

THE IMPACT OF DIGITAL TRANSFORMATION OF BUSINESS PROCESSES ON INNOVATION EFFICIENCY IN HEALTHCARE ENTERPRISES

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Abstract: Facing challenges such as inefficient traditional processes and uneven resource allocation, healthcare enterprises are accelerating digital transformation to optimize operations and stimulate innovation. This paper uses a 7-point Likert scale to collect and analyze data on digital transformation, innovation efficiency and enterprise characteristics of healthcare enterprises. The study finds that the digital transformation of business processes in five major areas, namely automated software, automated execution, digital information collection, departmental collaboration, and procurement digitization, significantly contributes to the innovation efficiency of healthcare enterprises, which highlights the key role of digital transformation in improving healthcare's operational efficiency and innovation capability.

Keywords: healthcare enterprises, digital transformation, innovation efficiency

1. Introduction

The digital economy, as a new type of economic form with digital information and knowledge as the core production factors, is reshaping the global resource allocation, economic structural framework and competition pattern with unprecedented power. In the wave of digitization, fundamental technologies such as artificial intelligence and blockchain continue to emerge and undergo rapid iteration and upgrading, becoming the key driving force to promote the transformation of the economic model to digitalization, networking and intelligence. Digital transformation not only crosses the boundaries of industries, but also penetrates into the subtleties of various economic fields, injecting a strong impetus for the vigorous development of the global economy.

In order to realize the effective development of the digital economy, comprehensive digital transformation at the enterprise level is particularly important. Digital transformation involves the penetration of everything from production processes to sales strategies to service delivery. By actively adopting digital transformation strategies and integrated information technology applications, companies can significantly improve productivity, stimulate business model innovation, and effectively broaden market boundaries ^[1]. The core impact of the digital economy is directly reflected in the digital transformation of enterprises, which not only disrupts the traditional production paradigm, but also profoundly reshapes the evolutionary path of enterprise organizational structure, heralding new opportunities and breakthroughs for high-quality development ^[2]. Against this backdrop, enterprises need to keep pace with the times and deepen their digital transformation strategies to capitalize on the infinite possibilities offered by the digital economy.

The core of the healthcare industry is to safeguard public health and well-being, and its business processes, as the cornerstone of realizing this goal, are undergoing profound changes. Traditional healthcare business processes are often accompanied by challenges such as inefficiency, uneven resource allocation, and limited patient experience ^[3]. To overcome these obstacles, many healthcare companies are accelerating the digital transformation of business processes, leveraging advanced digital technologies and innovative thinking to optimize operations and stimulate innovation ^[4]. By deeply integrating digital technologies, healthcare companies are able to reshape their internal operational processes and realize full digital management from patient booking, diagnosis and treatment services to subsequent health management, thus significantly improving service efficiency and reducing unnecessary resource consumption.

This study aims to delve into how digital transformation can enhance the innovation efficiency of healthcare enterprises by optimizing business processes. Specifically, the study will analyze the current status of digital transformation in healthcare enterprises, identify the role of digital transformation in transforming business processes, and how this transformation contributes to the improvement of innovation efficiency. By collecting empirical data and conducting in-depth analysis, the study will reveal the intrinsic connection between digital transformation of business processes and innovation efficiency in healthcare enterprises, providing theoretical support and empirical evidence for industry practice.

2. Summarize

2.1 Digital Transformation of Business Processes in Healthcare Enterprises

The digital transformation of the healthcare sector by leveraging cutting-edge technologies such as cloud computing, big data, artificial intelligence and the Internet of Things (IoT) is expected to reshape business operations, management models, product offerings, and customer experience in all aspects. Digital transformation in the healthcare industry not only focuses on technological innovation, but also profoundly affects the strategic positioning, organizational culture and operational mechanism of enterprises, aiming to improve operational efficiency, reduce costs, strengthen service quality and stimulate innovation ^[5]. It encompasses automation software enhancement, full automation of business processes, digital data collection and analysis, efficient cross-departmental collaboration, and digital innovation of procurement processes ^[6]. From the initial application of electronic medical record system to the comprehensive depth of intelligent diagnosis, remote monitoring and e-procurement, the process of digital transformation of business processes not only enhances the efficiency and quality of medical services, but also promotes the optimal allocation of resources and the transparent management of the supply chain, leading the industry to move towards intelligence and collaboration.

