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Research Article

Intelligent System Construction Paths for Digitalization Process of Real Economy: A Study from the Perspective of Artificial Intelligence and Platform Leverage

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This study studies the internal driving force and system construction issues in the integration of information technology and traditional business. Established on theory of platform leverage in the value creation, we use causal analysis and case studies to explore two closely related questions with data of 31 digital platforms (including 21 focal cases and 10 reference cases): (i) what is the value creation mechanism of these digital platforms? and (ii) how does the value creation mechanism affect the construction path of the system? The study identified three typical value creation mechanism configurations, i.e., innovation-driven, business integration, and data-driven, and then explained the system construction paths of these three configurations. We observed that the production and innovation leverages are the general construction drivers of the platform. However, the transaction leverage is only significant in a small number of platforms; that is, the role of network effects can be observed. These findings can deepen our understanding of platform theory in the digitalization of the real economy and explain why network effects cannot be the source of competitive advantage within the economic digitalization scenarios. We believe that it is of great significance to the digital transformation practice of the economy.

1. Introduction

With the deep integration of information technologies such as the Internet of things (IoT), cloud computing, and big data with traditional business models, the digitization of the real economy is changing the competitive landscapes in many industries and ultimately completely reshaping the market and society [1–3]. In the process of digital transformation, the practice of forming a cross-organizational coordination system based on digital platforms and driving the digital transformation of access enterprises [4] has spread across various real economic fields such as manufacturing, distribution, and professional services, representing the current mainstream phenomenon of the digital transformation. However, the process of digital transformation in real economy has similar structural characteristics to the classic Internet economy whose typical characteristic is individual access. Furthermore, it exhibits completely different economic characteristics, which leads to frequent difficulties in platform patterns based on experience logic. Exploring its inherent principles will not only help reduce the huge waste of resources and business opportunities for enterprises but also be the key to the smooth implementation of digital transformation strategy in China and even all over in world.

Exploring the inherent principles of cross-organizational coordination system cannot ignore the basic characteristics of organizational coordination, which determines the construction logic of the entire system. The current research on digital transformation in Industry 4.0 and information systems generally agrees that the system has two basic characteristics: firstly, the integration process is the combination of information systems and enterprise operation systems [5–7]; secondly, it is difficult to see the economic benefits of digitalization in the short term [8]. The above two characteristics make the value creation ability of digital platforms become the key to system construction [9].

The value creation ability of the platform in organizational coordination is the role of leverage, intending to emphasize that the platform can achieve leverage beyond the conventional input-output ratio through certain measures [10]. The authors proposed three leverages based on combing different schools of research, that is transaction leverage, production leverage, and innovation leverage. The current mainstream of construction logic in platform system believes that traction leverage is the core value creation mechanism of the platform. Transaction leverage reflects the role of positive network effect (In the discussion context of platform competitive advantage, platform entrepreneurship, and other issues, network effects generally refer to positive effects, such as and Evans [11]; that is, when a market involves different customer groups, the number of individuals in different customer groups determines the value of the market [12].) that represents the core view of market intermediary stream and has a profound impact on practice [10–13]. The market intermediary stream can be reviewed as the affiliation of platform construction, and construction logic corresponding to the view of affiliation is called the structure view [14]. The structural perspective leads the system construction logic of the platform to digital transformation, focuses on the fit between the platform and the users of platform and even other stakeholders, and emphasizes the importance of strategic attention to different users of platform [14, 15]. Although the structural view has received extensive attention, there is a lack of comprehensive discussion on the impact of the two basic characteristics in digitization, and it is still difficult to systematically answer two basic theoretical questions: (1) what value-creating mechanisms do digital platforms in different industries have? (2) How does the value creation mechanism affect the construction path of the system? These two issues are closely related and are the core of understanding the laws of digitalization of the real economy and determine the direction and focus of resource investment in practice.

Platforms are everywhere, including all the patterns of Internet within an organization or interorganizations [16], and the complexity of the system and the diversity of system patterns make it difficult to conduct research using a single case study approach. This study will adopt a hybrid research method of fuzzy set qualitative comparative analysis (fsQCA) and case study. We firstly use fsQCA as an auxiliary method [17] to classify multiple cases and use case study to link the complex and diverse platform context with the effect of system construction. The major contributions of this study are as follows:

(i) investigate the internal driving force and system construction issues in the integration of information technology and traditional business

(ii) We use causal analysis and case studies to explore (i) what is the value creation mechanism of these digital platforms and (ii) how does the value creation mechanism affect the construction path of the system

(iii) We discuss the dynamic mechanism and construction path of the system in the digital transformation process

The following sections are carried out in the following order: Section 2 reviews the literature on the leverage of platform value creation and the digital characteristics of the real economy and identifies research questions; Section 3 introduces research design and case selection; Sections 4 and 5 introduce the steps and findings of fsQCA and case studies, show the causal logic configuration of the platform value found by fsQCA, and analyze the system construction paths under different logic configurations; Section 6 is the discussion; and finally, Section 7 concludes this study.

2. Theoretical Background

2.1. Leverage of Value Creation in Platform. "Platform" is used to describe the management phenomenon of individual products, product systems, industry supply chains, markets, industries, and even clusters [18] and is sometimes referred to as platform strategy [14]. Researchers generally believe that modularity and mutual benefit are two core characteristics of platforms [15], and they are the source of value creation in platform. Organizational stream reviews that the organizational resources and capability structures should be shared [19]. The product family stream represents that economic advantages are created in supporting flexibility in product development and product functionality [20]. The market intermediation stream emphasizes the efficiency of two-sided market in connecting supply and demand [12]. Platform ecosystem stream identifies the specialization and complementarity embodied in sharing core technologies [21], which are the result of the combined effects of modularity and mutual benefits. Three leverages are put forward based on two characteristics of the value creation mechanism, among which, the transaction leverage is mainly based on the classic research of the market intermediary stream, the production leverage is mainly based on the classic research of the organization and product family stream, and the innovation leverage is mainly based on the classic research of the platform ecosystem stream [10]. The definitions and dimensions of various leverages are detailed in Table 1.

The basic feature of digitization is that platform operators use information systems to provide digital service activities for various users [30]. We used CiteSpace to analyze the Web of Science literature around the related literature and found that there are two perspectives that discussed the potentials brought by digital information technology and the advantages generated by integration, that is, information technology perspective and digital service perspective, both of which provided rich insights for understanding leverages (see Table 1).

2.1.1. Trade Leverage. The information technology perspective literature treats digital platforms as software-based platforms [35], representing that the reprogrammability, data homogeneity, and self-referentiality of digital technologies provide technical support for the realization of a two-sided market structure [23]. With such support, value is created for transactions between supply and demand (or multiple parties) by directly matching supply and demand,

Table 1: Three leverages in digitalization.

	Transaction leverage	Production leverage	Innovation leverage
Definition	Improve transaction efficiency and reduce search costs based on manipulation of pricing and governance including market availability, pricing mechanism, and entry mechanism	Use interfaces and standards to share resources to motivate economies of scale and scope including production (including service) quality/efficiency, production organization, and production methods	Use interfaces and standards to share resources to facilitate the creation of new goods and services including product/service quality and new product/service business process
Information technology perspective	(i) The layered network architecture provided by digital technologies supports the multi-/bilateral market structure of the physical world [22, 23]	(i) The widespread use of IoT components promotes monitoring, control optimization, and autonomy, promotes new business generation, and improves management efficiency [1, 24, 25]	(i) Digital artifacts lead to changes in the time and space boundaries of innovation, promote knowledge sharing and collaborative changes, and shape distributed innovation (ii) The modular and complementary architecture of the digital platform facilitates collaboration between the platform and access parties [26–29]
Digital service perspective	Data help service providers reduce market friction by matching two different players searching for each other [22, 30–32]	Effective data analysis can improve services or execute data-driven algorithmic decision-making processes more efficiently [7, 33, 34]	Data can fuel open innovation, or expand business models to new customer groups [32]

Note. The division and definition of leverage are based on Thomas et al.

suggesting possible transactions, or providing powerful search capabilities [36]. The literature from the perspective of digital services believes that digital services are a data-intensive process [37], which works by accessing different data sources to form an intelligent autonomous system with users, providing platform with the opportunity to create data streams and create opportunities for further development of value-added services [30]. It has been proved that the logical structure of two-sided markets correlates with emerging opportunities created by data [32], and data help reduce market friction in matching participants [36]. The above research shows that IT and digital services themselves contain the basis for the generation of transaction leverage and do not necessarily rely on platform operators to achieve through pricing mechanisms and entry mechanisms.

2.1.2. Production Leverage. The role of information system in production is closely connected to new technological hardware. The widespread use of IoT components not only provides value in terms of monitoring, control, optimization, and autonomy [1], making the real world more personalized and efficient, and enabling the creation of value-added services [24], but also greatly improves the management efficiency of industrial processes in enterprises [25]. The large amount of user/product-generated data is the key to creating value [33], and companies can use effective data analysis to provide better services or more efficient decision-making processes to gain competitive advantage [7, 34]. Therefore, the generation of production leverage is not only based on the combination of modular and complementary but also depends on the productivity brought by digital systems and data.

