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Literature review on the consequences of enterprise digital transformation based on CiteSpace: Hotspots, trends and opportunities

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Abstract: The booming of the digital economy has sped up the development of several industries. Through digital transformation, companies are continuously enhancing their capacity to adjust to the external economic environment, which affects every facet of their business. However, there is a scarcity of comprehensive analysis of research on the hotspots, trends and opportunities on the consequences of Enterprise Digital Transformation (EDT). Therefore, this study uses CiteSpace to visually analyze a knowledge network based on a sample of 817 publications from 2018 to 2024. The results indicate that since 2021, the count of published papers in this area has drastically increased. The keyword analysis shows that EDT, performance, innovation, environmental, social and governance (ESG), and big data have become the hotspots in this research area. Future researchers mainly focus on the impact of EDT on firm financial performance, sustainable development, and environmental performance. The research methods used were primarily questionnaire survey and secondary data. majority of the present research focuses on how management, innovation, and finances are affected by EDT. The findings of this study are beneficial for researchers to find ideas and references for future studies on the consequences of EDT.

Keywords: *CiteSpace, Enterprise Digital Transformation, Finance Performance, Innovation.*

1. Introduction

Enterprise digital transformation (EDT) is a process. In order to create distinct competitive advantages and accomplish enterprise transformation, upgrading, and performance improvement, businesses alter their strategies, organizational structures, and business models as from the external digital economy.

The foundation for corporate digital transformation is provided by the digital economy's explosive growth. Numerous industries are growing quickly due to the digital economy, which is also a major factor in changing economic structure and optimizing the allocation of industrial resources [1, 2]. The White Paper on the Global Digital Economy (2024) states that the digital economy grew rapidly in 2023. To reach over $33 trillion, or 60% of GDP, the digital economies of the US, China, Germany, Japan, and South Korea expanded by more than 8% a year, which is almost 8 percentage points more than in 2019. The digital economy has caused a substantial transformation in the external environment of organizations [3, 4]. Enterprise is one of the most important economic sectors in the macroeconomy. Among the most significant concerns now is encouraging companies to embrace digital transformation and adapt to the expansion of the digital economy [5, 6]. Therefore, the ability of businesses to take advantage of the opportunities and challenges presented by the digital economy and accomplish digital transformation is crucial for macroeconomic growth as well as for the survival and growth of individual businesses.

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The consequences of EDT have been extensively studied. Researchers also comb the literature in this research area in order to find the hotspots, trends and opportunities of EDT research. Vial [7] reviewed 228 literatures, summarized the concepts, methods and impacts of EDT, and prospected future research opportunities. Feliciano-Cestero, et al. [8] used Bibliometrics to analyze the literature on enterprise internationalization and digital transformation over the previous 20 years. They also discussed future research trends, research hotspots, and research networks in this field from the perspectives of individuals, enterprises, and macro. Plekhanov, et al. [9] examined the process of EDT from three perspectives: core activities, peripheral activities and the external environment. Zou, et al. [10] examined EDT measuring techniques and indicators, as well as how the indicators were used from an industry standpoint. Relevant research on the effects of EDT in particular industries was also examined by several academics. For example, Inversini [11] examined studies on EDT in the travel and tourism sector.

The literature listed above provides a summary of pertinent EDT research from a particular angle, which will greatly advance future EDT research. Nevertheless, there isn't any literature that thoroughly summarizes the consequences of EDT. In order to make up for this gap, this paper uses CiteSpace to conduct a comprehensive literature review of the research on the consequences of EDT, hoping to provide ideas for future researchers' relevant research and provide references for policy makers to formulate policies. Through a quantitative analysis and methodical review of the literature on the consequences of EDT, the following problems will be addressed in this paper:

(1) What are the changes in the number of publications in this area?

(2) What are the characteristics of research teams, publications, countries, etc. in this research area?

(3) Which areas of this topic are now the focus of intense research?

The rest of the paper is structured as follows: Section 2 describes the data collection and research methods, while Section 3 is the quantitative analysis of literature features. Section 4 represents the quantitative analysis of the literature content. Section 5 is the thematic analysis of the consequences of EDT. Finally, Section 6 is the research conclusions and future research opportunities.

2. Data Collection and Research Method

2.1. Data Collection

The source of the research data used in this paper is from the Web of Science Core Collection. The database is the world's leading source of academic information, with journals covering the most authoritative literature on EDT. This research was conducted on December 19, 2024, using the keyword of EDT. This study, which examines the digital maturity and transformation process of organizations, greatly aids research on the various consequences of EDT since Accenture issued the Digital Transformation Index survey of Chinese enterprises in 2018.

Therefore, the search period of literature is set to 2018-2024 in this paper. Specifically, on the Web of Science Core Collection, starting with ALL = ("corporate digital transformation" OR "firm digital transformation" OR" enterprise digital transformation") was searched for the search term, and a total of 5,159 articles were obtained. To ensure that the literature is relevant to the consequences of EDT, this study manually selects each literature by reading its title, keywords, abstract and full text. After data cleaning, 817 articles were obtained.

