The Impact of Digital Transformation on Enterprise Performance

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Abstract

This study aims to explore the impact of digital transformation on enterprise performance. The samples came from manufacturing enterprises in China to explore the relationship between digital transformation and enterprise performance. This paper uses a sample of 400, which is more than 5 times the number of observed variables, which is 280. This study uses quantitative analysis methods to test the research hypotheses of this study. It adopts the structural equation modeling (SEM) method to verify the effectiveness of the proposed theoretical framework. A questionnaire was also used to collect data. This study collected 400 first-hand pieces of information in the form of questionnaires and used AMOS and SPSS statistical software to process and analyze the data. The empirical analysis of this study confirms that digital transformation has a positive impact on enterprise performance, which not only provides a new perspective for theoretical research but also provides practical suggestions for companies to achieve sustainable competitive advantages in the digital era.

Keywords: digital transformation; enterprise performance; manufacturing enterprises; China; structural equation modeling

Introduction

With the rise of computer technology and the emergence of the Internet, companies have gradually begun to realize the importance of information technology for business management and development. At the end of the last century and the beginning of this century, many enterprises have invested in information technology to improve operational efficiency and business agility (Matt et al., 2015).

Therefore, new research is gradually turning to a comprehensive perspective to study and explore the comprehensive impact mechanism of digital transformation on enterprise performance. With the in-depth development of a new round of scientific and technological revolution and industrial transformation, China's development in the new era is facing new strategic opportunities and challenges. The report of the 20th National Congress of the Communist Party of China proposed to accelerate the construction of a new development pattern and strive to promote high-quality development. Enterprises should actively promote the implementation of digital transformation strategies, regard improving enterprise performance as the primary task of enterprise development, achieve high-quality enterprise development, and promote the deep integration of the digital economy and the real economy. Digital transformation is an important issue that cannot be ignored in today's business world. It marks the development direction of traditional enterprises from traditional business models to digital and intelligent development (Bouwman et al., 2018).

Digital transformation is not only a technological change but also a profound change in enterprise strategy, organizational structure, and business model. In the process of implementing digital transformation, enterprises need to focus not only on the application of technology but also on cultural changes and the improvement of employees' digital capabilities. By building a flexible organizational structure and innovative business models, companies can better respond to market changes and customer needs, thereby achieving sustainable development and enhancing competitive advantages. In this process, the support of leadership and the active participation of employees are crucial. In addition, companies need to continuously strengthen collaboration with external partners and build an open ecosystem to achieve resource sharing and win-win development. Digital transformation is not only a key path for companies to achieve high-quality development but also an important engine for promoting national economic transformation and upgrading.

Based on the research conclusions, this paper proposes inspiration and suggestions for enterprises to improve their performance through digital transformation and raises the following questions: What is the impact of digital transformation on enterprise performance? This paper first conducts a theoretical analysis based on digital transformation and enterprise performance, proposes a value logic definition of digital transformation, and derives a research hypothesis model to analyze from the perspective of digital transformation and enterprise performance.

Objective

To explore the direct relationship between digital transformation (DT) and enterprise performance (EP) in Chinese manufacturing enterprises.

Scope of Research

1. Target Population: This study focuses on manufacturing enterprises in China. The population selected is managers of various enterprises with extensive enterprises. Determination of sample size: in cases where the size of the population is unknown, according to Wu and Yang (2014), the sample size should be more than 5 times the number of observed variables. So this paper uses 400 samples; it's more than 280 samples.

2. Time Frame and Data Collection: Data collection period: 2023–2024. Data collection during this period covers the changes that companies have experienced during the digital transformation process and their dynamic capability improvement during this period.

3. Data source: Manufacturing companies in Heilongjiang Province, China, data collection is carried out through enterprise questionnaires, interviews, and public enterprise performance data. Data collection will focus on indicators such as these companies' production structure, business model, technology application, and overall enterprise performance.

