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Digital Transformation Motivations and Pathways for Manufacturing Enterprises: A Case Study of Lenovo Group

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Abstract. In the 2022 Government Work Report, the emphasis on "strengthening the core competitiveness of manufacturing" underscores the significance of robustly developing digital transformation in the manufacturing sector, which stands as a cornerstone of our national economy. The unexpected COVID-19 pandemic in 2020 adversely affected our country's manufacturing industry. However, some digitally mature enterprises displayed resilience and vitality, thereby stimulating traditional manufacturing companies to embark on digital transformation. This paper selects Lenovo Group as the subject of study for two reasons: firstly, Lenovo Group represents a traditional manufacturing enterprise, and secondly, Lenovo Group stands out as an exemplary enterprise in the field of digital transformation in 2023. This paper investigates the internal motivations of Lenovo Group for digital transformation, including suboptimal results in mergers and acquisitions integration and a lack of core technologies in the "trade, work, and technology" research. It also examines external motivations, such as robust support from national policies and intensified industry competition. The paper analyzes the pathway to Lenovo Group's digital transformation, encompassing data intelligence, intelligentization of the upstream and downstream supply chain, and the expansion of digital transformation consultancy services, with the aim of providing insights for other manufacturing companies undergoing digital transformation.

Keywords: Digital Transformation; Manufacturing Industry; Lenovo Group.

1. Introduction

The 20th National Congress of the Communist Party of China highlighted the need to promote the deep integration of digital economy and real economy, address significant challenges in the digital transformation of traditional industries, and accelerate the digital transformation of traditional industries. Manufacturing, as the backbone industry of a major economy, must consolidate its position and develop new competitive advantages through digital upgrades. The outbreak of the COVID-19 pandemic in 2020 brought multifaceted challenges to traditional manufacturing companies in terms of management, supply chains, funding, and markets, forcing these companies to reassess the maturity of their own digital transformation and accelerate their digital transformation initiatives.

In recent years, almost all domestic technology companies have been undergoing digital transformation. Leading traditional manufacturers such as Haier, Gree, Midea, and Xiaomi, as well as internet giants like Tencent, Baidu, and Alibaba, have all embarked on digital transformation with the hope of reaping benefits in this process, and they have achieved notable success. Lenovo Group, also a manufacturing company, has ventured into digital transformation. Lenovo Group began its exploration of digital transformation in 2013 and underwent internal and industry structural adjustments in 2018. It actively pursued four major business sectors: intelligent IoT, intelligent industry, intelligent services, and intelligent channels. As a global leader in intelligent devices, Lenovo provides billions of intelligent terminal devices to users worldwide each year, including computers, tablets, smartphones, and more. In 2022, Lenovo ranked first in global PC sales. As a top global supplier of enterprise digital and intelligent solutions, Lenovo actively promotes the development of "devices + cloud" and "infrastructure + cloud" across the industry, as well as the implementation of intelligent solutions. This paper takes Lenovo Group as a case study to primarily analyze the motivations and pathways of Lenovo Group's digital transformation, with the hope of offering guidance to manufacturing enterprises currently undergoing digital transformation.

2. Literature Review

Digital transformation is the proactive, systematic, and comprehensive transformation and upgrading of enterprises to adapt to the digital economic environment and address the needs of enterprise survival, development, and market changes in the context of global digital transformation. It involves the in-depth application of new-generation digital technologies to construct a fully perceptive, seamlessly connected, highly intelligent digital twin enterprise. This leads to the optimization and transformation of the physical world, with innovative and remodeled traditional management, business, and commercial models, resulting in business success, growth, and development. Zhang Wei (2022) defines digital transformation as harnessing the potential of digital technology to drive various changes and developments, making business operations more intelligent and networked, thereby advancing economic progress through the advantages of digital technology.

Yang Wang et al. (2020) distinguish digital transformation as a transformation based on digital conversion and digital upgrades, extending to the core business of the company, with the aim of creating new business models. Various scholars have differing opinions regarding the concept of digital transformation. Tobias et al. (2020) assert that digital transformation, grounded in digital technology, introduces unique changes in business operations and value creation. Jiang Luan, Ling Yupeng, and their team (2022) emphasize the significant positive impact of digital transformation on a company's resilience and its role in promoting exploratory and exploitative innovation. They state that digital transformation enhances a company's resilience and competitive strength. Kong Weipan (2023) defines digital transformation as the comprehensive transformation of core value chains in a company, encompassing research, production, and sales, through the effective use of digital means and digital resources. This iterative upgrading of organizational structure, management models, organizational behavior, and corporate culture assists companies in enhancing their value creation ability, competitiveness, operational efficiency, and profitability.