2.2. Research Method

Using statistical methods, bibliometrics was initially applied in libraries to examine publications, academics, and content in particular fields [12]. In order to thoroughly examine the current body of knowledge and investigate potential avenues for future study, researchers primarily employ bibliometrics to conduct literature research in a variety of subjects [13]. With the popularization of digital tools, more and more researchers are visualizing subject knowledge through knowledge maps to analyze the hotspots of theoretical research, the structure identification and the evolution trend of subject areas. Now common knowledge graph visualization software includes Arnet Miner, Paper Lens,

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TDA, VOS viewer, Bibexcel and CiteSpace. Compared with other software, CiteSpace focuses on analyzing the evolution trend of research frontiers of disciplines and the internal connections between different research frontiers. It is easy to operate and has clear visualization results, and is widely used in academic research areas. Chen [14] developed a research framework for visual literature analysis and made the first use of CiteSpace for literature analysis. The research foundation for further studies is provided by this paper's analysis of the publication date, journal, author, country, co-citation, keywords, and other factors. CiteSpace was then utilized by an increasing number of academics to conduct bibliometric research. For instance, Xu, et al. [15] examined the state of research and potential directions for future studies in the area of heavy metal contamination in deserts. Cao, et al. [16] examined the state of research in the area of industrial transformation and upgrading as well as potential directions for future study. Therefore, this paper uses CiteSpace 6.1.R6 software to visually analyze relevant literature on EDT, and provides a basis for relevant literature on research progress, frontier hotspots, evolutionary path and future trends in this area.

3. Quantitative Analysis of Literature Features

3.1. Publication Time and Number

To a certain degree, the quantity of research publications on corporate digital transformation may be used to gauge the current state of the field. Empirical articles on the consequences of EDT were initially published in 2018, as seen in Figure 1. However, there is little relevant literature from 2018-2020. Since 2021, the amount of literature on the consequences of EDT has increased dramatically. Specifically, there are 14 papers in 2018-2020, 23 in 2021, 87 in 2022, 268 in 2023, and 425 in 2024. It is evident that the relevant research has grown in popularity. Concern over how the digital transition will affect corporate operations at all levels is growing among researchers.

Figure 1.
Number of articles each year (2018-2024).

3.2. Information on published journals

58 journals made contributions to the field out of the 517 papers that were counted. This demonstrates how the study of the effects of EDT has gained popularity. Among the 58 journals, 45 published 10 articles or less, and 13 published more than 10 articles. These journals cover a wide range of fields, such as Business & Economics, Science & Technology, Environmental Sciences, Public Administration, etc. This demonstrates that research on the consequences of EDT is an interdisciplinary field that encompasses a broad variety of topics.

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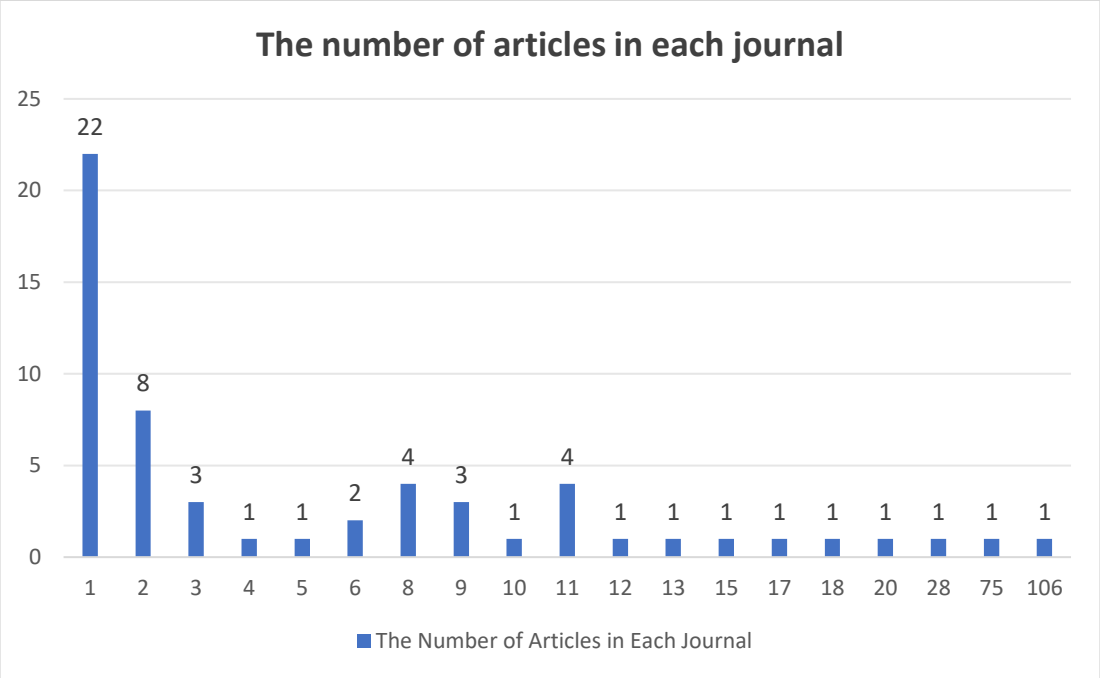

Figure 2.
The number of articles in each journal.