Literature reviews

In recent years, the impact of digital transformation on enterprise performance has become a hot research topic. Research on the impact of digitalization on business models has found that digital transformation enables enterprises to better adapt to market needs, thereby improving performance. Research highlights that digital transformation is crucial for companies to compete in the digital era (Bouwman et al., 2018). In terms of digital business strategy, digital transformation plays a key role in improving enterprise performance. A successful digital strategy should combine business goals and realize the company's strategic vision through technological innovation, thereby affecting performance improvement (Bharadwaj et al., 2013). The widespread application of digital technology has had a profound impact on enterprises. By improving efficiency and innovating business models, digital transformation helps companies better adapt to market changes and improve overall performance levels (Brynjolfsson & McAfee, 2014). Digital transformation provides

enterprises with the opportunity to rethink and adjust their business models. Through innovative business models, enterprises can respond to market demands more flexibly and improve performance levels (Chesbrough & Rosenbloom, 2002). Digital transformation provides enterprises with a wide range of business model innovation possibilities. By redesigning the value chain and optimizing resource allocation, enterprises can improve production efficiency and reduce costs, thereby having a positive impact on performance (Foss & Saebi, 2017).

Digitalization denotes the profound metamorphosis in how businesses execute operations, furnish value to customers, and engage with stakeholders by harnessing the capabilities of digital technologies. Digital transformation constitutes a business overhaul instigated by the emergence of cutting–edge technologies (Tang, 2021). It entails harnessing the capabilities of digital technologies, including artificial intelligence, cloud computing, big data analytics, the Internet of Things, and automation, to propel innovation, optimize processes, and augment business outcomes (McAfee & Brynjolfsson, 2017). Digital transformation is a byproduct of the information technology era. It progressively permeates the core operations of enterprises, building upon their existing business models, thereby achieving business models that meet the personalized needs of consumers (Westerman et al., 2014). As per pertinent professional elucidations, digital transformation denotes the conversion of analog formats into digital counterparts. Digital upgrading encompasses the comprehensive digital refinement of the entire workflow, enhancing operational efficiency for enterprises to attain the objectives of cost reduction and efficiency enhancement, thereby creating additional value for customers. Digital transformation exerts influence across multiple facets of an organization, encompassing its strategy, operations, culture, and customer experience.

Enterprise performance is the measure of the ability and performance of a business to achieve its goals and expected results over a specified period. It is a comprehensive evaluation index of enterprise management, reflecting the achievements and performance of enterprises in many aspects. Financial performance is the most basic and important aspect. Titman et al. (2004) measure the profitability and efficiency of enterprises through financial indicators such as operating income, profit margin, and return on production and health to reflect financial performance. Market performance focuses on the performance of enterprises in market competition, involving market share, brand recognition, customer satisfaction, and other indicators that directly reflect the enterprise's product quality. Or the acceptance and competitive position of the service in the market. Operational performance focuses on the production and operational efficiency of the enterprise, such

as production efficiency, cost control, supply chain management, etc. Excellent operational performance can reduce costs, increase production capacity, and enhance the competitiveness of enterprises. Finally, strategic performance is to evaluate the success of a company's strategic decision–making, involving indicators such as innovation capability, new product launch rate, and market expansion capabilities. Effective strategic performance helps companies adapt to market changes, discover new opportunities, and maintain competitive advantages. Scholars believe that the improvement of enterprise performance is crucial to enterprise development. Excellent performance can not only bring higher revenue and market share to the company, but also help to enhance the belonging of employees It will enhance enterprise image and brand value, attract more investment and partners, and lay a solid foundation for the sustainable development of the enterprise. Therefore, enterprises should constantly pay attention to and optimize their performance, and continuously improve their competitiveness and market performance through effective strategic planning, innovation, and continuous improvement. From the perspective of behavior, scholars believe that enterprise performance is not only the result of enterprise behavior but is more reflected in the process of enterprise behavior. Campbell (1990) asserted that the evolution of enterprise performance is constrained by various behavioral factors within enterprises. Drawing upon references, this paper contends that enterprise performance, as the outcomes garnered by the company within a specified timeframe, mirrors the performance or results accomplished by the organization in a specific undertaking.