2.2 Innovation Efficiency

Innovation efficiency is a key indicator of an enterprise's innovation capability, reflecting its ability to successfully transform new products, technologies, services or processes into innovations by investing capital, manpower and time with limited resources ^[7]. Specifically, product innovation focuses on the development of new products with market competitiveness; service innovation is dedicated to improving service quality and meeting diversified needs; and process innovation focuses on the optimization of internal operations, aiming to improve efficiency and reduce costs, thus enhancing the overall competitiveness of the enterprise ^[8]. The synergistic effect of innovation dimensions shapes the innovation efficiency of an enterprise and promotes its sustainable development and leadership in the market.

2.3 The Impact of Digital Transformation of Healthcare Business Processes on Innovation Efficiency

In today's rapidly evolving healthcare landscape, digital transformation has emerged as the pivotal force driving industry innovation and efficiency leaps. It not only fundamentally disrupts the traditional operational models of healthcare enterprises but also vastly stimulates the vibrant growth of innovative activities, leading the entire healthcare service system into an unprecedented era of transformation. In the realm of product research and development, the infusion of digital transformation significantly accelerates the entire process from creative conception to market launch. Leveraging cutting-edge technologies such as cloud computing and artificial intelligence, enterprises can rapidly iterate product prototypes in virtual environments, conduct performance testing, and optimize user experiences, thereby greatly enhancing innovation efficiency.

Amidst the current digital wave, healthcare enterprises are actively embracing digital transformation of their business processes to bolster innovation efficiency and market competitiveness [9]. This article delves into five key aspects of this transformation: automated software application, automated execution, digital collection, departmental collaboration, and digital procurement, exploring how they collectively contribute to the innovation efficiency of healthcare enterprises.

Automated software serves as one of the cornerstones of digital transformation. By incorporating advanced automation tools and systems, healthcare enterprises can automate routine tasks such as medical record management, drug inventory monitoring, and patient appointment scheduling [10]. This not only significantly reduces manual labor time and error rates but also frees up employees' bandwidth to dedicate more effort to high-value innovative activities, thereby unlocking valuable resources for corporate innovation.

Building upon automated software, healthcare enterprises further automate the execution of business processes.

From patient consultations to the formulation and implementation of treatment plans, and onto subsequent health management, the entire automated execution process operates in a more efficient and precise manner [11]. This automation minimizes human intervention, enhances process consistency and predictability, and fosters a more stable environment for innovation.

Through the establishment of comprehensive data collection systems, enterprises can real-time and accurately gather data from various business segments, including patient information, treatment outcomes, and equipment usage. In-depth analysis of this data unearths invaluable resources for innovation, enhancing data integrity and accuracy while constructing a holistic data view to underpin robust innovation decisions [12].

A unified information platform and workflow facilitate seamless information sharing and collaboration among different departments. Collaboration not only elevates work efficiency but also breaks down departmental barriers, fostering cross-disciplinary exchanges and collaborations [13]. This collaboration enables enterprises to swiftly respond to market changes, integrate resources, and collaboratively drive the implementation and development of innovation projects.

The introduction of digital tools such as electronic procurement systems and supplier management systems automates and transparentizes the procurement process, reducing costs, enhancing efficiency, and ensuring the quality and safety of procured materials. Digital procurement offers greater flexibility in procurement strategy selection, enabling enterprises to swiftly adjust procurement plans based on market demands and internal resource conditions, thereby providing robust material support for innovation activities [14].

In conclusion, the digital transformation of healthcare business processes, spanning automated software application, automated execution, digital collection, departmental collaboration, and digital procurement, exerts profound impacts on innovation efficiency. These transformative initiatives collectively fortify the enterprise's innovation ecosystem, enhancing productivity, cutting costs, strengthening data insights, fostering interdepartmental cooperation, and providing more agile and efficient procurement support.