2.1.3. Innovation Leverage. Existing literature has pointed out that digital infrastructure enhances the innovation capability of enterprises through two functions [28]: firstly, digital technology leads to changes in the time and space boundaries of innovation, enabling the innovation process to spread across time and space, promoting knowledge sharing, collaborative paradigm change, and the emergence of a distributed innovation landscape [26]; secondly, the boundaries and interface functions of digital platforms change the function of boundaries, turning boundaries between complementary companies from barriers to point of penetration for resource connections [27], facilitating cross-organizational collaboration and the creation of new products [26, 28, 29]. From a data service perspective, the data in the platform can be used as a trigger to enhance the value capture mechanism of entire system [32], which can facilitate the open innovation of the platform or expand the business model to new customer groups [32]. On the one hand, these findings show that the digital system has changed the principles of innovation, and on the other hand, the emergence of multi-/bilateral market structure is not necessarily the result of the increase in the number of access parties, but may be an endogenous value-added method of the system.

2.2. System Construction Characteristics in Digitization of the Real Economy

2.2.1. Influencing Factors in Platform Context. The digitization of real economy is characterized by the fusion of information systems and business operating systems [30]. The result of digitalization is a complex cyber-physical system [38]. The factors from the business operating system and other factors in the progress of integration of IT system and operation system will exert significant impacts on digitalization, which results in the uniqueness of the system construction. The platform context refers to the characteristics of platform that affect the leverages [6], including various factors impacting digitization. Combing the research

of information technology and platform governance, we can see that the platform context involves both information technology and enterprise operations. Digitization means the deep integration of information technology and daily operations of enterprises, which requires digital platforms to penetrate business processes. Therefore, the system construction process is regarded as a process of human-machine integration and business integration [39, 40]. The newest research also highly emphasizes the role of the two integrations in the progress of digitization. According to Accenture research, 86% of senior managers believe that the use of digital technologies at the personal level is important to digitization ("accessed" "title="https://www.accenture.com/us-en/insights/technology/technology-trends-2021, accessed"">https://www.accenture.com/us-en/insights/technology/technology-trends-2021, accessed to 20.3.2021). In digital transformation, research mostly emphasizes the role of new technologies in integrating different processes and activities [41]. Achieving digitization requires recombining digital assets with other organizational resources to transform the way business. Digitalization can enhance the value creation through continuously sensing and seizing market opportunities as demonstrated in [9, 19].

In addition, the platform context involves the factors of all parties involved in the platform system. The platform system is a value co-creation system composed of platform operators and various users, and they are the key subjects that influence leverages [9]. From the perspective of system operation, the ability to provide high-quality digital services is an important prerequisite for the generation of leverages. For example, the triggering role of data in the capture of system value will provide advantages for the digital companies which already have certain amount of business [32]. However, this triggering effect needs sufficient data resources and the abilities of data mining, which reflects the resource endowment in the progress of platform's growth. From the perspective of users, since digitization often requires a certain amount of investment, for example, the digitalization in industries may represent the transformation of production lines, but it is difficult to achieve economic results in the short term, so it faces the "digital paradox" [42]. The users may have higher requirements than strategic fit [14] when participating in digitalization. Due to the particularity of the digitization of real economy, the impact from the platform context may be complex and diverse.

2.2.2. Measurement of System Construction. The digitization of the real economy is also characterized by a long economic return cycle, which limits the use of financial indicators to measure transformation results. On the one hand, digitalization comes with high installation costs and long payback periods [42], and many companies are willing to accept short-term losses in exchange for long-term growth [9]. On the other hand, the various improvements brought about by digital technologies are often more attractive, and new business models are often placed on higher expectations than the direct economic effects. Digitalization can dynamically adjust production processes through process monitoring and leverage transformative digital metrics to provide finer-grained insights [9], which will bring new business models to enterprises [19].

In terms of the characteristics of digitalization, the quick response enthusiasm of users can reflect the system construction effect much better. The essence of digitization is the realization of complex solutions in integration [30], which will pose huge challenges to the knowledge and capabilities of platform owners [41]. The active interaction and response of users will facilitate the sharing of more resources, knowledge, and skills [6] and promote the digitalization process.

It can be seen from the above research that leverage is an inherent feature of the platform, and the three leverages coexist in a platform context. However, due to the differentiated platform contexts, different combinations of leverage may be used to promote system interaction and then have an impact on system construction. The following research will provide the following possibilities: firstly, the leverage is examined through the effect of constructing digital platform system; secondly, the platform context factors through clarifying leverages will be found; and finally, we will identify different system construction paths with different leverages. However, as far as the current research is concerned, there are still a series of issues to be studied in the research topics related to the value creation mechanism and system construction in the digitalization of real economy, such as what different leverage combinations are mainly present in the value creation mechanism? what is the platform context for various value creation mechanisms? and what are the significant influencing factors in the platform context? From the platform environment to value creation to system interaction, what are the key driving forces in different value creation mechanisms? The key to revealing this series of problems lies in how to classify complex and diverse platform contexts.

3. Methodology

We view the digital platforms as a set of creating value through multi-agent collaboration. According to the principles of set theory (open set and pair set axioms), there are several subsets reflecting the diversity of contexts. fsQCA can support the research of relatively large amount of cases and find various configurations. fsQCA has been affirmed by mainstream journals all over the world [43], and its logical basis is finding the unique phenomenon in comparison [44]. faQCA reduces complexity in limited diversity cases, provides a framework for case comparison, and explores the patterns of configuration types [17].

This study will use fsQCA and case study jointly to find the value creation mechanisms. The reasons are as follows: firstly, the combination of leverages reflects the specific mechanisms of platform value creation, and fsQCA has the advantages of finding regularities in a specific combination [17]. When performing configuration analysis, it can identify a typical case. fsQCA can also present a framework of combination between different leverages and provide opportunities of inducing commonness and finally clearly

Table 2: Overview of the research methods.

Research method selection	fsQCA	Case study
The purpose of analysis	(i) Distinguish and analyze the connection of value creation mechanisms (explore whether the notion of affiliation is a realistic system-building logic) (ii) Establish a causal logic configuration to provide a basis for case interpretation	(i) Identify characteristics, dynamics, and building path of configurations (ii) Answer why affiliation is not the construction logic of in reality
The resources of research	(i) Construct variable value (ii) Describe each case	(i) Construct logic configuration (ii) Describe each case
The output of research	(i) The logic relation of value creation mechanism (ii) The framework of logic configuration	(i) The characteristics of platform configuration (ii) The driving forces and paths of system construction

show the commonness of logical configurations. Based on the above analysis of fsQCA, it is found that the multi-case analysis can show the relationship between the characteristics of platform context in the logical configuration, the value creation mechanism configuration, and the system construction result, thus showing the digital realization path. The internal logical relationship of the two methods is shown in Table 2. The entire analysis process includes many cross-stage iterations. For example, when problems are encountered in the consistency check in fsQCA, additional research on conflict cases is required to confirm the accuracy of assignments. The case study will observe the robustness of typical case studies and the commonness of cases through dynamically adjusting the case scope and criteria of consistency.

There are two sources of the analyzed cases in this study: one is the 8 first-hand cases developed by authors, and the other is 23 second-hand cases recorded in China Management Case Sharing Center (Three conditions are required to be met when selecting case base cases: (1) the keywords contain "platform (ecosystem)," "digital transformation," and "digital information system"; (2) there are substantial expressions of three types of leverages and system construction effects; and (3) there is a commitment to the authenticity of the information.). The cases tracked by the author's team have records of multiple rounds of field investigations and interviews. In addition to the case text, the second-hand cases are supplemented with other second-hand data and confirmatory research. There is no significant difference in the completeness of information between the two sources of cases.

In terms of case selection, we follow the classification of platforms proposed by 44 and focus on supply chain platforms (case codes starting with B) and industrial platforms (case codes starting with C), both of which represent the collaborative relationship between platform operators and users. At the same time, 10 intra-enterprise platforms are added for reference (the case code starts with A) (The cases for reference help to play an opposing reference role in indicator assignment, consistency checking, and case subset discovery. The research and data analysis process for the reference case is the same as that for the focus case. Reference cases include A-HMZY, A-XADT, A-KTZN, A-ZKXC, A-ZHCG, A-FSK, A-LBJT, A-MCYP, A-HBJT, and A-BLJT.). It can be seen from Table 3 that production or professional services in the supply chain platform are common features, while professional services in the industrial platform are the main manifestation, both of which reflect the basic characteristics of the business integration. In terms of functional positioning, 6 of 9 supply chain platforms have transaction functions, while only 3 of 12 industrial platforms have transaction functions. The case information and details are shown in Table 3.

4. fsQCA

4.1. Variable Assignment. This study identifies antecedent variables and configuration output variables according to the constructs and dimensions presented in the well-known theory of the platform leverage in the value creation [10]. In addition to the three leverage effects, as discussed earlier, the antecedent variables also add the platform type (Platform_type) as a control variable to eliminate the influence of the type gap, and the configuration output variable adopts the construction effect; see Table 4 for further details.