A total of 363 papers were published in the top 10 journals (as shown in Table 1), accounting for 70.21%, which greatly promoted the research on the consequences of EDT. Among the journals with a large number of articles, Sustainability has 106 articles, accounting for 20.50% of all articles. There were 28 papers published in PLoS One, accounting for 5.42% of all articles. Both of these open access journals publish a significant number of articles each year. The top journals in the area are Finance Research Letters, Technological Forecasting and Social Change, International Review of Financial Analysis, Economic Analysis and Policy. These journals have a high impact factor, and the total number of publications is 118, accounting for 22.82%.

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Table 1.
Journal publications.

No.	Source journal	Research area	Journal impact factor (2023)	Journal citation indicator (2023)	Number of issued articles	Prop (%)
1	Sustainability	Science & technology - other topics environmental sciences & ecology	3.6	0.68	106	20.50
2	Finance research letters	Business & economics	7.4	2.72	75	14.51
3	PLoS One	Science & technology - other topics	2.9	0.88	28	5.42
4	Technological forecasting and social change	Public administration business & economics	12.9	2.60	20	3.87
5	International review of economics & finance	Business & economics	4.8	1.39	18	3.48
6	Systems	Social sciences - other topics	2.3	1.42	17	3.29
7	Heliyon	Science & technology - other topics	3.4	0.82	15	2.90
8	Technology analysis & strategic management	Business & economics science & technology - other topics	2.9	0.71	13	2.51
9	International review of financial analysis	Business & economics	7.5	2.31	12	2.32
10	Applied economics	Business & economics	1.8	0.56	11	2.13
11	Economic analysis and policy	Economics	7.9	2.7	11	2.13
12	Environment development and sustainability	Science & technology - other topics environmental sciences & ecology	4.7	0.81	11	2.13
13	European journal of innovation management	Business & economics	5	1.04	11	2.13

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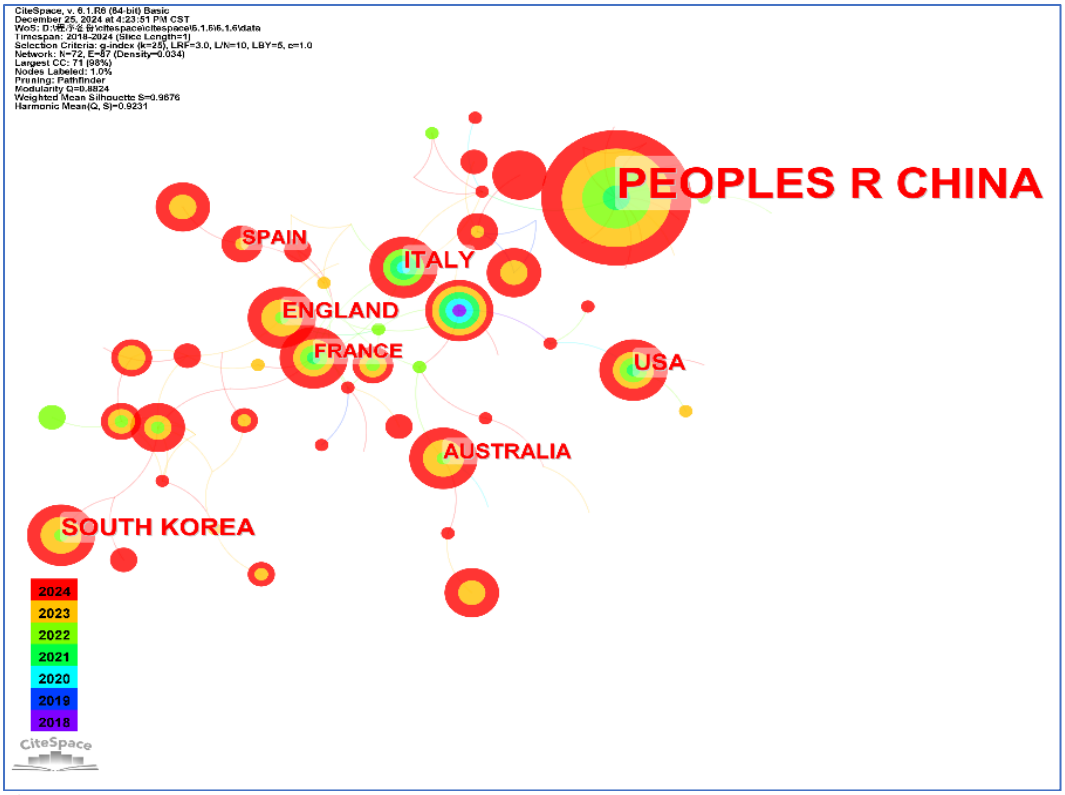

Figure 3.
The authors county analysis map.