Digital transformation has a profound impact on enterprise performance by affecting business models and improving efficiency and innovation. Achieving digital transformation is not a static process. Enterprises need to continuously adapt to changing technology and market environments to ensure that digital transformation continues to improve performance.

Therefore, this paper proposes the following hypothesis:

H1: Digital transformation has an impact on business performance.

Methodology

There are two basic research methods, namely quantitative methods and qualitative methods.

Quantitative Analysis: Quantitative analysis is a quantitatively based research method that emphasizes the use of tools. In quantitative research, data are usually measured, analyzed, and

interpreted in numerical form. Qualitative Analysis: Qualitative analysis is a qualitative–based research method that emphasizes the understanding and interpretation of non–numerical data. This approach focuses on multiple perspectives of social reality, with the researcher's interviewee becoming the "expert"—the researcher trying to explain his or her view of reality.

This paper uses these methods to conduct research:

Population and Sample

This paper mainly takes the manufacturing industry in Heilongjiang as the research object. China's manufacturing industry plays an important role in the global economy and has played an important role in promoting China's economic growth and job creation. The sample size should be more than 5 times the number of observed variables, which means that each parameter to be estimated in the model corresponds to several times the number of subjects or cases. The view that the sample size is required to be proportional to the observed variables is not sufficiently supported, as this issue is influenced by many other factors. However, all statisticians believe that the larger the sample size, the more accurate the parameter estimation results of SEM (Wu & Yang, 2014). Determination of sample size: in cases where the size of the population is unknown, according to Wu and Yang (2014), the sample size should be more than 5 times the number of observed variables. So, this paper uses 400 samples; it's more than 280 samples.

Questionnaire design

The questionnaire contains 2 variables, digital transformation that affects enterprise performance. The 6 explanatory variables are product development, manufacturing, user services, and enterprise ecological cooperation in digital transformation; survival performance and growth performance in enterprise performance, and one explained variable is enterprise performance.

Each variable is measured by 3–10 items in the questionnaire, and all items are 5–point Likert scales, with ratings from strongly disagree to strongly agree to reflect the respondents' views on the nature of the items.

Reliability Test and Validity Test

This study tested the questionnaire before actually using it (pre–test), collected data from 30 people, and calculated the reliability coefficient using the statistical Cronbach's Alpha data analysis results. The results showed that the reliability correlation coefficient was 0.905, higher than 0.70, indicating that the measurement tool was reliable. Subsequently, this study used the questionnaire to collect actual data from 400 people, using a quantitative research method. Before

the formal questionnaire was distributed, outstanding scholars in this research field were sought to conduct IOC analysis. IOC: Item Objective Congruence Index.

The questionnaire method is used to collect data, which is mainly distributed to enterprise managers. After the data is collected, it will be organized and analyzed. This study will use IBM SPSS 27.0 and Amos 24.0 statistical analysis software to conduct statistical analysis on the data and draw conclusions about the impact of digital transformation and enterprise dynamic capabilities on enterprise performance and the intermediary role of business model innovation in it, thereby providing insights into the regional economy of the manufacturing industry in Heilongjiang Province, China and contribute to its revitalization and sustainable development.

In this study, a total of 620 questionnaires were distributed to senior managers of 400 manufacturing companies in Heilongjiang Province, China, to ensure at least 280 valid questionnaires. This survey collected a total of 465 questionnaires, of which 65 had missing information. These 65 questionnaires were directly excluded, and the remaining 400 questionnaires were further analyzed.

Data Collection Procedure

Questionnaire distribution methods include:

1. Distribute online questionnaires to managers who are working in companies.

2. Distribute questionnaires to managers through companies' mailboxes.

3. The effective sample size required for empirical research was obtained through the above questionnaire distribution.

Data Analysis

Structural equation modeling (SEM) is an important statistical method in contemporary quantitative research in behavioral and social fields, used to analyze complex relationships between constructs and indicators. It combines causality models, measurement models, and path analysis and is suitable for exploring associations between latent variables, multi-level causal relationships, and observed variables.