2.4 Research hypotheses

The digital transformation of business processes in healthcare enterprises is a multidimensional change process, which has a profound impact on the innovation efficiency and overall operational effectiveness of enterprises. It is not only a technological innovation, but also a comprehensive upgrade of organizational structure, service model, patient experience and internal collaboration mechanism.

Hypothesis 1: Digital transformation of business processes in healthcare firms promotes innovation efficiency.

3. Object and method

3.1 Subjects

The research respondents (management staff of different types of healthcare companies) were invited to fill in the questionnaire voluntarily. Respondents completed the questionnaire online through Questionnaire Star.

3.2 Measurement tools

The Likert scale is an interval scale used to assess the extent to which respondents agree with statements measuring opinions and attitudes. Unlike other assessment methods, the Likert scale is a scale based on empirical data and does not rely on the subjective opinion of the rater. Likert scale is a valid and reliable measurement tool (Jebb et al.) Its homogeneity and reliability make it a commonly used assessment tool, which is widely used in social science and psychological research.

The independent, dependent and control variables of the questionnaire were computed using a 7-point Likert scale with endpoints categorized as "Strongly Disagree" and "Strongly Agree" with "Neutral" in the middle.

3.3 Program

Questionnaires were distributed on the questionnaire star platform, and 408 questionnaires were collected, including 408 valid questionnaires. Excel entered data, and statistical analysis was conducted in Stata. The results are as follows.

4. Bear fruit

4.1 Internal consistency analysis

The Cronbach's alpha value for the questionnaire data in this paper is 0.922, which exceeds the criterion of 0.9, indicating a high degree of internal consistency and reliability of the items or questions in the scale, as shown in Table 1. This high value usually implies that the items in the scale are closely related and together they effectively measure an underlying concept or construct. In addition, Cronbach's alpha has a mean value of 0.912, making the scale or questionnaire well

suited for further data analysis. Whether conducting factor analysis or regression analysis, scales provide reliable results. Although we sometimes aim for higher alpha values, 0.922 is already a fairly good result, indicating the high quality of the scale.

Table 1. Cronbach's alpha value

Variable	Obs	Sign	Test correlation	Rest correlation	Average covariance	interitem	Alpha
Nov	408	+	0.542	0.464	1.350		0.923
software	408	+	0.552	0.481	1.356		0.922
execution	408	+	0.562	0.495	1.357		0.922
collection	408	+	0.535	0.464	1.365		0.922
collaboration	408	+	0.558	0.487	1.354		0.922
procurement	408	+	0.569	0.498	1.348		0.922
teams	408	+	0.804	0.763	1.253		0.913
policy	408	+	0.814	0.773	1.245		0.912
export	408	+	0.823	0.783	1.238		0.912
risk	408	+	0.821	0.782	1.243		0.912
competition	408	+	0.802	0.759	1.252		0.913
industrydigital	408	+	0.793	0.750	1.262		0.913
culture	408	+	0.826	0.786	1.235		0.912
rd	408	+	0.798	0.754	1.251		0.913
Test scale					1.293		0.922

4.2 Basic information of the study subjects

Based on the investigation of the impact of digital transformation on the innovation efficiency of healthcare enterprises, the results were analyzed using descriptive statistics. A total of 408 samples were collected, meeting the sample size requirement, as shown in Table 2. Among them, the dependent variable innovation efficiency covers the following five core dimensions: innovation capability, ability to develop new products or services, vigor of innovation activities, efficiency of data management, and quality of innovation project management. Each of these dimensions was quantitatively assessed in depth and weighted to arrive at the innovation efficiency indicator. The average value of innovation efficiency is 4.885, which means that the level of innovation activity in healthcare organizations is very high. In examining the impact of digital transformation of business processes on innovation efficiency in healthcare enterprises, this paper selects a series of firm- and industry-level control variables to ensure the comprehensiveness and accuracy of the analysis. The control variables cover the proportion of innovation teams to measure the core strength of the firm's internal innovation capability; the impact of policy changes to assess the potential impact of changes in the external environment on the firm's innovation activities; the degree of exporting as an indicator of the firm's international market participation and internationalization strategy; the risk management of innovation, reflecting the firm's coping strategies and effectiveness in facing the uncertainties and risks of the innovation process; and the degree of industry competition, to analyze the impact of the competitive market environment on the firm's innovation activities. The degree of competition, which is used to analyze the pressure of the competitive market environment on the innovation efficiency and strategic choices of the enterprise; the speed of digital transformation of the industry, which reveals the speed and depth of the entire industry's progress towards digitalization, and its importance to the positioning of the enterprise's innovation strategy; in addition, it also includes the enterprise's innovation culture, which is the core value and atmosphere that drives the enterprise to continue to innovate and pursue excellence; and last but not least, the proportion of R&D investment, as a key financial indicator, which directly reflects the importance of the enterprise's innovation activities and the strength of resource investment.

