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Research on the Identification of Key Factors for the Development of Digital Empowerment Platform Enterprises

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Abstract: Purpose: It is difficult for small- and medium-sized enterprises to modify themselves to achieve digital transformation; a digital empowerment platform can help small- and medium-sized enterprises (SMEs) to digitalize. Therefore, it is of great significance to identify the key factors of the development of logarithmic words. Design: This study first uses the ISM method to establish a network of influencing factors, identifies key factors from the perspectives of network structure and enterprise competitive advantage, and finally conducts a comprehensive analysis using a six-quadrant matrix. Findings: Capital, talent, and data collection and analysis technology are key factors driving the development of digital empowerment platforms. Standards, accurate and continuous industry information, and efficient and sustained co-operation with empowered industry enterprises and research institutions are key factors in establishing a sustained competitive advantage. This study proposes two development paths for enterprises and two policy recommendations. Originality: (1) The history of digital empowerment platform enterprises is relatively short, and there are relatively few studies on the influencing factors of its development. (2) By employing mathematical network analysis and competitive advantage analysis methods and comprehensively analyzing key factors, this study innovates the multi-factor evaluation method.

Keywords: digital transformation; digital empowerment platform; key factor identification; network structure analysis; competitive advantage of enterprises

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1. Introduction

Digital transformation plays a pivotal role in the development of industry [1–4]. However, the majority of manufacturing enterprises are small- and medium-sized enterprises (SMEs), which generally have lower levels of informationization and intelligence and thus face certain difficulties in achieving transformation on their own [5,6]. McKinsey's research shows that the failure rate of traditional enterprises to transform digitally is as high as 70–80% [7].

Fortunately, in recent years, a small number of large enterprises have completed their own digital transformation, resulting in their own strengths, and they have been able to build a common industrial internet platform for the digital transformation requirements of small- and medium-sized enterprises. These universal industrial internet platforms—cross-industry and cross-domain—have been able to digitize other enterprises and have promoted the development of China's industrial digital transformation. This article calls these platforms digital empowerment platforms.

In terms of its empowerment mechanism, the digital empowerment platform typically focuses on specific application scenarios to carry out targeted data empowerment actions. Reintegrating, optimizing, and reconstructing data resources drive platform users to form data production capabilities, ultimately promoting the upgrade of enterprises in aspects such as production efficiency.

In order to introduce the general process, application, and effect of data empowerment platforms in more detail, this paper takes the famous Chinese empowering platform COSMOPlat as an example. COSMOPlat was born out of the Haier Group in Qingdao, China, which has completed its digital transformation. Based on the production technology and experience of the Haier Group's digitalization throughout the entire process, COSMOPlat has refined the common digital equipment and experience and modularized it according to the production process, building a full process empowerment service of "interactive customization–open design–precise marketing–modular procurement–intelligent production–smart logistics–smart service". In order to better empower different industries and achieve success in the empowered industry, COSMOPlat co-operates with leading enterprises and research institutes in the empowered industry to obtain market information and technology and improve the quality of the empowerment. Currently, COSMOPlat has provided empowerment services to 15 industries, including automotive, building ceramics, and apparel, as shown in Figure 1 below.

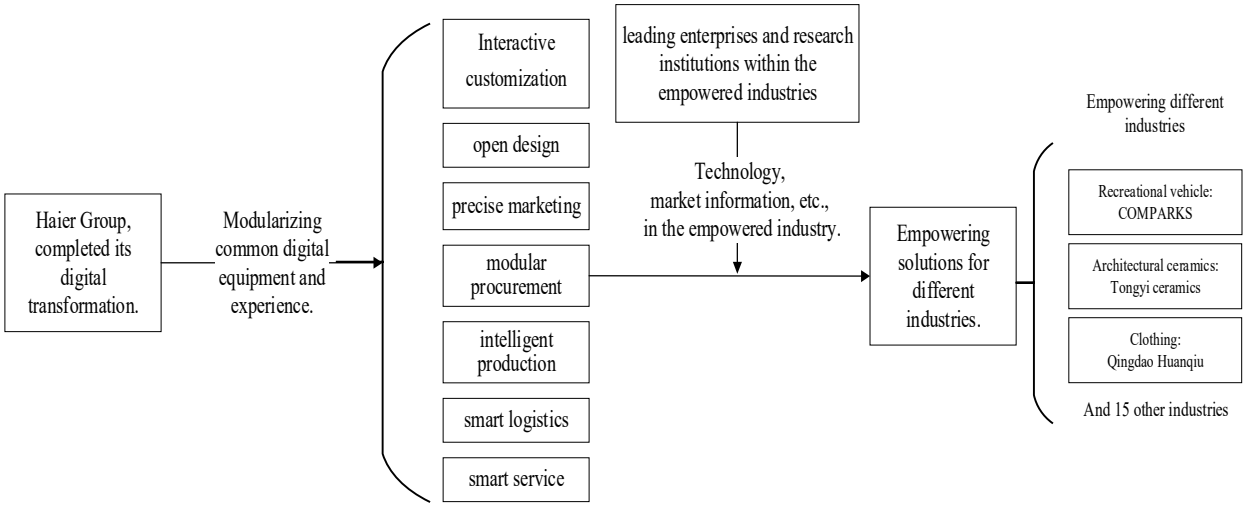

Figure 1. The empowerment process of the digital empowerment platform.

After COSMOPlat empowered COMPARKS RV, the delivery cycle of COMPARKS RV was reduced from the original 35 days to 20 days, the cost of the product was reduced by 7.3%, and the order was increased by 62%.

Currently, digital empowerment platforms are thriving, but most current research still focuses on explaining "how the various characteristics of digital empowerment platforms come about", such as the empowerment mechanism [8,9], value co-creation mechanism [10], and value sharing mechanism [11]. There are relatively fewer answers to "how should digital empowerment platform enterprises develop", and the guidance for the development of digital empowerment platforms is still somewhat insufficient.

What factors influence the development of digital empowerment platforms? Among the many influencing factors, which factors have the most significant impact, that is, which factors are the key factors? Is it possible to obtain some corporate advice and policy advice from it? This article will attempt to explore these questions.

The failure rate of traditional enterprises to implement digital transformation on their own is as high as 70 to 80% [7]. According to a report jointly authored by the National Industrial Information Security Development Research Center and Accenture Consulting, only 7% of enterprises have achieved significant results in digital transformation [12]. The digital empowerment platform can digitally empower other enterprises across industries and fields and help other enterprises carry out digital transformation. This study identifies the key factors for the development of digital empowerment platforms, which can promote the development of digital empowerment platforms and then help SMEs to digitalize and promote high-quality manufacturing development.

2. Literature Review

2.1. Research on the Definition of Digital Empowerment

Digital empowerment refers to the process of leveraging digital technologies such as cloud computing and blockchain to realize the value of data through digital capabilities and means [13,14]. Specifically speaking, digital empowerment involves establishing a platform with digital infrastructure through a series of business function layout and technical architecture designs and interacting with enterprises to give them the corresponding digital capabilities; this helps enterprises get rid of the traditional production mode of operation and accelerate the transformation in order to achieve the role of empowerment [15].

In order to illustrate digital empowerment more specifically, this study selects three key aspects of enterprise operation: demand prediction, product design, and pricing management [15]:

(1) Demand prediction: Taking Amazon as an example, in addition to transaction data, it can also record user browsing, purchase, use, evaluation, and other data, including search keywords and page stay time. These behavioral characteristics are often the direct expression of user preferences and their individual needs, coupled with powerful data analysis capabilities; they can more accurately predict customer needs and lay a good foundation for improving operation management performance. For example, when recommending application downloads, the system considers downloading and browsing behaviors, and based on "Involvement Theory", it can better understand customer needs and make accurate recommendations [16].

(2) Product design: First of all, a large amount of consumer usage data and social media data make it possible for enterprises to accurately design products in line with market trends. For example, through the mobile application Nike+, Nike can collect the user's movement frequency, time/location information, and other sports data, as well as better understand the user's sports habits and create designs more suitable for the user's needs of Nike products. Secondly, the development of technologies such as digital simulation, virtual reality (VR), and augmented reality (AR) allows companies to accurately simulate products on electronic devices and display them in a visual mode. Finally, in order to better meet the trend of increasingly personalized consumer demand in the digital era and achieve personalized design to the greatest extent, many enterprises have begun to use cloud computing technology to achieve client product customization through software. For example, consumers can set the user interface of digital products and the functional layout of hardware products according to their usage habits.