Based on the literature review, the relationship was established. According to the characteristics of this study, the research framework of this study was developed as shown in Figure 1.
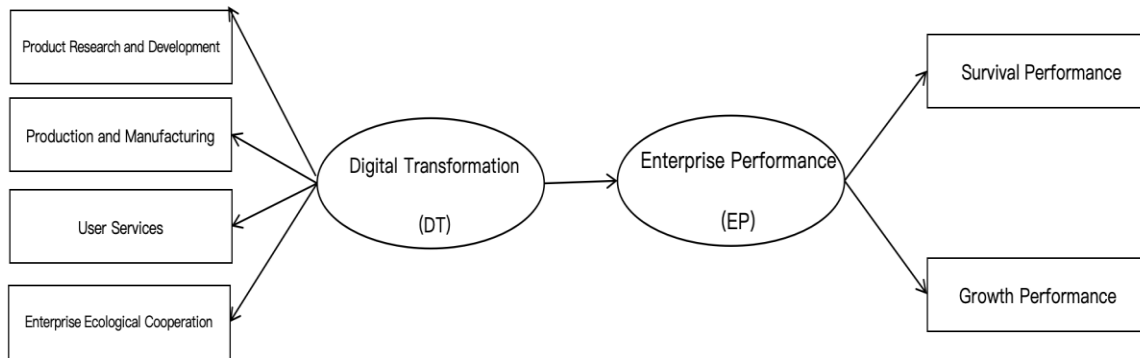
Figure 1 Conceptual framework

Qualitative Part

The sample was screened as those with more than 5 years of experience as CEOs. When determining the sample size, the guidelines proposed by Creswell (2006) were followed, which suggested that a sample size of more than 6 respondents is appropriate in a study with homogeneous samples. Considering the industry nature of the sample in this study, 10 respondents were selected.

The interview outline designed for this study included five questions:

Q1: How do you think digital transformation affects enterprise performance?

Q2: How do you think enterprise dynamic capabilities affect enterprise performance?

Q3: In your opinion, what role does business model innovation play in the impact of digital transformation and enterprise performance?

Q4: In your opinion, what role does business model innovation play in the impact of enterprise dynamic capabilities and enterprise performance?

Q5: How do you think digital transformation affects business model innovation?

Q6: How do you think enterprise dynamic capabilities affect business model innovation?

Q7: How do you think business model innovation affects enterprise performance?

Results

To study the impact of digital transformation on the sustainable operating performance of enterprises in Heilongjiang Province and to decompose these impacts, this paper adopts a mixed research method including quantitative analysis and qualitative analysis by considering digital

transformation. In the quantitative analysis, this article collects first-hand information in the form of questionnaires and conducts quantitative analysis on the collected valid information. This article selected a total of 400 samples and collected first-hand data in the form of this questionnaire. This study established a structural equation model. The structural model has a high degree of goodness of fit.

In the qualitative analysis, this article used the interview method to conduct face-to-face interviews with the CEOs of ten companies. By answering the questions in the interview outline, it was found that the results of the qualitative analysis were consistent with the results of the quantitative analysis, further validating the arguments proposed in this article.

Data preparation

Table 1 displays abbreviations of variables in the conceptual framework.

Table 1 Variables abbreviations

Variable Type	Variable Name	Abbreviation
Independent variable	Digital Transformation	DT
Dependent variable	Enterprise Performance	EP
Observed variables	Product research and development	PRD
	Production and manufacturing	PM
	User services	US
	Enterprise ecological cooperation	EEC
	Survival performance	SP
	Growth performance	GP

Reliability and Validity Tests

Reliability test

This study first conducted a reliability analysis on the formal questionnaire. When conducting reliability analysis, statistical software was used to calculate the Cronbach's alpha coefficient value of the corresponding scale of each dimension, as well as the Cronbach's alpha coefficient value of the entire questionnaire. The calculation results are shown in Table 2.

