenges, especially the COVID-19 pandemic makes business managers more aware of the importance of digital technology. With the urgency of digital transformation, more firms combine traditional business models with new technologies and new demands, and innovate existing business models in order to gain a sustainable competitive advantage. Through the analysis of the connotation of digital technology, digital transformation, digital business model and business model innovation, this article explores the impact mechanism of corporate digital transformation on business model innovation, attempts to answer why and how digital innovation affects business model innovation, and analysed the future development trend of business model innovation in the digital context.

Keywords: Digital, Digital Transformation, Business Model, Business Model Innovation, Digital Business Model

1. Introduction

In recent years, the breakthrough and integrated development of digital technology has promoted the rapid development of digital process, which has exerted a great influence on the business activities, innovation and entrepreneurship of firms, as well as the innovation of business model (Nambisan et al.,2017). Digital technology makes the originally stable and impermeable boundary between market subjects to the fuzzy and dynamic approach, as opposed to a traditional situation discrete, lacerate, one-way information delivery mechanism is different, the digital situation of each subject in a more open and dynamic context, become more two-way information delivery, real-time and continuity. Digital infrastructure and digital technology have penetrated into all areas of production and life, creating new ways of work, communication and cooperation, and giving rise to new market demands and consumption upgrades. In order to adapt to this change, more and more firms have begun digital transformation. At the same time, the collaboration between individual, firm, government, organization, transaction, interactive easier, producing a large amount of available for access to the data source at the same time, the disturbance and reconstruct the firm value creation, access and delivery way, create a lot of new digital business model (Sorescu,2017), the business model will be based on informatization and industrialization level fusion of deep innovation, Will bring bigger subversion and innovation for industry, such as kodak and blockbuster firm because of its not for business model innovation to

change in digital technology to survive, and the new economic paradigm and the reality, Uber, Facebook, Alibaba, JD.com, Meituan, Pinduoduo and other firms can make full use of the digital transformation to innovative business model, so as to seize the Opportunity bonus brought by digital transformation in the fierce market competition.

Under the current international economic situation, Digital technology plays an irreplaceable supporting role in the fields of economy and trade, international exchange, production, education and so on, which contains great economic and social value. Digital transformation is an important trend of social development and a driving force for firms to maintain competitiveness and cultivate new growth poles. Especially in deal with the worldwide spread of the COVID-19, the online medical care, online education, remote work, and contactless services have become a mandatory requirement. The closure of schools and offices, the maintenance of social distancing, and long-term isolation have generated strong demand for digital technology, and only firms that adapt to digital innovation and meet the upgrading of consumer demand can achieve better development. Countries also attach great importance to the process of digital transformation, and have introduced national strategies to accelerate it, such as Germany's Industry 4.0 Plan, the Industrial Internet of the United States, and the Industrial 2050 Plan of the United Kingdom. In China, Government proposed to "accelerate digital development, create new advantages of the digital economy, promote digital industrialization and industrial digital transformation in a coordinated manner, accelerate the pace of digital society construction, and create a sound digital economy ecological environment." Digital economy includes digital industrialization and industrial digitalization. Industrial digitalization refers to digital transformation, which is the core component of digital economy. Accelerated industrial digitalization has become an important support force for the development of national economy. Today, as the trend of economic integration is accelerating, it is of great significance for building a global digital economy power and achieving high-quality and rapid economic development to adapt to the trend of a new round of scientific and technological revolution and industrial change, continuously enhance economic productivity and improve social governance model by using digital technology.

The business model is regarded as a linking framework that describes the value proposition, value creation, value delivery, and value capture activities of the firm. The embedding of digital technology can not only improve the business process of an enterprise, but also fundamentally re-examine the company's focus and combination of opportunities, by changing the way of value creation, value delivery and value capture of the innovative firm's business model. In recent years, while the research on the digital transformation and digital innovation of firms is increasing gradually, the research on the business model innovation brought by the digital transformation is also emerging constantly. But through the literature review found that most studies focused on one or several digital technologies to study the influence of business model component, or in one industry to explore the relationship between them, or from a single perspective to analyse their relationship, there are few comprehensive and systematic discussions on the relationship between enterprise digital transformation and business model innovation. So that, this paper systematically combs and explores the relationship between digital transformation and business model innovation, and makes an in-depth analysis of the future development trend of digital-driven business model innovation.