3.3. Publications by Country

According to the nations of the published authors, 661 of the 817 literatures examined were produced by Chinese academics, making up 80.91% of the total. This suggests that Chinese academics are more interested in studying company digital transformation. The development of the digital economy is highly valued in Chinese policy. Chinese companies place a high value on digital transformation. The Department of Business Services of the China Federation of Industry and Commerce, Tencent Research Institute, and Central University of Finance and Economics jointly published the Digital Transformation of Chinese Private Companies Research Report, which found that 61.84% of Chinese private enterprises have implemented digital transformation in their primary business domains. In this regard, research on the consequences of EDT is highly valued by Chinese academics.

3.4. Author Co-citation Analysis

Readers may better comprehend the development of research teams in the field of consequences of EDT by using co-citation analysis. In this paper, the CiteSpace software was used to select the node type as the Cited Author, and 817 studies in the field of consequences of EDT were co-cited for author analysis. The co-cited author map obtained is shown in Figure 4. In this figure, the larger the node shape, the more referees.

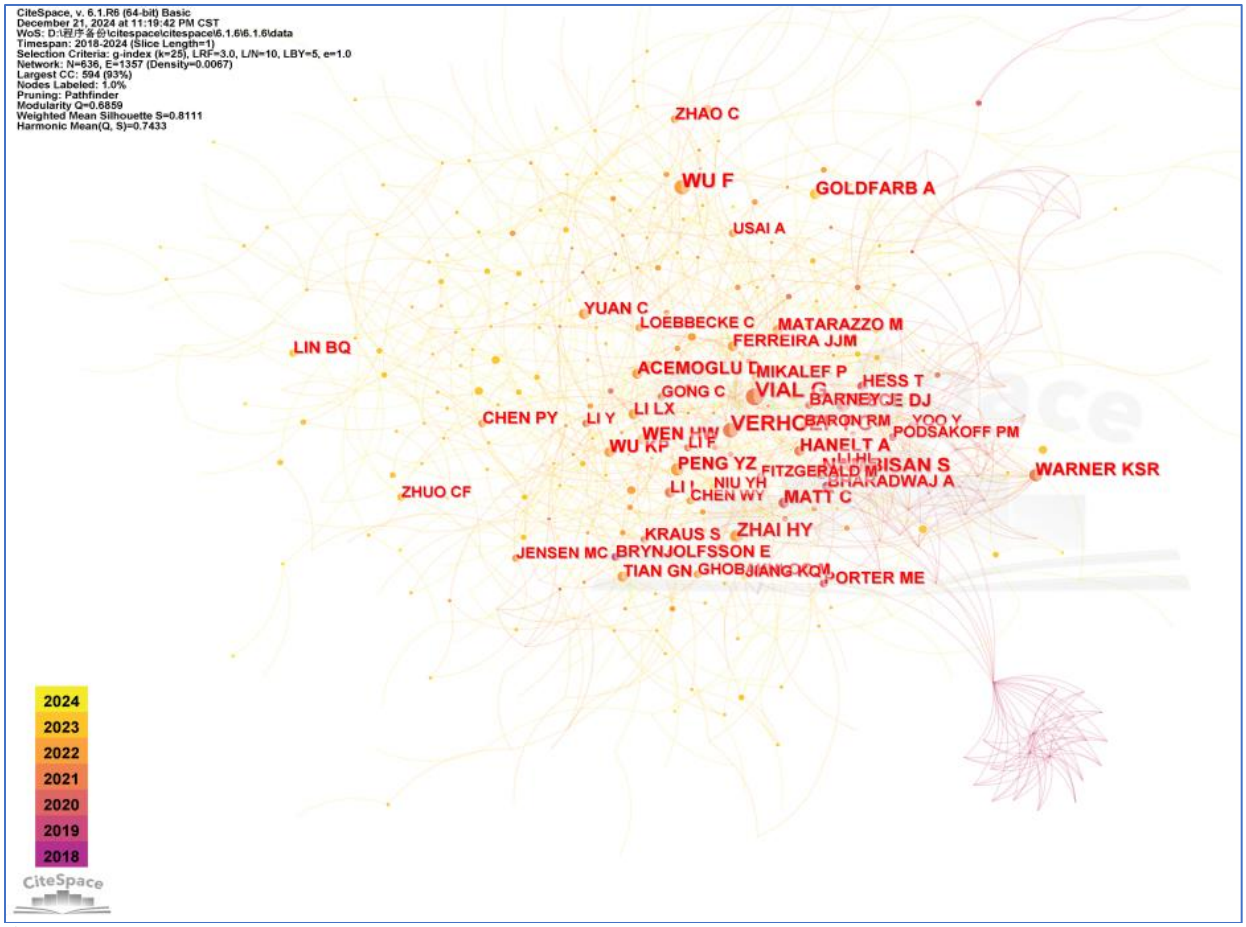

Figure 4.
The authors co-cited analysis map.

As can be seen from Figure 3, Vial G, Verhoef, Wu F, Nambisan S, Zhai HY are the five most cited authors. Vial G is an early literature summarizing relevant research on EDT. Nambisan S is one of the earliest literature to analyze the effects of digital transformation using questionnaires. Wu F's innovative use of text analysis to measure EDT, which provides new trains of thought for subsequent empirical research. Authors cited more than 50 times are listed in the figure. These authors provide a theoretical basis and research experience for the consequences of EDT, and they have great influence and contribution to the research area.