(3) Pricing management: By learning from data, companies can dynamically optimize pricing strategies and achieve better revenue management. Now, unstructured consumer review data have become important information for enterprises in pricing [16], especially for experiential products such as movies and theaters. Enterprises can learn about the quality of their products from consumer review data, discover the price demand function, and thus make better pricing decisions. Increase profit [17]: In some service industries, when combined with user behavior data, it is even possible to achieve "one person, one price"; for example, insurance companies can collect consumers' driving behavior data in real time so as to have a deeper understanding of users' driving habits and more reasonably formulate "one person, one price" insurance prices.

2.2. Research on Self-Digital Empowerment and Platform Digital Empowerment

Early research mainly focused on the perspective of enterprise self-digitization empowerment. An enterprise's big data technology capability will significantly affect its competitiveness in terms of data, as well as its ability to organize, construct, and mine operable information in data [18]. Enterprise digitalization can realize the interaction and resource integration between supply and demand so as to realize the process of value co-creation. Organizations can improve their data analytics and value connectivity capa-

bilities by empowering employees and users [19]. Liu Qilei et al. took China's Xuzhou Construction Machinery Group and Shaanxi Automobile Group as examples to study the empowering mechanism of data elements for enterprises; they concluded the basic empowering logic of "extensive participation–accurate matching–value co-creation" [20]. Li Yang studied the self-digital empowerment process of Haier Group, and its digital transformation process includes user interaction, interactive innovation customization, intelligent production, etc. [21].

Subsequently, after realizing self-digital empowerment, a few outstanding enterprises developed an industrial internet platform to provide digital empowerment services for other enterprises, especially small- and medium-sized enterprises lacking digital transformation capability [6,22], which is called platform empowerment.

The correlation logic between self-empowerment and platform empowerment is as follows: enterprises first digitize their own resources, industrial production processes, and experiences, that is, self-digital empowerment; then, the enterprise modularizes this digital production equipment and these experiences and transforms the enterprise's organizational structure into a platform. Finally, based on digitalization and platformization, intelligent manufacturing and service productization are realized, and the production capacity of users is improved as a whole, meaning that platform empowerment is completed [23].

The academic community is quickly catching up with this, and its research scope mainly includes the following areas:

(1) The definition of platform empowerment: Industrial internet platform empowerment refers to the behavior of leading enterprises to build an industrial internet platform based on digital technology advantages and network scale advantages, meet the personalized, networked, and intelligent needs of manufacturing enterprises, and use the platform to help other manufacturing enterprises improve their production and operation level, establish co-operative relationships, and create industrial economic value and social value [24].

(2) Platform empowerment behavior: Chen Wu et al. stated that the behavior of industrial internet platform empowerment is manifested in "promoting the digitalization and modeling of elements", "driving the assembly, topology, and coupling of multi-element heterogeneous resources in the platform environment", and "providing data governance support" [23]. From the perspective of value co-creation, Ma Yongkai et al. studied and concluded that the industrial internet platform includes adaptation, bridging, and consulting [25].

(3) Platform empowerment mechanism: Sun Xinbo et al. analyzed the behavior of industrial internet platforms using data elements for organizational empowerment, structural empowerment, and domain empowerment; on this basis, they proposed the mechanism path of "data resource action–data capability generation–ecological value realization" [8]; Lv Ziwei et al. summarized the content and process of the industrial internet empowerment of COSMOPlat and found that the digital empowering process follows the logical relationship of "R&D empowerment–production empowerment–operation empowerment" step by step. At the same time, the industrial internet platform empowers enterprises and consumers to form a value co-creation model [6].

(4) Platform empowerment effect: He et al. found that industrial internet empowerment has a significant effect on promoting industrial digital transformation. Among them, factors such as the digitalization of industry peers, technology absorption, talent introduction, and innovation integration have a significant moderating effect on the promotion effect [22].

2.3. Research on Digital Empowerment Platform Development

The time that data empowerment platforms have existed is relatively short, so there are relatively few studies on the development of data empowerment platforms at present. Su et al. proposed an evolution path of digital empowerment platforms: "resource assembly–platform empowerment–interdependent symbiosis–resource orchestration–field

empowerment–nested symbiosis–resource coordination–ecological empowerment–equal symbiosis" [26].

More relevant research on the industrial internet platform ecosystem can be found. From the perspective of platform architecture, the platform ecosystem is usually centered around the platform initiator, who creates a shareable technological core, and ecosystem members engage in value creation and value capture by using this core [27]. Specifically, the platform initiator designs the platform architecture, which has a relatively stable core and a set of variable complementary modules, empowering other members to engage in activities such as data collection, data storage, data flow, and commercialization [28,29].

The development of industrial internet platforms can be divided into the following stages:

(1) Initial stage: The platform initiator primarily establishes a basic development product platform and completes foundational activities [27,30,31]. For instance, industrial digital platforms create programmable, addressable, perceptive, transmissible, memorable, traceable, and relatable digital modules, allowing manufacturers to collect valuable data and visualize services on an installed basis [32].

(2) Optimization stage: The platform initiator needs to add complementary modules to the core, adjust platform boundaries, and conduct platform governance [27]. The value of the platform depends on the introduction of management for various purposes and different participants over the years [33]. Therefore, the platform initiator must continuously adjust the platform boundaries and increase the platform's openness. This leads to relevant theories on platform development governance. Platform governance needs to address the tension between platform openness and control while also managing co-operation and competition with complementors [34]. Unlike B2C digital markets, complementors cannot self-select to join the platform [35]. Most industrial digital platforms appear in the form of proprietary platforms, with the platform initiator typically launching platform development in conjunction with a group of exclusive complementors, traditional intermediaries, and customers. Subsequently, the platform initiator needs to make careful strategic decisions about how many complementors to attract to the platform and what types of complementors to attract [35]. For example, the platform envelope strategy, where "a platform provider enters the market of another platform by bundling its own platform functionalities with those of the target platform, leveraging shared user relationships and common components" [36]. However, overall, the current literature is not yet clear on the causes and consequences of the selection of complementors in the evolution of platform ecosystems [27].

2.4. Research Deficiencies

Current research on digital empowerment primarily evolves with the development of enterprise practices, transitioning from the study of "enterprise self-empowerment mechanisms" to "cross-boundary empowerment mechanisms". Although there are studies on digital empowerment platforms, most focus on their empowerment mechanisms and value co-creation mechanisms, mainly explaining how their empowerment functions and value creation are generated. Research on how to promote the development of digital empowerment platforms is relatively scarce.

There is still relatively little research on how to promote the development of digital empowerment platforms, and the guidance for the development of digital empowerment platform enterprises is still somewhat insufficient.

Therefore, this paper will attempt to explore the following questions: What factors influence the development of digital empowerment platforms? What are the relationships between these factors? What factors play a key role? Is it possible to obtain some corporate advice and policy advice from it?

3. Research Framework Design

From the perspective of research methods, there are many common multi-factor evaluation methods at present, but most of these methods are based on the relationship between factors for evaluation, such as the hierarchical analysis of the importance of comparing factors, correlation analysis of the changing relationship between factors, sensitivity analysis, and other statistical methods. However, these mathematical analysis methods ignore the consideration of the characteristics of the influencing factors from the perspective of management, such as VRIO theory.

From the perspective of research problems, the development goal of digital empowerment platforms is changing. In the initial stage of development, the main goal (of development) is to quickly complete development construction; after the development is completed, the main goal is to build a sustainable competitive advantage. The development goals of these two stages are different, so it is necessary to select corresponding methods to evaluate the key factors from the above two perspectives.

For the former, the influence of various influencing factors on various aspects of the digital empowerment platform enterprise can be evaluated, that is, from the perspective of the relationship between influencing factors. Considering that the influencing factors are hardly independent of each other and influence each other to form a network, this study uses a network structure analysis method to analyze and evaluate.

For the latter, the main theory of sustainable competitive advantage is VRIO theory and its derivative theory, so we chose this theory for analysis and evaluation.

The specific research framework design is as follows (Figure 2):

(1) Identification of influencing factors and construction of the relationship network:

In this study, data collection was carried out by reading the literature, news reports, and other secondary materials to understand the development of digital empowerment platform enterprises. We selected typical digital empowerment platform enterprises and conducted field research and verification to ensure an accurate and detailed understanding of the development of digital empowerment platform enterprises.