The fuzzy assignment of research indicators is the basis of the analysis. In fact, this requires a comprehensive and complete understanding of all cases. In this research, we use the quartile assignment method, which is put forward by Ragin [45]. This method mainly includes three steps: (1) review the whole cases, extract the materials for indexes, make tables for each case, and merge the materials according to the dimensions; (2) set the key points (0.33, 0.67) according to the quartile method and identify case groups; and (3) sort the cases within the group and assign subjective numbers to the indicators. The fuzzy assignment process of the indicators is shown in Table 5. Further details on this method are illustrated in Ragin [45].

4.2. Logical Relationship of Leverages. This study uses transaction leverage to reflect network effects, as transaction leverage reflects the information matching and search value brought about by (virtual) two-sided market [22]. However, because "the number of users of one group affecting the willingness of other groups to access" in the concept of network effect [12] is an abstract description, it is difficult to

Table 3: Information of cases.

No.	Case code	Case description	Case sources	Platform functions
1	B-GBWJ	Digitally empowered internal platform/stationery manufacturing in R&D design, manufacturing, service marketing	Second-hand case Communication investigation	Transaction manufacturing
2	B-MYZS	A shared manufacturing platform aiming at outputting cloud services of the whole value chain/covering multiple manufacturing industries	Second-hand case Communication investigation	Manufacturing
3	B-QHW	Transaction, collaboration, and sharing platform of industrial chain resources in the chemical industry/chemical product transaction, industry information, legal services, etc.	Second-hand case	Transaction service
4	B-PM	Construction industry platform based on BIM technology/BIM software and construction solutions for the construction industry	Second-hand case field investigation	Personal services
5	B-ZSZK	Industrial Internet platform based on data services/covering transportation and multi-manufacturing industries	Second-hand case Communication investigation	Transaction manufacturing
6	B-ZTGF	Underground engineering whole industry chain platform/shield machine leasing, engineer sharing, equipment part trading, shield tunneling construction, etc.	Second-hand case	Transaction service manufacturing
7	B-HCB	"Internet + logistics" sharing platform/vehicle-cargo matching, after-vehicle services, and three major business systems of finance	Second-hand case Communication investigation	Transaction Services
8	B-ZCQC	Collaborative design and lean manufacturing enterprise platform/rail transit equipment manufacturing	Second-hand case Communication investigation	Manufacturing
9	B HYJT	Production and trading platform of the whole industry chain of chemical fiber textile industry/chemical industry	Field investigation	Manufacturing transaction
10	C-MHS	Chemical industry B2B platform/chemical industry information transaction service	Second-hand case	Transaction services
11	C-ZBJW	"Big data+" crowdsourcing service platform/intellectual property, finance and taxation, finance, printing	Second-hand case	Professional services
12	C-HLB	Advertising creative vertical service crowdsourcing platform/brand case, technology development, and other services	Second-hand case	Professional services
13	C-HMW	Whole industry chain solution B2B innovation platform/new services such as cloud computing and information services	Second-hand case	Professional services
14	C-AJSH	One-stop home improvement service platform/home improvement process and services	Second-hand case	Professional services
15	C-YSJJ	C2F cloud home online customization platform/custom furniture whole process and service	Second-hand case Communication investigation	Professional services
16	C-NBCX	Customized service industrial Internet platform/textile intelligent manufacturing online and services	Second-hand case	Manufacturing services
17	C-SYB	Capacity sharing intelligent manufacturing platform/full-process service of metal and plastic processing and production	Field investigation	Professional service
18	C-ZFW	Textile industry idle capacity service platform/textile industry upstream and downstream enterprise transactions	Field investigation	Transaction
19	C-SZZN	AI service and business platform/"intelligent + artificial" model legal consultation and AI + RPA digital employee service	Field investigation	Professional service
20	C-XLMY	Psychological counseling service platform based on artificial intelligence/"intelligent + artificial" mode of psychological counseling service	Field investigation	Professional service
21	X-XBB	A comprehensive service platform for the luggage industry/industry chain capacity sharing service aiming at building the whole industry chain ecosystem of luggage and leather goods	Field investigation	Transaction

Note. *Production function: the access terminal is a platform function that dynamically identifies the data source and can go deep into the machine level; transaction function: the access terminal is a platform function that statically identifies the data source and mainly promotes transactions; professional service functions: platform functions that provide professional services based on industry professional activities; the distinction between transaction and professional service functions is based on whether professional activities continue to exist in the transaction.

Table 4: Variables.

Types of variables	Definitions and dimensions	Explanation
Leverage	Transaction leverage (match): improves transaction efficiency through information retrieval and matching capabilities (i) Market availability: improves the availability of market information and improves transaction efficiency through information technology (ii) Pricing mechanism: improves transaction efficiency through pricing mechanism and means Production leverage (production): achieving economies of scale and scope based on recombination of assets/resources in production, generating leverage (i) Product quality/efficiency: digitization improves product/service design quality or reduces cost and development time through reutilization of production resources (ii) Organizational constructor: digitization changes organizational structures, reorganizes supply chains, or generates new ways of organizing business Innovation leverage (innovation): the collection of assets drives innovation and the realization of complementary economies and the creation of new products/services (i) Product quality: digitalization improves product performance and service quality through efficient use of knowledge (ii) New product: digitization facilitates the development of new products or services (iii) Business model innovation (It is difficult to distinguish production methods and organizational processes in the data from cases, and they both reflect the content of business model innovation so this study uses business model innovation as a dimension of innovation leverage.): digitization changes the way value is created by innovating business processes/connections Platform type: the degree of extension from within the enterprise to the industry (in the actual measurement, the assignment range is first determined according to the type of platform; that is, the internal platform of the enterprise is less than 0.33, the industry chain platform is between 0.33 and 0.67, and the industrial platform is greater than 0.67)	Antecedent variables
The outcome of system construction	Outcome: the extension of users' acceptance (in this study, the quartile method is used to measure the resistance encountered in the digitalization. Less than 0.33 represents there are obvious twists and turns in the progress of digitalization; from 0.33 to 0.67 means the process is basically smooth when encountering obstacles; more than 0.67 suggests there is no obstacle in the progress of digitalization)	*Output variables*

find data in cases, while transaction leverage defines the specific activities or means of realization. The research explores the following questions in turn: (1) is transaction leverage an important value-creating mechanism in reality? A key point in the indicator value is 0.67, and a leverage variable above this value means that the system is being built substantially. The assignments of each dimension are combined according to the logical OR algorithm, which reflects the strength of various leverages in a case (As long as there is a strong leverage in one dimension, it indicates that the leverage is strong. The calculation method is as follows: $a = \max(a_1, a_2, \ldots, a_m)$). When the transaction leverage exceeds the key point of 0.67, it means that the transaction leverage is an important value creation mechanism. (2) Is trading leverage an antecedent or a consequence of system construction? The causal relationship between transaction leverage and "production + innovation leverage" is tested, respectively, and then, the logical relationship between transaction leverage and "production + innovation leverage" is analyzed with transaction leverage as the outcome variable.

Firstly, a significance analysis on each leverage is performed. Figure 1 shows the numbers of the three leverages for each case. In terms of quantity, among 21 cases, only four cases (QHW, ZTGF, HCB, and MHS) have transaction leverages. Exceeding the key point means that the network effect promotes the system construction, but correspondingly, there are 16 cases where the production leverage or innovation leverage has played a promoting role, and there are 3 cases (GBWJ, ZFW, and XBB) that show no leverage to reach the substantial influence line of 0.67. Notably, in three of four cases where the transaction leverage exceeded the key point, the production and/or innovation leverage also exceeded the key point, which leads us to speculate that the transaction leverage may be the result of other leverages. According to the view of affiliation (the intermediary market stream in Thomas et al. 10), transaction leverage is the core value creation mechanism of platforms, and correspondingly, the logic or effects of production leverage and innovation leverage represent competing hypotheses. The mean value of transaction leverage of 0.57 means that no significant impact is achieved, while the corresponding numbers of production leverage and innovation leverage both exceed the key point of 0.67, and the logical OR effect reaches 0.76. This shows that transaction leverage is not an important value-creating mechanism, and the competitive view of affiliation can be more realistically supported. Compared with network effect logic, it is more realistic to overcome real difficulties in digitalization through production leverage or innovation leverage.

Furthermore, the causal relationship between transaction leverage and "production + innovation leverage" is tested, respectively, and then, the logical relationship

Table 5: Fuzzy assignment of indicators.