4. Quantitative Analysis of Literature Content

4.1. Keyword Co-occurrence Analysis

Keywords are highly condensed to the content of the article and can reveal the correlation of knowledge in the discipline. The research hotspots and trends of the consequences of EDT may be observed by examining the top keywords. In this paper, the CiteSpace software is used to analyze 517 pieces of literature obtained; Node type is selected Keyword, Years Per Slice=1. The keyword co-occurrence map in the research area of consequences of EDT is obtained. The result shown in Figure 5.

Digital transformation, innovation, impact, performance, and technology are the top five keywords. Additional examination of the keywords' centrality ranking reveals that researchers focus heavily on how EDT affects performance, social responsibility, innovation, dynamic capabilities, and other areas. The information asymmetry hypothesis is most frequently applied in those works. Further, the central

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collinearity analysis is carried out on all keywords, and combined with the research methods, data sources, and research results used by researchers. The works on the impacts of EDT are categorized into four fields in this paper: (1) Financial performance is significantly impacted by EDT. (2) Enterprise innovation is significantly impacted by EDT. Researchers focus a big of attention on the effects of breakthrough and green innovation in addition to enterprise innovation. (3) Enterprise dynamic capacity is significantly impacted by EDT. (4) By altering how digital technology is applied, EDT affects dynamic capability, innovation, and performance.

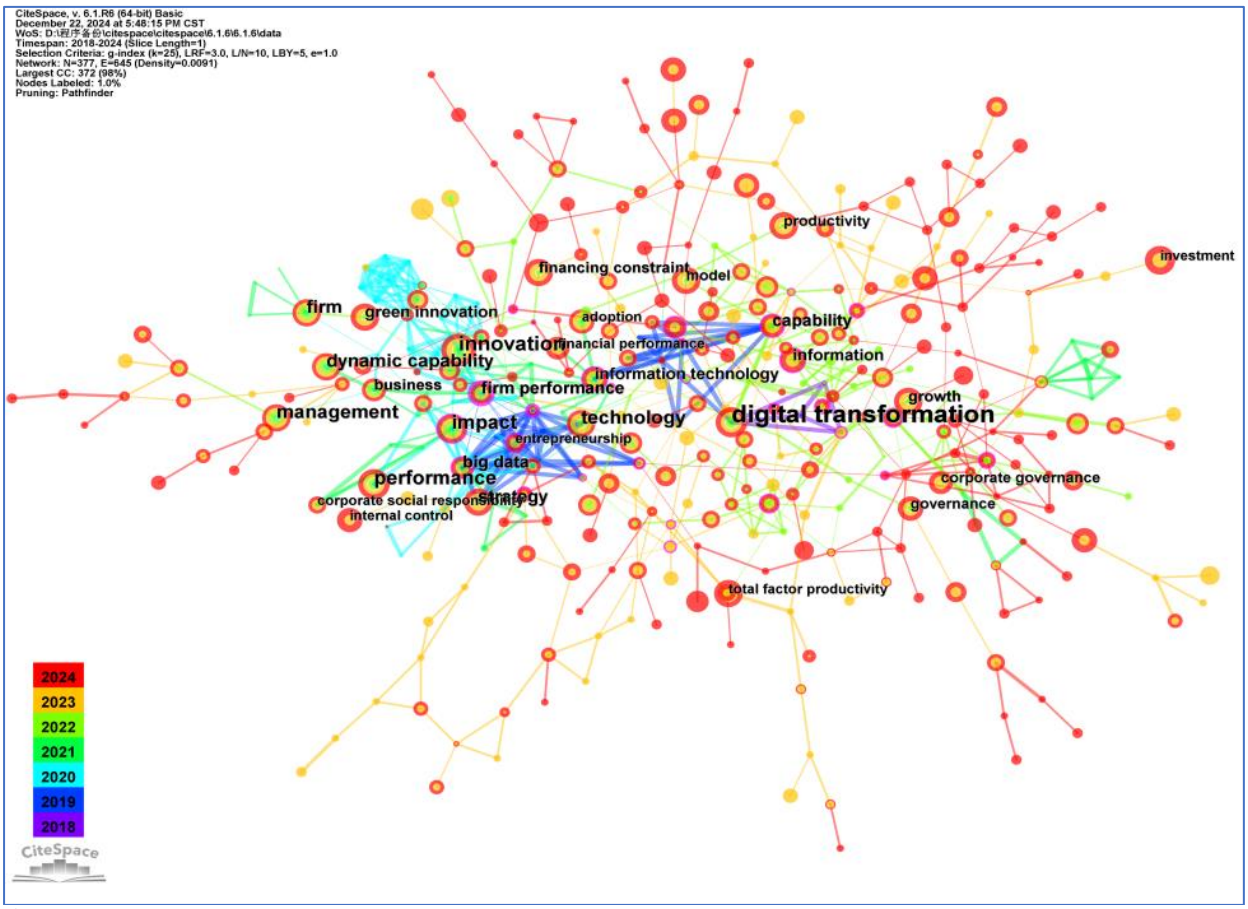

Figure 5.
Co-occurrence analysis of keywords.

