Digital Technology-driven Business Model Innovations: A Bibliometric Analysis

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Digital Technology-driven Business Model Innovations:

A Bibliometric Analysis

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Abstract: With the advent of the data age, digital technology has been widely used in business model innovation. To understand the current research situation in the field of digital technology-driven business model innovation and reveal the knowledge structure, research hotspots, and development trends in this research field, this paper adopts statistical analysis, co-citation analysis, cluster analysis and other methods to carry out bibliometric analysis and knowledge mapping on the relevant literature included in the Web of Science database. The research results show that customer relationship management, digital economy and financial service system, sustainable development and digital service innovation, and the competition and cooperation mechanism of enterprises are hot topics in this field. Moreover, digital platform, firm performance, and value creation are the main research directions in the future.

Keywords: digital technology, business model innovation, bibliometrics analysis

1.   INTRODUCTION

The business model is a hot topic in the Internet boom. A good business model is essential to the success of an organization, which can explain the operation mechanism of an enterprise. The ability of enterprises to develop innovative business models is of great commercial significance, but there are many challenges to improve innovation ability[1]. Digital technology has promoted the development of the industry and become a booster of business model innovation[2]. Enterprises need to use digital technology to explore more capabilities and establish a new business model to create long-term value.

At present, bibliometric analysis has played an essential role in showing the research status of disciplines or fields. Therefore, it is of considerable significance for future research to fully and accurately reveal the overall knowledge structure and frontier dynamics in the field of business model innovation driven by this digital technology.

Above all, this paper takes the relevant literature in the web of science database as the research object, reveals the research content and knowledge structure in this field, and explores the research hotspot and development trend. This paper can help scholars understand the research status of digital technology-driven business model innovation, and provide some reference for the in-depth exploration in this field.

2.   DATA SOURCES AND RESEARCH METHODS

2.1   Data sources

To ensure the accuracy and reliability of the retrieval results, this paper selects the Web of Science Core Collection as the data source. Using "Digital technologies" and "business model innovations" as keywords to carry out theme retrieval, the period is 2014 to 2020, and the data collection time is March 12, 2020. We obtain

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a total of 401 literature records after the retrieval results were deduplicated and corrected. Every literature record includes the title, abstract, keywords, author and institution information of the author, the year and journal of publication, and all citation information.

2.2 Research methods

This paper uses the bibliometric method and visual knowledge mapping to study the relevant literature about digital technology promoting business model innovation. (1) Statistical analysis method: With the statistical analysis method, this paper studies the number of published literature, citation number, national distribution and subject category distribution. (2) Literature co-citation analysis: it means the number of times that two documents are cited simultaneously by one or more documents. Highly cited documents represent the knowledge base of the research field. (3) Keyword clustering analysis: it is to cluster keywords according to their co-occurrence intensity and classify keywords with substantial similarity into one category, to explore research hotspots in this field. (4) Keyword emergence analysis: it can reflect the dynamic changes in a research field and identify research frontiers and trends by identifying keywords that rapidly increase in a certain period.

3.   STATISTICAL ANALYSIS

3.1 The overall growth trend analysis

The trend change of the number of published literature and cited literature is an important indicator to measure the research progress of a specific discipline or field. It is of considerable significance to evaluate the stage of this field and predict the future development trend. Table 1 shows the annual number of publications and citations in the research field of digital technologies promoting business model innovation from 2014 to 2020. Since the retrieval date is March 12, 2020, the number of papers in this year is not complete. Figure 1 shows the fitting function results of the number of annual publications and citations in the six years from 2014 to 2019, which directly reflects the overall growth trend of this research field.