2. Digital Technology and Digital Transformation

2.1 Digital Technology

Digital technology refers to the products or services embedded in or supported by information and communication technology (Lyytinen et al.,2018), which are composed of three different but related elements, including digital components, digital platforms and digital infrastructure. Digital components refer to digital applications or media content that provide users with specific functions or values(Briel et al.,2018), and hardware and software that provide customers with a certain function in physical devices. Such as APP in mobile phones, digital sensing devices in smart home, toys, clothing, etc. (e.g. Amazon Dash Button, Nike Sensor). Digital platform refers to the provision of shared public services and architecture for complementary products such as digital components, such as IOS and Android operating systems for mobile phones. Digital infrastructure is the digital technology tools and systems that provide communication, collaboration and computing power for innovation and entrepreneurship, such as cloud computing technology, blockchain,

Internet of Things technology, digital makerspace, etc. Digital technologies have digital capabilities, so they can become malleable, editable, self-referential, and interactive (Nambisan et al.,2017)., which enable them to evolve even after implementation and use, and to generate new forms of agency within and between processes.

2.2 Digital Transformation

In recent years, the study of digital problems from the economic perspective has gradually increased, and the digital economy has begun to heat up. Digital economy is a new economic form produced with the development of digital technology, and it rapidly promotes the digital transformation of the industry and the whole society. At present, digital transformation has become an important opportunity for firms to adapt to the digital environment and pursue digital value dividends to achieve rapid growth(Shan et al.,2021).Digital transition refers to the use of digital technology to realize the business improvement, efficiency improvement and restructure the process of value creation way(Fischer et al.,2020), Its essence is to promote the in-depth integration of traditional and digital industries, break through data barriers at different levels and between different industries, drive changes in production methods, business models and industrial organization, build a new digital economic system and digital ecological environment, and improve industrial efficiency and Business efficiency. Next, we analyse the driving factors and transformation stages of enterprises' digital transformation.

(1) Why Digital Technologies Prompt Transformation

First of all, the emergence of ubiquitous big data and emerging digital technology has a profound impact on the business behavior of firms, and the organizational form, value network, distribution channel and customer interface of firms will have significant changes(Ng et al.,2017)..Although some technical effect in the current application scenario and the actual effect is not as strong as expected, but the wide use of digital technology has made it clear that, these digital technology will affect the cost structure of the firm, such as the use of digital technology in some scenarios can not only replace the high cost of human services and reduce labour costs, It can also improve transaction efficiency and optimize logistics distribution to reduce supply chain costs. Secondly, digital technology has brought fundamental changes to the original competition pattern of the market. Cross-boundary and global competition is emerging one after another, and the intensity of competition is also increasing, giving birth to many unicorns in the digital field. If defeating "Master Kong" instant noodles is no longer " Uni-President", it may be "Meituan". Nowadays, digital firm magnate like Amazon, Facebook, JD.com, Ant Group, Meituan, and Byte Dance have grown rapidly and dominate many industries. Such globalization and cross-border competition have intensified the competition among firms. If firms do not carry out digital transformation in time, they will face the danger of being eliminated by competition.

Finally, with the spread of digital devices, consumer behaviour is changing. Market data shows that consumers are shifting their purchasing behaviour from offline to online (Kannan et al.,2017). With the help of shopping apps and social media, consumers will have more right to know and more active. By sharing product reviews, they can help other customers (Beckers et al.,2018) and provide reference for others' purchasing behaviour. Meanwhile, consumers can experience goods offline and then place orders online. This gives birth to a new value delivery mechanism and value network structure, firms need to use digital technology and digital technology facilities to meet the ever-upgrading consumer demand.

(2) The Phase of Digital Transformation

Although there have been a lot of literature on digitalization related studies, there are still relatively frequent interchanges in the use of digitalization, digitalization and digital transformation. The three terms are clarified here, which are also the three stages of digital transformation (Ted Saarikko et al.,2020).

Digitization is the process of converting analog signals into digital signals, that is, encoding analog signals into digital forms and storing, processing and transmitting this information through computers (Loebbecke et al.,2015). This process allows the separation of information content between form, function and access. For example, the use of vinyl records to store music with analogue signals requires tight coupling between content and form. People cannot easily separate the data (music) from the medium (record), and it can only be

accessed in a specific technical form (phonograph, etc.).When music is digitized, it may be distributed in different formats (e.g., MP3, FLAC), using different media (e.g., physical CDs, online streaming), and accessible to consumers through a variety of digital terminal devices (e.g., CD players, computers, smartphones).Digitization also involves the conversion of capture activities or behaviours into virtual signals by means of digital devices. Generally, digitalization will not change firm value creation activities, but when these data are combined with digital technologies such as big data and robots, they will not only realize cost-effective resource allocation (Vendrell et al.,2017), but also complete functional behaviours such as automatic operation or remote monitoring.