Table 2.
High frequency keywords.

No	Keywords	Frequency	Centrality
1	Digital transformation	597	0.07
2	Innovation	193	0.01
3	Technology	130	0.02
4	Management	110	0.07
5	Strategy	80	0.02
6	Firm performance	71	0.24
7	Big data	66	0.14
8	Capability	63	0.11
9	Information	60	0.13
10	Green innovation	57	0.02

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4.2. Keyword Emergence Analysis

In order to further understand the current research situation of consequences of EDT, this paper uses CiteSpace software to draw the keyword emergence map, which is shown in Figure 6. Year represents the time when the keyword appears; Begin and End respectively represent the start and end of the keyword emergence; strength is the intensity of the keyword emergence; light blue represents that the keyword does not appear; dark blue represents that the keyword appears; and red represents the period during which the keyword emergence. From the time of keyword emergence, information technology is the earliest keyword emergence. It is evident that researchers focus more on how corporate digital transformation affects enterprise information technology investment and other factors. Later, a growing number of researchers concentrate on the ways that business models, innovation, and other elements are impacted by EDT. From the point of view of the intensity of keyword emergence, information technology, business, business models, management, and performance are the hotspots that researchers pay attention to. From the perspective of the duration of keyword emergence, most keywords can last one to two years. This illustrates how research in this field is growing rapidly and how scholarly attention is constantly changing to the consequences of EDT. Academics may keep concentrating on how EDT impacts their financial performance, sustainable development, and environmental performance. Researchers will probably keep looking into how EDT affects other activities because the aforementioned hotspots also lasted for two years.

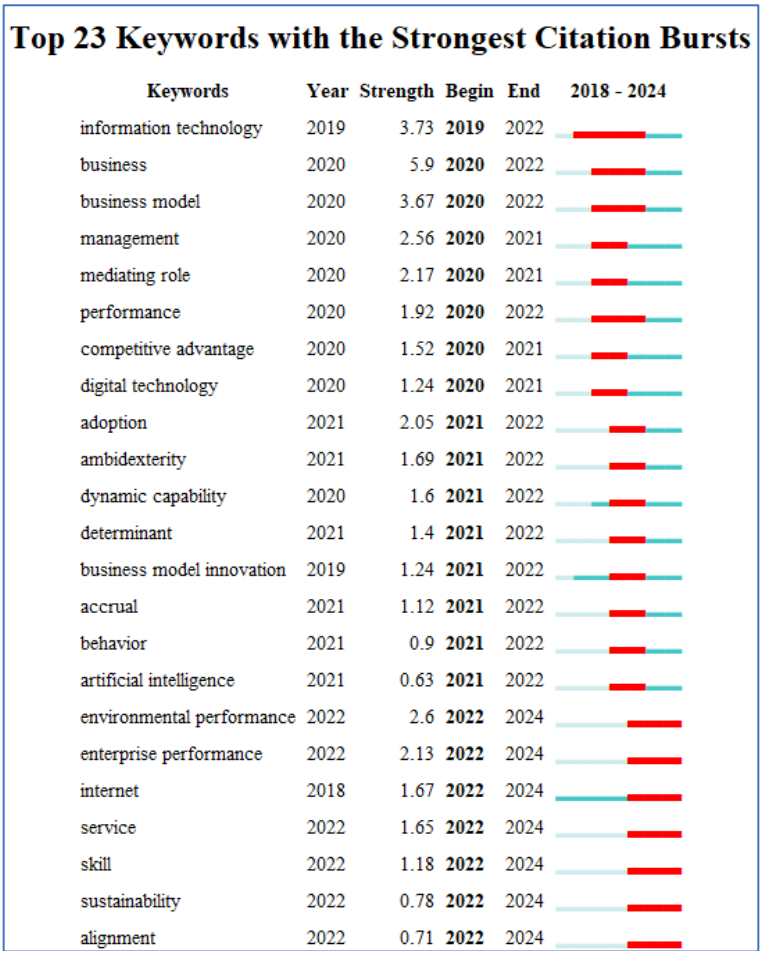

Figure 6.
Keyword emergence map.