Because each influencing factor often affects the others, its complex influence relationship constitutes a network. Through the processing and analysis of collected realistic texts and interview materials, the interpretative structural model (ISM) was used to sort complex factor sets into structural relationship matrix diagrams and transform ambiguous ideas into intuitive and clear structural relationships [37]. Therefore, we chose this method, drew the directed network diagram among the influencing factors, and presented the mutual relationship among the influencing factors.

(2) Identification of key factors based on relational network structure:

When the development of a digital empowerment platform is in its initial stage, the main goal of development is to quickly complete development and construction. Therefore, it is necessary to evaluate the influence of various influencing factors on all aspects of digital empowerment platform enterprises and select the influential factors with greater influence as the key factors. Inspired by the DEMATEL method, this study selects the path calculation method in network analysis, calculates the influence degree of each factor, and identifies the key factors.

(3) Identification of key factors based on an enterprise's competitive advantage:

After the completion of enterprise development and construction, its main goal is to build a sustainable competitive advantage. VRIO theory is a classic theory that is used to study factors and enterprise competitive advantage. Therefore, VRIO(S) theory, an extension of VRIO theory, was selected to identify the key factors from the perspective of enterprise competitive advantage.

(4) Comprehensive analysis and management suggestions:

The key factors were identified from the two perspectives of network structure and the establishment of enterprise competitive advantage. This phase also requires classified

research on the key factors to be conducted. Based on the idea of the Boston Matrix, this study establishes a six-quadrant matrix, divides and discusses the key factors, and puts forward suggestions for digital empowerment platform enterprises and the government.

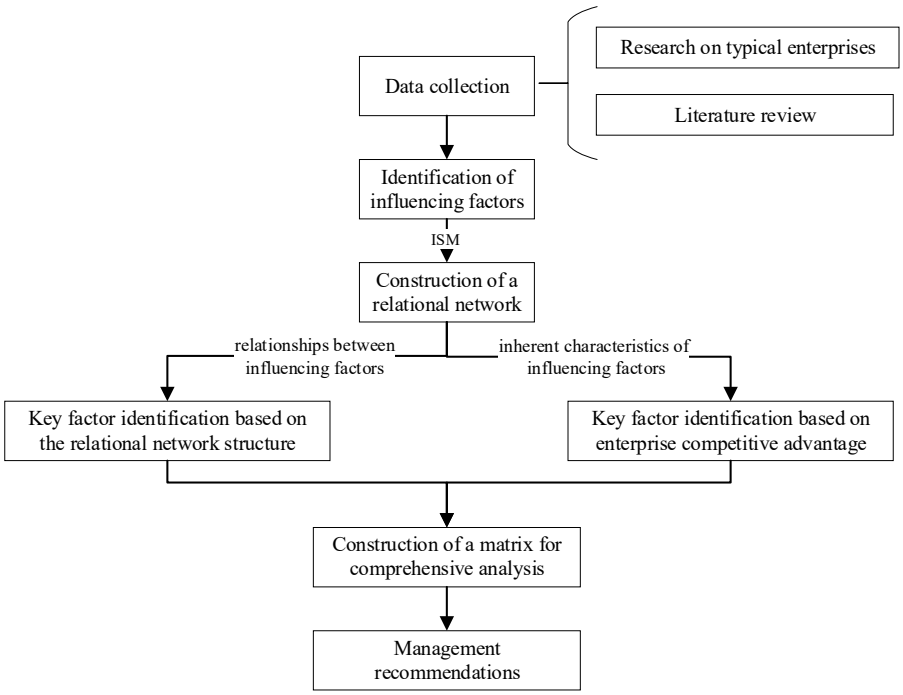

Figure 2. Research framework.

4. Identification of Influencing Factors and Research on Relational Networks

4.1. Data Collection

The current digital empowerment industry is in its infancy, with most platforms still in the early stages of development. COSMOPlat is one of the few platforms that has matured, being one of the first batches of industrial internet platform companies in China to explore. COSMOPlat has consistently topped the list of the "Cross-Industry and Cross-Field Industrial Internet Platform List" selected by the Ministry of Industry and Information Technology for 5 consecutive years.

This study analyzes the primary data from the founding team of COSMOPlat via interviews and secondary data from academic and corporate sources. COSMOPlat was interviewed extensively by the research team across three sessions in 2023 and 2024. The collected data, presented in Table 1, include over 10,000 words from interviews and information from academic papers, news, and corporate disclosures.

Table 1. Data sources and statistics.

Data Type	Information Type	Source	Quantity
Primary data	Semi-structured interviews with enterprise	COSMOPlat founding team	Three sessions, over 10 h in total
Secondary data	Corporate official website	Introduction and achievements related to the platform	Approximately 60,000 words
	Corporate news reports	Reports on the platform's development and the enterprises it empowers	Approximately 130,000 words
	Academic journal articles	Literature research related to COSMOPlat	12 papers
Other	Other relevant material	Industrial internet White Papers, academic journal articles on the industrial internet, etc.	six documents

4.2. Identification of Influencing Factors

We used PEST analysis to categorize the empowerment platform's external factors into political, economic, social, and technological groups and added internal platform factors, resulting in five categories. From this, 25 key influencing factors were identified, detailed in Table 2.

Table 2. Identification of influencing factors.

Category	Name	Code	Sources
Political	Government support	F1	[38–40]
	Evaluation system	F2	[38,41]
	Government development strategy	F3	[38,41]
	Data-related legal system	F4	[39]
	National policies information of other industries	F5	Interview refinement
Economic	Talent	F6	[38]
	Funding	F7	[38–40]
	Industry associations	F8	[38,40]
Social	Industrial internet research institutions	F9	[39,40]
	Development prospects information of other industries	F10	Interview refinement
	Current status information of other industries	F11	Interview refinement
	User demand information of other industries	F12	Interview refinement
	Cross-industry exchange	F13	Interview refinement
	Co-operation with enterprises in the empowered industry	F14	Interview refinement
	Co-operation with research institutes in empowered industry	F15	Interview refinement
	Core technologies of empowered industry	F16	Interview refinement
	Market information of empowered industry	F17	Interview refinement
Technology	Data acquisition and analysis technology	F18	[26,38,42,43]
	Manufacturing and other technologies	F19	[38,40]
	Standards	F20	[38–40]
Self	Empowerment platform construction	F21	[6,38,44]
	Layout of empowered industry range	F22	Interview refinement
	Quality of empowerment	F23	Interview refinement
	Completeness of platform functions	F24	Interview refinement
	Field of the parent company of the platform	F25	Interview refinement

4.3. Establishing the Direct Matrix

By referring to the ISM method, a direct matrix was established to represent the mutual influence of various elements. This study invited five experts to use a five-point Likert scale to rate the relationships between these 25 factors. A score of 0 indicates no influence, 0.2 indicates a minor influence, 0.4 indicates the presence of an influence, 0.6 signifies a significant influence, and 0.8 denotes an absolute influence.

In this survey, multiple raters directly evaluated and scored the relationship among the factors, and it was necessary to test whether multiple raters' evaluations of the same aspect were consistent and whether the evaluation results (the reliability of the raters) were credible. Therefore, Kendall's coefficient of concordance was calculated in this study. The number of factors evaluated in this study is greater than seven; therefore, chi-square significance testing was required.

The calculated Kendall harmony coefficient was 0.854 (higher than 0.80). Then, the chi-square test was carried out based on the Kendall coefficient, and the p value was 0.000 (lower than 0.05), indicating significance. In summary, Kendall's coefficient of concordance and the chi-square test both show that the scoring results of this survey have good consistency and high credibility.

Ultimately, based on the average scores of the aforementioned ratings, a preliminary direct influence matrix (A) was formed.

