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Research on the Impact of Enterprise Digital-Intelligent Transformation on New Quality Productivity: A Case Study of Mindray

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Abstract. With the development of the digital economy, digital-intelligent transformation has become an important force for creating new quality productivity. This paper uses Mindray Medical International Co., Ltd. (Mindray) as a case study. It reviews Mindray's digital-intelligent transformation process since 2015 and uses the entropy-weight Analytic Hierarchy Process (AHP) method to build an evaluation indicator system. The paper evaluates how this transformation affects the company's new quality productivity from three aspects: input, production, and output. The results show that from 2018 to 2024, Mindray's overall score of new quality productivity increased steadily. This means that digital-intelligent transformation has continuously improved the company's total factor productivity. In addition, Mindray has built a smart healthcare ecosystem based on "Device + IT + AI". This ecosystem enables intelligent upgrading in research and development, production, and services. As a result, production factors are allocated in a more innovative way, and the value of data is used more efficiently.

Keywords: New Quality Productivity, Digital-Intelligent Transformation, Digital Economy

1. Introduction

Since the 18th National Congress of the Communist Party of China, China has promoted the strategy of "making the digital economy stronger, better, and larger". Under this policy guidance, China's digital economy has developed rapidly. It has changed the structure of domestic industries and influenced how resources are allocated worldwide. At present, global industrial chains are being reshaped by intelligent technologies, and China is further promoting its strategy of becoming a manufacturing powerhouse. In this context, the medical device industry must seize the opportunity of digital-intelligent transformation. This transformation is important for improving industrial competitiveness and is closely related to the goal of serving national health and advancing the "Healthy China" strategy. The digitalization and intelligent upgrading of high-end medical devices can help enterprises develop new quality productivity and improve the overall level of the industrial chain. Mindray is a leading company in China's medical device industry and is also a pioneer in digital-intelligent transformation. Through technological innovation and ecosystem construction, Mindray solves problems in clinical diagnosis, treatment, and hospital management. In this way, it

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changes how value is created in medical services. Mindray's transformation experience has strong reference value. In the face of global competition and fast technological change, upgrading its digital-intelligent strategy is an unavoidable choice for Mindray to build competitive advantages and achieve high-quality development. This study focuses on Mindray's transformation practices. It analyzes the development of its digital-intelligent capabilities, explains how these capabilities improve new quality productivity, and summarizes useful paths and experiences for manufacturing enterprises, especially those in the medical device industry.

2. Literature review

2.1. Connotation of digital-intelligent transformation

In recent years, with the deep integration of digital technology and intelligent technology, digital-intelligent transformation has attracted wide attention from both scholars and industry practitioners. However, there is no unified definition, and different scholars explain it in different ways. Some scholars believe that digital-intelligent transformation is a process in which enterprises build on traditional informatization and digitalization, and then use intelligent technologies such as artificial intelligence, big data, and cloud computing to improve organizational structure and production and operation models [1]. In this context, "digital" mainly refers to information processing technologies, such as data collection, analysis, and processing. "Intelligent" refers to intelligent equipment and decision-making support, such as machine learning and artificial intelligence [2]. Digital-intelligent transformation is not simply the addition of digitalization and intelligentization. Instead, it is a new development model formed through the deep integration of technology, data, and business processes. This integration changes enterprises from using tools to being driven by data intelligence. It represents an advanced ecosystem created by the combination of intelligent technology and socio-economic systems. Based on big data infrastructure and driven by AI technologies such as machine learning, enterprises can turn data into decisions and actions, and then reshape business processes and organizational structures [3].

2.2. Connotation of new quality productivity

In September 2023, the concept of "new quality productivity" was formally proposed. It emphasizes the integration of scientific and technological innovation resources, the development of strategic emerging industries and future industries, and the acceleration of new quality productivity formation. New quality productivity is an important economic concept. It represents a qualitative change in productivity development. Its core is technological innovation, and it depends on major breakthroughs in key and disruptive technologies. Its most important feature is very high efficiency, which is much higher than that of traditional productivity models. This efficiency supports sustainable and high-quality development [4]. When key and disruptive technologies accumulate and pass a certain threshold, they will cause a fundamental restructuring of productivity. This restructuring leads to the emergence of new quality productivity and promotes social progress [5]. Therefore, the essence of new quality productivity can be summarized as "high technology, high efficiency, and high quality". It goes beyond traditional production methods that rely heavily on resources and cause high environmental costs. It meets the development needs of the new era and fits well with new development concepts [6].