Li Hui et al. (2020) contend that the path of digital transformation for a company is a differentiation path, subject to internal constraints such as the industry in which the company operates, its size, lifecycle stage, human resources, and technological and financial support. Lv Tie (2019) maintains that the purpose of digital transformation in traditional industries is to leverage digital technology to address challenges in corporate and industry development, redefine and design products and services, achieve business transformation, innovation, and growth. In practice, strengthening value creation, data integration, and platform empowerment are significant trends in the digital transformation of traditional industries.

This paper defines digital transformation as the process through which enterprises leverage digital technology and technological methods to bring about changes in their technology, organizational structure, and management models to enhance their performance.

3. Company Profile

Lenovo Group is a global technology company founded in China, with operations spanning across 180 markets. Lenovo is committed to global development, continuous innovation, and the construction of a more inclusive, trustworthy, and sustainable digital society. It leads and empowers the transformation in the era of intelligence, providing improved experiences and opportunities for millions of consumers worldwide.

Amid the opportunity for industrial upgrading in the new era of intelligence, Lenovo has introduced its Intelligent Transformation Strategy, positioning itself as a leader and enabler in the intelligent transformation of industries. This strategy revolves around three key directions: Smart IoT (SmartIoT), Smart Infrastructure (SmartInfrastructure), and Smart Verticals & Services (SmartVerticals&Services). Lenovo will continue to invest in technological innovation, social value, and shift towards a service-oriented transformation, strengthening the connection between "One

Lenovo" and digitalization. In the future, services and solutions will be forged as Lenovo's new core competencies.

At present, Lenovo's core business consists of three major business groups: the IDG Smart Device Business Group, focused on Smart IoT; the ISG Infrastructure Solutions Business Group, specialized in Smart Infrastructure; and the SSG Solution Services Business Group, concentrating on Smart Verticals & Services. Lenovo has approximately 77,000 employees worldwide, with an annual revenue of 424 billion RMB for the 2022/23 fiscal year.

4. Motivations for Lenovo Group's Digital Transformation

As society rapidly evolves into an era characterized by digital transformation, which is marked by constant change and uncertainty, digitization has emerged as the most prominent certainty. For businesses, digital transformation has become an inevitable path, especially for traditional enterprises striving to thrive in fiercely competitive markets. The reasons for Lenovo Group's pursuit of digital transformation are outlined as follows.

4.1. External Factors for Lenovo Group's Digital Transformation

4.1.1. Strong Support from National Policies

Advancing the "Digital China" initiative is a robust support for the modernization of China's governance system and governance capacity. Both the 19th and 20th National Congresses of the Communist Party of China underscored the need to address prominent issues in the digital transformation of traditional industries, accelerate the digital transformation of traditional industries, and strengthen the construction of a "Digital China" and "Smart Society." There is a clear emphasis on advancing digital development, particularly in the digitization of the manufacturing industry. In May 2015, "Made in China 2025" first mentioned intelligent manufacturing, driving the development of the manufacturing industry by applying big data technology to its operations, enabling it to move towards intelligentization and fostering surrounding intelligence. General Secretary Xi Jinping highlighted the importance of promoting the integration of the digital economy and the real economy during the 34th collective study of the Political Bureau of the CPC Central Committee. This includes grasping the direction of digitization, networking, and intelligence, and promoting the digitization of various industries, including manufacturing. The central government places great importance on informatization. Xi Jinping emphasized that without informatization, there can be no modernization. Informatization has brought the Chinese nation unprecedented opportunities, and it is imperative to seize the historical opportunities for the development of informatization. During the 14th Five-Year Plan period, informatization entered a new stage of accelerating digital development and building a "Digital China."

The strong support from the national government creates a favorable macroeconomic backdrop for corporate digital transformation, consequently enhancing the economic strength of China.

4.1.2. Intensified Industry Competition

Lenovo Group operates across a wide range of businesses with significant growth potential. This includes intelligent smartphones, PC devices, and comprehensive service offerings, where Lenovo faces fierce competition in the Chinese market and even more intense global competition. In every facet of Lenovo's business, from product design, research and development, production, sales, and after-sales services, intense competition is evident. There are also numerous alternative brands in the market, potentially displacing Lenovo Group's products. Lenovo's primary competitors include Huawei, Xiaomi, and others, who continuously expand their market share through their competitive offerings. Simultaneously, international competitors such as HP, Dell, and Apple pose even more rigorous competition. With the continuous development of technology, user-friendly smartphones have become the preferred choice for the general public, subsequently affecting the development of computers. Among numerous smartphone brands, Huawei, Xiaomi, and Apple have a significant

market presence. Lenovo Group's technology in the smartphone sector is not as mature, and therefore, it faces fierce competition.

