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Research on the Digital Transformation Process from Dependent to Self-Empowered Upgrading

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Abstract: In the face of many challenges in the digital era, how to accelerate the digital transformation of enterprises has become a topic of widespread concern in academia and industry. In the face of many challenges in the digital era, how to accelerate the digital transformation of enterprises has become a topic of widespread concern in academia and industry. Considering that the stage of this solution is to first rely on relevant enterprises to upgrade and build digital systems, and then cultivate their own digital capabilities, so as to complete the iteration of digital system capabilities and achieve continuous self-empowerment upgrades, it is named as the research on the process of upgrading from dependent to self-empowered to digital transformation.

Keywords: Dependent upgrades, Self-endowed upgrades, Digital transformation.

1. Introduction

The 14th Five-Year Plan proposes: "Accelerate the construction of a digital China, and comprehensively promote the transformation of production methods, lifestyles and management methods." With the rapid development of a new round of information technology in the digital era, digital thinking, business ecosystem, big data platform, and value chain collaboration are favored by more and more enterprises. In the face of many opportunities and challenges in the digital era, how to accelerate the digital transformation of traditional building materials industry enterprises is a hot issue in current practical discussion and theoretical research.

Although there have been studies to analyze the process of digital transformation, such as Vial (2019), it is found that the process of digital transformation is the process of using digital technology to trigger the strategic response of enterprises and the change of value creation path; There is a lack of research on how leading enterprises in the industry can borrow external resources and platforms to improve their own digital level. Considering the increasing emergence of traditional building materials industry enterprises building their own digital transformation with the help of internal and external platforms, the research on the digital transformation process, path and mode of industry leading enterprises based on internal and external resources and platforms needs to be strengthened urgently.

Based on a longitudinal single case study of a typical case, Ruitai Masteel New Material Technology Co., Ltd., this paper finds that: 1) Manufacturing enterprises have accelerated their digital transformation by using internal and external Internet enterprises to go through three stages: "digital system construction, digital capability cultivation, and digital system capability iteration".2) Promote the digital transformation of incumbent enterprises through the strategy of building enterprise digital systems, including direct and indirect paths. The direct path is for the incumbent enterprise to build the enterprise digital system based on the empowerment of internal and external resources in the digital strategy demand stage, while the indirect path is for the incumbent enterprise to complete the digital transformation of the enterprise through self-empowered upgrade of its own digital system capability iteration in the digital capability building stage. 3) Compared with the traditional digital transformation model, the digital transformation model has advantages in terms of development sustainability, autonomy and rapid integration of digital resources.

2. Literature References

2.1. Research on Digital Transformation

Digital transformation research still focuses on the construction of conceptual and theoretical frameworks. Through a systematic review of the definition of digital transformation in the existing literature, digital transformation is defined as the process in which an entity makes important changes to its business activities through the integrated use of information technology, computing technology, communication technology and connection technology.

The early research on digital transformation in the field of information systems focused on exploring the unique attributes of technology and its impact on organizational business from the perspective of technology along the evolution of information technology to digital technology (Nambisan et al., 2017; Yoo et al., 2012).

Scholars of organizational and strategic management realize that digital transformation is not only a technical issue, but also involves a full range of changes in enterprise strategy, business model, operational adjustment and organizational structure triggered by the technology portfolio, emphasizing the process of enterprise using digital technology to carry out organizational change to promote the acquisition of competitive advantage (Hanelt et al., 2021; Yan et al., 2021).

Based on the definition of digital transformation by Vial (2019), this study believes that digital transformation is the process in which enterprises trigger changes in all aspects of economic activities such as R&D and design, manufacturing and organization through the combination of digital technologies, so as to improve the value creation of physical enterprises.