$A =$

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21	F22	F23	F24	F25
F1	0	0.70	0.20	0.21	0.23	0.21	0.22	0.72	0.24	0.24	0.24	0.22	0.24	0.22	0.23	0.23	0.24	0.22	0.22	0.21	0.25	0.22	0.24	0.23	0.11
F2	0.14	0	0.71	0.21	0.21	0.25	0.22	0.22	0.25	0.23	0.23	0.22	0.22	0.25	0.24	0.23	0.21	0.24	0.20	0.22	0.22	0.20	0.22	0.25	0.14
F3	0.11	0.25	0	0.70	0.24	0.72	0.71	0.72	0.71	0.23	0.23	0.24	0.21	0.23	0.25	0.25	0.24	0.25	0.23	0.71	0.23	0.22	0.23	0.25	0.12
F4	0.11	0.10	0.13	0	0.23	0.11	0.15	0.20	0.12	0.12	0.14	0.12	0.33	0.20	0.25	0.22	0.23	0.74	0.24	0.24	0.25	0.21	0.22	0.24	0.10
F5	0.12	0.14	0.11	0.15	0	0.14	0.13	0.14	0.11	0.11	0.11	0.11	0.14	0.13	0.15	0.13	0.14	0.14	0.11	0.12	0.13	0.70	0.23	0.13	0.10
F6	0.12	0.15	0.14	0.14	0.32	0	0.22	0.13	0.24	0.14	0.13	0.15	0.35	0.23	0.23	0.24	0.25	0.71	0.73	0.24	0.22	0.25	0.22	0.71	0.12
F7	0.10	0.14	0.14	0.13	0.14	0.83	0	0.10	0.11	0.11	0.12	0.12	0.22	0.15	0.14	0.14	0.12	0.71	0.75	0.35	0.70	0.23	0.20	0.21	0.13
F8	0.15	0.73	0.10	0.13	0.15	0.14	0.10	0	0.14	0.22	0.25	0.22	0.22	0.24	0.24	0.21	0.23	0.20	0.24	0.22	0.24	0.21	0.20	0.21	0.10
F9	0.14	0.12	0.14	0.13	0.13	0.21	0.10	0.13	0	0.12	0.12	0.14	0.14	0.13	0.12	0.13	0.14	0.72	0.70	0.22	0.25	0.10	0.11	0.11	0.12
F10	0.31	0.12	0.20	0.13	0.12	0.10	0.14	0.11	0.15	0	0.15	0.13	0.12	0.25	0.25	0.23	0.21	0.25	0.21	0.12	0.14	0.71	0.12	0.13	0.14
F11	0.32	0.14	0.25	0.21	0.20	0.14	0.11	0.12	0.10	0.21	0	0.22	0.11	0.25	0.23	0.21	0.24	0.21	0.11	0.13	0.13	0.74	0.20	0.24	0.11
F12	0.33	0.13	0.21	0.25	0.21	0.12	0.24	0.21	0.24	0.24	0.21	0	0.25	0.22	0.22	0.25	0.22	0.20	0.11	0.23	0.23	0.75	0.24	0.23	0.12
F13	0.23	0.22	0.22	0.21	0.71	0.23	0.23	0.24	0.23	0.72	0.71	0.71	0	0.23	0.22	0.22	0.72	0.24	0.20	0.24	0.20	0.24	0.23	0.21	0.11
F14	0.14	0.15	0.15	0.11	0.22	0.12	0.15	0.15	0.13	0.25	0.21	0.23	0.11	0	0.25	0.72	0.23	0.13	0.13	0.13	0.10	0.13	0.34	0.12	0.14
F15	0.14	0.12	0.13	0.12	0.20	0.12	0.12	0.11	0.11	0.24	0.21	0.24	0.11	0.21	0	0.74	0.22	0.14	0.14	0.14	0.12	0.13	0.30	0.10	0.12
F16	0.14	0.14	0.12	0.15	0.22	0.10	0.12	0.14	0.14	0.23	0.21	0.23	0.11	0.21	0.25	0	0.23	0.11	0.13	0.15	0.15	0.11	0.74	0.15	0.10
F17	0.11	0.14	0.10	0.11	0.1	0.13	0.14	0.15	0.13	0.22	0.22	0.21	0.13	0.21	0.23	0.21	0	0.11	0.11	0.12	0.11	0.12	0.12	0.15	0.11
F18	0.15	0.12	0.11	0.13	0.34	0.11	0.13	0.12	0.12	0.23	0.21	0.25	0.72	0.72	0.72	0.22	0.24	0	0.13	0.74	0.23	0.20	0.24	0.74	0.12
F19	0.11	0.12	0.13	0.15	0.11	0.10	0.14	0.13	0.10	0.12	0.12	0.12	0.12	0.12	0.15	0.12	0.14	0.13	0	0.72	0.32	0.14	0.23	0.75	0.12
F20	0.15	0.14	0.13	0.12	0.11	0.13	0.11	0.10	0.13	0.14	0.12	0.12	0.10	0.11	0.11	0.11	0.11	0.12	0.13	0	0.71	0.15	0.21	0.13	0.11
F21	0.10	0.13	0.11	0.10	0.13	0.13	0.11	0.15	0.14	0.12	0.10	0.11	0.14	0.13	0.14	0.14	0.11	0.14	0.12	0.14	0	0.11	0.11	0.14	0.11
F22	0.13	0.14	0.13	0.12	0.13	0.12	0.12	0.13	0.13	0.13	0.12	0.13	0.15	0.11	0.13	0.10	0.11	0.10	0.12	0.12	0.11	0	0.12	0.12	0.12
F23	0.14	0.13	0.13	0.12	0.15	0.12	0.11	0.14	0.12	0.11	0.14	0.15	0.13	0.14	0.11	0.10	0.13	0.10	0.14	0.11	0.14	0.14	0	0.12	0.10
F24	0.12	0.13	0.12	0.13	0.10	0.11	0.14	0.13	0.10	0.13	0.13	0.10	0.14	0.13	0.13	0.11	0.11	0.12	0.12	0.10	0.75	0.23	0.12	0	0.11
F25	0.11	0.15	0.11	0.13	0.13	0.72	0.12	0.14	0.13	0.12	0.11	0.12	0.10	0.11	0.12	0.12	0.10	0.73	0.74	0.10	0.12	0.13	0.14	0.13	0

4.4. Establishing the Adjacency Matrix

It is necessary to introduce a threshold, λ, to eliminate relationships with a smaller degree of influence between factors, facilitating the division of the hierarchical structure. The selection of λ has various methods, and the subjective nature of expert judgment is strong. Therefore, we chose an objective method for determining its value:

$$\lambda = \overline{a} + s \tag{1}$$

in which $\overline{a}$ is the average of the elements in the direct matrix (A), and s is the variance of the elements in the direct matrix (A); the calculation yields $\lambda = 0.36$.

The elements b_{ij} within the adjacency matrix B are as follows:

$$b_{ij} = \begin{cases} 1, \ a_{ij} \geq \lambda \\ 0, \ a_{ij} < \lambda \end{cases} \tag{2}$$

in which if $b_{ij} = 1$, then factor S_i has an influence relationship with S_j; if $b_{ij} = 0$, then factor Si has no direct influence relationship with S_j.

The adjacency matrix (B) constructed according to the above approach is as follows:

$B =$

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21	F22	F23	F24	F25
F1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F3	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
F4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
F5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
F6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	1	0
F7	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0
F8	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
F10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
F11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
F12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
F13	0	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0
F14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
F15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
F16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
F17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F18	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0	0	1	0
F19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
F20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
F21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
F25	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0

4.5. Calculation of the Reachability Matrix

The reachability matrix represents whether a factor can indirectly influence another factor through other factors. The specific calculation rules are as follows:

The adjacency matrix (B) satisfies

$$(B + E)^{n-1} \neq (B + E)^n = (B + E)^{n+1} \tag{3}$$

in which matrix EE is the identity matrix.

The obtained matrix $R = (B + E)^n$ is the reachability matrix, where matrix E is the identity matrix.

$R =$

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21	F22	F23	F24	F25
F1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
F2	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
F3	0	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
F4	0	0	0	1	1	0	0	0	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0
F5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
F6	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	1	0
F7	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0
F8	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
F9	0	0	0	0	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
F10	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
F11	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
F12	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
F13	0	0	0	1	1	0	0	0	0	1	1	1	1	0	0	0	1	0	0	0	0	1	0	0	0
F14	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0
F15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0
F16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
F17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
F18	0	0	0	0	1	0	0	0	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0
F19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	0
F20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
F21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
F22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
F23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
F24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
F25	0	0	0	0	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

4.6. Hierarchical Structure

For each factor S_i, the set of factors that S_i can reach is called the reachable set, $R(S_i)$, and the set of all factors that can reach S_i is called the antecedent set, $A(S_i)$.