Table 1.   The number of annual published literature and cited literature

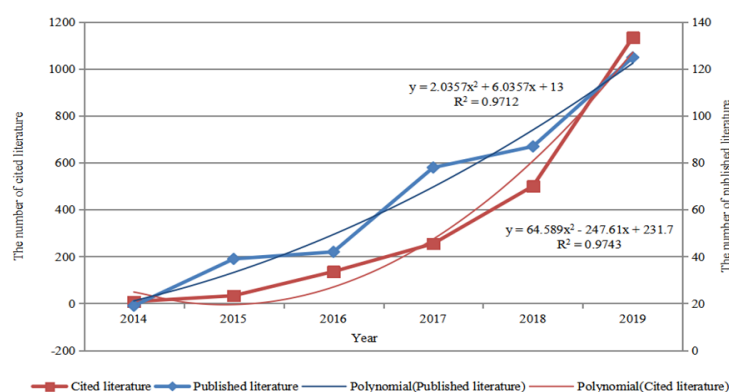| Year	2014	2015	2016	2017	2018	2019	2020
Published literature	19	39	42	78	87	125	11
Cited literature	8	33	136	255	501	1135	187

Figure 1.   The fitting function results of annual published literature and cited literature

On the whole, the number of published literature each year shows an increasing trend, which can be roughly divided into two stages: the first stage is the foundation stage (before 2016). The number of literature published in this stage increases slowly, which indicates that digital technology has not widely applied to business model innovation. The second stage is the rapid development stage (2017 to date), with 47 literature published from 2017 to 2019, an increase of nearly 100% compared with the 23 literature published from 2014

to 2016 in the first stage, showing an explosive growth trend. The polynomial curve R^2 fitted is 0.9712, which shows that digital technology is increasingly widely used in business model innovation. The number of cited literature per year increased rapidly from 8 times in 2014 to 1135 times in 2019. The fitted polynomial curve R2 of the cited literature every year is 0.9743. Digital technology has become a hot spot and research direction of promoting business model innovation, which has attracted extensive attention from scholars. This indicates that with the rise of artificial intelligence, the Internet, and digital economy, digital technology plays an increasingly important role in business model innovation.

3.2   The country analysis

To understand the research status and progress in the field of digital technology promoting business model innovation around the world, this part analyzes the national spatial characteristics of relevant research. Table 2 shows the betweenness centrality of the top ten countries in the total amount of literature issued. The betweenness centrality is an indicator of the importance of nodes in the network, and it measures the cooperation between countries. The higher the betweenness centrality, the closer the cooperation with other countries. Figure 2 shows the changing trend of annual publication volume in the top ten countries in publishing frequency.

Table 2.   The betweenness centrality of the top ten countries

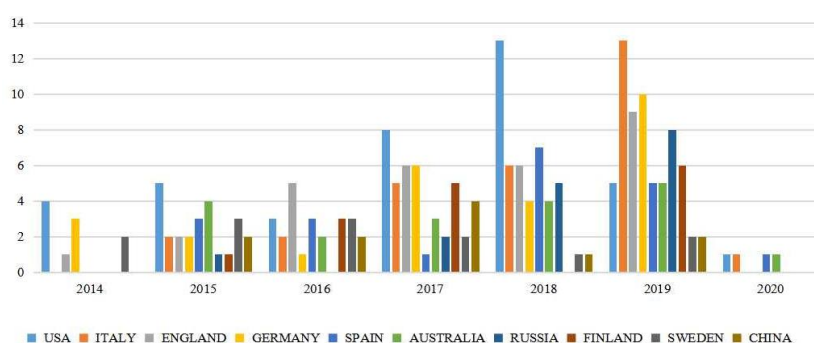| Country	USA	ITALY	ENGLAND	GERMANY	SPAIN	AUSTRALIA	RUSSIA	FINLAND	SWEDEN	CHINA
Centrality	0.12	0.32	0.24	0.31	0.03	0.08	0.00	0.06	0.01	0.05

Figure 2.   The annual publication volume in the top ten countries

In the field of digital technology promoting business model innovation, the most significant number and contribution is the USA, followed by Italy, England, Germany, Spain, and other countries. The total amount of published literature shows an increasing trend. However, the number is still small, which indicates that the research on digital technology to promote business model innovation is still in its infancy. The number of published literature in the USA showed an increasing trend from 2014 to 2018 but decreased in 2019, in other countries increased rapidly this year, indicating that other countries attached importance to research in this field. As far as China is concerned, the number of published documents ranks 10th, indicating that the degree of attention needs to be further improved. China's betweenness centrality is low (0.05), suggesting that China's international cooperation in this field is not close, which suggests that Chinese scholars need to strengthen foreign exchanges and further increase international academic cooperation.