2.2. Research on Dependency Upgrades

The center of this paper is the dependent upgrading of the traditional manufacturing industry, which wants to "leverage" the empowerment of Internet enterprises, which is a favorable way for the traditional manufacturing industry to upgrade in the technological innovation network, but in this process, the traditional manufacturing industry is faced with the dilemma of "how to rely on the core enterprises to take advantage of the upgrade, but not lose the autonomy". The traditional manufacturing industry joins the technological innovation network and becomes a node in the innovation network, which can use the internal resources of the network to achieve its own upgrading (Li, 2018). However, in the process of integrating into the innovation network, if traditional manufacturing enterprises only carry out technical exchanges with Internet enterprises and blindly absorb the differentiated resources from Internet enterprises, traditional manufacturing enterprises will face the situation of over-dependence on Internet enterprises and then lose their autonomy. In this regard, traditional manufacturing enterprises need to consider how to refine and export their own accumulated experience in the industry, and achieve complementary co-creation with Internet enterprises, so as to finally realize the "rise of the trend" of relying on Internet enterprises (Jacobides, 2018). On the other hand, if traditional manufacturing enterprises cannot reduce their dependence on Internet companies and lack bargaining power, it is difficult for them to profit from the co-creation behavior of both parties, which will eventually lead to the end of being swallowed up by Internet companies (Teece, 1986).

If traditional manufacturing enterprises want to take advantage of the situation of Internet enterprises to achieve dependent upgrades, they need to deal with the structural dependence and process dependence with Internet enterprises. Structural dependence refers to the intrinsically related resources between traditional manufacturing enterprises and Internet enterprises, and this complementarity from resources enables in-depth cooperation between the two sides. Process dependence refers to the fact that both parties have scarce and irreplaceable resources from each other, and this dependence arises in the process of the transaction.

In the innovation network, the intention of traditional manufacturing enterprises to adjust the two dependencies must be realized through corporate behavior and strategy, and among them, the intention of traditional manufacturing enterprises to enhance structural dependence and enhance complementarity with Internet enterprises must be realized through the actual reorganization of corporate strategy complementary resources and value proposition. If traditional manufacturing enterprises want to reduce their dependence on the process and reduce their dependence on Internet enterprises, they must achieve the improvement of their independent capabilities through the actual enterprise strategy, technological diversification and open innovation, and relatively reduce the dependence on core enterprises.

3. Research Design

3.1. Research Methodology

This paper focuses on how traditional manufacturing enterprises can upgrade from relying on external Internet enterprises to building their own digital capabilities to accelerate digital transformation, which is typical research "How" question, and the vertical single case study method is suitable to answer this kind of question, so this paper adopts the vertical single case study method. First, the specific process of exploring how enterprises achieve digital transformation is a process and mechanism study, and the use of case studies can help to combine specific processes and further open up the "black box" of specific mechanisms (Ravasi and Schultz, 2006). Secondly, digital transformation is a new phenomenon that both management practice and theory pay attention to, and the single case study method is an effective method to analyze new phenomena and new theories, and can discover new perspectives and new laws from it. Finally, the research question in this paper belongs to the study of process evolution, and a single case is helpful to explore the specific process of stage evolution from the time dimension (Vande Ven and Huber, 1990).

3.2. Research Object

3.2.1. Case selection.

This paper takes Ruitai Masteel as a typical case study object, mainly based on the following considerations:

a. Follow the principle of case typicality.

Ruitai Masteel is a key refractory manufacturer in China, and its 5G+ industrial Internet application - "Transparent Factory" project was selected into the "Ministry of Industry and Information Technology's 2022 Industrial Internet Pilot Demonstration List", which is the first transparent factory in Anhui Province. Ruitai Masteel, together with Pegasus Zhike and Tencent Weiling, deeply integrates new sensors, intelligent control systems, industrial robots, complete sets of automation equipment and related information systems through the intelligent comprehensive Internet of Things platform, opens up end-to-end data connection, builds a personalized Internet industrial platform for enterprises, and jointly implements Ruitai Masteel's 5G+ industrial Internet application - transparent factory project. The "grafting" intelligent transformation of the traditional manufacturing industry with the thinking of "Internet +" is an inevitable choice for traditional manufacturing enterprises to improve quality and efficiency. It not only drives the digital development of enterprises in the ecosystem, but also accelerates its own digital transformation. Compared with other companies, the transparent factory built by Ruitai Masteel accelerates the process of digital transformation of enterprises very quickly, and the transparent factory built by Ruitai Masteel has also won many honors.

b. Follow the principle of representativeness.