The intersection of the reachable set and the antecedent set is called the intersection set, $C(S_i)$.

$$C(S_i) = C(S_i) \cap A(S_i) \tag{4}$$

On this basis, the influencing factors are hierarchically classified to satisfy the equation.

$$R(S_i) = C(S_i) \tag{5}$$

The top-level factors (Level I) are identified and removed first. The process is then iterated for the remaining factors to determine Level II, continuing until all top-level factors are identified. The hierarchical structure of these factors, based on their relationships in the adjacency matrix, is depicted in Figure 3.

From a horizontal perspective, the development of the empowerment platform is mainly influenced by three kinds of factors: platform construction, the layout of the empowerment industry range, and the quality of empowerment. Among these, the layout of the empowerment industry range and the quality of digital empowerment are two distinct points compared to ordinary platforms and industries:

(1) Empowerment platform construction factors: These mainly include funding, talent, manufacturing technology, data acquisition and analysis technology, standards, and other factors.

(2) Empowerment industry range layout factors: Unlike ordinary platforms that serve consumers by facilitating transactions, the target of empowerment platform services is various industries in the manufacturing sector that require empowerment. Due to the significant differences between industries, the empowerment solutions and equipment needed vary. Empowerment platform enterprises must make choices when planning the industry layout, such as balancing the relationship between benefits and costs and setting an appropriate range of industries to empower.

In this process, the platform needs to engage in cross-industry communication, taking into account the development prospects of other industries, the current state of the industry, the national development strategies, and the user needs to plan the layout of the industries to be empowered.

(3) Empowerment quality factors: Unlike traditional industrial manufacturing models, empowerment platforms involve too many industries with significant differences between them. It is challenging for empowerment platform enterprises to thoroughly understand

the basic knowledge of each industry and possess relevant resources. They must rely on and integrate resources within the empowered industries, especially enterprises and research institutes, to create high-quality empowerment solutions.

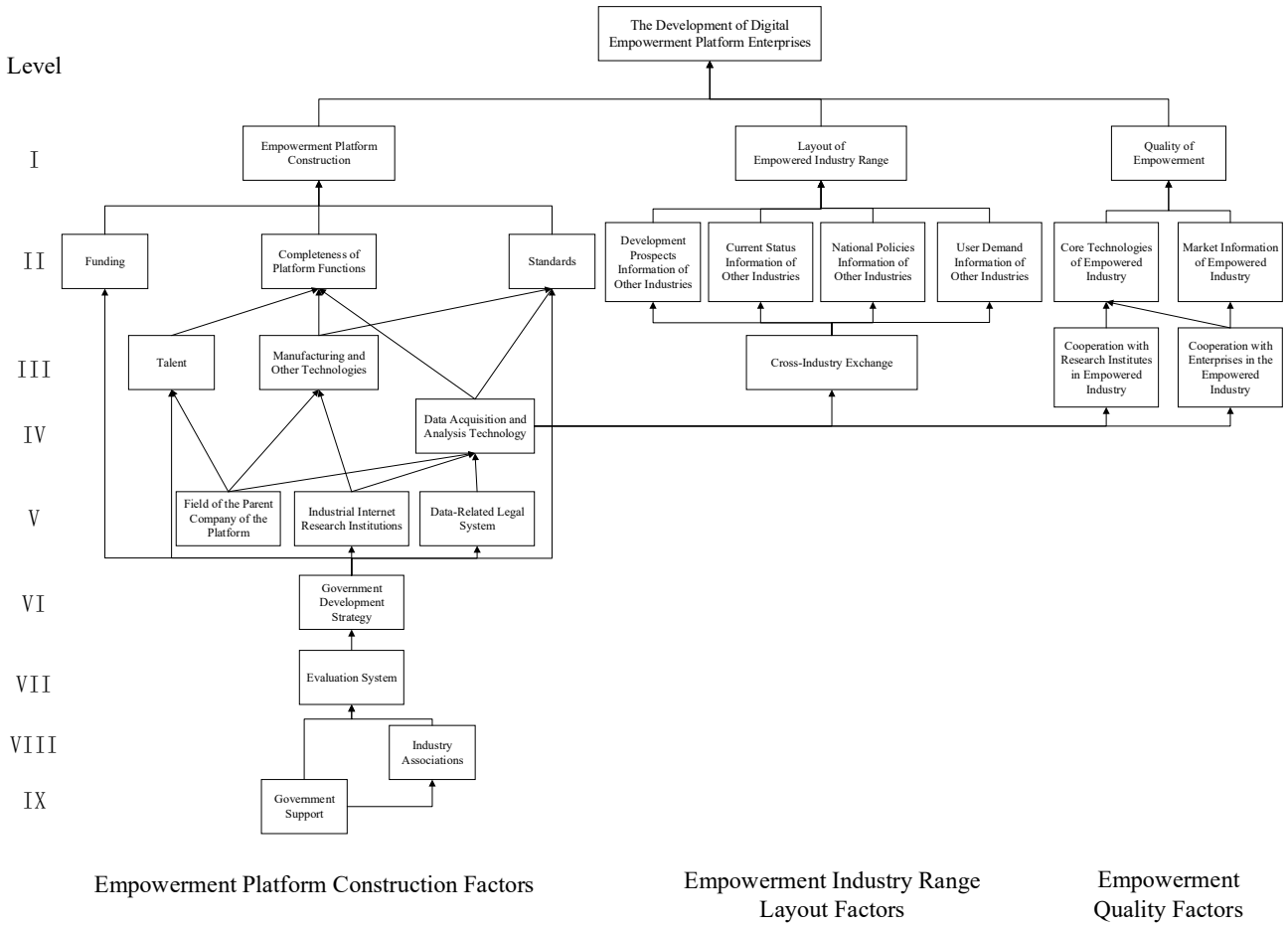

Figure 3. Relationship network of influencing factors.

By collaborating with enterprises within the empowered industry, especially leading enterprises, it is possible to acquire the technology, equipment, and industry experience (that may be behind the leading enterprises but is advanced compared to the industry average) needed to formulate empowerment solutions. Co-operating with research institutes allows for targeted research and development and the acquisition of the latest technologies and empowerment solutions.

From a vertical perspective, the influencing factors are divided into three levels:

(1) The main aspects of platform development (Level I), including empowerment platform construction, empowerment industry range layout, and empowerment quality;
(2) The internal factors of the platform (Levels II to IV), including funding, talent, technology, cross-industry communication, and co-operation;
(3) The external factors of the platform (Levels V to IX), including industrial internet research institutions, data-related legal systems, government development strategies, evaluation systems, industry associations, and government support. The logic for promoting platform development is that the government constructs an evaluation system, and industry associations assist in providing industry information. By using the evaluation system, the government can grasp the current status of the empowerment platform and, based on its weaknesses, formulate targeted strategic development plans. Measures such as providing subsidies, cultivating talent, building research institutes, and setting national standards are taken to promote the development of

funding, talent, manufacturing technology, data acquisition and analysis technology, and standards.

5. Identification of Key Factors Based on the Relational Network Structure

The purpose of this study is to identify the key factors needed for the development of digital empowerment platform enterprises and to propose valuable suggestions for the enterprise. Therefore, from the aforementioned 25 influencing factors, this study selects 12 resources that platform enterprises can control for further identification research: standards, funding, talent, data acquisition and analysis technology, manufacturing technology, completeness of platform functions, national policy information of other industries, development prospects information of other industries, current status information of other industries, user demand information of other industries, co-operation with enterprises in the empowered industry, and co-operation with research institutes in the empowered industry.

From the perspective of network structure, we evaluate the impact of these 12 resources on other factors and their overall driving effect on the development of digital empowerment platform enterprises and calculate the comprehensive effect of direct and indirect influences between system factors.

Firstly, we standardize the direct matrix (A) according to the following equation to obtain the standardized direct matrix (N):

$$x = max[max\sum_{i=1}^{n} a_{ij}, max\sum_{j=1}^{n} a_{ij}] \tag{6}$$

$$\boldsymbol{N} = \frac{\boldsymbol{A}}{\boldsymbol{x}} \tag{7}$$

Then, based on the path calculation methods in graph theory, the elements N_{ij} of the standardized direct matrix (N) represent the weight, or the degree of influence, from factor i to factor j; the elements N^2 of the second power ${N^2}_{ij}$ represent the sum of influences from all paths passing through one intermediate node from factor i to factor j; the elements N^k of the k-th power ${N^k}_{ij}$ represent the sum of influences from all paths passing through $k-1$ intermediate nodes from factor i to factor j.