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4.3. Analysis of Research Methods Based on Literature Content

Researchers can examine the consequences of EDT using two primary approaches. One is the questionnaire survey. In order to obtain research data, early researchers mainly used questionnaires to obtain research data. For instance, Cenamor, et al. [17] issued a questionnaire to 230 entrepreneurial SMEs. It is found in this paper that enterprise performance is proven to be significantly improved by EDT. Sarfraz, et al. [18] issued questionnaires to bank employees and obtained data from 371 enterprises. This paper's conclusion was that fintech may further enhance businesses' sustainable performance and support their digital transformation. In a study of 496 businesses, Straková, et al. [19] discovered that EDT significantly positively improves financial performance and competitiveness. The second is empirical research. Following Wu, et al. [20] innovative use of text analysis to realize the digital transformation of the majority of listed companies, an increasing number of researchers are employing the empirical research technique to investigate the effects of the consequences of EDT. Taking data from Chinese main board-listed manufacturing companies from 2008 to 2020 as samples, Zhen, et al. [21] measured EDT using text analysis. This paper came to the conclusion that decisions made by enterprises regarding digital transformation significantly improve their capacity for sustainable innovation. Using 12,516 data from 2,941 Chinese listed companies between 2014 and 2020, Huang, et al. [22] discovered a positive U-shaped link between idiosyncratic risk and EDT. The questionnaire survey method and case study method can obtain first-hand data, but compared with the whole sample, the sample studied is very limited, and the research conclusions obtained are not universal. In recent studies, more and more studies have adopted empirical research to examine the consequences of EDT.

5. Thematic Analysis of Consequences of Enterprise Digital Transformation

Companies face additional risks resulting the expansion of the digital economy. Companies of all sizes and types must go through digital transformation to adapt to the external environment in order to meet the challenges of the digital economy and achieve sustainable development [23]. Only by coordinating strategy and absorptive ability can an organization undergo digital transformation [2]. A number of activities will undoubtedly be impacted by this series of changes. In the existing research, the financial effect, innovation effect and management effect of EDT are three prominent research themes.

5.1. Financial Effect of Enterprise Digital Transformation

5.1.1. Enterprise Digital Transformation and Performance

Whether EDT can promote performance has always been the focus of researchers' attention. The existing research mainly divides into two points of view. The majority of academics think that performance can be enhanced by EDT. This is supported by the study's use of questionnaires to gather data. For example, Cenamor, et al. [17] claimed that the growth of digital platforms may promote the modernization and transformation of organizational design, which would enhance the effectiveness of resource allocation and communication both internally and externally. In this case, their supply network will be more effective, which will help promote enterprise performance. Business success may be increased by promoting digital transformation in internationalization, according to a survey conducted by Yu, et al. [24] on 11 companies. The effect of EDT strategy on performance was examined by Wang, et al. [25]. It has been discovered that short-term may be successfully enhanced by EDT, as well as long-term performance. According to further study, excessive levels of cognitive conflict might reduce the beneficial effects of digital transformation strategies on financial performance, whilst moderate levels of cognitive conflict can enhance them. Empirical studies using capital market data have reached the same conclusion. Xu, et al. [26] discovered that by promoting enterprise ecological innovation, EDT may enhance sustainable performance. Zhang and Yang [27] stated that EDT can significantly improve finance performance through business model innovation, and enterprise innovation ability improves the positive effect of digital transformation on financial performance.

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But some academics state that performance is negatively impacted by business digital transformation. Organizations undergoing digital transformation must invest a substantial amount of resources, and if processes and structures are not changed, financial performance will suffer [28].

5.1.2. Enterprise Digital Transformation and Cash Holding

Demir and Ersan [29] pointed out that the level of enterprise cash holdings will be affected by internal and external environment. Businesses accelerate digital transformation due to the effects of the digital economy, and financial operations are also impacted by general changes in organizational structure, business model, information efficiency, and other areas. According to Kotios, et al. [30] the digital transformation of banks has the potential to enhance the operation of financial services and improve businesses' cash forecasts. Using data from Chinese listed companies, Sun, et al. [31] verified that digital technology utilization may assist reduce information asymmetry, which in turn lowers agency and transaction costs, after the digital transformation of non-financial organizations. These consequences aid in lowering the amount of cash held by the company.

5.1.3. Enterprise Digital Transformation and Cost Control

As stated by Yoo, et al. [32] the digital innovation increases following EDT. The improvement of the level of digital innovation has further reduced the operating costs and transaction costs of enterprises. Academics focus a lot of attention on how EDT affects costs. It is generally believed that EDT can drive cost reduction. According to operational costs, EDT is the process by which companies utilize digital technologies to update and modify their technology, processes, and organizations as well as to rebuild their business models. According to Loebbecke and Picot [33] and Gölzer and Fritzsche [34] rebuilding the business model lowers operational costs for businesses and improves the quality of company decision making. From the perspective of transaction costs, in a survey of 938 non-financial businesses, Ferreira, et al. [35] discovered that EDT lower transaction costs, increasing businesses' overall competitiveness. According to a technical perspective by Matarazzo, et al. [36] companies were able to overcome time and geographical constraints by the use of digital technologies including big data, artificial intelligence, and mobile Internet. These technologies reduce the information asymmetry faced by enterprises and help reduce the transaction costs faced by companies. From the perspective of agency costs, according to Ilvonen, et al. [37] and Sousa-Zomer et al. (2020), EDT lowers agency costs, enhances the quality of information transmission, and encourages real-time information transmission.