Ruitai Masteel is a manufacturing enterprise rooted in Ma'anshan, Anhui Province, and is a typical example of a leading enterprise in the refractory industry to build an industrial Internet platform. In September 2020, the General Office of the Ministry of Industry and Information Technology issued the "Action Plan for the Digital Transformation of Intelligent Manufacturing in the Building Materials Industry (2021-2023)", which clearly pointed out that by 2023, the refractory industry will have a significant increase in the level of digitalization, networking and intelligence in the whole industry, and the operating costs, production efficiency and service levels will continue to improve, promote the upgrading, modernization and safety of the industrial chain, and accelerate the entry into the advanced manufacturing industry. Taking Ruitai Masteel as the case study object is more conducive to analyzing the specific process of accelerating digital transformation with the help of internal and external digital resources in combination with

digital scenarios.

c. Follow the principle of data availability.

The research team has accumulated a lot of second-hand information and first-hand interview data of Ruitai Masteel and Transparent Factory projects, and the data can be obtained in a variety of ways.

3.3. Company Introduces

Founded in 1958, the predecessor of Ruitai Masteel, Masteel Refractory, covers an area of 190,000 square meters and has a net fixed asset value of 34.76 million yuan. In May 2017, Masteel Group and Ruitai Technology Co., Ltd. established Ruitai Masteel to deepen the enterprise reform by means of joint reorganization. The company adheres to the principle of "scientific and technological innovation, honest management, and the creation of refractory brand; Quality-oriented, continuous improvement, to meet customer requirements" as the company's business philosophy.

In the process of transformation and upgrading, Ruitai Masteel resolutely eliminated the outdated and backward production lines and equipment, invested more than 200 million yuan, moved into the intelligent industrial park, in accordance with the high standards and high starting point in the new plant, according to the objective needs of the refractory industry from the traditional industry to automation, intelligence and green environmental protection transformation and upgrading, aiming at the international advanced level, intelligent manufacturing and information technology, the introduction of high-temperature material production lines and factory management links, in accordance with the high standards of green intelligent factories, It only took more than a year to build the first intelligent manufacturing production line of energy-saving and environmentally friendly high-temperature steel materials in China.

In 2018, Ruitai Masteel and Tencent Cloud reached a cooperation, and joined hands with ecosystem partners such as Pegasus Zhike and Xuanma Technology to develop the first "transparent factory" in China using Tencent's Weiling IoT platform. The "transparent factory" is a deep integration of new sensors, intelligent control systems, industrial robots, complete sets of automation equipment and related information systems through an intelligent and comprehensive IoT platform, opening up the last mile of industrial digital and intelligent transformation and business value landing.

As a leading enterprise in the refractory industry, Ruitai Masteel has been committed to the digital development of the enterprise itself and the industry. In November 2021, at the "Industrial Internet Achievement Release" forum of the Industrial Internet Conference, the vertical industry group of the Industrial Internet Industry Alliance (hereinafter referred to as "AII/Alliance") announced the list of 2020 industrial Internet vertical industry application cases, and the Ruitai Masteel transparent factory project was successfully selected. On February 18, 2022, the Ministry of Industry and Information Technology announced the list of unveiling units and excellent scenarios of intelligent manufacturing pilot demonstration factories in 2021, and a total of 110 enterprises and 241 scenarios were selected across the country. Ruitai Masteel, a member of Ruitai Technology Co., Ltd., was successfully selected into the list of excellent scenes. The key events in the process of Ruitai Masteel's construction of a "transparent factory" to realize the upgrade from dependency to self-empowerment are shown in Figure 1.