Table 2 Reliability Test Results

Scale	Number of Items	Cronbach's Alpha
DT	19	0.944
EP	7	0.870

It can be seen from Table 3 that the DT scale contains 19 items, and its Cronbach's alpha is 0.944 (>0.7), indicating that the DT scale has good reliability. Similarly, the EP scale also has good reliability and meets the requirements of questionnaire analysis.

Validity Tests

This article uses confirmatory factor analysis (CFA) to verify whether the convergent validity and discriminant validity of the questionnaire scales meet the standards. Table 3 and Table 4 show the results of confirmatory factor analysis about DT and EP. From Table 3 and Table 4, it can be seen that the model fit indicators of the confirmatory factor analysis measurement model have all reached an acceptable level.

Table 3 CFA model fitting index measurement model (DT)

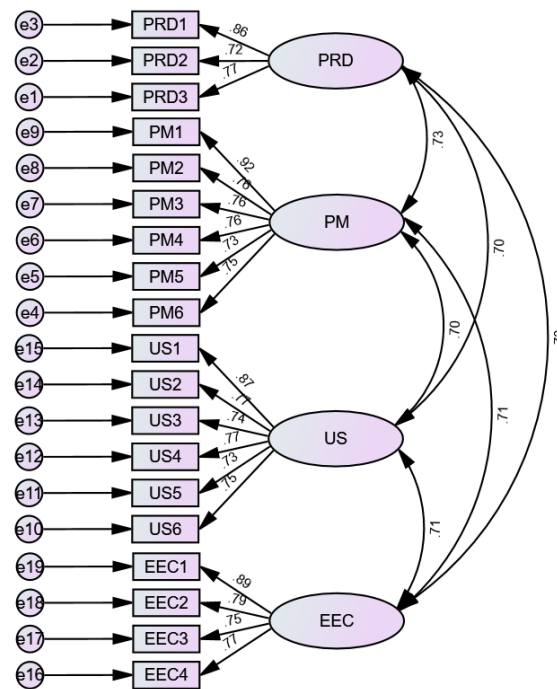| Model Fit Indicators	Threshold	Estimate
χ^2/ DF	[1,5]	1.108
NFI	>0.9	0.967
CFI	>0.9	0.997
GFI	>0.9	0.959
AGFI	>0.9	0.946
RMR	<0.08	0.033
RMSEA	<0.08	0.016

Figure 2 Digital Transformation (DT) second–order CFA results

Table 4 CFA model fitting index measurement model (EP)

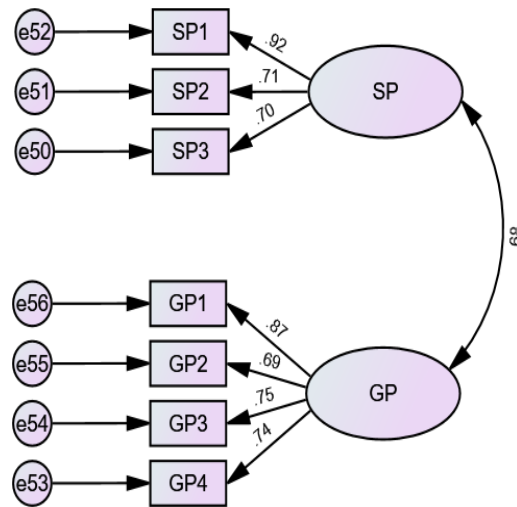| Model Fit Indicators	Threshold	Estimate
$\chi^2/$ DF	[1,5]	1.513
NFI	>0.9	0.985
CFI	>0.9	0.995
GFI	>0.9	0.987
AGFI	>0.9	0.971
RMR	<0.08	0.034
RMSEA	<0.08	0.036

Figure 3 Enterprise performance (EP) second–order CFA results

Convergent Validity Analysis

Table 5 presents the convergent validity test results of this study. From Table 5, it can be seen that the standardized factor loadings, CR, and AVE of each variable measurement item in this article meet the requirements. Therefore, the 2 variable scales used in this study have good convergent validity.

