Research on the Relationship between Digital Transformation, Dynamic Capabilities and Firm Performance Based on Fuzzy Mathematics

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Abstract
With increasing uncertainty, the relatively stable business environment of enterprises no longer exists. How companies rely on dynamic capabilities to improve firm performance and continue operations is an academic issue that is currently concerned in the field of strategic management. This article analyzes the relationship between corporate digital transformation, dynamic capabilities and corporate performance. Guided by the double standard assessment method and the fuzzy mathematics method, double standards factor fuzzy evaluation matrix is built to evaluate factors of firm performance. According to its analysis results, the company can implement strategic adjustments, which may provide a reference for the company to improve performance and continuity operations.

Keywords: *Digital Transformation; Dynamic Capabilities; Firm Performance; Fuzzy Mathematics; Fuzzy Evaluation Matrix*

1. INTRODUCTION

In recent years, China has been concentrating on the project of corporate digital transformation. Only when relevant companies do this step well, can they maintain their competitive advantages and improve their performance. In the process of digital transformation, companies not only need a new generation of digital technology to upgrade their business, but also a team with only technical foundation, industry insights and practical experience to provide companies with a full range of digital services from strategy to business to operation. The purpose of digital transformation is not digitization itself, but intelligent decision-making on the basis of digitization. Digitization is relatively simple, but intelligence is more complicated. AI scientists and management experts need to work together to find personalized solutions for enterprises.

In the context of digital transformation, how companies can better find the direction of digital development, promote companies to build dynamic capabilities of resource integration and help companies achieve better performance, is an important topic of strategic management research. In order to succeed in the digital transformation of an enterprise and improve firm performance, it is necessary to clarify the definitions, roles and relationships of the three aspects of digital transformation, dynamic capabilities and enterprise performance in theory.

2. THE RELATIONSHIP BETWEEN ENTERPRISE DIGITAL TRANSFORMATION AND FIRM PERFORMANCE

Digital transformation is a high-level transformation based on Digitization and Digitalization that further touches the company's core business and aims to create a new business model. In recent years, as emerging technologies such as big data, cloud computing, and artificial intelligence have penetrated into the industry and the degree of enterprise empowerment has increased, digital transformation has become the only way for enterprises to achieve sustainable operations.

2.1 The Importance of Digital Transformation

The core driving force of the development of the information industry is digitization. After the information is digitized, the flexibility of time and space can be changed, thereby completely changing people's lifestyle.

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Computers can analyze digitized information and extract all kinds of knowledge. After the knowledge is accumulated, social resources can be reorganized. Generally speaking, the current level of digitization in human society is very shallow. If we can go farther, there will be a lot of room for us to create wealth. The world-famous consulting company Capgemini also made corresponding research. Research has found that companies that have succeeded in digital transformation are likely to increase their profitability by 26%, their valuation by 12%, and their revenue-to-asset ratio by 9%. It can be seen that digital transformation is particularly important for enterprises. It can be seen that digital transformation is particularly important for enterprises. The IT era is based on self-control and self-management, but the DT (Data Technology) era is based on technology that serves the public and stimulates productivity. The difference between the two seems to be a technical difference, but it is actually a difference in ideology. Today's DT era pays more attention to relying on a large amount of business data generated by business systems. With the help of the data processing capabilities provided by the DT era, it provides support for business decision making, creates a closed data loop, and generates a steady stream of value [1].

2.2 How to Implement Enterprise Digital Transformation

As far as the current domestic situation is concerned, more than 80% of enterprises is still focusing on IT. They have become a larger cost center for enterprises, but they have not demonstrated commercial value, and have not solved the problems of production relations and productivity. They are still cost centers in the process of digital transformation, not a value center.

It is widely known that first-tier Internet companies such as Alibaba, Tencent, Baidu, and JD.com all have a variety of and complex business systems. Faced with daily average PB and total EB-level business data, they have long been committed to building a strong data center. Achieved digital transformation and provided assistance to the business. What we want to discuss is not how companies can make digital transformation successful, but how companies can implement digital transformation smoothly and orderly in the DT era.

Digital transformation is not the technological transformation, nor is it the digitization of an application or business, but the transformation of customer-driven strategies and operations. This requires not only the implementation of digital technology, but also organizational changes in various departments. Digital transformation should be deployed and promoted by the top decision makers of the enterprise. Only strong leadership can stimulate the motivation of all employees and increase the probability of success.

Firstly, digital transformation is a manager's project. Secondly, digital transformation enterprises must have clear goals—what to do, what problems to solve, and what effects to produce—it must be analyzed and considered in advance. It is necessary to truly understand the meaning and methods of digital transformation ideologically and cognitively, and improve the cognition of all employees of the enterprise, especially the cognition of middle and senior managers. Change thinking, center on customer needs, use data as assets, technology as means, and rely on talents to build a technology platform system that supports business innovation that can quickly meet customer needs, and support customer service and business innovation.