Digitization refers to the social technological process of using digital products or systems to develop new organizational procedures, business models or business products, and describes how to use digital technology to change existing business processes (Li F et al.,2016).In the case of music, the separation of content and medium has allowed iTunes and Spotify to redefine the way we access and consume audio entertainment. In addition, streaming audio services have brought innovation to business models by changing the way singers, producers and distributors are paid. In the digital sharing economy, multiple users can access and use the same product, shifting the nature of the transaction from product retail to product access, with customers paying by the number of times they use a product rather than by previous purchases. Equipment vendors can easily monitor machine health remotely and dispatch technicians to perform predictive maintenance before costly failures occur. In the digital scenario, firms can utilize digital technology to optimize existing business processes and create additional value by enhancing user experience (Yan et al.,2021).

Digital transformation is a sociocultural process of adapting firms to new organizational forms and skill sets that need to remain viable and relevant in the digital environment (Ted Saarikko, et al.,2020).The purpose of digital transformation is to trigger a major change in firm attributes through the combination of information, computing, communication and connection technologies, influence the whole operation mode of the firm, and change the business logic or value creation process of the firm through simplification and reconstruction of business processes (Li, et al.,2018).Digital transformation using digital technology with suppliers, customers and competitors across situation interaction, advanced combination of physical components and digital resource (e.g. IoT, AI, machine learning) to help firms to make better use of existing core competence or develop new core competence to gain competitive advantage, For example, existing car firms can avoid accidents, improve customer experience and gain competitive advantage by adding digital devices such as cameras and sensors for blind spot detection. Volvo Cars is recruiting senior digital executives and dedicating a large portion of its R&D investment to digital projects to speed up progress on digital projects such as autonomous driving and concierge services. Hence, in addition to significant changes to the internal workings of firms, digital transformation also pushes innovation beyond organizational boundaries into external innovation networks or ecosystems.

3. Digital innovation and digital business model innovation

3.1 Digital Innovation

Digitization will bring about the association and reorganization of production factors within and between firms, promote the appropriate arrangement and optimization of factors, and then bring comprehensive innovation and profound transformative influence on the products and services, organizational structure, production process and business model of firms(Yan Junzhou, et al., 2021), which is called digital innovation of firms. Different from traditional technological innovation, digital innovation, as a new form of technological innovation, will have a profound impact on firms in both some new and traditional fields (Warner,& Wager, et al.,2019).On the one hand, digital innovation promotes market competition in new areas such as franchising or financial investment featuring relevant legal and financial financing, thus providing firms such as Uber, Spotify and Airbnb with competitive advantages that are different from existing incumbents. On the other hand, digital technology can enable some firms in traditional fields to access and obtain a large number of resources at limited cost and energy, narrowing the resource gap between small and medium-sized firms and large firms in this field.

At present, there are three main viewpoints on the interpretation of the connotation of digital innovation. One is to emphasize that digital innovation is a process in which an firm uses digital tools, digital channels and

digital methods to improve its innovation process and improve its operational capability and innovation performance (Nambisan, S. et al.,2017).The second is to emphasize that digital innovation is a result by embedding digital resources into physical components and using the recombination of physical components and digital technologies to create new products, provide new services and construct new organizations or new forms of business (Jahanmir, et al.,2018).The third holds that by integrating digital technology into the traditional innovation process, firms can bring new products or services, optimization of production process, organizational structure change and business model innovation and other overall changes (Liu Yang, et al., 2020), and even change or subvert the entire industry. Scholars divide digital innovation into five main types (Fichmanl, et al.,2014) according to their forms of expression: digital product innovation, digital service innovation, digital process innovation, digital organization innovation and digital business model innovation. It should be pointed out that the relationship between various types of digital innovation is not either-or, and there may be a cross-integration phenomenon (Yan Junzhou, et al.,2021).

3.2 Digital Business Model Innovation

Digital business model refers to the model in which firms embed digital technologies (i.e. the combination of information, computing, communication and connection technologies) into their original business model, change their business activities, and apply digitalization to value proposition, value creation, value delivery or acquisition. Research shows that firms using digital business models are much better than those without digital business models in terms of benefit growth and operational efficiency (Westerman et al.,2018).