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2.3. Impact of digital and intelligent change on new good productivity

Digital and intelligent change is basically a process. In this process, companies arrange production things in new ways. Through big changes, it makes technology productivity, green productivity and digital productivity much better. At the same time, it starts new production things. It also makes a good cycle: technology new ideas, better use of resources, and higher production speed. This change is an important way for companies to develop well and keep good competition ability for a long time [7]. Among all things, people with skills are very important for digital and intelligent change. Companies should train and get people who have digital and intelligent skills and can think of new ideas. These people can help people and machines work better together. They can make research better and let companies have more new ideas. So, companies can make their new good productivity much better [8].

3. Case analysis

3.1. Company profile

Mindray started in Shenzhen in 1991. It grew with China's medical machine industry. The company is leading in three big areas: patient monitoring and life support, in-vitro diagnosis, and medical imaging. Its development shows China's medical technology progress—from following others, to keeping up, and even leading global competitors in some areas. In 2018, Mindray was listed on Shenzhen Stock Exchange's ChiNext board. This showed the capital market likes it very much. Now, Mindray's products and services are used in more than 190 countries and regions. In China, its products are in nearly 110,000 medical places. More than 99% of top hospitals use its products. So, Mindray is a representative Chinese company in high-end medical equipment. In the future, Mindray wants to build an advanced research system. This system is driven by market needs, new ideas and data. By watching global market trends and user needs closely, the company plans to serve different medical scenes. It will do this by updating products and expanding business. It wants to keep leading in global medical technology competition.

3.2. Mindray's digital and intelligent change journey

In 2015, Mindray started its digital change plan. The goals are intelligent development and global business. The company focused on making its medical device research, development and production processes digital. It introduced industrial internet structure and built data-sharing platforms to support smart production. From 2016 to 2017, Mindray used big data to make production management better. It introduced an intelligent production line management system (MPS) to watch the whole production process automatically. At the same time, the company used AI to help check product quality. This made high-end ultrasound equipment production faster and better. During this time, Mindray also made its own remote operation and maintenance cloud platform called MediCloud. This platform made equipment fault response faster. Starting in 2020, Mindray worked with medical institutions to build the "Three Rui" smart healthcare system. This system changed medical service's technology structure and cooperation way. Its parts include: "RuiZhiLian" (a data integration center), "Mindray Smart Lab" (makes lab management and work better), and "RuiYing Cloud++" (focuses on imaging services to meet clinical needs better). In 2024, Mindray entered a new stage of its "Device + IT + AI" plan. It launched a high-end obstetrics and gynecology ultrasound diagnostic system called Nuewa A20. This showed big progress in intelligent imaging. In

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December 2024, Mindray released “Yuanqi Critical Care Large Model” for intensive care scenes. This system collects vital sign data and helps doctors make diagnosis and treatment decisions. Data from 2023 test shows it can make intensive care unit work 30% more efficient. Now, the “Yuanqi” system is used in more than 200 hospitals. Each device processes about 100,000 data records every day. This is an important step for Mindray’s smart healthcare plan.

4. The impact of Mindray's digital and intelligent change on new good productivity

This paper uses entropy-weight AHP method to build an evaluation system. This system includes many parts of digital-intelligent change and new good productivity. Entropy weight method calculates objective weights. AHP method calculates subjective weights. By combining these two weights, the paper evaluates the company’s new good productivity and analyzes its relation with digital-intelligent change. New good productivity is the main power for social and economic development. It has three key features: high technology, high efficiency, and high quality. Its most important index is the improvement of total factor productivity. This improvement comes from production factor changes that make output higher. To study new good productivity, this paper uses Mindray’s data from 2018 to 2024. It builds an evaluation system from three parts: input, production, and output. These three parts mean: basic development foundation, key driving power, and final result. They are closely connected and develop together. This connection makes new good productivity different from traditional productivity. It helps form a good development cycle. This paper further analyzes these three parts and their relations.