	The first step	The second step	第三步
contents	I) Classifying and integrate case data According to the materials collected in the independent case material table, the expressions that best reflect the characteristics of the case indicators are classified one by one according to the variable dimensions.	I) Identifying the key points Comprehensively understand the meaning of the expressions, sort them in order of impact strength, and find out whether there is a significant impact on the cut-off point and whether it has a substantial impact on the system construction.°	I) Assigning indexes Independently compare each expression in the three groups identified by the two key points, and assign corresponding numbers according to the strengthof the effect
examples	I) *Product quality/efficiency* II) Changed the status quo of exchanging overtime for economic benefits... It only takes 7 days to complete the customization, and the minimum cost is only 2,000 yuan (A-KTZN) III) Through the big data of freight transportation...realize intelligent vehicle and cargo matching, intelligent real -time scheduling...improve the operation efficiency of road logistics, and reasonably change the flow and direction of transportation capacity (B-HCB) IV) Deeply solve...multi-party collaboration problems, improve the work efficiency of construction enterprises, provide...solutions (B-PM) I) The first house interior measurement software to optimize the design process... Improve service efficiency and reduce labor costs (C-YSJJ) II) "Remote shop inspection system" greatly improves the efficiency, ... 6 shop inspection tasks can be completed every day, which improves the efficiency (A-MCYP) III) Using the big data of the platform, subcontract the total order of the brand to the appropriate processing factory... The order can be completed in as little as 3 days (C-SYB)	Key point: 0.33 The dividing line between the low and middle segments, the difference in is whether a realistic and credible significant impact can be found Key point: 0.67 The boundary between the middle section and the high section, the difference in impact is whether it has a substantial impact on the system construction	0-0.33 0.33-0.67 0.67-1
Notes:	I) Generally, it is the expression that best reflects the core business, or the expression that has a substantive effect in the corresponding material of the indicator.	I) The attention of this step should be placed on judging which influence level the material belongs to; II) The key point is not to divide the material sequence into three equal parts, it should be judged according to the material.	I) The assignment within the group does not need to be uniform, and the order and size should be judged according to the actual content.

between transaction leverage and "production + innovation leverage" is analyzed with transaction leverage as the outcome variable. Table 2 is two-dimensional diagram based on the above analysis. When the causality hypothesis is satisfied, the points representing the case will be uniformly distributed on one side of the diagonal, and the consistency test value is close to 1; on the contrary, when the points are randomly scattered on both sides of the diagonal, then the assumption cannot be satisfied. It is generally considered that the consistency level is an ideal level when it exceeds 0.9.

As shown in Figure 2, except that the results of Figure 2(a) do not support the causality hypothesis, Figures 2(b) and 2(c) both support the assumption that the X condition is a sufficient condition for the Y result [17]. This shows that the concept of affiliation perspective of system construction cannot be supported, while the competitive hypothesis is strongly supported. The data support that transaction leverage is the result of the value creation activities of production and innovation leverage, indicating that transaction leverage is not the antecedent of system construction, but the result of system construction. We propose the following proposition based on the above analysis.

Proposition 1. *In the digital platform formed by the digitization of the real economy, the network effect is not a means to promote the system construction, but the result of system construction.*

4.3. Configuration Analysis. The fsQCA configuration analysis determines the identification of the characteristics of platform context and discovers the paths of system construction. It mainly includes the following steps: (1) carrying out logical operations on different dimensions of each leverage according to the logic and merging variables to eliminate vacancies; (2) calibrating data (fsQCA is an analysis based on the principle of set theory, so it is also a formal system. The numerical structure after logical merging

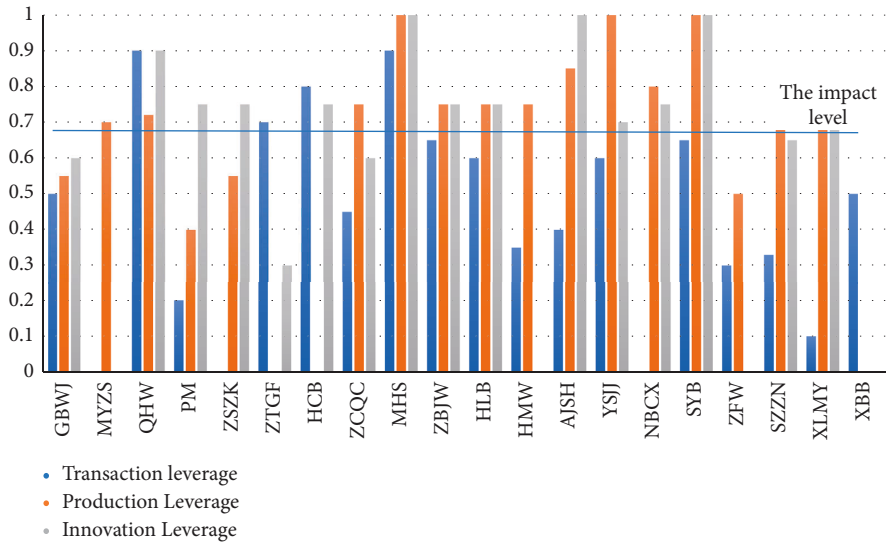

Figure 1: Significant comparison of three leverages.

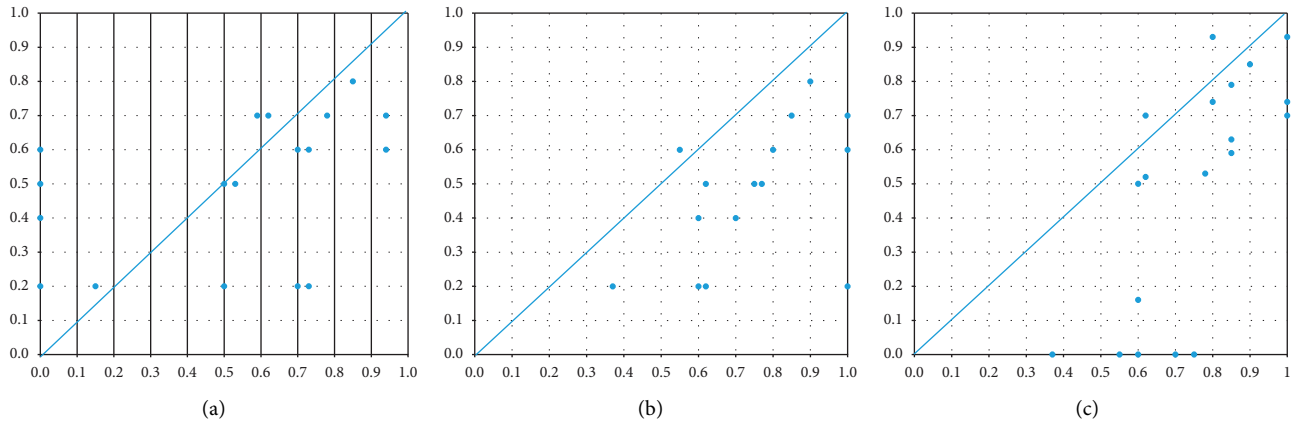

Figure 2: Two-dimensional logic verification of transaction leverage. (a) X: match. Y: outcome. Consist. $X \geq Y$: 0.5336. (b) X: Production and Innovation. Y: outcome. Consist. $X \geq Y$: 0.9946. (c) X: Pro.andInno. Y: match. Consist. $X \geq Y$: 0.9774.

has changed, and it is difficult to ensure the basic symmetry relative to the intermediate value. The calibration maps 0.67 to 0.5, 0, and 1, which remains unchanged.); (3) adjusting the case selection range and consistency criteria for standard configuration analysis, and comparing the results to ensure the robustness of the analysis results; (4) conducting additional investigations and assignment corrections for contradictory cases; and (5) configuration analysis and identifying antecedent combinations and corresponding cases. Among them, in the analysis of step 3, the test coverage of transaction leverage as a logical output is high (97.8%), but the consistency is not high, which indicates the existence of different subsets. Therefore, we transform different levels of consistency to compare output from standard configuration analysis to enhance robustness (The exploration found that better results can be obtained with a lower consistency standard, and the intra-enterprise platform and no two-sided market can be removed through the "~Platform_type" variable. Therefore, the final output is based on the analysis of 31 cases.).

The process of configuration analysis is also the process of identifying and deleting inappropriate cases: (1) there are three cases who did not generate a bilateral structure, that is, MYZS, PM, and ZSZK, so they are not included in the final case studies. The identified configurations included all cases that have developed into a two-sided market structure, which ensures the rationality of the discussion of transaction leverage; (2) among the four subsets generated by the configuration analysis, there is one subset (including ZFW and XBB) that shows completely different characteristics from other cases, because both of them are only online trading platforms in the industry, and they have not been integrated with the business as of the time of the survey, which is difficult to reflect the actual research purpose, so we will not discuss these two cases.

Table 6 presents different value creation configurations (According to the exploratory analysis, this table removes the configuration with the "~Platform_type" antecedent condition in the consistency level of 0.735 and the intermediate solution results in the full case set (this category

Table 6: Platform system construction truth table and typical cases.

No.	Assumptions and implications	Coverage	Consistency	Typical case (membership degree greater than 0.5)
I	Innovation ∗ match	0.462	0.754	C-MHS, B-HCB, B-QHW, B-ZTGF, C-ZBJW, C-SYB, C-YSJJ, B-GBWJ, C-HLB, B-ZCQC, C-AJSH
II	Production ∗ innovation	0.589	0.702	C-MHS, C-YSJJ, C-SYB, C-AJSH, C-NBCX, B-ZCQC, C-ZBJW, C-HLB, B-QHW, C-SZZN, C-XLMY, C-HYJT
III	Production ∗ platform_type ∗ match	0.373	0.761	C-MHS, C-SYB, C-YSJJ, C-ZBJW, C-HLB, B-QHW, C-AJSH, C-HMW

shows the reference case and the one that does not produce a bilateral platform structure), which brings into view all cases that generate the business characteristics of a bilateral structure. Not shown in the table is a subset that did not achieve integration with the business.), showing different combinations of leverages in different subsets. Subset I has good innovation leverage and transaction leverage, subset II has good production leverage and innovation leverage, and subset III has good production leverage and transaction leverage. The significance of the three subsets is that it allows us to distinguish different platform contexts in all cases, examine the origin of transaction leverage and reasons why it cannot work, and deeply analyze the dynamic mechanism in system construction. The three subsets are both overlapping and different, which shows that the complexity of the value creation mechanism of the platform cannot be explained by a single leverage. This also explains the reason why most of the system constructions that seek to use network effect logic will get into trouble in reality.