A business model innovation is defined as a change in the value creation, value appropriation, or value delivery function of a firm that results in a significant change to the firm's value proposition (Alina Sorescu, 2017)

Digital business model innovation refers to the embedding of digital technology (that is, the combination of information, computing, communication and connection technology) that changes the value creation and value capture methods and value delivery mechanisms of firms, and ultimately leads to major changes in the value proposition of firms, changes or re- Shaped the existing business model. The core feature of the digital business model is that firms reduce their dependence on physical components (Erevelles et al.,2016) and based on the application of digital infrastructure(Warner & Wager,2019), they have created a new business model based on the dematerialization of processes. When digital technology becomes a key driving factor for business model innovation, it will enhance, supplement and replace the existing business model from the three paths of automation and digital enhancement, digital expansion and digital transformation, and bring innovation or reconstruction to the business model (Li F,2020). When digital technology or digital technology facilities serve as a trading platform for buyers and sellers in the exchange of goods and services, platform-based digital business models such as JD.com, Pinduoduo, and Meituan will emerge in large numbers. Using the diversity and rapidity of big data, firms such as HSTYLE and ZARA's fast fashion business model is enabled by the variety and velocity of their big data systems: real-time analysis of trending fashion data from third-party vendors and customer spending data from their stores allows them to provide an ever-changing assortment of on-trend clothing, while maintaining a low inventory. For example, digital service innovation (e.g. Airbnb and Didi) is due to the emergence of digital technology that has created new forms of services, changed the original innovation process and organizational structure, and finally brought digital innovation in business models.

4. How Digital Transformation Improve Business Model Innovation

With the popularity of mobile devices and the acceleration of data processing capabilities, the digitization of information has gradually deepened, and physical components and digital resources have more opportunities for coupling innovation. These coupling innovations will have a continuous impact on business model components. First, digital technology allows loose coupling between physical components and digital resources, and this innovation is less restricted by the existing firm architecture levels and resource dependencies. Therefore, any given digital resource (digital product or digital system) can quickly produce many different branches of different types and uses. Secondly, due to the low barriers to entry of digital technology, small firms will encounter fewer restrictions when transforming innovative ideas into viable market products, which will have an impact on the creation and delivery of corporate value. In some cases,

these digital firms may also have an impact on an existing industry. For example, ride-sharing services such as Uber and Didi have posed a challenge to the taxi industry (Ted Saarikko et al.,2020), this competitive threat to commercial taxi drivers has been significant enough to cause social unrest (Rubin and Scott, 2015).

4.1 Some Digital Technologies and Business Model Components

Generally speaking, the application of digital technology and digital innovation will affect one or more business model components of a firm to varying degrees. Due to the integration of cyber-physical systems (CPSs) and the Internet of Things, all physical devices can be connected to the Internet to generate and collect data, and the analysis and use of these data provide innovative products and services for firms Probably (Abide, et al., 2021). Big data analysis helps firms to provide more personalized products and services, and part of the corporate value proposition has been positively affected. The Internet of Things reduces production costs by improving inventory management, reducing machine downtime, and better-quality control. It also improves production efficiency through machine-to-machine communication and product tracking systems, and provides innovations in value creation and delivery.

Virtual reality (VR) and augmented reality (AR), and other conditions for simulation of the flow patterns under different scenarios, demo, etc, to staff training, diagnosis, identify problems, quality inspection, equipment maintenance, consumer guide, such as digital services, but also provide consumers with virtual consumption experience, improve the efficiency of the collaboration process, improve customer relationships. Autonomous Things (ATs) such as robotics, Autonomous driving, Digital twins and other technologies can be used for the implementation of time-consuming and repetitive tasks, maintenance and repair, service training, etc., as well as in potentially hazardous and unsuitable work environments. UAVs are widely used in data collection and delivery of detection, inspection, evaluation and identification, and unmanned technology is being widely tested and initially applied in transportation. All these technologies improve work efficiency and operation precision, and reduce labour costs. Therefore, the activities, capabilities, resources and competitiveness of firms will be positively affected by digital technologies, which will have an impact on the key business components and business models of firms (Abide, et al.,2021).