The comprehensive impact matrix (T), which represents the combined effect of direct and indirect influences between system factors, is calculated as follows:

$$T = \left(N + N^2 + N^3 + \cdots + N^k + \cdots\right) = \sum_{k=1}^{\infty} N^k \tag{8}$$

according to the Neumann series summation formula:

$$\begin{aligned} T &= \left(N + N^2 + N^3 + \cdots + N^k + \cdots\right) = \sum_{k=1}^{\infty} N^k \\ &= N(E-N)^{-1} \end{aligned} \tag{9}$$

$T =$

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21	F22	F23	F24	F25
F1	0.03	0.13	0.06	0.06	0.07	0.06	0.06	0.12	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.04
F2	0.05	0.04	0.12	0.06	0.07	0.07	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.07	0.08	0.08	0.08	0.07	0.08	0.04
F3	0.06	0.08	0.05	0.13	0.08	0.13	0.13	0.13	0.13	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.11	0.10	0.15	0.10	0.10	0.09	0.10	0.05
F4	0.04	0.04	0.04	0.03	0.06	0.04	0.05	0.05	0.04	0.05	0.05	0.05	0.07	0.06	0.07	0.07	0.06	0.13	0.07	0.07	0.07	0.07	0.06	0.07	0.03
F5	0.03	0.04	0.03	0.04	0.02	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.11	0.05	0.04	0.03
F6	0.05	0.05	0.05	0.05	0.08	0.04	0.06	0.05	0.06	0.06	0.06	0.06	0.08	0.07	0.07	0.07	0.07	0.13	0.13	0.08	0.08	0.08	0.07	0.14	0.04
F7	0.05	0.06	0.06	0.06	0.06	0.16	0.04	0.05	0.05	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.06	0.14	0.14	0.10	0.14	0.07	0.06	0.08	0.04
F8	0.04	0.12	0.05	0.04	0.05	0.05	0.04	0.03	0.05	0.06	0.06	0.06	0.06	0.06	0.07	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.06	0.07	0.03
F9	0.04	0.04	0.04	0.04	0.05	0.05	0.04	0.04	0.03	0.05	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.12	0.12	0.07	0.07	0.05	0.05	0.06	0.03
F10	0.06	0.04	0.05	0.04	0.05	0.04	0.04	0.04	0.04	0.03	0.05	0.05	0.04	0.06	0.06	0.06	0.06	0.07	0.06	0.05	0.05	0.12	0.05	0.05	0.03
F11	0.06	0.05	0.06	0.05	0.06	0.05	0.04	0.05	0.04	0.06	0.03	0.06	0.04	0.06	0.06	0.06	0.06	0.07	0.05	0.05	0.05	0.13	0.06	0.07	0.03
F12	0.07	0.05	0.06	0.06	0.06	0.05	0.06	0.06	0.06	0.06	0.06	0.04	0.07	0.06	0.07	0.07	0.06	0.07	0.06	0.07	0.07	0.14	0.07	0.07	0.04
F13	0.07	0.07	0.07	0.07	0.14	0.07	0.07	0.08	0.07	0.13	0.13	0.13	0.05	0.08	0.08	0.08	0.14	0.09	0.08	0.09	0.09	0.11	0.08	0.08	0.04
F14	0.04	0.04	0.04	0.04	0.06	0.04	0.04	0.05	0.04	0.06	0.05	0.06	0.04	0.03	0.06	0.12	0.06	0.05	0.05	0.05	0.05	0.06	0.08	0.05	0.03
F15	0.04	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.06	0.05	0.06	0.04	0.06	0.03	0.12	0.06	0.05	0.05	0.05	0.05	0.05	0.07	0.05	0.03
F16	0.03	0.04	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.04	0.05	0.06	0.03	0.06	0.05	0.05	0.05	0.05	0.05	0.12	0.05	0.03
F17	0.05	0.04	0.03	0.03	0.05	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.04	0.05	0.05	0.05	0.03	0.04	0.04	0.04	0.04	0.05	0.04	0.05	0.03
F18	0.04	0.06	0.05	0.05	0.09	0.05	0.05	0.06	0.05	0.08	0.07	0.08	0.13	0.13	0.13	0.08	0.08	0.05	0.06	0.14	0.09	0.08	0.08	0.14	0.04
F19	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.04	0.05	0.03	0.12	0.08	0.05	0.06	0.12	0.03
F20	0.05	0.04	0.04	0.03	0.04	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.11	0.05	0.05	0.04	0.03
F21	0.04	0.03	0.03	0.03	0.04	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.03
F22	0.04	0.04	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.04	0.03	0.03	0.04	0.03	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.03	0.04	0.04	0.03
F23	0.03	0.04	0.03	0.03	0.04	0.03	0.03	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.02	0.04	0.02
F24	0.03	0.04	0.03	0.03	0.04	0.03	0.04	0.04	0.03	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.12	0.06	0.04	0.03	0.03
F25	0.04	0.05	0.04	0.04	0.05	0.11	0.04	0.05	0.04	0.05	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.13	0.13	0.06	0.06	0.06	0.05	0.07	0.02

in which each element T_{ij} in T represents the influence and driving effect of F_i on F_j.

Therefore, the sum of the elements in each row can represent the overall influence and driving effect of F_i on the system, becoming the influence degree, denoted as D_i.

$$D_i = \sum_{j=1}^{n} x_{ij}, (i = 1, 2, \ldots, n) \quad (10)$$

Finally, the influence degrees D_i of the 12 resources are calculated and shown in Figure 4 below.

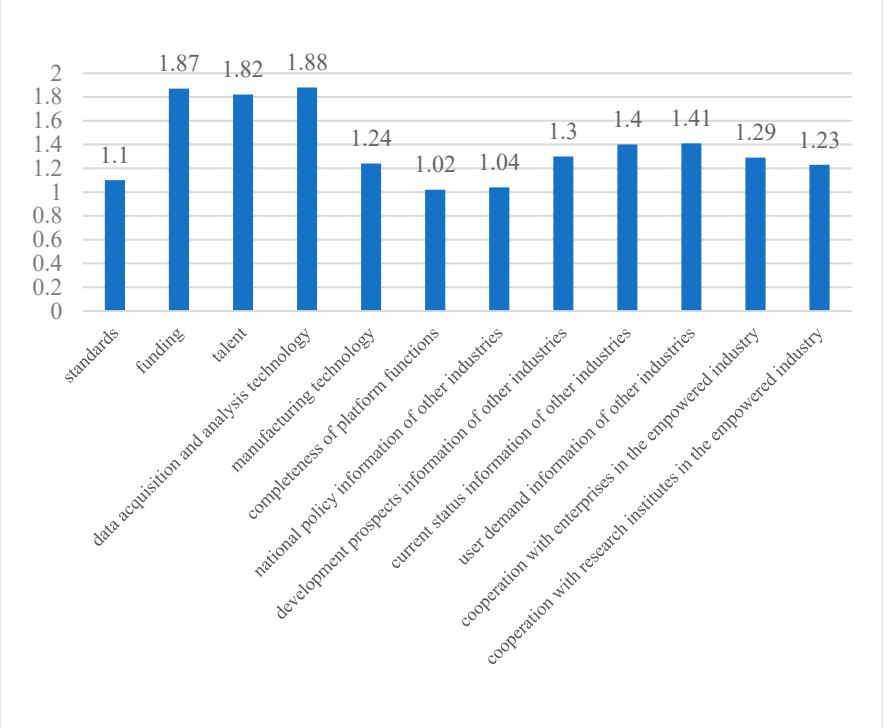

Figure 4. Influence degrees of resources.

From Figure 4, funding and talent have influence degrees of 1.87 and 1.82, respectively, and have a significant impact on enterprise development. The reasons are obvious and do not require further argumentation; the degree of influence of data acquisition and analysis technology is 1.88. The reasons for this are that (1) this factor is one of the influencing factors of platform construction and can drive the development of platform construction; (2) data acquisition and analysis technology can empower the platform to obtain information from other industries, enhancing its ability to strategically layout empowering industries; (3) data acquisition and analysis technology can also be used to retrieve information from enterprises and research institutes within the empowered industries, facilitating co-operation with them and elevating the quality of empowerment development.

Therefore, funding, talent, and data acquisition and analysis technology are key factors that can drive the development of digital empowerment platform enterprises.