3.3   The category analysis

The distribution of research literature categories can help scholars understand the core content of the research field of digital technology promoting business model innovation, which provides more effective

reference sources for further research in this field. The Citespace can identify burst words of the research category, which can understand the characteristics of temporal distribution and dynamic change and better reflect the research frontier and development trend in the knowledge domain.

Table 3.   The research High-Frequency Categories

Frequency	Centrality	Year	Category
96	0.09	2014	Management
87	0.19	2014	Computer Science
80	0.03	2014	Business
75	0.39	2014	Engineering
61	0.07	2014	Computer Science, Information Systems
31	0.08	2014	Information Science & Library Science
27	0.01	2014	Engineering, Electrical& Electronic
27	0.01	2014	Computer Science, Theory & Methods
22	0.02	2015	Economics
22	0.00	2014	Public Administration

Table 4.   Top 5 Categories with the Strongest Citation Bursts

Subject Categories	Year	Strength	Begin	End	2014--2020
Operation Reaearch&Management Science	2014	2.2109	2015	2016	
Computer Science, Theory & Methods	2014	3.3447	2015	2016	
Computer Science,Artifical Intelligence	2014	1.3922	2015	2017	
Education,Scientific Disciplines	2014	1.3745	2016	2017	
Economics	2014	2.6116	2018	2020	

Table 3 is illustrated that the research category is not limited to the field of management but also involves Computer Science, Business, Engineering, Information Systems, Library Science, and other disciplines. It shows that the research on digital technology in the field of promoting business model innovation presents a diversified and cross-development trend. From Table 4 that " Computer Science, Artificial Intelligence " and " Economics " are the research categories with the most prolonged period (2015-2017), and " Computer Science, Theory & Methods " are the research categories with the most considerable burst strength. Before 2017, the main research fields were Operation Research, Management Science, and Computer Science. In the past three years, the research field has mainly focused on economics.

4.   RESEARCH TREND ANALYSIS

4.1 The research foundation

Co-citation analysis of literature means that other papers cite two or more literature at the same time, then the two literature form a co-citation relationship. The more frequently cited literature can represent the research foundation in this field. Table 5 shows the top 8 references cited in the research field of digital technology-driven business model innovation. Reading them can identify a research basis.

The research basis mainly includes two aspects: (1) The Concept and Application of Business Model：Based on the multi-disciplinary perspective, the concept of business model should be more precise, and the business model can conceptualize as an interdependent activity system. Zott C et al. put forward a method to promote the study of business model, expanding the application scenarios of business model[3]. (2) The Rise of Digital Business Model: Digital technology is gradually applying to the business strategy, organization

operation, products, and services of enterprises, which fundamentally promotes the innovation of the business model. Bharadwaj A et al. point out that cross-industry and cross-department enterprises should rethink the role of IT strategy and innovate the digital business model promptly[4].

Table 5. The high frequency cited literature

Cited Frequency	Centrality	First author(year)	Literature title
40	0.12	Zott, C(2011)	The Business Model: Recent Developments and Future Research.
34	0.05	Teece, D. J (2010)	Business Model, Business Strategy, and Innovation.
32	0.17	Bharadwaj, A(2013)	Digital business strategy: toward a next generation of insights
22	0.10	Yoo, Y(2012)	Organizing for Innovation in the Digitized World
19	0.11	Yoo, Y(2010)	Research Commentary—The New Organizing Logic of Digital Innovation: An Agenda for Information Systems Research
17	0.15	Gawer, A (2013).	Industry Platforms and Ecosystem Innovation
17	0.16	Chesbrough, H.(2010)	Business Model Innovation: Opportunities and Barriers
16	0.09	Zott, C(2010)	Business Model Design: An Activity System Perspective