The basis of transformation is data. Digitization is to collect data required for daily operations and innovation of enterprises through various technical means; data on customer experience of using products or services; market change data; industry trend data, etc., forming a panoramic view of enterprise daily operations' Maps, customer panoramas, product panoramas, market changes and industry trends panoramas, etc., so as to improve corporate operational efficiency and create new business models. Companies can discover areas that can be improved in their operations and even develop new business models [2], by mining the value of data through digital means.

2.3 The Key to Digital Transformation

The key of digital transformation is to find an entry point in line with the status quo of the enterprise and a feasible implementation path. Finding the links and chains that have bottlenecks, pain points, and difficulties is the core of the problem. This is also conducive to the concentration of human, financial and material resources, grasping those key and important issues to solve. For example, the company's operating model, organizational structure, work resources, customer service, all-round experience, innovation capabilities, product development, technical capabilities, service delivery, etc. Only through research and self-examination can companies sort out bottlenecks, demands, and problems, and determine the scope and direction of transformation, in order to effectively promote this work. It is necessary to solve the problem of transfer and improve the production capacity and management and operation level of the enterprise.

2.4 Professional Services Are a Solid Guarantee for Digital Transformation

The challenge of digital transformation lies not in how to master digital technology, but in establishing a digital roadmap based on a panoramic view of strategy, data, technology, and operations to drive performance growth with pragmatic technology, and creating the necessary conditions and culture for landing to enable

enterprises and companies Transform into a mature digital organization.

According to the investigation and analysis, many companies will make some misjudgments in the direction of advancing digital transformation: either they are too radical, taking too many steps, or they are too conservative, only changing IT, not business, turning digital transformation into information improved.

In order not to make detours or make detours, and to complete the important project of digital transformation as soon as possible, a scientific, rigorous and effective professional team must be used to complete it. Professional services are a solid guarantee for the success of digital transformation. In the process of digital transformation, companies not only need a new generation of digital technology to upgrade their business, but also a team with deep technical foundation, industry insights and practical experience to provide them with a full range of digitalization from strategy to business to operation and maintenance service. These cross-industry expert teams can provide targeted guidance for each stage of the digital transformation of commercial companies, allowing enterprises to rise to the forefront in the evolution of the industry, and provide transformation results for the ever-changing digital world.

3. THE RELATIONSHIPT BETWEEN DYNAMIC CAPABILITIES AND FIRM PERFORMANCE

Teece (1997) believes that the financial performance of a company increases with the improvement of its ability to integrate and reorganize resources. The research of Griffit & Harvey (2001) shows that strong dynamic capabilities have a positive effect on accelerating the internationalization process of enterprises. Zott (2003) believes that the difference in the timing, cost and learning of dynamic capabilities in resource allocation is the cause of the difference in enterprise performance, but this difference in performance does not have a long-term nature [3]. Teece (2014) believes that dynamic capabilities with non-copy able and imitative characteristics can obtain long-term performance through protection, creation, and intangible assets of the enterprise [4].

Enterprise performance refers to the operating efficiency of the enterprise and the performance of the operator during a certain operating period. The level of corporate operating efficiency is mainly manifested in the profitability, asset operation level, debt solvency and follow-up development capabilities. The performance of the operator is mainly reflected by the achievements and contributions made by the operator to the operation, growth and development of the enterprise in the process of operating and managing the enterprise.

Obtaining sustainable competitive advantage is the pursuit of every enterprise, and it is also the prerequisite for every enterprise to improve its performance. In the current hyper-competitive environment, traditional core competence can no longer bring long-term sustainable competitiveness to enterprises, and even cause core rigidity. In a hyper-competitive environment, the concept of how to obtain and maintain a sustainable competitive advantage for enterprises has been put forward by more and more scholars.

In the early 1980s, the dominant strategic management theory was Porter's theory of industrial organization. With the rapid development of core competence theory, some limitations of core competence also emerged. However, in a dynamically changing environment, the original core competence of an enterprise may become a hindrance to the development of the firms' burden [5]. Competence theory encounters unprecedented obstacles to its own development and cannot explain how companies obtain competitive advantages in dynamic markets and why certain companies have sustained competitive advantages. In this context, Teece et al. originally proposed the concept of the ability to change capabilities-dynamic capabilities, and defined dynamic capabilities as the company's ability to integrate, build, and reconfigure internal and external capabilities to respond to rapidly changing environments. However, dynamic capabilities theory is still in the exploratory stage.