5. Case Study

5.1. Identifying the Characteristics of Platform Context. The main purpose of the case analysis is to analyze typical cases in the configuration under the guidance of the logical relationship shown in each configuration. The major steps in the case analysis are as follows. Firstly, key platform characteristics are identified. Each group of cases is analyzed one by one, the factors that promote the system construction in the platform environment characteristics are realized, and the factors in the platform system that are conducive to human-machine integration (named human-machine integration), and the factors in the platform system that are conducive to the integration of platform services and supplier business (named as business integration), and the factors in the platform system that are conducive to promoting the value-added of the platform (named as system value-added) are obtained. These three factors are the key factors that promote the construction of the system. Figure 3 represents the progress of configurations inducing the data. The secondary theme (C1–C5) reflects the characteristic factors from the platform owners and users (In addition to the significant influence of the characteristics of users in the business integration, the influence of the platform operator in the other two aspects has absolute advantages.).

5.2. Identifying the Path System Construction. The second step of case analysis is to complete the induction of subset features and identifying system construction path based on identifying key cases. Based on the logical antecedent variables hinted by the three configuration subsets, we analyze in the following way: how does the production leverage and innovation leverage in configuration I promote transaction leverage and system construction? What is the reason why the transaction leverage of configuration II is not significant enough? What characteristics make the transaction leverage of configuration III significant? The exploration led us to discover respectively the strong role of innovative use of information technology in system construction, the reasons for business integration that inhibited the generation of transaction leverage, but also promoted system construction, and the remarkable characteristics of data-driven facilitated system construction. Through multi-case analysis, we put them in the most suitable classifications and name three new subsets with no intersection as innovation-driven path, business-driven path, and data-driven path.

For the convenience of induction, different symbols are used to mark the impacts of the characteristics of platform context: "●" means that it has a substantial impact on the system construction, "◎" means that it has a significant impact but has not reached a substantial level, and "○" means not mentioned or the influence is not enough to reach a significant level. These three symbols reflect the order of influence from strong to weak; blank means there is inconsistency in the performance of typical cases within the group; and "⟶" means causal dynamic relationship. Note that this notation method is used in the following Tables 7.

5.2.1. Innovation-Driven Path. The "innovation" here in Tables 8 and 9 refers to the technology and means of innovative business development through information technology, with the purpose of achieving production efficiency and product/service improvement. The logical framework characteristic of the innovation-driven subset is that it has good innovation leverage and transaction leverage. The newest digital technology is the key to solving business problems, and digital platforms often give better play to its technological advantages. This huge advantage of technological progress has played a role that cannot be ignored in digital transformation. Table 7 presents three representative cases, which demonstrate this feature well.

The cases in this configuration all demonstrate the great role of advanced digital technology and digital systems in system construction. This configuration subset has obvious characteristics in terms of human-machine integration and business integration, which is an important reason for good innovation leverage and transaction leverage, and is reflected in the innovation-driven path of platform value co-creation.

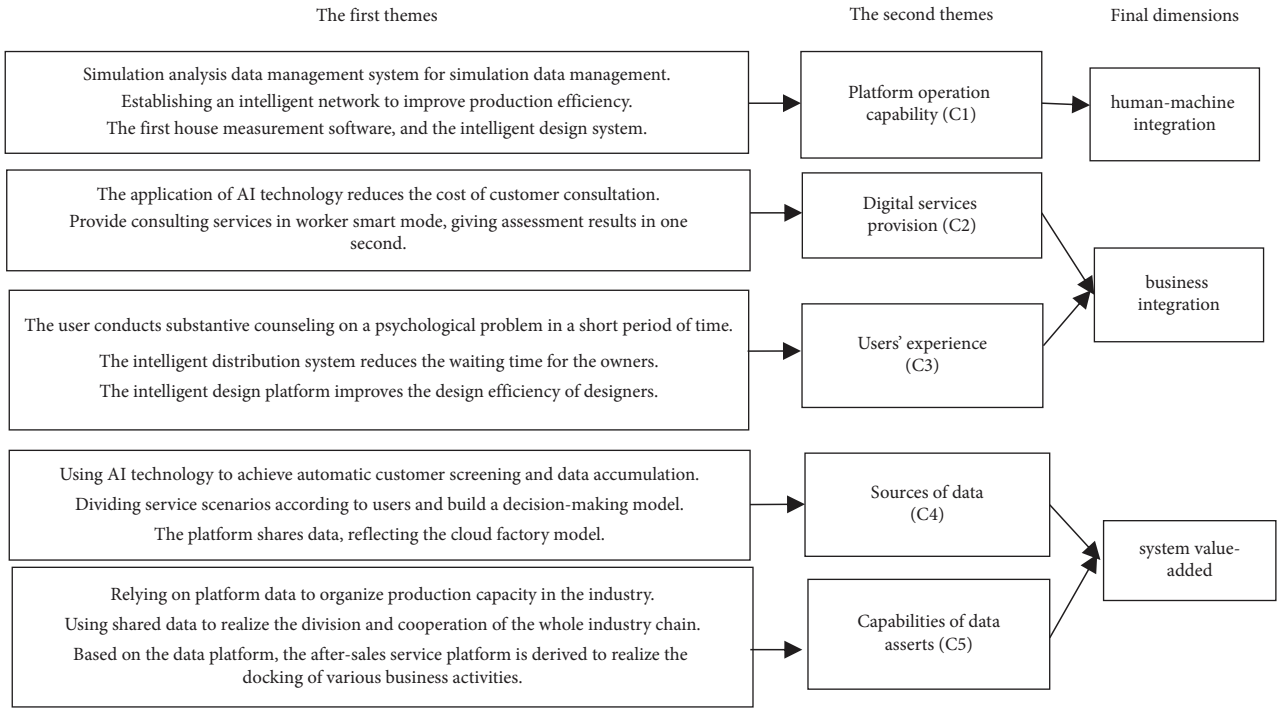

Figure 3: Data structure diagram.

Human-machine integration and business integration have resulted in significant innovation-driven effects in terms of production methods, product quality, production organization, and business model innovation. The excellent platform operation ability enables ZCQC to develop simulation data system and GBWJ to use big data technology test equipment, which bring the improvement on production and efficiency for these two companies. Digital service provision and the users' experience have promoted YSJJ to adopt a distributed production method, realize the synergy of the whole production value chain, achieve a huge efficiency improvement in organizing production, and promote business model innovation. The characteristics of good human-machine integration and business integration not only improve the users' experience but also bring more potential users and improve market availability. For example, the development of CRRC B2B trading platform of ZCQC is directly related to the good experience in the adoption of technologies such as simulation data systems; the good experience in the adoption of data systems and other technologies is directly related to the improvement of transaction efficiency of YSJJ, which is also related to the experience of using new data technologies on the design platform. Overall, it is the performance and experience improvements brought about by digital technology that drives the systematic construction of the platform.

5.2.2. Business Integration Path. Digital services are the integration of technologies and processes from different knowledge domains across enterprise boundaries [25]. This has brought great challenges to the capabilities of enterprises, especially those entrepreneurs who have invested in the industry with cross-border ideas and technology outside the industry. This configuration is also an extension of the previous configuration. The logical framework of this subset is characterized by good production leverage and innovation leverage, reflecting the difference between new business cases and incumbent platform owners, and explaining the reason why transaction leverage did not work in this configuration. The three representative cases listed in Table 8 are all entrepreneurial platform cases, reflecting platform owners need to go deep into the business for value creation due to the professionalism of knowledge, which also limits transaction leverage.

Entrepreneurs rely on advanced digital technology to solve the problems that plague traditional industries and go deep into the business to create value for customers with complementary suppliers. Three conditions are required: the basic is owning and being able to make a digital platform system work well. For example, XLMY gets substantive consultation in a short time, and SYB can subcontract the business skillfully. Both of which rely on digital facilities to provide customers with products and services with higher efficiency and higher quality and generate platform value, which is a fundamental characteristic of entrepreneurial success. However, the basis of providing professional services is the need to be highly familiar with the business the platforms are engaged in and to be involved in the business from beginning to end. These characteristics limit the platform's transaction matching function. For example, HLB establishes marketing platform to help the authors to finish the works, and the engineers of SYB need to deeply analyze each order received by the platform, which limits their ability to assist and accept orders.

The cases of configuration all go through a trial-and-error process of attracting customers by relying on matching

Table 7: Innovation-driven path.