Table 5 Convergent validity analysis

Variable	Title	Estimate	SE	C.R.	Std. Estimate	AVE	CR	P
PRD	PRD3	1.000			0.766	0.614	0.826	
	PRD2	0.922	0.065	14.134	0.720			***
	PRD1	1.286	0.077	16.660	0.859			***
PM	PM6	1.000			0.747	0.610	0.903	
	PM5	1.040	0.070	14.887	0.735			***
	PM4	1.044	0.068	15.459	0.760			***
	PM3	1.078	0.070	15.397	0.757			***
	PM2	1.029	0.067	15.384	0.757			***
	PM1	1.588	0.084	18.943	0.915			***

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Table 5 (continue)

Variable	Title	Estimate	SE	C.R.	Std. Estimate	AVE	CR	P
US	US6	1.000			0.749			
	US5	0.969	0.066	14.727	0.732			***
	US4	1.025	0.066	15.510	0.767			***
	US3	0.993	0.067	14.913	0.740	0.598	0.899	***
	US2	1.009	0.065	15.498	0.767			***
	US1	1.366	0.076	17.885	0.874			***
EEC	EEC4	1.000			0.770			
	EEC3	0.983	0.063	15.566	0.754	0.646	0.879	***
	EEC2	1.027	0.063	16.433	0.790			***
	EEC1	1.329	0.071	18.799	0.894			***
SP	SP3	1.000			0.697			
	SP2	1.035	0.080	12.987	0.708	0.614	0.824	***
	SP1	1.579	0.107	14.712	0.924			***
GP	GP4	1.000			0.740			
	GP3	1.018	0.072	14.221	0.746	0.581	0.847	***
	GP2	0.967	0.074	13.096	0.688			***
	GP1	1.331	0.083	16.106	0.865			***

Discriminant Validity Analysis

Table 6 Discriminant validity test results of each dimension of the digital transformation scale

Variable	PRD	PM	US	EEC
PRD	0.614			
PM	0.727	0.610		
US	0.697	0.699	0.598	
EEC	0.733	0.708	0.706	0.646
Square root of AVE	0.784	0.781	0.773	0.804

Table 7 Discriminant validity test results of each dimension of the enterprise performance scale.

Variable	GP	SP
GP	0.614	
SP	0.683	0.581
Square root of AVE	0.784	0.762

Model Fit Indicators of the SEM

To verify hypothesis H1, this article constructs a structural equation model (SEM) and analyzes the impact relationships among the two variables of DT and EP.

Table 8 shows model fit indicators of the SEM. From Table 8, it can be seen that the model fit indicators of the SEM have all reached an acceptable level.

Table 8 Model Fit Indicators of the SEM

Model Fit Indicators	Threshold	Estimate
CMIN/DF	[1,5]	1.097
NFI	>0.9	0.951
IFI	>0.9	0.995
TLI	>0.9	0.995
CFI	>0.9	0.995
GFI	>0.9	0.941
RMSEA	<0.08	0.016

From the model fit test results in Table 8, it can be seen that CMIN/DF=1.097 is in the range of 1–5, and RMSEA=0.016 is in the excellent range of <0.08. In addition, the test results of NFI, IFI, TLI, CFI, and GFI all reached an excellent level of above 0.9. Therefore, the comprehensive results of this analysis show that the CFA model of EP has a good degree of fitness.

SEM model path relationship hypothesis testing results of EP influencing factors

From the analysis results in Table 9, it can be seen that in the path hypothesis relationship test of this study, DT significantly positively predicts EP (β=0.862, p<0.001), so hypothesis H1 is established.