4.2 The research hotspots

Keywords are highly abstracted and summarized from the literature topics. It is very representative to examine the hot research topics in a research field through high-frequency keywords, which can effectively determine the hot research area. Use CiteSpace, set the time slice to 1 year, extract the keywords of Top50, and use Pathfinder algorithm to cut. By combining keywords with the same meaning and removing meaningless high-frequency words, this part obtains the final high-frequency keywords. Next, we use LLR to name the cluster, where N = 201, E= 404. Modular Q and Silhouette are the indicators to measure the clustering effect. Modular Q is usually higher than 0.3, and the Silhouette is higher than 0.5. The high-frequency keyword clustering graph obtained in this paper has the Modularity Q = 0.7668, and the Silhouette = 0.7158, which shows that the clustering result is reliable and significant. Figure 4 is illustrated the clustering map of high-frequency keywords and Table 6 is illustrated details of citation network clustering. Besides, the Silhouette under each cluster is higher than 0.7, which shows that the clustering result is perfect.
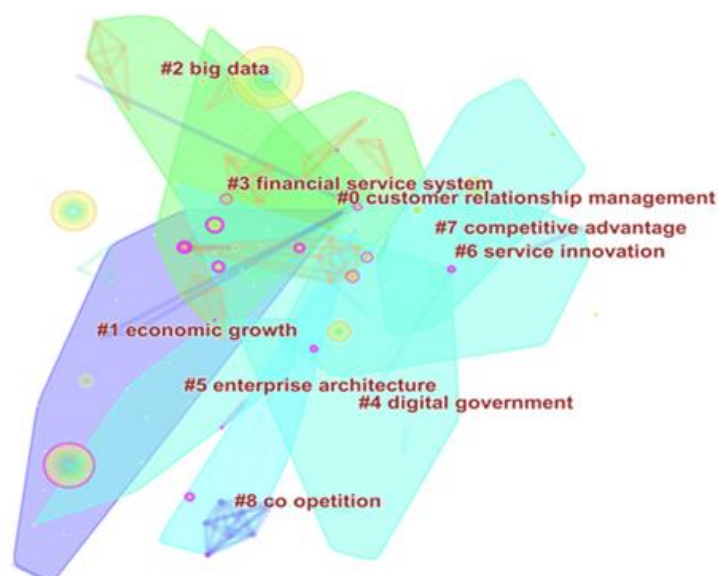

Figure 4.   High-frequency keyword clustering mapping

Table 6.   The details of citation network clustering

Cluster label	Size	Silhouette	Mean	Top Terms(LLR)
customer relationship management (#0)	28	0.775	2017	customer relationship management;high-speed broadband; big data
economic growth (#1)	19	0.881	2014	economic growth; technology dominance theory; telecommunication service
big data (#2)	18	0.832	2017	big data; precision medicine; supply chain
financial service system (#3)	18	0.915	2017	financial service system; digital transformation; research priority
digital government (#4)	17	0.724	2016	digital government; digital capability ; user acceptance
enterprise architecture (#5)	17	0.706	2016	enterprise architecture; digital economy ; decision making
service innovation (#6)	14	0.790	2016	service innovation ; business model innovation; digital transformation
competitive advantage (#7)	14	0.848	2016	competitive advantage ; firm performance ; capturing value
coopetition (#8)	12	0.913	2015	coopetition ; case study ; coopetition-based business model

According to the high-frequency keyword clustering mapping and reading the representative literature under each cluster, the research focus of digital technology-driven business model innovation mainly focuses on four aspects: customer relationship management (#0); digital economy and financial service system (#1,#2,#3); sustainable development and digital service innovation (#4,# 6); the competition and cooperation mechanism of enterprises (#5,#7,#8).

(1) Customer relationship management: This topic focuses on digital technology that has changed the operation mode of customer relationships in the traditional business model. The role of the Internet of Things and Big Data has affected investment in customer relationship management in the modern service industry. To prevent market share from being influenced by traditional competitors and disruptive business models, the customer relationship management industry has adopted digital innovation-driven business model. Bogers M et al. discuss how enterprises should organize a more open business model when digital technology changes the business model into a consumer-centered one[5].