4.2. Internal Factors for Lenovo Group's Digital Transformation

4.2.1. Suboptimal Mergers and Acquisitions (M&A) Integration

In 2014, Lenovo Group acquired the mobile phone business of Motorola, a foreign company. The most significant challenge in M&A is the integration of cultures, which, in this case, was not managed effectively. Furthermore, during the process of business integration, consistency in product offerings was overlooked, leading to competitive relationships between Lenovo Group's existing mobile phone business and the newly acquired business. Lenovo Group's mobile phones are priced relatively low, primarily relying on subsidies from telecom operators to maintain profitability. Subsequently, three major telecom operators reduced subsidies for Lenovo Group's mobile phones. However, Lenovo Group did not adjust its strategies in response to the reduced subsidies, resulting in declining profitability in the smartphone sector. With the decrease in subsidies from the telecom operators, the popularity of smartphones, especially considering the rapid development of the internet, became significant. Lenovo Group gradually lagged behind the pace of societal development, leading to a reduction in its smartphone profitability. Lenovo Group initially intended to utilize Motorola's patented technology in mobile phone operations. Lenovo aimed to integrate Motorola's patented technology into its mobile business. After the merger, Lenovo Group's research and development technology and the number of patent applications gradually decreased each year. Without the integration of advanced technology, the acquired technology did not contribute to future growth.

4.2.2. Lack of Core Technologies in "Trade, Work, and Technology" Research

Lenovo's founder, Liu Chuanzhi, had long established the direction for Lenovo's development, placing trade at the forefront. Under this approach, Lenovo continually expanded into diverse industries, including PC, healthcare, food, and elderly care. However, Lenovo was "big but not strong," failing to develop its core technologies. Over the years, Lenovo neither developed its own chips nor possessed its proprietary systems, preventing it from establishing differentiation. In the long run, Lenovo did not create sustainable competitive advantages. Lenovo invested relatively little in research and development (R&D). Comparatively, Huawei allocated about 11.62% of its income to R&D in 2011, 13.66% in 2012, 13.2% in 2013, 14.17% in 2014, and 15% in 2015. Huawei's R&D expenditure as a percentage of income averaged around 13%. In contrast, Lenovo allocated 1.5% of its income to R&D in 2011, 1.64% in 2012, 1.89% in 2013, 2.64% in 2014, and 3.32% in 2015. Over the period from 2011 to 2015, Lenovo's R&D expenditure as a percentage of income averaged around 2%. Lenovo invested significantly less in R&D compared to Huawei. Consequently, Lenovo could not attract exceptional talents, and this lack of investment, combined with a shortage of core technology, hindered its technical development.

Lenovo Group faces numerous factors compelling its digital transformation. The strong support from national policies and intensified industry competition are significant external drivers. Internally, suboptimal M&A integration and a lack of core technologies in "trade, work, and technology" research have direct impacts on Lenovo's digital transformation.

5. The Digital Transformation Pathway of Lenovo Group

The years 2014-2015 marked the pilot phase of Lenovo's digital transformation, with a primary focus on addressing business needs through initiatives such as meeting scattered digital requirements, conducting small-scale pilot optimizations of technological architecture, IT department involvement in the form of specialized teams, and experimenting with the adoption of new technologies while absorbing learning. In 2016, Lenovo entered a critical year in the overall planning of its digital transformation, emphasizing the establishment of a systematic approach to digital transformation. Key measures included considering digital transformation requirements from a holistic perspective, defining application scenarios and business frameworks, achieving consensus at the top leadership

level, optimizing and restructuring technological architecture, and analyzing the digital business value. The period from 2017 to 2019 witnessed Lenovo's comprehensive promotion of digital transformation, with a particular focus on transforming into a digital-native organization and driving digital business innovation through digital technologies. Lenovo underwent several adjustments to its business unit structure, promoted an agile culture across the organization, established digital-native organizations for new IT to support operations, and developed new applications based on the new architecture while gradually migrating old systems to the new framework. Beyond 2020, Lenovo entered the phase of continuous optimization in its digital transformation journey. Building upon established digital operational mechanisms, Lenovo responded swiftly to market changes, iterated its business, technology, and organizational strategies, and achieved significant results. Key initiatives included optimizing the group's business unit structure and operational mechanisms based on market shifts, especially in the post-pandemic era, dual circulation, and new infrastructure needs. Lenovo established new business units in venture capital, supply chain services, and service solutions. Furthermore, Lenovo initiated an "endogenous externalization" mechanism to export its established digital capabilities.