Cloud technology provides flexibility and mobility for storing valuable information, accessing information anytime, anywhere, updating information, managing documents, and sharing consistent information throughout the organization. Cloud technology can also be used to increase data sharing across firm boundaries and reduce the cost of information and resource acquisition for firms. It directly affects the activities and capabilities of most firms in the industry, thereby affecting the competitiveness of firms. In addition, cloud technology also provides a collaborative working environment for firms and stakeholders, improves cooperative relations, and has an impact on the value delivery components of the business model.

Although cloud technology provides convenience and flexibility for the transfer of data across organizations, it is not yet secure enough for sensitive data in industries such as finance, insurance, and public management. Blockchain technology can provide effective guarantee for the safe delivery of information. Blockchain provides firms with transparent business transactions, secure information sharing and collaboration between stakeholders, smart contracts and trusted protocols for digital identities promote fair payment and data integrity, and ensure that the entire process of information is encrypted and available. Traceability, eliminates dependence on third parties, and communicates directly with suppliers, which will have a greater impact on the firm's process innovation and business model.

3DP can create parts needed for repairs that meet specific material requirements to support the supply of critical resources, such as repair and operation materials. The technology can also reduce lead times and eliminate transportation.3DP materials can be used as a resource for experimentation and physical exercise, and provide possibilities for research and development departments to explore and test new materials. In addition, it also provides product customization to provide better products and services for customers in the manufacturing and construction industries.

Mobile communication technology (MTs) to improve the people's interaction and communication form, they can be used for customer support and sales channels, positive influence on the firm activities and processes, such as the booking, payment, learning, experience, and interaction processes such as customers can at any time to check the inventory, orders, tracking process state, access and delivery of information, etc. In addition,

MTS enables smooth information flow among stakeholders, clear process tracking, and can provide remote work assistance (Abide, et al.,2021).As a result, they improve stakeholder relationships, enhance the cooperation viscosity and interaction efficiency between each other.

4.2 Digital Transformation and Business Model Innovation

Firm digital transformation is the deep integration of digital technology and business model. Digital technology is the tool and means of digital transformation, while business model innovation is the final result of digital transformation. Digital transformation and the application of digital technology have become the key driving force of business model innovation. It has brought new ways of value creation and value capture, new value delivery mechanism and transaction architecture to firms, and created new organizational forms such as cross-boundary organization. First of all, digital technology and digital information enable firms to accurately subdivide customers, dig deeper consumer needs, improve the personalization of products and the pertinence of services, and have an impact on the innovation of firm value proposition. Secondly, digital media, digital platform and digital infrastructure have a profound impact on the key resources, activities, distribution channels, customer relationships and other elements in the firm value network components, and innovate or reconstruct the value creation and delivery mode. Moreover, digital technology can optimize the cost structure and revenue model of firms, innovate and expand the ways of obtaining value of firms, effectively improve the profitability and competitiveness of firms, and exert an impact on the way of profitability of firms.

(1) Digital Transformation and Value Proposition

In the digital era, the channels and ways for firms to collect and obtain information and data from the outside have increased significantly. By reorganizing, integrating, and analysing the huge amounts of data obtained, firms can extract valuable information about consumers, markets, and industry environments. It can accurately grasp market supply, potential consumer demand and industry development trends, and guide firms to complete value proposition innovation through market segmentation, product structure analysis, R&D and production optimization.

Digital technology can help firms accurately grasp the heterogeneous characteristics of consumers and carry out precision marketing. In the digital era, firms can obtain customer behaviour data and product life-cycle data from different sources and channels, and the electronic database formed has become the main source for them to observe the market situation and consumer behaviour. Firm through technical means to analyse the digital information mining, the diversity of data and the analysis of digital technology can help firms gain deeper levels of consumer demand and preference, accurate grasp of consumer heterogeneity, help its detailed classification standard and form a narrow market segment, Accurate marketing is carried out for consumers and potential customers with different preferences. For example, digital platform firms such as Pinduoduo and Byte Dance etc digital firms capture and analyse consumers' click, browse, follow and other operations through powerful algorithm models and data processing capabilities, providing consumers with precise push and personalized services.

Through the analysis of digital information can help firms to gain insight into the real and potential needs of consumers. Due to the volatility, concealment and contextuality of consumer demand, the static, structured and lagging data obtained by previous data collection methods cannot reflect changes in consumer demand in a timely manner. Digital technology provide possibility for firms to obtain consumer real-time dynamic data, through technical means for consumers in the network footprint, clicks, browsing time, goods purchased, discussion frequency, such as depth analysis, obtain the consumers' interests, hobbies, values, way of life and other characteristics. At the same time, the firm can also through a variety of mobile terminal App or digital device for the sensor data (such as through camera records the customer a product in the supermarket in front of the stop time), understand the real needs of customers and the specific use of goods, and explore the potential needs of consumers, fully meet their deep-seated needs, and provide consumer satisfaction and customer stickiness.