This study believes that dynamic capabilities refer to the ability of an enterprise to maintain or change its strategic capabilities and basic capabilities, and obtain new knowledge and capabilities through the absorption and integration of resources and the improvement of its own innovative capabilities through learning and knowledge management. Dynamic capabilities can gradually integrate and improve existing capabilities and improve efficiency, enabling enterprises to obtain sustainable competitive advantages in a dynamic, complex and uncertain environment. Dynamic capabilities help companies build resources and assets, and reset assets to respond to innovation needs, market and business environment changes. Dynamic capabilities can be divided into three dimensions: identifying and evaluating opportunities; mobilizing resources to meet needs and opportunities and deriving value from them; and continuing to update. Ordinary capabilities are not enough to drive sustainable competitive advantages [6]. Dynamic capabilities of enterprises are an important way to obtain and maintain sustainable competitive advantages.

Based on the data of empirical research [7], through systematic analysis, explore the impact of corporate dynamic capabilities on performance based on the adjustment effect of environmental turbulence. The results show that dynamic capabilities contribute to the improvement of business performance, but environmental uncertainty is the driving factor of

business dynamic capabilities, and environmental uncertainty has a significant moderating effect on dynamic capabilities and corporate performance.

4. THE RELATIONSHIP BETWEEN DIGITAL TRANSFORMATION, DYNAMIC CAPABILITIES, AND FIRM PERFORMANCE

By analyzing and summarizing the theories of some scholars at home and abroad, and combing the relationship between digital transformation, dynamic capabilities, and corporate performance, this study defines the concepts and connotations of digital transformation, dynamic capabilities, and corporate performance, and gives the relationship and role of the three.

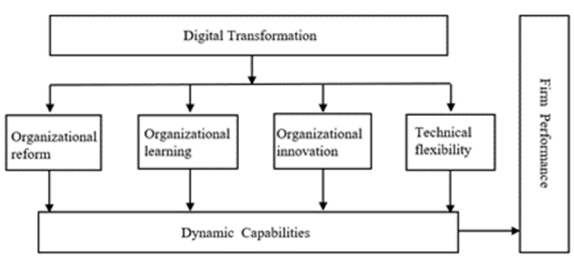

Figure 1. The relationship between dynamic capabilities.

Based on the literature review of dynamic capabilities, we subdivided dynamic capabilities into four dimensions: organizational change capabilities (Teece, 1997), organizational innovation capabilities, technical flexibility capabilities (Ianisti & Clark, 1994), and organizational learning capabilities (Zollo & Winter, 2002. And through these four aspects to measure the dynamic capabilities. Then, an expert group composed of corporate executives and university professors is formed first, and the expert group evaluates the levels of the four factors. As the expert group's assessment is descriptive, it cannot be used directly for judgment. Therefore, we introduce fuzzy mathematics methods to transform the fuzzy language of grade evaluation into fuzzy intervals.

We divide the capabilities into five levels: great, big, ordinary, small, and negligible according to the size difference that the capability may bring to the firm performance [8]. For firms in the digital transformation period, what needs to be focused on are those major capabilities that can bring "great" and "big" to firm performance. According to the different possibilities of the positive effects, these possibilities are described as: huge, big, medium, small, and limited.

The specific operations are as follows: P is the possible level of possible ability of each subdivided dynamic ability factor, and its fuzzy expression is:

$$\tilde{P} = \begin{bmatrix} \text{Limited} \\ \text{Small} \\ \text{Medium} \\ \text{Big} \\ \text{Huge} \end{bmatrix} = \begin{bmatrix} \widetilde{0.1} \\ \widetilde{0.3} \\ \widetilde{0.5} \\ \widetilde{0.7} \\ \widetilde{0.9} \end{bmatrix} \in \begin{bmatrix} [0,0.2] \\ 0.2, 0.4 \\ 0.4, 0.6 \\ 0.6, 0.8 \\ 0.8, 1.0 \end{bmatrix} \quad (1)$$

E is the positive effect brought to the enterprise by the above four abilities (only the big and great are selected). Calculated on a hundred-point system, its fuzzy expression is:

$$\tilde{E} = \begin{bmatrix} \text{Negligible} \\ \text{Small} \\ \text{Ordinary} \\ \text{Big} \\ \text{Great} \end{bmatrix} = \begin{bmatrix} \widetilde{10} \\ \widetilde{30} \\ \widetilde{50} \\ \widetilde{70} \\ \widetilde{90} \end{bmatrix} \in \begin{bmatrix} [0,20] \\ [20,40] \\ [40,60] \\ [60,80] \\ [80,100] \end{bmatrix} \quad (2)$$

According to the ability grade evaluation matrix, the corresponding relationship between the effect and the five evaluation grades of dynamic ability is listed in the form of fuzzy interval. Take the union of all fuzzy intervals corresponding to the same level to obtain the total level fuzzy interval of dynamic capability O.