Establishing the Evaluation Indicator System

Table 1. Evaluation indicator system

Target Layer	Criterion Layer	Indicator Layer
Impact of Digital-Intelligent Transformation on Enterprise New Quality Productivity A	Input B1	Proportion of R&D Personnel C1
		Investment to Operating Revenue C2
		Proportion of Fixed Assets C3
		Proportion of Intangible Assets C4
	Production B2	Total Asset Turnover C5
		Reciprocal of Equity Multiplier C6
	Output B3	Operating Revenue Growth Rate C7
		Return on Equity (ROE) C8

Determining Indicator Weights Using the Entropy Weight Method

As shown below:

Obtaining original data:

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Table 2. Mindray's original data

Mindray	R&D Personnel %	R&D/Revenue Ratio %	Fixed Assets %	Intangible Assets %	Total Asset Turnover	1/Equity Multiplier	Revenue Growth Rate %	ROE %
2018	24.45	10.33	11.8888	4.164381178	0.7627	0.701803635	23.0858	34.1555
2019	25.54	9.96	10.47167647	3.7195782	0.7006	0.726269155	20.3778	27.736
2020	25.94	9.97	9.605096324	3.438015881	0.7135	0.699300699	26.9984	31.8011
2021	23.78	10.79	9.8989	5.409571255	0.7077	0.707764173	20.1834	31.8594
2022	24.39	10.51	9.1153	4.228730726	0.7158	0.684556407	20.1668	32.6034
2023	24.52	10.82	11.4509	4.641131706	0.7379	0.695555401	15.0376	35.6014
2024	24.27	10.91	12.51009209	11.86846936	0.7023	0.719579765	5.1353	33.8503

Summary of AHP + Entropy Weight Method Weights:

Table 3. Summary table of AHP + entropy weights

Indicator	Weight	Comprehensive Weight	Indicator	Weight
Proportion of R&D Personnel	0.2290	0.0955	Input	0.4486
Ratio of R&D Investment to Operating Revenue	0.3380	0.1322		
Proportion of Fixed Assets	0.1409	0.0700		
Proportion of Intangible Assets	0.2921	0.1509		
Total Asset Turnover	0.7409	0.3099	Production	0.4078
Reciprocal of Equity Multiplier	0.2591	0.0979		
Operating Revenue Growth Rate	0.3728	0.0511	Output	0.1436
Return on Equity (ROE)	0.6272	0.0926		

Score Summary:

Table 4. Summary of Mindray's performance comprehensive scores

Year	R&D Personnel % Score	R&D/Revenue Ratio % Score	Fixed Assets % Score	Intangible Assets % Score	Total Asset Turnover Score	1/Equity Multiplier Score	Revenue Growth Rate % Score	ROE % Score	Total Score
2018	0.0099	0.0137	0.0174	0.0082	0.1412	0.0161	0.0096	0.0178	0.2339
2019	0.0261	0.0000	0.0085	0.0032	0.0000	0.0000	0.0082	0.0000	0.0460
2020	0.0321	0.0004	0.0031	0.0000	0.0293	0.0177	0.0117	0.0113	0.1056
2021	0.0000	0.0307	0.0049	0.0222	0.0162	0.0122	0.0081	0.0114	0.1057
2022	0.0091	0.0204	0.0000	0.0089	0.0346	0.0274	0.0081	0.0135	0.1218
2023	0.0110	0.0318	0.0147	0.0135	0.0848	0.0202	0.0053	0.0218	0.2031
2024	0.0073	0.0352	0.0213	0.0949	0.0039	0.0044	0.0000	0.0169	0.1839

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Figure 1. Summary of comprehensive performance scores of mindray medical