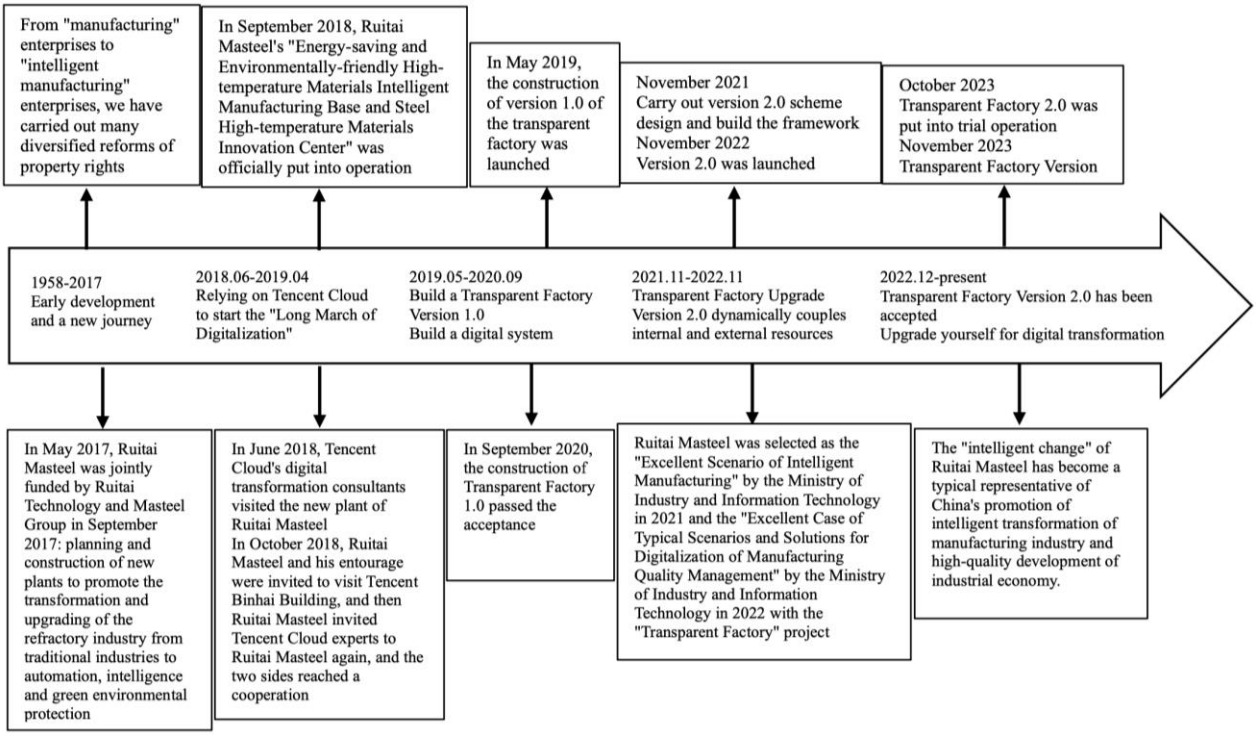

Figure 1. Ruitai Masteel builds a transparent factory to realize the key event axis of the digital transformation process from dependent to self-endowed upgrade

Source: Compiled by the author

3.4. Data collection and analysis

Following the principle of "triangulation verification", the research team conducted multiple rounds of interviews to obtain first-hand data on the basis of collecting second-hand data from case companies. For the collection of case data, the research team used three main methods: document collection,

on-site observation and on-site interviews, with semi-structured interviews as the main method, supplemented by documents and on-site observations. Diversifying data sources and types helps to follow the principles of triangulation to ensure the credibility of the data (Jick, 1979).

3.4.1. Semi-structured interviews.

The in-depth interviews with the internal senior management of Ruitai Masteel are mainly divided into three stages: the first stage of the interview From October 2023, the research team conducted preliminary interviews with the senior management and management of Ruitai Masteel, mainly focusing on the construction of Ruitai Masteel and the transparent factory, and the development history of Ruitai Masteel. The second phase will focus on March-May 2024, with the research team conducting in-depth interviews with senior management of Ruitai Masteel, and multiple interviews with the person in charge of the transparent factory and the technical team. At the same time, in-depth interviews were conducted with the persons in charge related to digital transformation to obtain first-hand information on the digital transformation of Ruitai Masteel, and according to the specific stages of digital transformation, the main persons in charge of different stages and senior managers who are familiar with the development of the enterprise were discussed. The third phase will focus on July-August 2024, where the research team will conduct interviews with relevant department personnel, especially those related to Tencent Cloud, Pegasus Zhike and Xuanma Technology, to further collect data on the digital development process of Ruitai Masteel from the perspective of partners.