Case	Characteristics of platform					Leverage		Data from cases
	C1	C2	C3	C4	C5	Transaction	Production	Innovation	
B-ZCQC	●	●	●	◎	◎	◎	●	●	Case summary: relying on the improvement of production efficiency and quality, the platform business volume is generated, and the capital operation management platform and the material circulation platform are derived. "...Work station system rhythm, centering on quality, efficiency and benefit, from... etc. To eliminate waste and continue to improve" (C2/C3 ⟶ production method); "all products have achieved full three-dimensional design, ... improve in order to improve the efficiency and quality of simulation analysis, establish a unified, standardized, efficient and collaborative business process in key business links such as ..." (C1/C2/C3 ⟶ product quality); "the accumulation of business volume generates a large amount of platform funds. Upstream and downstream of the industrial chain, build an e-commerce platform for the global rail transit field, and strive to create a B2B trading platform for waste and recycled materials" (C1/C2/C3/C4 ⟶ market availability)
C-HMW	●	●	●	○	○	○	●	●	Case summary: based on the intelligent digital network, the improvement of product quality and efficiency, the improvement of production organization, and the construction of industrial Internet system are derived. "Building an intelligent network, reducing the cost of each node in the enterprise and the industrial chain, improving communication efficiency, achieving high end-to-end integration, and ultimately improving production efficiency"; "...intelligent transformation project, reducing production personnel by 66 people and reducing the proportion of copying 50%...a 10.8x increase." (C1/C2/C3 ⟶ product quality/efficiency); "integrate advanced technologies such as the Internet of things, edge computing, big data, artificial intelligence. Integrate and optimize industrial resources. Launch on the basis of the industrial Internet application service platform...." (C1/C2/C3 ⟶ new products, business model innovation)
C-YSJJ	●	●	●	○	○	○	●	●	Case summary: relying on advanced digital technology and systems, it has achieved a comprehensive improvement in product quality/efficiency, production organization, production methods, and business processes, attracting users to the platform. "The first building interior measurement software, optimizing the design process...improving service efficiency adopting an intelligent design system to improve the designer's design efficiency" (C1/C2/C3 ⟶ product quality/efficiency); "using distributed production methods, synergistically integrate upstream and downstream enterprise resources to realize the synergy of the whole product value chain" (C1/C2/C3 ⟶ production organization); "designers and customers based on the platform's massive data... Accurately and quickly grasp customer needs.... The first FIM home furnishing information model meet different needs" (C1/C2/C3 ⟶ business model innovation; C1/c2/C3 ⟶ transaction efficiency)

Table 7: Continued.

Case	Characteristics of platform					Leverage			Data from cases
	C1	C2	C3	C4	C5	Transaction	Production	Innovation	
Commonness	●	●	●				●	●	Logical framework features: good innovation leverage and trading leverage. The good human-machine integration (C1) and business integration (C2/C3) of the platform promote the production and innovation levers, promote the comprehensive digital determination of the access users, and drive more access, thereby promoting the construction of the system. Among them, the advanced nature of new technology is the key premise of the dynamic mechanism of the whole system

transactions, but ultimately solve the difficult problem of system construction by integrating professional teams into the business and realizing the integration of information technology and business. The common point between the business integration path and the innovation path is that both types of configurations appear in different groups in Table 5 at the same time. The difference is that the business integration path has a typical "cross-border" feature, while the innovation-driven approach represents the new technologies adopted in the industry. Differences in business foundations lead to differences in construction paths.

5.2.3. Data-Driven Path. The digital service of the platform is a data-intensive process, which creates opportunities for further development of value-added services, and has proved to be easy to derive the logical structure of the two-sided market, which brings the possibility for the incumbent enterprises to completely build a multilateral platform and finally finish the digital transformation. The logical framework characteristics of this subset are that it has good production leverage, transaction leverage, and relatively difficult organizational interactions. The three representative cases listed in Table 9 are typical representatives of this configuration.

The common feature of this group of representative cases is the companies that have accumulated business at first and then with the help of new products or services derived from data accumulation finally form a multilateral platform. This model needs to deal with two challenges. One is how to solve the problem of business digitalization. Due to the complexity of the business, it is necessary to rely on very rich industry experience to meet this challenge. For example, NBCX developed HP2-52C automatic computerized flat knitting machine; ZTGF handles the supply and demand information of shield owners and demanders, and QHW provides product customization, formulation technology consulting services, etc., all of which are inseparable from a deep understanding of the industry. The second is how to solve the problem of sufficient business volume. In the final construction of the trading platform of each case, only sufficient business volume can generate a large amount of data accumulation, which provides conditions for value-added services based on data analysis. The coexistence of the two conditions not only challenges the capabilities of the platform owners but also leads to more and more complex systems. It is necessary to distinguish various complex services and establish a multilateral market with limited scale but various types. QHW is very a good example. QHW forms the business platformization of 7 service products in 3 major sectors. Although the scale is objective in terms of total volume, with the complexity of the business, the operating cost of the platform will also increase rapidly.

5.3. Comparison of Paths. The third step of the case study is to compare the system construction paths and obtain the different influence mechanisms of the complex platform context on the system construction path. The three configurations rely on different value creation mechanisms to realize the system construction, in which the factors influencing leverage are different, and the dynamic mechanisms of the influencing factors to induce the value creation mechanisms are also different. The key inducing mechanisms of the three paths are different: in innovation-driven path, the production, and/or innovation leverage are the key factors that affect the subjective evaluation for users; in the business integration path, the platform owners solve business problems for the business supplier to generate production and/or innovation leverage, while in the data-driven path, system value-added is the premise of production and innovation leverage. The contexts of platforms of the three paths have both commonalities and differences: firstly, a well-operated digital platform system (C1) is an indispensable basic condition for all construction paths and is the premise of human-machine integration, business integration, and system productivity; secondly, it is also a basic premise to be able to solve problems in digital services based on this system (C2); the users' experience (C3) in business integration is also a commonality condition, though the inducing mechanism is different (such as innovation-driven and business integration-driven). The difference is that data-driven comes from mature systems, and it also places higher demands on the scale (C4) and capability (C5) of the digital system itself.

However, transaction leverage is not a key driver in any of the three paths. The reason is that transaction leverage reflects the advantages in connection structure and

Table 8: Business integration path.

Cases	Characteristics of platform					Leverages			Data from cases
	C1	C2	C3	C4	C5	Transaction	Production	Innovation	
C-XLMY	●	●	●	◎	◎	◎	●	●	Case summary: use AI technology to match customers, solve the difficult problems of traditional psychological counseling, improve service efficiency, generate professional services, and promote value creation. "The application of AI technology can greatly reduce the cost of customer consultation. . .. Users can enter substantive consultation for a certain psychological problem in a short period of time." (*C1/C2/C3 ⟶ production quality/efficiency*); research and development of psychological companionship and marketing robots. . .. Launched the "21 days to help you get out of lovelorn predicament" service. (*C2/C3 ⟶ new products*); "embed AI technology into the platform to realize automatic screening and data accumulation of customers, and the platform will automatically guide professional consultants" (*C1/C2/C3/C4/C5 ⟶ business model innovation*)
C-HLB	●	●	●	○	○	○	●	●	Case summary: the platform builds its own professional team, goes deep into the business content level, relies on the digital platform to provide platform customers with products and services with higher efficiency and higher quality, and generate platform value. "The self-built design team matches the creators who live on the platform, and cooperates with the creator's progress, . . . to complete the design in only 23 hours" (*C2/C3 ⟶ product quality*); "the self-built marketing creative team helps the creators complete the work., internalize the industry knowledge into the platform, and improve the service quality of the platform" (*C1/C2/C3 ⟶ production organization*); "provide customized package services for customers and provide comprehensive consulting services." (*C1/C2/C3 ⟶ business model innovation*)
C-SYB	●	●	●	◎	◎	○	●	●	Case summary: the platform builds its own technology research and development department, enters the production process of the manufacturing industry, and relies on digital technology and systems to achieve service and product innovation and generate platform value. "Using the platform's big data, subcontract the total order of the brand to the appropriate processing factory. . .. The fastest production can be realized in 3 days" (*C1/C2/C4/C5 ⟶ production quality/efficiency*); "on the platform the process research and development department was established internally, and the customer's products were split, and within two weeks. . .. Completed the tasks that competitors dared not take up" *(C2/C3 ⟶ production organization)*; "modularize production capacity and respond quickly according to customer needs." *(C2/C3 ⟶ business model innovation)* ". . .rely on data to organize the production capacity in the industry instead of the traditional way. . ." (*C1/C2/C3/C4/C5 ⟶ business model innovation*)

Table 8: Continued.

Cases	Characteristics of platform					Leverages			Data from cases
	C1	C2	C3	C4	C5	Transaction	Production	Innovation	
Commonness	●	●	●				●	●	Logical framework characteristics: good production levers and innovation levers. The entrepreneurial platform relies on operating a self-built digital platform system (CI), replacing traditional business forms (C2/C3) (psychological consultation, legal consultation, advertising creativity, processing services, etc.), solving matching problems in business development, relying on production, and the role of innovation leverage promotes the smooth development of business (C2/C3) and promotes the construction of the platform system. "Cross-boundary" integration is its basic feature

connection technology and is not enough to solve the obstacles that platforms provide digital services to users in digitalization. The machine integration and the business integration are the resistances for the network effect to exert influences. Even if these obstacles are resolved, as in the case of the data-driven path, since the platform owners have a broader vision (data volume) and sharper perception (data analysis capability) than users, the network between users is also not the dynamics for system construction. The network effects of the interaction between the two are also not the driving force of the system construction. According to the transaction leverage emphasized in affiliation and the production and innovation levers that embody the competitive dynamic mechanism, the system construction paths of the three configurations are shown in Figure 4.