Leverage big data information and digital analytics to dynamically promote product and service innovation. Firms can quickly understand through digital technology industry development, detailed data such as user demand, product sales, market, products and services can be implemented the full life cycle of tracking and

monitoring, collecting the feedback information of products and key behaviour with the feelings of consumers, to improve the product or service, implement appropriate arrangements and various resources the best combination of products and services, Targeted promotion of product and service innovation. For example, JD.com, Meituan, Pinduoduo, etc. dynamically provide products or services that match users' changing wishes and needs. Traditional insurance firm and cooperate with the 4S shop, by tire sensor data collection owner's driving habits, route and speed, mileage and other data, and combined with the insurance number, insurance amount, etc, the owners of consumption habits and precision analysis of demand, to provide customers with cost and guarantee a better coverage composite service.

(2) Digital transformation , Value Creation and Value Delivery

Value creation refers to how a firm creates products or services based on existing resources to meet customer needs. Value delivery refers to the process of how a firm delivers its products or services to customers for them to know, perceive and use, mainly including the connection mode and delivery channel in value exchange. In the digital age, the embedding of digital technology and the support of digital technology facilities have enriched and changed the mode of firm value creation and delivery.

Digital technology and digital media makes firms more new ways to come into contact with and get key production resources, enhance the firm value creation and extend the availability of key resources, firms can through the new way of more access to key information resources, and to integrate information resources and physical components, create a new product or service, Some firms even directly sell these digital information as products to obtain profits, which provides a new way and path for firm value creation and value delivery. Digitization expands the boundaries of enterprises, promotes the sharing of information resources and joint product research and development between enterprises and external stakeholders, and provides the possibility for the establishment of value co-creation networks.

Digital information drives innovation in key activities and processes. Digital information and big data analytics can help firms predict market trends, customer purchasing patterns, equipment maintenance cycles, etc., explore ways to reduce costs, and reduce uncertainty in business decisions and activities. For example, through the business analysis of big data, the logistics and supply chain management can be optimized and analysed to understand the freight demand and capacity of each logistics node, reduce the return empty load rate of trucks and optimize the delivery route. Before the holiday, firms can analyse the data collected through various Apps and other channels, and accurately predict the daily tourist flow of scenic spots in combination with weather factors, so as to realize flexible allocation of human resources. Blockchain technology can also encryptively protect the information and funds in value delivery, provide security guarantee and traceability mechanism for value creation and delivery, reduce the dependence on intermediaries, and provide more possibilities for the innovation of value delivery mechanism.

Digital technology provides new technical means for product promotion and distribution channels. Now more popular live webcast with goods, through studio exhibits demonstration and promotion, the user can directly with the host in real-time interaction, creating "all-weather, accessibility, without time and space boundary" trading process, building the online distribution channel integration, complementary and personalized fusion and multidimensional sales scenario, enrich and expand the value transfer mechanism.

(3) Digital Transformation and Value Capture

Digitalization can transform the way firms capture value. In the digital context, the profits of firms can be changed from selling products or services to leasing or licensing the right to use some products or services. The customer consumption and resource utilization mechanism of "not wanting to own, but seeking to use" makes more and more firms begin to explore new ways to obtain value. For example, 360 Antivirus can attract and lock customers to explore new profit points through free software, such as providing in-depth and personalized additional charging services. For another example, some software supplies split the original large and complete software package into multiple independent functional components, so that customers of different demand levels can purchase on demand to reduce the total cost of ownership. The value proposition of the firm has also changed from software development and seller to software service and problem-solving

providers. The selling mode has been changed to rent or service mode, and the unit fixed charge has been changed to charge according to the number of uses (Li wenlian et al.,2013).

Digitization can shorten the intermediate process of value capture. Digitalization has changed the long chain of value capture from raw material supply, production and processing, wholesale and retail, purchase and consumption under the traditional model, shortening the transaction chain, saving intermediary costs and online and offline collaborative costs, changing the cost structure and income sources of firms, and enabling consumers to buy goods at a lower price. The source of value capture is no longer limited to firms and consumers, and competitors and collaborators may also participate in it. While shortening the chain of value capture through digital media, the profit is maximized on the basis of cost reduction.