During all interviews, the research team made audio and written records, and organized and transcribed them into detailed interview notes in a timely manner after the conversation, so as to ensure that the interviewees' original words were recorded truthfully. In order to avoid subjective guidance of the interviewees, the research team prepared a targeted interview outline before the formal interview. After each round of interviews, the research team studied the results of the current round of interviews and corrected some of the questions. The specific interview information is shown in Table 1.

Table 1. Interview information from the case company

Interview time	Interviewees	Interview content	Length of the interview
October 2023	Chairman of Ruitai Masteel, Director of the Office	The development history of Ruitai Masteel The development history of Ruitai Masteel	240 minutes
October 2023	General Manager of Ruitai Masteel	Stages of development and dilemmas of transparent factories	180 minutes
March 2023	Deputy General Manager and Head of Finance of Ruitai Masteel	The specific process of Ruitai Masteel's digital transformation Transparent factory construction results	240 minutes
March 2023	Transparent factory manager and technical team	The basic situation and development history of the transparent factory Introduction of each molecular module of the transparent factory	240 minutes
July 2024	Tencent Cloud Digital Transformation Consultant	Introduction to the Weiling platform	180 minutes
July 2024	The relevant person in charge of Pegasus Zhike and Xuanma Technology	Introduction to the integration of big data platform and system	180 minutes

3.4.2. On-site observation and second-hand data.

In addition to semi-structured interviews, field observations and secondary data are used as important data sources.

a. On-site observation. The research team visited Ruitai Masteel's digital development exhibition hall and transparent factory data center, and during the research and interviews, the research team members visited different departments of the company several times.

b. Secondary Data. It mainly includes two types of internal information and external information of the company. Internal information is mainly provided by Ruitai Masteel's office, including internal reports since the establishment of the company, company annual reports and internal books; External materials include the company's official website, news media reports, books and CNKI literature. The field observation data, secondary data and interview data of the research team form a triangulation to help the research team further improve the validity of the research data.

3.4.3. Data analysis.

In this paper, the data analysis adopts the method of grounded theory coding, and analyzes the data according to different data sources to explore the specific path of enterprise digital transformation. The specific analysis steps are as follows: First, the research team broke down the collected data and followed the process of "primary data" to "initial scope" for first-order concept coding. First of all, the research team converted the audio recordings obtained from the survey into text to sort out the key events of Ruitai Masteel's digital transformation. Second, the research team members coded the interview data to find words and phrases that were relevant to the topic. Finally, first-order concepts such as "grasping supply-side structural reform", "scanning internal and external environmental changes", and "realizing the necessity of digital reform" are formed according to dimensions (the coding content is shown in Figure 2). Second, on the basis of first-order concepts, dialogue is conducted according to theory. The research team clustered first-order concepts to form second-order themes such as "perceiving the opportunity of digital reform, tailoring digital systems", and "realizing dependent upgrades". Thirdly, according to the content of the second-order theme and the research theme of this paper, the aggregate dimensions of "building the digital system of traditional manufacturing enterprises", "cultivating the digital capabilities of traditional manufacturing enterprises" and "completing the iteration of the digital system capabilities of traditional manufacturing enterprises" are finally formed (as shown in Figure 2). In order to ensure the rationality of the data analysis, the research team members work independently during the coding phase, and then check and check the data. When there are discrepancies in the coding results, the research team members discuss them until they reach a common opinion.