5.2. Innovation Effect of Enterprise Digital Transformation

Li, et al. [38] pointed out that after EDT, various capabilities of enterprises will undergo fundamental changes, such as business model, organizational capability and business capability, which affects enterprise innovation. Numerous articles have examined the connection between innovation and business digital transformation. It is widely accepted that enterprise innovation may be greatly aided by digital transformation. However, divergent opinions exist among academics about the relationship between innovation and EDT. First of all, companies may increase their degree of creativity by reducing their financial constraints and resource restrictions via EDT. Liu, et al. [39] found that digital transformation changes enterprise innovation by reducing operational, agency, and transaction costs for businesses through the use of digital technology, based on data from Chinese listed companies from 2013 to 2019. In addition, the research makes the case that digital transformation influences enterprise innovation by altering how businesses take chances. Zhang and Yang [27] verified that digital transformation has a significant positive effect on enterprise innovation. Further research found that age, gender, and educational background can limit this process using research data of Chinese listed companies from 2008 to 2020 as sample. Secondly, as the green economy grows, more and more academics are focusing on the mechanism that EDT affects green innovation. For example, according to Dou and Gao [40] EDT may raise green innovation by raising both the degree of innovation and the caliber of human resources. Thirdly, some academics focus on how enterprise innovation performance is

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affected by digital transformation. For instance, Sun, et al. [41] discovered that EDT alters the digital sharing mechanism and further enhances innovation performance using data of Chinese listed companies from 2012 to 2022 as sample.

5.3. Management Effects of Enterprise Digital Transformation

Researchers are very interested in how management and operations are affected by EDT. Liu, et al. [42] stated briefly that EDT affect the operation and management of micro-economic entities. However, empirical study on how managerial activities are affected by EDT began quite late. Research now focuses on two areas. Firstly, ESG performance may be impacted by EDT. Yang and Jin [43] found that digital transformation can significantly improve enterprise ESG performance using the population of Chinese A-share listed enterprises from 2010 to 2019. The influence was positively moderated by the senior management team's educational background and the CEO's tenure. Secondly, companies' supply chain management is improved via EDT. In a survey of 255 Chinese companies, Ning and Yao [44] discovered that EDT significantly improves supply chain performance and capabilities, as well as have an impact on companies' long-term competitive performance.

6. Research Conclusions and Future Research Opportunities

6.1. Research Conclusions

Based on the sample of 817 literature with EDT as keywords included in Web of Science Core Collection from 2018 to 2024, this paper applies CiteSpace software for visual analysis of knowledge map and mainly draws the following research conclusions:

First of all, this paper summarizes the literature status of the consequences of EDT. Quantitatively, the area is a hot spot for academic research. The number of published papers has grown exponentially since 2021, reaching 425 in 2024. From the published journals, the study on the consequences of EDT is an interdisciplinary subject. The top journals in the area are Finance Research Letters, Technological Forecasting and Social Change, International Review of Financial Analysis, Economic Analysis and Policy. The research field is mainly Business & Economics and Science & Technology. From the point of view of citation, earlier empirical research has become a hot spot in citation. Secondly, this paper discusses the research hot spot of the consequences of EDT. The keyword co-occurrence map shows that EDT, performance, innovation, and ESG are the research hotspots, and digital technology is the key element of EDT. Keyword clustering results show that enterprise performance, innovation and big data are the hotspots of researchers. Thirdly, this paper discusses the research frontiers of the consequences of EDT. The keyword emergence map shows that future researchers may continue to pay close attention to the effect of EDT on performance, sustainable development and environmental performance. Fourthly, this paper finds that the research methods of EDT are mainly questionnaire survey and empirical research. Fifthly, the majority of the present research focuses on how management, innovation, and finances are affected by EDT.

6.2. Future Research Opportunities

From the following perspectives, future studies on the consequences of EDT might be investigated:

a) To provide empirical evidence on the impact of EDT. Text analysis is the main technique utilized to measure the EDT in the empirical research based on listed company data that is currently available in the literature. But studies that derive evidence from listed companies in other countries are rare. Therefore, researchers from various countries are required to measure EDT based on the characteristics of domestic enterprises, the information disclosure of annual reports, and the characteristics of national corporate digital transformation policies, and then analyze its impact on enterprise financial activities and management activities.

b) To innovate research methods. In recent research, questionnaire survey and empirical research are the two most commonly used methods, and other research methods are relatively rare. However, the amount of data in questionnaire survey is relatively small and the representativeness is not strong. The

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validity of empirical research is limited by the choice of proxy variables. The above two methods have certain limitations. Future research should closely examine the consequences of EDT through field research based on excellent cases. It provides practical experience for the research of EDT.

c) To expand the research of EDT. At this stage, digital economy and green economy have become the main direction of economic development. Enterprises are faced with digital transformation and green transformation simultaneously. Research on the synergies between green transformation and digital transformation is scarce. Future research can examine how enterprise digital green collaborative transformation affects business and financial operations and offer empirical support for pertinent studies.

d) To predict the consequences of EDT. Most of the research being done now is based on historical data and has little forecasting ability. Future studies can conduct prediction studies using tools like artificial intelligence and big data, which can serve as a resource for businesses looking to comprehend the effects of digital transformation.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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