Digitization can help firms to establish dynamic pricing system and enrich the charging model of firms. Digitization is helpful for firms to establish dynamic and flexible pricing system. Through big data analysis, firms can capture commercial hot spots in time, optimize pricing mechanism, and even establish real-time dynamic pricing for different customers to improve profit margins. For example, when Radiohead released his seventh album "In Rainbows" in 2007, the team created a new pricing strategy of "pay as much as you like", allowing each consumer to determine the value of the product by themselves (Li F,2020). In some digital platforms such as shopping, travel and living consumption, the phenomenon of " Deceive old users or new users " for different users is based on the precise analysis of big data and adopts the dynamic classification pricing strategy. Although this may not be a good phenomenon for consumers, it exists in reality.

(4) Digital Transformation and Value Networks

Digital technology has expanded the business boundary of firms and promoted the innovation of value network. Digital technology and open platform realize value co-creation between firms and customers, such as crowdsourcing, user-generated content, etc., this change the role of market players in the original value network. The essence of the crowdsourcing model is the effective utilization of resources in discrete society (e.g. P&G, DuPont, Boeing, etc). User-generated content, is an emerging value co-creation mode of network information resources that enables users to participate, experience, create and share through the platform support of digital technology facilities in the decentralized digital context, such as Wikipedia, Google, Facebook, Baidu and other digital platforms. Users participate in the creation of content and services by uploading text, video, pictures, audio or sharing files.

Due to the availability and sharing of data, the cooperation between firms has been diversified, the depth and breadth of cooperation have been deepened, and the cooperation mode of co-creation, sharing and win-win has become the main cooperation mode of the members of the value network, and the value belonging has been enhanced. Digital media can ensure that firms can accurately contact customers in real time, understand customer concerns, and improve customer relationships. Value co-creation is a way of thinking that involves consumers, suppliers and other relevant market participants in the value-creation network of products or services. firms can use digital technology to share and integrate diversified data, and develop full-chain and full-scale product development and production with stakeholders. For example, the entire supply chain design cooperation of the automotive industry based on an integrated data platform, and digital giants such as Microsoft and Apple inviting customers to participate in product development and production are all innovations in the external value network of the company brought about by digitalization (Li wenlian et al.,2013).

In addition to external cooperation for the purpose of acquiring digital resources and technologies, digital technology itself, as a tool, can also greatly reduce the cost and risk of firms or consumers when acquiring and utilizing external resources, and provide new technological paths for firms to create and deliver new value. In the digital context, customers are not just passive recipients of product consumption. Their views or comments become an important basis for influencing others' purchase decisions, and they play the role of important disseminators and influencers of goods or services. Consumers can learn from others' perspectives. As in the comments, it reduces the information asymmetry in the process of obtaining external resources. At the same time, technologies such as blockchain can also ensure the security of information transmission and value networks, and reduce risks.

5. The Trend of business model innovation in digital context

In the context of digitalization, consumers' product and service demand are more flexible and personalized. Firms must be able to create new intelligent products and digital services to meet the growing consumer demand, which not only relies on digital infrastructure and digital technology, but also require firms to innovate existing business models. Therefore, an important trend in the digital transformation of business models is to use multiple business models to serve different market segments, sell different products or services to deal with multiple markets, or use different business models over time. Business model innovation rarely creates new business models based on unprecedented ideas. In most cases, digital technology allows firms to deploy a wider range of business models than before. One significant trend in business model innovation is the emergence of the portfolio business models (Li F,2020).

The first form is the market portfolio model. This occurs when a firm deploys two or more business models simultaneously to address different market segments. At this time of every business model may not new, and some financial gains in the field of market segmentation is usually in the whole financial ratio is not high also, but by sharing some components of the business model, after making composition can effectively reduce the cost, and income before is usually higher than the market portfolio, so that each market profitable. Digital technology has played a key enabler in this process by reducing costs and making portfolio management administratively and financially viable. For example, as an independent business, personalized children's books are not commercially feasible due to their limited sales. But now a digital printing firm is working with freelancers to produce personalized children's books by sharing the digital infrastructure, which are ordered online, then printed and distributed at higher prices, making the business viable and profitable. This activity has generated additional revenue for printing firms as a supplement to their mass printing business and new revenue for freelancers.