Figure 4 shows that human-machine integration and business integration promoting production leverage and innovation leverage are a common feature of the three configurations, which reflects the dynamic mechanisms shown in Tables 7–9. Among the two paths in which transaction leverage does not play a significant role, innovation-driven approach has better transaction leverage generation than the business integration path. The reason is that the characteristics of business integration limit the generation of transaction leverage. In the data-driven path where transaction leverage plays a significant role, the production leverage and innovation leverage that promote the increased volume of business and the data accumulation and data analysis capabilities that promote the play of transaction leverage are the main reasons. The assertion is not only confirmed by the causal connection between the data in the case analysis but also supported by the qualitative data information and the consistency test results of fsQCA, which shows the inappropriateness of promoting the digital transformation of the real economy by pursuing network effects in reality. From the above findings, the following propositions can be obtained:

Proposition 2. *In the digital platform formed by the digitization of the real economy, the production leverage and the innovation leverage are the main driving mechanisms for promoting the construction of the platform system. Human-machine integration, business integration, and data-driven are important platform context characteristics that lead to the production leverage and innovation leverage.*

Proposition 3. *In the digital platform formed by the digitization of the real economy, the deep integration of business is an important reason for inhibiting the generation of transaction leverage.*

Proposition 4. *In the digital platform formed by the digitization of the real economy, the generation of transaction leverage is premised on production leverage and/or innovation leverage, and data accumulation and data analysis capabilities are necessary conditions for transaction leverage to function.*

6. Discussion

6.1. Theoretical Contributions. The affiliation view of the platform (or the intermediary market stream) considers network effects to be the core source of a platform's competitive advantage. Under the influence of this theory, its strategic guidance tends to focus on aggregate volume, general governance, and community enhancement, and Eisenmann et al. [13], Evans et al. [11], Rochet, and Tirole [12] are the main sources of influence for this theoretical claim. The structural view formed by Adner [14] as the main representative and supplemented by Jacobides et al. [15] emphasizes the importance of users in system construction. The shift from the view of affiliation view to structure of structure view implies a shift from emphasizing the platform itself to emphasizing the impact of the business context. However, in this shift, the powerful influence of digital technology itself, the context characteristics of platform, and the complex dynamics of system construction are also not reflected, so a structural view remains difficult to answer for the complexities of platform value creation mechanisms in digitization. This study uses a large number of facts to show that the theory of affiliation view is not feasible in the real digital transformation and also identifies different situations

Table 9: Data-driven system construction path.

Case	Platform features					Leverages			Data from cases
	C1	C2	C3	C4	C5	Transaction	Production	Innovation	
C-NBCX	●	●	●	●	●	●	●	●	Case summary: based on the foundation of enterprise research and development, improve production technology, promote model transformation, and form an industry platform. "Development of HP2-52C fully automatic computerized flat knitting machine to realize fully automatic manufacturing to greatly shorten the production cycle" (*C2 ⟶ production quality/efficiency*); "integrate industry-leading enterprises and technical resources customized according to specific needs Production. . .. Formulate application system solutions to help customers reduce costs and increase efficiency" (*C1/C2/C3 ⟶ production organization*); "realize data sharing, and the cloud factory model realizes the division of labor and collaboration across the entire industry chain" (*C4/C5 ⟶ business model innovation ⟶ market availability*)
B-ZTGF	●	●	●	●	●	●	●	●	Case summary: based on the digital transformation of the shield business, a more efficient production form has been generated, and a multi-/bilateral market structure has been derived. "Through the shield cloud platform to achieve zero-distance contact between management personnel and the site. . .. Using the accumulated experience of experts and engineers to solve various difficult problems in construction in a timely manner feeding back the experience in construction technology and technological innovation on the technological innovation of shield machine equipment" (*C1/C2/C3 ⟶ production organization/business model innovation*); ". . .getting through the supply and demand information of shield machine owners and demanders through offline contracts to achieve the platform online and offline. Linkage financial institutions can provide financial security the 'work service mall e-commerce platform' for shield machine equipment parts trading, providing one-stop comprehensive solutions" (*C1/C2/C3/C4/C5 ⟶ market availability*)
B-QHW	●	●	●	●	●	●	●	●	Case summary: solve the tedious problems in the actual connection, generate an effective production form, and derive a complex multilateral platform model. ". . .Rihuahui information sharing platform, on the basis of product customization and formula technical consulting services provided by the platform, quickly customize the production of disinfection and sterilization products" (*C1/C2/C3 ⟶ business model innovation*); "the first-hand market the information is sent to the R&D side, and the formulas, products, etc. researched by the platform are matched. . .. Continue to launch innovative businesses, and have launched 7 service products in 3 major sectors, covering. . ." (*C4/C5 ⟶ new products*); "make upstream and downstream companies are more transparent, convenient and efficient, simplifying the transaction process" (*C4/C5 ⟶ market availability*)
Commonness	●	●	●	●	●	●	●	●	Logical framework features: good production leverage, transaction leverage, and highly difficult organizational interactions. With the foundation of human-machine integration and business integration (C1/C2/C3), based on the ability of data accumulation and data analysis (C4/C5), it can realize the leverage value of production and innovation and then gradually promote the value creation mechanism of transaction leverage. A mature system and sufficient traffic are the basic characteristics

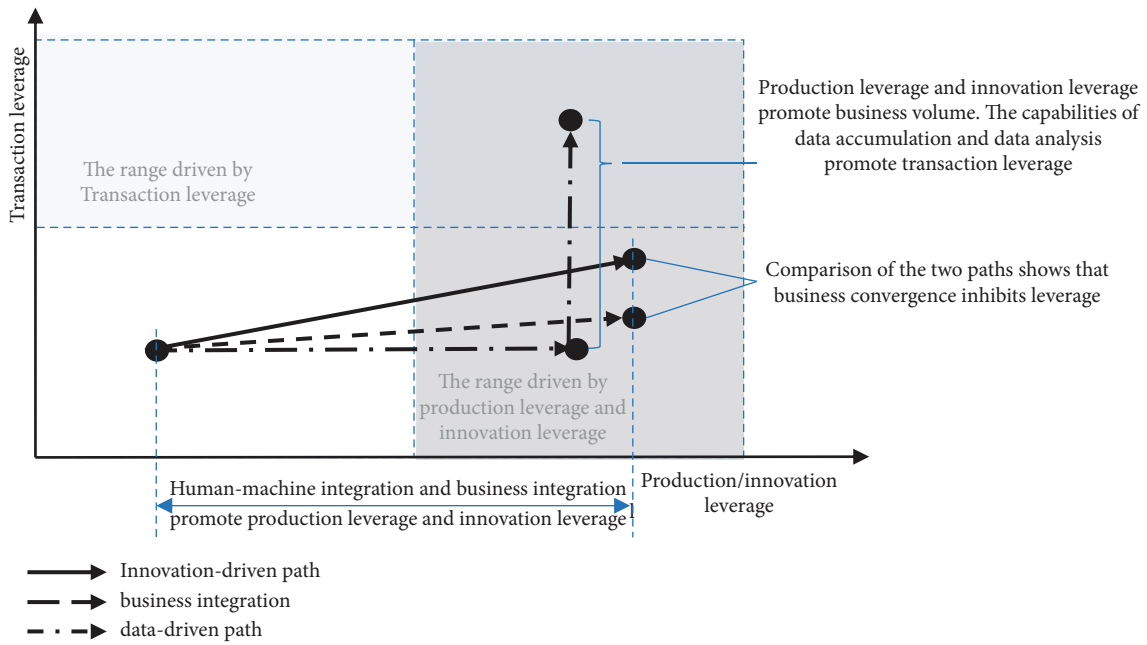

Figure 4: System construction path of the three platform value lever configurations.

Table 10: Theoretical contributions.

System construction paths	Findings	Theoretical contributions	Typical cases
Innovation-driven path	Rely on advanced digital technologies and systems to promote production leverage and innovation leverage, create value for users, and facilitate system construction. Preconditions are as follows: (i) Advanced digital technologies and systems (ii) Production efficiency improvement and product innovation	The structure view only provides a perspective, but it is still not enough to answer the value creation mechanisms and process of the platform. This theory gives the answer from the perspective of digital technology and innovation	ZCQC GBWJ HMW YSJJ AJSH
Business integration-driven path	Solve industry problems with advanced digital technologies and systems, and go deep into the business to create value for customers with complementary suppliers. Preconditions are as follows: (i) Digital technology to solve industry problems (ii) In-depth integration of business and suppliers	The affiliation view is only suitable for the situation where the platform participates in the value creation of complementary advantages with unscaled resources, and there is a theoretical blind spot. This theory explains the mechanism and realization path of the platform participating in the value creation with scaled resources under the complex industry matching situation	XLMY SZZN HLB SYB
Data-driven path	Relying on a certain scale of business volume and digital systems to achieve data accumulation, relying on analytical capabilities to derive new products or services, forming a multilateral platform. Preconditions are as follows: (i) Digital systems with good human-machine and business integration (ii) A certain scale of business volume (iii) Data accumulation and analysis ability	Platform complexity is an important factor limiting the value creation ability of platforms, and the subordination and structure views have not paid attention to this impact. This theory emphasizes that intrinsic value creation is the foundation and provides the premise, motivation, and process for the growth of the platform system	NBCX ZTGF QHW HYJT HCB

of innovation-driven, business integration, and data-driven and develops the structure view (see Table 10).