$$\tilde{O} = \begin{bmatrix} \text{First level} \\ \text{Second level} \\ \text{Third level} \\ \text{Fourth level} \\ \text{Fifth level} \end{bmatrix} \in \begin{bmatrix} [\text{x}, \text{x}] \\ [\text{x}, \text{x}] \\ [\text{x}, \text{x}] \\ [\text{x}, \text{x}] \\ [\text{x}, \text{x}] \end{bmatrix} \quad (3)$$

As shown in formula 3 (X represents the specific value calculated according to the formula), after the data are fuzzified, the fuzzy interval of different levels will have a high probability of "crossing". Therefore, in order to avoid the same value belonging to different levels at the same time, after the expert group's results of importance and possibility are multiplied, the ability level of the factor cannot be directly judged. For this reason, the fuzzy lattice closeness algorithm is used to further accurately process the result [8].

According to the scoring results of the expert group, a normal fuzzy set of dynamic capabilities is constructed. First, based on the grid close degree calculation method-formulas (4), each element is scored based on the evaluation opinions of different experts. The grid closeness is calculated on the fuzzy set formed by the result and the fuzzy sets of different levels of evaluation criteria. The ability level corresponding to the highest closeness is the ability level of the element. The lattice closeness algorithm of normal fuzzy sets is:

$$\left(\widetilde{A_j}, \widetilde{A_i}\right) = e^{-\left(\frac{a_j - a_i}{b_j + b_i}\right)^2}, \quad j = 1, \dots, 5, \quad i = 1, \dots n \quad (4)$$

According to formula 4, substituting the known $\widetilde{A^{(1)}}$, $\widetilde{A^{(2)}}$,..., $\widetilde{A^{(5)}} \in U, \widetilde{A} \in U$ into the evaluation model, we can determine the closest factor to $\widetilde{A^{(i)}}$.

Finally, a summary table of ability levels can be

obtained, based on which the company can make corresponding strategic adjustments according to the situation.

The digital transformation of enterprises has a significant positive effect on dynamic capabilities. Companies that are good at learning can quickly and effectively restructure the organizational structure and reset corporate resources, and detect and respond to opportunities and threats in the environment (Slater & Narver, 1995) to respond to changes in the environment. Dynamic capabilities also have a significant positive effect on corporate performance, which is consistent with the conclusions of other empirical studies (Griffth & Harvey, 2001; Zott, 2003; Teece, 2007), thus once again verifying that Teece et al [9]. (2007) The view that dynamic capability is the source of a company's sustainable competitive advantage.

Dynamic capabilities play a part of the mediating role between digital transformation and corporate performance [10]. The success of digital transformation indirectly affects corporate performance through dynamic capabilities. For companies, the improvement of operational capabilities needs to be achieved through the success of digital transformation. Only when companies achieve digital transformation can they effectively improve their performance.

On the whole, the first is the digital transformation of enterprises, which is the foundation and prerequisite; the second is to enhance the dynamic capabilities of the enterprise, which is the key and the starting point; the third is to improve the performance of the enterprise and promote the development of the enterprise, which is the goal and also result. Companies should improve their digital cognition to the level of organizational strategy, and timely adapt to changes in the internal and external environments, and adjust the company's business model by focusing on the development of dynamic capabilities.

5. CONCLUSION

This research is based on fuzzy mathematics and constructs a dynamic capability analysis tool. It analyzes how various factors of dynamic capability have an effect on business performance and how much effect it has in the digital transformation period, which increases the connotation of dynamic capability.

To sum up, the mathematical model constructed by the study provides a new perspective for understanding the dynamic capabilities of enterprises and the solution of enterprise performance problems. Digitization is not to overthrow the past informatization of enterprises, but to integrate and optimize the past enterprise informatization systems. Digital transformation can promote the establishment of collaborative relationships between various dimensions of dynamic capabilities, and on this basis can promote the integration of knowledge resources; successful digital transformation can promote the creation of corporate value and performance. On the basis of integration and optimization, enterprises improve their management and operation levels, and use new technical means to enhance their new technical capabilities to adapt to the new requirements brought about by digital transformation.

Owing to the digital transformation period creates huge uncertainty in the corporate environment, future research needs to adopt more research methods to deeply explore the internal mechanism between dynamic capabilities and result variables (firm performance). Future research can also develop multiple case studies on this basis to clarify the differences and similarities of different companies' dynamic capabilities, and consider using longitudinal time series data to conduct research. Then, for companies in different industries, dynamic capabilities may be unique. Therefore, the dynamic capabilities promoted by each enterprise should be the part with commonalities and the individual part of the industry. Future research can focus on the characteristics of different industries and study the dynamic capability improvement paths of each industry.

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