The second form is the product portfolio model. Digitization allows many creative products to be consumed at different value-added levels or recombined into new products. In some sectors, direct contact can be digitally established between consumers and various stages of production, which generated new product types. For example, some work-in-progress can also be consumed separately or as a supplement to the final product, thus increasing the choice of product mix for consumers. For example, we originally intended to sell the oil painting of a famous artist as the final product, but we digitally captured the digital images or videos of the artist in different stages of making the oil painting, and consumed them digitally as the supplement of the new product or the final product. The extended scope for new products often required the firms to adopt a range of business models and manage them as a portfolio. The main objective was to create a sustainable business by extracting value from products, services and other assets.

The third form is the multi-sided business models. In a complex value network or ecosystem, value is co-created through interaction with multiple stakeholders upstream, downstream and horizontal (Mantena et al.,2012). This is different from a market portfolio model based on interaction with multiple segments of customers, or a product portfolio model in which work in different stages is either used as the final product or complements the final product. In a multi-sided business model, firms can use different business models to engage with suppliers, customers, and other stakeholders. Digital platforms can effectively manage multilateral relationships. For example, in the music industry, music production firms can cooperate with investors, sales firms, advertising firms, concert brokerage firms, CD retail stores, music distribution firms or platforms through a variety of cooperation modes to obtain relevant benefits through value co-creation.

The fourth form is some firms adopted a portfolio of different business models sequentially over time. That is firms can launch different business model combinations according to the time sequence of products. For example, a digital artist may first charge a live audience an entrance fee to experience the art process in his digital studio (similar to going to the theatre), and then license the finished digital art to the client for a fee. Eventually, works of art and custom products derived from the creation are sold to collectors (e.g. signed prints).

The degree of integration between portfolio business models depends on the nature of products, services and markets, and may range from a loose portfolio business models to a hybrid model that shares some key components, to a fully integrated multi-type business model as a new business model (Li F,2020).Portfolio business models can significantly improve the credibility of the financial sustainability of the firms and

stakeholders, to maximize the from different market segments, different stages of the work, or the market income portfolio business models to reduce the dependence on a particular source of income, thus reducing the risk, increase the firm's overall resilience.

6. Conclusion and discussion

This paper expounds the driving factors and development stages of digital transformation, which helps us to understand its connotation in a deeper level, and explores how digital technology and firm digital transformation promote business model innovation. It is found that the digital transformation of firms brings structural changes to the value proposition, value structure and value network of business models, and promotes the digital innovation of firms' business models through automation and digital enhancement, digital expansion and digital transformation mechanisms. Business model innovation can revolve around new ideas, new areas and new influences, which are clearly reflected in the business portfolio model: market portfolio model, product portfolio model, multilateral business model and sequential portfolio model. In most cases, digital technology has allowed firms to deploy a wider range of business models than before, as digital transformation has enabled an increasing number of firms to adopt a portfolio business model approach to enhance their financial sustainability and stakeholder credibility in response to changing consumption upgrades and increased competition.

With the application and penetration of digital technology in the whole process of production and manufacturing, the whole industrial chain and the whole life cycle of products, all-round innovation has been realized in production processes and business models. This change is not only an opportunity but also a challenge for incumbents and start-ups. Firms should speed up the transformation of production mode, make use of cross-field, cross-organization, collaborative and networked innovation platforms, more convenient access to and use external innovation resources, and improve their R&D, design, manufacturing and management services. In the selection, acquisition and use of digital resources, firms do not collect large amounts of data indiscriminately, but need to carefully collect the correct data required by firms. Digital infrastructure and digital technology should be used to embed data information into the original ecosystem of the firm. Based on the three stages of digital transformation, the digital transformation of the firm should be steadily promoted, and the integration of digital technology and traditional physical components should be used to provide new products and services for stakeholders. At the same time, it is also necessary to speed up the reform of organizational management model and the innovation of business model, actively build a new model of "platform+ maker + user" with multi-party participation, and promote an innovation ecosystem that combines online and offline, innovation and entrepreneurship, and resource pooling and capacity opening.

This article lacks case and empirical support, and the discussion is slightly thin. In the future, you can consider using multiple case studies or empirical studies to explore the relationship between firm digital transformation and business model innovation, and explore which specific business models should be deployed under what circumstances. It can better meet the needs of consumption upgrades and enhance the competitiveness of firms. At the same time, in view of the increasing number of business model portfolio models, new research is needed to quantitatively test whether business model portfolios can increase profitability and market competitiveness more than those firms that use a single business model over time. And how different types of firms should choose a suitable combination of business models.

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