5.1. Intelligent Data Across the Board

Lenovo Brain is an enterprise-level AI platform developed in-house by Lenovo, offering cloud-to-edge comprehensive AI solutions for industry users, covering the entire lifecycle from construction, deployment to operational support. Users can leverage Lenovo Brain's cloud-side, large-scale distributed training engine to build AI models tailored to specific scenarios. Importantly, as scenario-based AI models continue to evolve, users can generate AI solutions and achieve scalable deployment through an all-in-one development environment. Lenovo Brain has been extensively applied in Lenovo's intelligent devices, intelligent infrastructure, and a range of products and services for industry intelligence. It caters to industries such as manufacturing, energy, healthcare, education, finance, and retail, offering end-to-end support for AI solutions, from solution evaluation, visual construction, hardware selection, model adaptation, simulation testing, deployment, and operation and maintenance upgrades. Lenovo Group has refined the AI Master platform, which serves as a professional MLOps platform, providing AI developers with persistent workspaces, batch processing tasks, data visualization, data cleansing, data annotation, model training, model compression, model evaluation, model deployment, model services, real-time monitoring, and other services. This platform enhances resource utilization through flexible computational resource management while reducing the human effort required for AI development. The AI Master's hardware components primarily include GPU servers, CPU servers, and network devices. The platform virtualizes hardware devices, utilizes a self-developed intelligent scheduler for resource allocation, and offers various support functions like user management and quota management. For AI developers, the platform provides workspaces, batch processing tasks, and end-to-end MLOps, including data processing (e.g., data visualization, data cleansing, and data annotation), model construction (e.g., model training, model compression, and model evaluation), and model deployment.

5.2. Building a Digital Supply Chain Upstream and Downstream for Lenovo Group

Lenovo Group's industrial and supply chains are extensive, with a multitude of small and medium-sized enterprises facing challenges of limited digitalization, weak foundations in intelligence, and shortages in funds and technical talent. Lenovo Group adheres to an "endogenous externalization" strategy, enabling the digital and intelligent transformation of small and medium-sized enterprises through the new IT architecture of "edge-cloud-network-Internet-intelligence." This strategy helps to strengthen the development of the industrial and supply chains. Before 2017, Lenovo Group established the GSC (Global Supply Chain) digital transformation path, driving supply chain digital transformation through cloud computing, big data, and other methods. In three to four years, Lenovo Group invested nearly $90 million to create the "Smartest Brain" in the supply chain, the SCI (Smart Supply Chain Control Tower) system. The SCI, or Smart Supply Chain Control Tower, integrates scattered data from various departments within the entire supply chain into a digital system, providing

real-time, intuitive insights into the entire network operation, guiding end-to-end supply chain activities, and establishing a collaborative, consistent, agile, and demand-driven supply chain ecosystem. Importantly, it overcomes the traditional supply chain's barrier of step-by-step communication and allows Lenovo's supply chain management to reach suppliers at every level and even engage in cross-level scheduling. Lenovo plays a central role in the industrial and supply chain, serving as the "chain master." This term represents the core of the industrial supply chain ecosystem and is indispensable for strengthening the resilience of the industrial chain and supply chain.

5.3. Expanding Lenovo Group's Digital Transformation Consulting System

As early as 2013, Lenovo initiated a digital transformation with data intelligence at its core. Over five years, it built a globally unified full data platform, the Lenovo Unified Data Platform, covering 95% of its business and data. However, as customer demands evolved and market competition intensified, enterprise digital transformation became imperative. Many enterprises struggled to make digital transformation effective due to unclear strategic goals, limited practical experience, gaps in the value loop, shortages of professional talent, and inadequate digital awareness. Lenovo, through continuous exploration and learning, has developed the "START" digital transformation methodology, with data intelligence as its core. Internally, Lenovo established a digital transformation architecture system, including one hybrid cloud, five technology intelligence platforms, ten business intelligence platforms, and numerous intelligent applications. It achieved breakthroughs in various digital businesses such as digital customer management, intelligent manufacturing, and a smart supply chain, providing comprehensive support for the group's strategic transformation and rapid development. Externally, Lenovo empowers enterprises in their strategic planning, business development, and technology adoption through comprehensive digital solutions. For example, Lenovo assisted Sinopec in optimizing its system processes with a mature, reliable, high-performance SAPHANA solution, rapidly enhancing its IT capabilities, and facilitating Sinopec's own digital transformation, resulting in cost reduction, efficiency improvement, and innovative business models. There are many more successful cases. In 2023, Lenovo Group was recognized as one of the top ten outstanding enterprises in national digital transformation, offering valuable insights to other enterprises on their digital transformation journeys.

6. Conclusion

This paper provides a research analysis of Lenovo Group's digital transformation, focusing on the comprehensive intelligence of data, the establishment of Lenovo Brain and AI Master platforms, and the development of digital supply chains. Furthermore, it explores Lenovo Group's expansion of digital transformation consulting services. Lenovo has achieved significant advancements in digital transformation, improving efficiency through the reduction of manual computations, enhancing supply chain control through the SCI system, and providing expert guidance through the "START" methodology. In recognition of these achievements, Lenovo Group received the accolade of being among the top ten national digital transformation leaders in 2023, serving as an inspirational example for other enterprises embarking on their digital transformation journeys.

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