6. Identification of Key Factors Based on Enterprise Competitive Advantage

The previous section determined the degree of influence of resources on digital empowerment platform development through their relational network. This paper now complements the analysis by assessing the inherent characteristics of these factors from a management perspective, focusing on enhancing the enterprise's competitive advantage.

VRIO theory, which examines how valuable (V), rare (R), inimitable (I), and organizable (O) resources help to establish corporate competitive advantage, aligns with this study's objectives. However, the VRIO attributes of resources will change with the market

environment. To make up for this deficiency, in 2010, Professor Simão from Aberta University expanded the theory to VRIO(S), incorporating sustainability (S). Therefore, this study uses the VRIO(S) theory to evaluate the 12 resources one by one. The specific details are shown in Table 3 below:

Table 3. Evaluation based on enterprise competitive advantage.

No.	Resource	Attribute					Competitive Advantage
		V	R	I	O	S	
1	Standards	→	→	→	→	→	Sustainable competitive advantage
2	Funding	→					Low
3	Talent	→					Low
4	Data acquisition and analysis technology	→					Low
5	Production and manufacturing technologies	→					Low
6	Completeness of platform functions	→	→	→	→		Non-sustainable competitive advantage
7	Continuous and accurate national policy information of other industries	→	→	→	→	→	Sustainable competitive advantage
8	Continuous and accurate development prospect information of other industries	→	→	→	→	→	Sustainable competitive advantage
9	Continuous and accurate current status information of other industries	→	→	→	→	→	Sustainable competitive advantage
10	Continuous and accurate user demand information of other industries	→	→	→	→	→	Sustainable competitive advantage
11	Continuous and efficient co-operation with enterprises in the empowered industry	→	→	→	→	→	Sustainable competitive advantage
12	Continuous and efficient co-operation with research institutes in the empowered industry	→	→	→	→	→	Sustainable competitive advantage

From the table above, the following conclusions can be drawn:

(1) Standards are key factors in building sustainable competitive advantage:

Firstly, standards are value. A platform that pioneers the establishment of industry or national standards with its own technology and empowerment solutions can bring the following values: (1) it can enhance the platform's authoritative image; (2) it can form a chain of "technologization of technology patents–standardization of patents–licensing of standards", creating a competitive advantage [37]; and (3) it can exclude competitors' non-standard technologies and empowerment solutions, forcing opponents to spend extra time and cost on improvements.

Secondly, standards are unique and rare, thus exhibiting scarcity and inimitability. A platform can participate in industry associations to set industry standards and promote the establishment of national standards, making standards organizable. According to the law, the review period for national mandatory standards in China does not exceed 5 years, but in practice, there is a certain delay in the review and updating of standards. According to incomplete statistics, more than 30% of standards are over 10 years old. Therefore, standards also have a certain degree of sustainability.

In summary, a platform can establish industry standards first, build core competencies in reputation and patent revenue, and force other non-standard competitors to invest additional resources for improvement, weakening their competitiveness and thereby building sustainable competitive advantage.

(2) The competitive advantage brought by funding, talent, data acquisition and analysis, and manufacturing technology is relatively low:

Funding, talent, data acquisition and analysis technology, and manufacturing technology have high value and organizable attributes. However, most existing platforms currently come from large enterprises that have already completed their digital transformation on

their own, and they often possess substantial funding, talent, advanced data acquisition and analysis technology, and advanced manufacturing technology. Therefore, they do not exhibit rarity, and the potential to bring significant competitive advantages is relatively low.

(3) Comprehensive platform functionality is a key factor in building competitive advantage, but sustainability requires attention:

Existing empowerment platforms are often constructed by large enterprises in the fields of automation, manufacturing, software, and information technology, each with different focuses and incomplete functionalities. If the platform can integrate talents and technologies from these diverse fields to enhance its functionality, a comprehensive platform will currently possess VRIO attributes, empowering the platform to build core competencies in empowerment solutions and gain a competitive advantage. The renowned digital empowerment platform in China, COSMOPlat, has been consistently rated as an industry leader precisely because of its comprehensive empowerment capabilities.

However, as co-operation and complementarity among platforms increase, comprehensive functionality will become more common, and thus comprehensive platform functionality will not provide a lasting competitive advantage. The sustainability of competitive advantage requires attention.

(4) Continuous and accurate information from other industries is a key factor in building sustainable competitive advantage:

Information about the development prospects, current levels, national policies, and user demands of other industries is the foundational resource for platforms to decide whether to enter or abandon a particular industry and to carry out empowerment industry layout processes.

Only continuous and accurate information from other industries has value, rarity, and inimitability and can play a role sustainably. Such information helps platforms accurately assess the prospects, current status, and policy trends of other industries and quickly adjust their empowerment industry layout, thereby enhancing strategic layout and dynamic adjustment capabilities and building a sustainable competitive advantage for the platform.

(5) Continuous and efficient co-operation with enterprises and research institutes in the empowered industry is a key factor in building sustainable competitive advantage:

Continuous and efficient co-operation with leading enterprises and research institutes in the empowered industry can help platforms continuously obtain accurate market information and the core product technologies of the empowered industry, possessing VRIO(S) attributes, which can bring a sustained competitive advantage in terms of empowerment quality for the platform.

7. Comprehensive Analysis and Management Recommendations

7.1. Comprehensive Analysis

This study draws on the concept of the Boston Matrix to establish a six-quadrant matrix, categorizing the key factors identified from the two dimensions into six types for comprehensive analysis, as shown in Figure 5 below.

On the vertical axis, it is noteworthy that funding, data acquisition and analysis technology, and talent fall into Quadrant I, which are resources with a high degree of influence on the development of data empowerment platform enterprises, capable of rapidly promoting platform development and quickly achieving breakthroughs from nothing to something. The current industry of digital empowerment platform enterprises is in its initial stage, and enterprises should pay attention to these resources. However, it should also be noted that data empowerment platform companies come mostly from large enterprises that have completed their own digital transformation. For these large enterprises, capital, technology, and talent are not scarce resources and cannot bring them greater competitive advantages.

On the horizontal axis, it is worth noting that continuous and accurate information about other industries, continuous and efficient co-operation with enterprises and research institutes in the empowered industry, and standards fall into Quadrant VI, which are resources that can bring a sustainable competitive advantage, but their influence degree is relatively low, and their driving effect on the development of the empowerment platform enterprise is relatively low. Therefore, enterprises should focus on developing and utilizing these three types of resources after the platform is established, enhancing the corresponding core capabilities of the enterprise, and building a sustainable competitive advantage.

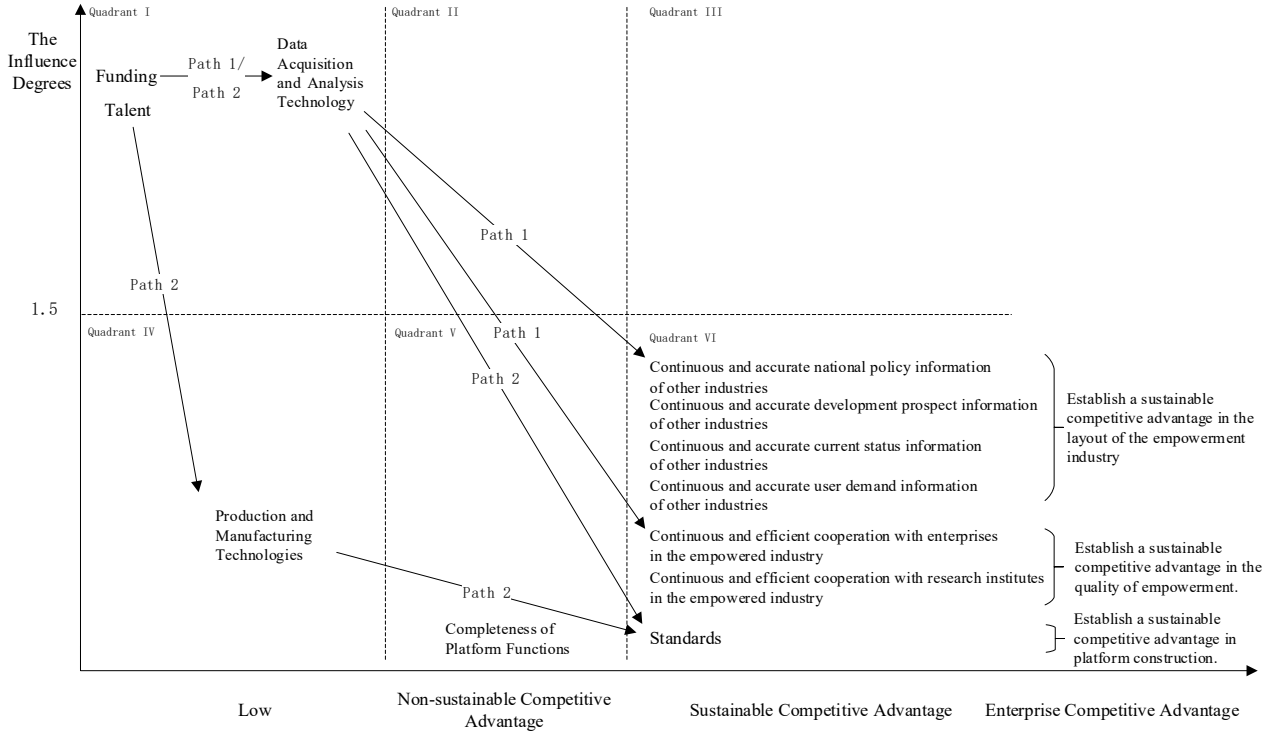

Figure 5. Six-quadrant classification matrix for key factor analysis.