(2) Digital economy and financial service system: Digital technology has widely used in finance, finance, banking, and other fields. The digital economy era has brought new opportunities for business model innovation. The digital transformation of the financial service industry challenges the market position of mainstream financial institutions and achieves disruptive innovation. Breidbach CF et al. discuss the significance of the digital economy model in establishing a new value chain in the banking industry[6]. Liebenau JM et al. point out the challenges related to the digital transformation of the financial service system to guide future research directions[7].

(3) Sustainable development and digital service innovation: Business model innovation usually fails to fully include the dimension of sustainability, while digital technology accelerates the sustainable development of enterprises. Business model innovation-oriented to sustainable development has become a research hotspot. Pappas IO et al. propose a conceptual model to provide a broader basis for the digital transformation and sustainable development of enterprises[8]. Besides, service providers are actively improving their competitiveness through a digital service-oriented business model. Based on case studies, Frank AG et al. point out how manufacturing enterprises can overcome challenges when expanding product focus with digital services[9].

(4)The competition and cooperation mechanism of enterprises: Digital platforms promote new forms of competition and cooperation mechanisms. Digital technology gives enterprises the ability to compete in the

digital world, changes the rules of competition and cooperation, and promotes the innovation of business model[10]. In the digital world, cooperation among competing enterprises has also become a phenomenon. Øiestad S et al. point out that the book publishing industry is currently undergoing a digital transformation, which challenges the existing business model and urges enterprises to re-examine their product mix and core competitiveness[11].

4.3 The research frontiers

The research frontier is the most potential research topic or field in scientific research. Different from the research hotspot, the research frontier usually shows a group of emergent dynamic concepts and potential research problems. Using keyword burst analysis can understand the temporal distribution and dynamic change characteristics of burst words. Table 7 shows the top 10 keywords with the most vigorous citation bursts.

Table 7.   Top 10 keywords with the strongest citation bursts

Keywords	Year	Strength	Begin	End	2014--2020
diffusion	2014	1.7762	2014	2016	
product	2014	2.1697	2014	2015	
competitive advantage	2014	1.4577	2015	2016	
absorptive capacity	2014	1.6159	2015	2017	
digital	2014	1.6682	2016	2017	
open innovation	2014	2.0874	2016	2017	
ecosystem	2014	1.8185	2017	2018	
digital platform	2014	1.7349	2017	2018	
firm performance	2014	2.2006	2017	2018	
value creation	2014	1.6547	2018	2020	

Table 7 is illustrated that the research field of digital technology promoting business model innovation presents diversified characteristics. The three keywords that have emerged in the past four years are "digital platform," "firm performance," and "value creation," which indicate that these research topics are relatively active and may become the frontier topics of this research field in the future. Using digital technology to build a digital platform provides technical support for enterprises and further promotes the innovation of business model. Future research topics will focus on the application of digital technology to the business model and where the outstanding performance and precious value brought to enterprises are reflected.

5.   RESEARCH CONCLUSION AND PROSPECT

This paper uses bibliometrics to summarize the external characteristics and knowledge structure of digital technology-driven business model innovation, besides reveals the research hotspot and research frontier. The results of the statistical analysis show that the number of published literature and cited literature each year shows an increasing trend, which shows that the influence is increasing year by year. The publishing countries mainly focus on the USA, Italy, England, Germany, and other countries. The research category involves management, computer science, business, engineering, information system, and other fields, showing a diversified and cross-development trend.

The research foundation mainly includes two aspects: the concept and application of the business model and the rise of the digital business model. In terms of research hotspot and research frontier, research hotspot focuses on four research themes: customer relationship management, digital economy and financial service system, sustainable development and digital service innovation, enterprise competition and cooperation

mechanism. The research frontier includes digital platforms, enterprise performance, and value creation.

Although the research theories and methods of the business model are relatively mature, due to the rise of digital technology in recent years, most of the research on the application of digital technology in business model innovation stays at the stage of theory and assumption. Furthermore, we should actively strengthen technical research and practical application in this field in the future. For example, in building a digital platform, how to make a breakthrough in digital technology to create more value for enterprises and customers is the crucial point to be solved.

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