Table 2. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Nov	408	4.885	1.697	1	6.8
software	408	5.373	1.579	1	7
execution	408	5.319	1.515	1	7
collection	408	5.439	1.533	1	7
collaboration	408	5.39	1.581	1	7
procurement	408	5.375	1.606	1	7
teams	408	5.181	1.716	1	7
policy	408	5.081	1.756	1	7
export	408	5.069	1.783	1	7

risk	408	5.132	1.746	1	7
competition	408	5.002	1.736	1	7
industrydigital	408	5.064	1.68	1	7
culture	408	5.115	1.798	1	7
rd	408	5.13	1.758	1	7

4.3 Regression analysis

Before the inclusion of control variables, the five key dimensions of digital transformation of business processes in healthcare firms-digital transformation automation software, automated execution, digital collection, departmental collaboration, and digitization of purchasing-significantly and strongly (at the 1% level of significance) contributed to innovation efficiency, as shown in Table 3 models (1) -(5) shown. However, when we include the control variables in the analytical framework, although the positive effect of digital transformation remains positive and significant, its significance level changes, as shown in Table 3 models (6) - (10). The contribution of automated software, digital collection and departmental collaboration to innovation efficiency remains robust at the 5% significance level, while the effects of digital collection and procurement digitization decrease to the 10% significance level. The statistical results strongly support Hypothesis 1 that digital transformation of business processes in healthcare firms does indeed positively contribute to innovation efficiency, and this positive effect remains significant even after accounting for multiple potential confounders.

Table 3. Regression analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Nov	Nov	Nov	Nov	Nov	Nov	Nov	Nov	Nov	Nov
software	0.212*** (4.06)				0.112** (2.32)					
execution		0.208*** (3.82)				0.090* (1.76)				
collection			0.198*** (3.66)				0.098** (1.97)			
collaboration				0.228*** (4.37)				0.125** (2.57)		
procure					0.205*** (3.98)				0.094* (1.95)	
Control	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
_cons	3.744*** (12.79)	3.776*** (12.51)	3.809*** (12.47)	3.658*** (12.51)	3.784*** (13.11)	1.904*** (5.76)	2.007*** (5.98)	1.946*** (5.70)	1.851*** (5.59)	2.002*** (6.17)
N	408	408	408	408	408	408	408	408	408	408
r2	0.039	0.035	0.032	0.045	0.038	0.233	0.229	0.231	0.236	0.230
F	16.490	14.568	13.397	19.118	15.857	13.468	13.144	13.251	13.639	13.243

Note: t statistics in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01

5. Conclusion

The digital economy is reshaping global resource allocation and economic structure, and digital transformation is penetrating across borders, injecting impetus for vigorous economic development. Traditional healthcare processes face challenges such as low efficiency and uneven resource allocation, and healthcare companies are accelerating digital transformation, using digital technology to optimize operations and stimulate innovation. This research focuses on how digital transformation can optimize healthcare processes and enhance innovation efficiency.

This paper systematically collects data on digital transformation of business processes, innovation efficiency, and firm characteristics of healthcare firms using a 7-point Likert scale methodology and conducts an in-depth analysis. The study reveals that five key aspects of digital transformation-automated software applications, automated execution, digital information collection, efficient interdepartmental collaboration, and digitization of purchasing processes-all significantly and positively contribute to the innovation efficiency of healthcare firms. This finding underscores the importance of digital transformation in the healthcare sector and its key role in driving operational efficiency and innovation.

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