7.2. Recommendations for the Development Path of Digital Empowerment Platform Enterprises

(1) Path 1: "Capital", "Talent", and "Data acquisition and analysis technology" → "Continuous and accurate information of the empowered industry" and "continuous and efficient cooperation with the empowered industry":

As shown in Path 1 of Figure 5, there are many factors affecting the development of empowering platform enterprises, among which capital, talent, and data acquisition, and analysis technology have a greater impact on the development of data empowering platform enterprises. In the initial stage, enterprises can focus on these three factors to achieve the rapid construction of data empowerment platforms. However, these three factors cannot bring a competitive advantage to enterprises.

What can bring a continuous competitive advantage to enterprises is "continuous and accurate empowered industry information", such as national policy information, development prospect information, industry status information, and consumer demand. Consider that "data acquisition analytics" is precisely the basis for obtaining "continuous accurate empowered industry information". Therefore, in the future, enterprises can determine some potential empowered industries according to their own strategic development goals and establish targeted data acquisition and analysis systems. For example, to find targeted data sources, build a targeted technical thesaurus and specialized consumer interaction thesaurus in order to obtain "more accurate information about the empowered industries". This more accurate information can help companies position themselves in empowering industries and help them build a sustainable competitive advantage.

In addition, enterprises can also use data acquisition and analysis technology to establish a special technology dynamic monitoring system around the empowered industry, accurately identify the "best partners between enterprises and research institutes", establish continuous and efficient co-operation relationships, develop high-quality empowering solutions, and establish sustainable competitive advantages. For example, COSMOPlat has now achieved 24/7 monitoring of 913 technical areas in 51 major directions across the industry. This all-weather monitoring system has provided great help for Haier in carrying out technical co-operation with the outside world and building sustainable competitive advantages.

(2) Path 2: "Capital", "Talent", and "Technology"→"Standards":

As shown in Path 2 of Figure 5, enterprises can promote the development of the platform through funds, focus on the development of data acquisition and analysis technology, production and manufacturing technology, create standards, form a chain of "technique patented–patent standardized–standard licensed", and build sustainable competitive advantages.

7.3. Policy Recommendations

(1) Use standards to attract corporate innovation:

Technological innovations that meet market demands are the foundation of forming technical standards [37]. Government departments can leverage industry associations to stay informed about industry technological trends, establish standard-setting committees, and appropriately increase the frequency of standard updates, giving companies more opportunities to establish competitive advantages from building standards and thereby encouraging companies to actively engage in technological innovation.

In addition, the government should also support enterprises in obtaining patents and establishing standards in the international market to enhance the global influence and competitiveness of Chinese empowerment platform enterprises, making them a shining business card for showcasing the nation's strength.

(2) Improve data-related legislation to support the development and application of data technology:

Data acquisition and analysis technology plays a significant role in promoting the development of digital empowerment platform enterprises. On the one hand, it can affect the ability to collect and analyze information from the empowered industry and the capability to conduct layouts in the empowerment industry range. On the other hand, it is also related to the depth of understanding and co-operation with the platform, industries, and research institutes, thereby enhancing the quality of empowerment. The government can support the development and application of data acquisition and analysis technology by improving data protection regulations and establishing data trading systems to facilitate data flow.

8. Summary

Digital transformation plays a pivotal role in the development of industry. However, the majority of manufacturing enterprises are small- and medium-sized enterprises (SMEs) that face certain difficulties in achieving digital transformation on their own. The emergence of digital empowerment platform enterprises in recent years has opened up a new path for the transformation of SMEs, which is of great research significance. Current research mostly focuses on the mechanisms of empowerment platforms, with fewer studies on the development factors of empowerment platform enterprises, which is somewhat insufficient for guiding the development of empowerment platforms. Therefore, we conducted a study on the identification of key factors for the development of digital empowerment platform enterprises.

Identifying the key factors of digital empowerment platforms involves evaluating numerous influencing factors. There are many multi-factor evaluation methods currently available, but most of these analysis methods are based on mathematical analysis, neglecting the evaluation of the inherent characteristics of the influencing factors from a

management perspective. In addition, the main purpose of its development is to quickly complete the construction of platform enterprises. After the construction of the platform enterprise is completed, the main goal of its development is to build a continuous competitive advantage. Different stages of development goals are different, and the key factors of evaluation development must be evaluated in multiple ways from multiple angles.

Therefore, this study reconstructed the evaluation method for influencing factors: Firstly, this study used the ISM method to construct the relational network structure among factors; then, it identified key factors from the perspectives of relational network structure and enterprise competitive advantage; finally, by drawing on the Boston Matrix, it constructed a six-quadrant matrix to enable comprehensive analyses of the influences.

On this basis, the following research conclusions were drawn:

(1) From the perspectives of network structure and enterprise competitive advantage, six key factors were identified:

Through field research and a literature review, this study identified 25 main influencing factors and constructed a relational network among them. From the perspective of network structure, funding, talent, and data collection and analysis technology were identified as key factors driving the development of digital empowerment platform enterprises; from the perspective of enterprise competitive advantage, standards, continuously accurate information from other industries, and continuous and efficient co-operation with enterprises and research institutes in the empowered industry were identified as key factors for establishing a sustainable competitive advantage for data empowerment platform enterprises.

(2) Two development path recommendations were proposed for digital empowerment platform enterprises:

Digital empowerment platform enterprises are currently in the initial stage, and enterprises should value the use of resources with a greater impact and driving force on enterprise development, namely funding, talent, and data collection and analysis technology, to promote the rapid development of digital empowerment platform enterprises. However, the above three resources in the field of digital empowerment platform enterprises cannot bring about a sustainable competitive advantage to the enterprise. Therefore, in the later stages of development, enterprises should focus on applying for obtaining and using continuously accurate information from other industries, building continuous and efficient co-operation with enterprises and research institutes, and standards in the empowered industry, thereby enhancing the corresponding core capabilities of the enterprise and building a sustainable competitive advantage.

On this basis, this paper proposes the following two development paths: ① Path 1: "Capital", "Talent", and "Data acquisition and analysis technology"→"Continuous and accurate information of the empowered industry" and "continuous and efficient cooperation with the empowered industry". It could enhance the platform enterprise's empowerment industry layout capabilities and the platform's empowerment quality and build a sustainable competitive advantage. ② Path 2: "Capital", "Talent", and "Technology"→"Standards". It could build a sustainable competitive advantage.

In addition, this paper proposes two suggestions for the government: "Use standards to attract corporate innovation" and "Improve data-related laws to support the development and application of data technology".

At present, digital empowerment platform enterprises are still in the initial stage, and there is a lack of macro-quantitative data in the industry. Due to this situation, this study used more qualitative methods for research. Subsequently, as digital empowerment platform enterprises become more mature, more in-depth and systematic quantitative research can be conducted on the basis of data collection.

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Q.Z.; Investigation, Y.X. and Z.W.; Resources, Y.X. and Z.W.; Data curation, Z.W.; Writing—original draft, Y.X. and Z.W.; Writing—review & editing, Y.X. and Z.W.; Supervision, Y.X.; Project administration, Y.X.; Funding acquisition, Y.X. All authors have read and agreed to the published version of the manuscript.

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