We used a special method to check carefully. The picture above clearly shows how Mindray's work indicators changed from 2018 to 2024. Mindray became a public company in 2018, so this paper uses data from 2018 onwards to make sure the data is correct and complete. 2018 was an important year for Mindray. It was the year when the company became public, and it also started to change to digital and smart ways quickly. Many indicators were quite high that year, and they went back to normal levels the next year. The picture shows that Mindray's overall score generally went up from 2019 to 2024. The score in 2019 was lower than that in 2018. This is normal when a company just starts to make the digital and smart change. During this time, the company mainly focused on adjusting its systems and improving its work processes. In 2020, the company became stable and started to get better. This shows that its digital and smart basic facilities became more mature, and the automatic production got better. From 2021 to 2023, the score kept going up. This means that the digital and smart decision-making systems and the digital supply chain started to work together. Because of this, the time to develop new products became shorter, and the speed of inventory turnover got better. In 2024, although the growth speed slowed down, the overall score was still high. This tells us that the company entered a deeper stage of the digital and smart change. At this stage, big data analysis helped a lot in making more accurate product development and innovation. Also, the company's market share became top 3 in the industry. These results prove that the change to digital and smart ways is a systematic and step-by-step process. It continuously strengthens the new quality productivity of the enterprise. It not only provides strong power for the company's development and innovation, but also offers a successful model that other medical device companies can learn from and use.

5. Conclusion and suggestions

5.1. Conclusion

This paper first reviews the basic meanings of digital-intelligent transformation and new quality productivity and explains how they are related. It then uses the Mindray case and the entropy weight method to evaluate how digital-intelligent transformation improves enterprise new quality productivity. The results show that Mindray has a clear transformation path. It started with basic device digitalization, then moved to system interconnection, and finally developed intelligent decision-making to lead value creation. Through this process, Mindray built an open digital ecosystem and integrated external resources to form a cooperative network. The company achieved a shift from improving internal efficiency to promoting collaborative innovation across the industrial ecosystem. This provides a transformation model that other enterprises in the industry can follow. The case shows that digital-intelligent transformation must be promoted together through

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technology, organizational structure, and business models in order to effectively cultivate new quality productivity.

At the same time, Mindray's experience shows that digital infrastructure based on advanced technologies such as big data is the foundation for developing new quality productivity. By building a smart healthcare ecosystem, the company realized device interconnection, data collection, and data analysis, and connected the entire value chain. This promoted the transformation of production factors into a new system and reflects the innovative allocation of factors and value release that characterize new quality productivity. Financial data further confirms the effectiveness of the transformation. After implementing the digital-intelligent strategy, Mindray's key performance indicators reached leading positions in the industry. Its solutions help partner hospitals improve diagnosis and treatment efficiency, reduce costs, increase customer dependence, and raise the share of high value-added revenue. This shows that digital-intelligent transformation creates value beyond internal optimization. By expanding its ecosystem and service scope, the company opened new growth opportunities, met the requirements of new quality productivity for higher total factor productivity, and demonstrated strong empowering effects.

5.2. Suggestions

With the development of the digital economy, market demand is becoming more flexible and personalized. Traditional supply models can no longer meet these needs, but this also creates opportunities for enterprises to develop new quality productivity. Enterprises should no longer see digital-intelligent technology only as a tool for small-scale improvement. Instead, they should treat digital-intelligent transformation as the core driving force of new quality productivity. Enterprises need to shift from a tool-oriented mindset to an ecosystem-oriented mindset and make digital intelligence a strategic core.

In the new economic environment, technological innovation is the main driving force of new quality productivity. Building independent research and development capabilities is the foundation for enterprises to gain competitive advantages. Manufacturing enterprises should rely on advanced technologies to achieve major development progress. They should increase R&D investment, strengthen existing technologies, carry out forward-looking research, build innovation ecosystems, accelerate the upgrading and application of new products, and form core competitiveness. In this way, enterprises can provide continuous momentum for the growth of new quality productivity.

In the contemporary economic system, laborers are the core subjects of value creation. Technical and R&D interdisciplinary talents who master frontier knowledge and possess innovative capabilities are the decisive force driving enterprise technological revolution and digital-intelligent transformation. In the face of requirements for high-quality development and the deepening evolution of digital-intelligence, enterprises need to establish high-quality talent teams, make talent ecosystem construction a core strategy, build competitive compensation and benefits systems, create clear career development ladders and fair promotion mechanisms, and stimulate talent's innovative vitality and enthusiasm. Building a highland of human capital can provide innovative momentum for breakthroughs in new technologies and the emergence of new models, laying a solid talent foundation for the development of new quality productivity.

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