Table 9 Path relations

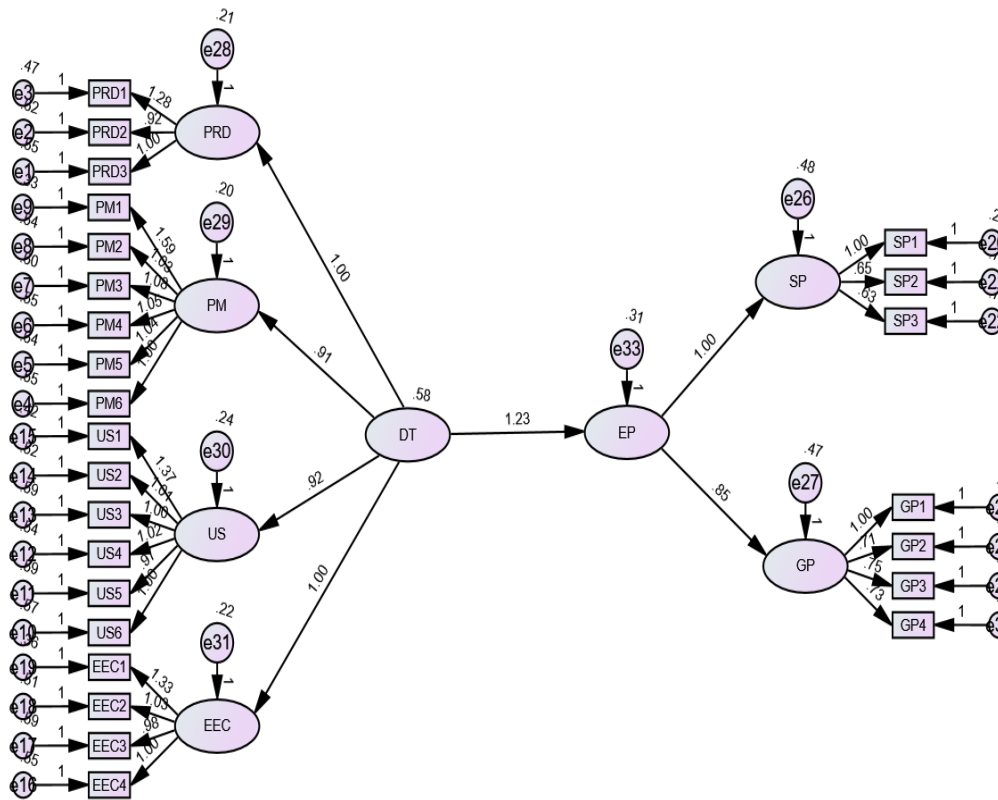| Path relations			Std.Estimate	S.E.	C.R.	P
EP	<---	DT	0.862	0.103	12.019	***
PRD	<---	DT	0.859			
PM	<---	DT	0.844	0.077	11.889	***
US	<---	DT	0.819	0.078	11.67	***
EEC	<---	DT	0.852	0.082	12.124	***
SP	<---	EP	0.845			
GP	<---	EP	0.803	0.065	13.018	***
PRD3	<---	PRD	0.767			
PRD2	<---	PRD	0.721	0.065	14.208	***
PRD1	<---	PRD	0.857	0.076	16.771	***
PM6	<---	PM	0.746			
PM5	<---	PM	0.734	0.07	14.868	***
PM4	<---	PM	0.761	0.068	15.463	***
PM3	<---	PM	0.756	0.07	15.355	***
PM2	<---	PM	0.757	0.067	15.377	***
PM1	<---	PM	0.916	0.084	18.94	***
US6	<---	US	0.749			
US5	<---	US	0.733	0.066	14.74	***
US4	<---	US	0.766	0.066	15.481	***
US3	<---	US	0.742	0.067	14.939	***
US2	<---	US	0.765	0.065	15.464	***
US1	<---	US	0.875	0.076	17.898	***
EEC4	<---	EEC	0.77			
EEC3	<---	EEC	0.755	0.063	15.6	***
EEC2	<---	EEC	0.79	0.062	16.459	***
EEC1	<---	EEC	0.893	0.071	18.843	***
SP1	<---	SP	0.926			
SP2	<---	SP	0.706	0.042	15.656	***
SP3	<---	SP	0.697	0.041	15.415	***
GP1	<---	GP	0.878			
GP2	<---	GP	0.684	0.048	14.893	***
GP3	<---	GP	0.739	0.045	16.514	***
GP4	<---	GP	0.733	0.045	16.337	***