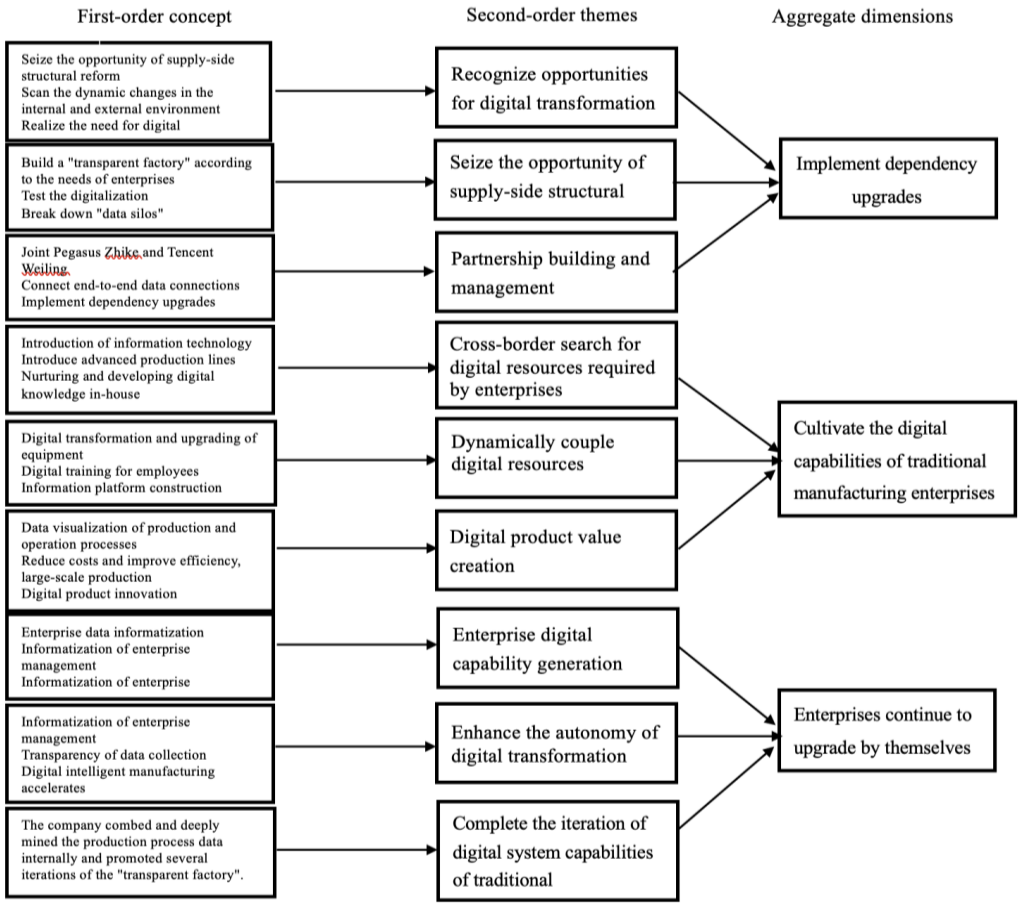

Figure 2. Data structure

Source: Compiled by the author

4. Conclusion

In the digital era, manufacturing companies face numerous challenges, making the acceleration of digital transformation a critical topic in both industry and academia. Through a longitudinal single case study of Ruitai Masteel New Material Technology Co., Ltd., this research identifies a key pathway for digital transformation: "dependent upgrade—dynamic coupling—self-empowerment." This transformation process not only reflects the strategic upgrades enterprises undertake to coordinate various exploration and development issues but also enriches the theoretical discourse surrounding digital transformation models.

The study reveals that manufacturing enterprises progress through three distinct stages during their digital transformation: digital strategic needs, digital resource acquisition, and digital capability building. In the "Digital Strategic Needs" stage, enterprises clarify their requirements for digital strategies. During the "Digital Resource Acquisition" phase, they purposefully identify and integrate both internal and external digital resources. In the "Digital Capability Building" stage, the continuous innovation of internet enterprises, along with their inherent digital capabilities, facilitates the enhancement of the digital capabilities of incumbent firms. This process underscores the flexibility that enterprises must exhibit at various stages to ensure the effective implementation of digital transformation.

Moreover, enterprises adopt three strategies during the transformation process: dependency, coupling, and self-empowerment, to navigate complex market conditions and internal challenges. This strategic diversity allows firms to achieve a dynamic balance between resource integration and capability development, thereby enhancing the sustainability and autonomy of their digital transformation efforts. Compared to traditional digital transformation models, the framework proposed in this study demonstrates significant advantages in adaptability, resource integration speed, and self-empowerment.

In summary, this research not only offers a viable pathway for digital transformation in manufacturing enterprises but also establishes a foundation for future studies in related fields. It is hoped that this work will inspire more companies to actively explore innovative models of digital transformation, ultimately promoting the digitalization of the entire industry.

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