Figure 4 SEM model of EP (Enterprise performance) influencing factors

Discussion

The results of this study show that digital transformation has a significant positive predictive effect on enterprise performance, which is consistent with the research hypothesis H1. In other words, the more successful the digital transformation is, the better the enterprise's performance will be. The research results are consistent with the research results of Zhai et al. (2022). They argue that normal levels of digital transformation better predict a company's long-term performance, while excessive levels of digital transformation can improve a company's short-term performance.

Although digital transformation in manufacturing requires higher fixed expenditures (Melrose et al., 2021), it is positively related to enterprise performance. This means that digital transformation does help improve business performance, which will help managers and policymakers decide to promote digital transformation. Digital transformation has a multifaceted impact on business performance. By improving the availability and quality of data, digital transformation enables businesses to make more accurate and real-time decisions. This helps reduce operational risks and improve operational efficiency, thereby having a positive impact on the performance of the business

(McAfee & Brynjolffson, 2012). Digital transformation improves interaction and communication between businesses and customers. Through digital channels, companies can interact with customers more directly and in real time, understand customer needs, and provide personalized products and services. This strengthening of customer relationships can help improve customer satisfaction, strengthen customer loyalty, and have a positive impact on enterprise performance (Verhoef et al., 2015). Digital transformation can also improve internal collaboration and team effectiveness, allowing employees to share information more flexibly, work collaboratively, and improve work efficiency. This is of great significance to improving the overall performance of the enterprise.

Conclusions

This study established a structural equation model. The structural model has a high degree of goodness of fit. Amos and SPSS software were used to conduct empirical analysis on the collected questionnaire data, including reliability testing, validity testing, descriptive statistical analysis, correlation analysis, path analysis, decomposition effect analysis, and moderation effect analysis. The CMIN/DF value of this model is 1.097, which is less than 3. The RMSEA value of this research model is 0.016, which is less than 0.08, indicating that the model has good fitness. The NFI, RFI, IFI, TLI, and CFI of this model are all greater than 0.9, indicating that the model has good fitness.

The path analysis results of this study support the 1st hypothesis: there is a positive correlation between the impact of digital transformation on enterprise performance.

Suggestions

Through the following suggestions, future research can more fully understand the impact of digital transformation on enterprise performance and provide stronger support for enterprise management.

It is necessary to explore different types of digital transformation measures and their impact on performance. Digital transformation includes a variety of technologies and methods, such as automation, data analysis, cloud computing, and the Internet of Things. The impact of each technology on enterprise performance may be different, so it is necessary to study in detail how these technologies specifically affect enterprise performance indicators, such as production efficiency, cost reduction, customer satisfaction, and market share. In addition, potential mediating variables

and moderating variables, such as business model innovation, should also be considered to fully understand the effects of digital transformation.

Conducting long-term tracking studies can help reveal the performance changes of companies after implementing digital transformation. These studies should include companies of different sizes and industries, analyze their successes and challenges in the process of digital transformation, and provide references for other companies. In addition, it is crucial to explore how digital transformation affects companies' competitive advantage and market position.

Studying the impact of policy and management interventions on digital transformation is also an important direction for the future. Different types of policy support and management strategies may have a significant impact on the digital transformation of enterprises, especially in different economic and cultural contexts.

New Knowledge

For business managers, it is strategically important to gain a deeper understanding of the impact of digital transformation on business performance. This kind of research can help managers gain a clearer understanding of the core values and key success factors of digital transformation. When formulating digital strategies and implementing changes, managers can optimize resource allocation in a more targeted manner and improve the organization's adaptability, thereby maximizing the positive impact of digital transformation on enterprise performance. This has a practical role for enterprises to maintain competitive advantages and sustainable development in the digital era.

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