6.1.1. Theoretical Contributions of Innovation-Driven Path. The structure view believes that, unlike e-commerce and social media and other consumer-oriented Internet, most digital transformation has "strong connection characteristics" [14]; that is, the connection of platforms does not provide an "accidental connection possibility," but a substantial investing in service solutions leads to a relatively stable relationship between service recipients and providers. This theoretical claim explains why value co-creation activities by users in digital transformation are difficult. This

study finds that production leverage and innovation leverage act to address the user's dilemma when accessing the platform. A realistic and feasible path is to rely on advanced digital technologies and digital systems to promote the leveraging of production and innovation and create value for users. When the leverage is strong enough, the users can easily intuitively feel the advantages of accessing the platform, and potential users can easily access the system under the demonstration effect, thus solving the problem of value co-creation. In this case, two antecedents are indispensable: (1) advanced digital technologies and digital systems and (2) production efficiency improvement and product innovation.

The innovation-driven path shows that digital systems have the triple advantages of transaction leverage, production leverage, and innovation leverage. Although the convenience of modular complementarity is implied in itself, the adoption of digital technologies and systems often faces huge system integration difficulties in implementation. Advantages are not inevitable. In the system construction, the integration of digital technology and traditional technology is accompanied by various innovations. If the new digital technologies and system can be successfully controlled, it will bring enough efficiency improvement and become the driving force to attract more access users to access the platform. The innovation-driven path gives the power sources of the platform approach from the perspective of the combination of digital technologies and business domains. The structure view put forward by Adner [14] is still not enough to answer the motivation and process of system construction, and this study emphasizes the importance of new technologies and provides a path of system construction through improving the efficiency and added product/service.

6.1.2. Theoretical Contribution of the Business Integration Path. The platform theory of affiliation view believes that increasing the number of users is the way to obtain a competitive advantage. The implicit premise is that there is friction in the transaction, resulting in transaction costs, and the platform has information and professional advantages in the transaction. Low-cost replication leads to system advantages, which embodies the alternative economic logic proposed by Garud and Kumaraswamy [46]; that is, the transaction led by the platform owners achieves economies of scale and scope in the process of replacing direct transactions between the two parties. The finding of this study is different from the phenomenon observed in the view of affiliation. The professional advantage of platform is a professional technical activity. It relies on advanced digital technologies to solve the problems that plague traditional businesses in the industry and goes deep into the business to work with complementary suppliers to create value for customers, not just deal matching.

There are two antecedents to business integration path: (1) advanced digital technologies solve industrial problems and (2) deep integration into business. The first condition produces substitution advantages, and the second condition enables platform owners and professional service providers to achieve economies of scale and scope in the division of labor and cooperation. However, differences in transaction activity and technical expertise lead to differences in the conditions for creating network effects. According to the division of resource types by Wassmer and Dussauge [47], due to the powerful capability of information search and matching in digital technology, the resources that facilitate transactions are scale-free resources in digital systems; that is, they are reused and resourced. It does not affect the ability of resources to create value, so the bottleneck of system value creation lies in the inability to attract more users, rather than the lack of the system's ability to process transactions. However, in the case of creating service value in the progress of business, the digital system provides a combination of platform capabilities and professional service provider capabilities. This activity no longer has the attribute of no scale, which limits the possibility of creating value through transaction capabilities. In this case, it is difficult to observe the significance of the network effect, and the method of expanding the access of the platform is often futile. This finding reveals the fundamental difference between the digital transformation platform that goes deep into the business and the classic Internet platform studied from the view of affiliation; that is, the complex business characteristics lead to the platform requiring the intervention of scaled resources in transaction matching, which limits the scope of the platform's asset scope economy and inhibits the role of transaction leverage.

6.1.3. Theoretical Contributions of Data-Driven Path. Digital service is a data-intensive activity that can create value-added services, reduce market friction, and create conditions for transaction leverage. However, digital services have the characteristics of cross-enterprise boundaries, which bring challenges to the knowledge and capabilities of service providers and bring about challenges to the knowledge and capabilities of service providers. Suppressing the willingness of service recipients to accept, this situation will make the generation of transaction leverage face uncertainty. This study shows that successful data driving firstly occurs in the digital platform system built by enterprises. The realization of digital transformation helps in data accumulation and relies on digital analysis to derive new products or services, forming a multilateral platform. The realization of this approach depends on three antecedents: (1) a digital system integrating human-machine and business; (2) a certain scale of business volume; and (3) data accumulation and analysis capabilities.

Different from the view of affiliation, which emphasizes the creation of users' numbers and platform governance, and also different from the view of structure, the data-driven multilateral platforms reveal the importance of data in the multilateral structure and the endogenous dynamics of digital platforms. As summarized by Mikalef et al. [34], data have been increasingly confirmed as an emerging source of production means and capabilities in the digital context [48]. However, we found that the three antecedent conditions are indispensable and demonstrated the complexity of systems through sufficient realistic materials (similar evidence such as

the formulation of hypermodule platforms). It is this complexity that places high demands on industry experience and data analysis capabilities. This study reveals the preconditions for the value creation of digital platforms, points out the inhibitory role of transaction leverage, and emphasizes that the construction of digital platform system construction is an endogenous growth process. The difference between our findings and the view of affiliation is that it emphasizes that solving problems in service is the foundation of generating value, rather than establishing external relationships. The difference from the view of structure is that this study gives the premise, motivation, and process of system growth.

6.2. Practical Contributions. The practical inspiration of this study is that it clearly shows the importance of building platform internal force in the process of digital transformation, rather than focusing on the potential structure. In particular, for the entrepreneurships with platform as the organizational structure, the system construction should not overemphasize the platform's customer volume, but choose an appropriate platform path according to the specific platform context, strengthen its own capacities, and use the capabilities endowed by digital technologies and digital systems to enhance the value perception of users through innovation, business specialization, and data-driven methods. The construction of a digital platform system is a process of endogenous growth. Solving problems in services and discovering intrinsic value is fundamental. For example, the value of digital systems is reflected through internal innovation, and value is created in solving practical problems. The enterprises should fully exploit the service quality improvement potential endowed by digital assets to enable platform users to achieve improved benefits. The specific inspirations are as follows:

(i) Firstly, human-machine integration and business integration through innovation-driven role are promoted. Digital technologies and digital platforms are advanced forms to replace traditional business forms, but their efficiency and innovation cannot be taken for granted. The enterprises should actively build internal capabilities, effectively harness the value creation potential endowed by new technologies and systems, and give full play to digital technologies and digital systems in production. The active role in innovation and promotion of human-machine integration and business integration in platform access is an effective way to effectively solve the concerns of platform users.

(ii) Secondly, value in deep business participation is created. The digital transformation of traditional industries is not to solve simple matching and docking problems. Platform owners, especially entrepreneurs, should focus on relying on the advantages of digital technologies in solving traditional problems and creating values in the specialization of participating businesses and cooperation with suppliers, rather than blindly expanding the number of users.

(iii) Thirdly, the platform's own digital capacities are strengthened. Digital services are often accompanied by the generation of a large amount of data. Active digital analysis capabilities and digital application capabilities are not only the premise to ensure the effective operation of the platform but also the capability basis for derivative value-added services and multi-/bilateral markets. Therefore, strengthening digital capacity building is an effective means to effectively achieve digital transformation and enhance the platform's advantages.

6.3. Limitations. The cross-platform perspective and a large number of platforms ptovide this study with strong power of factor discovery and verification capabilities. However, with the limitations of concerns and phenomena, this study also has two limitations: (1) from the point of view of concerns, this study focuses on the system comparison of cross-platform contexts. The too wide vision makes it impossible to introduce and analyze in detail in this study, and it is difficult to introduce in detail the process of exploring the causal connection of factors under different environmental configurations; (2) from the phenomenon of concern, this study focuses on the process of deep integration of information technologies and business systems, resulting in the measurement of variables and the selection of cases are consistent with this research phenomenon, and the conclusion may have a certain deviation from the mature platform. Nonetheless, the potential for theoretical discovery arising from multi-context comparison and induction is undeniable, and if further analysis of the three logical configurations identified in this study is conducted, it will provide a deeper theoretical understanding and practice of the platform approach in digitization transformation.

7. Conclusions and Future Work

This study uses a large number of cases in industries where the information technology is integrated with industries in China and discusses the dynamic mechanism and construction path of the system construction in the digital transformation from the perspective of the leverages of platform method. The study found that production leverage and innovation leverage are the general construction drivers of platform, and transaction leverage is only significant in a small number of platforms; that is, the role of network effects can be observed. There are many reasons why transaction leverage is difficult to become the main driving force, but from the perspective of system characteristics, the digitization of the real economy requires the human-machine integration and business integration between the digital platforms and users, which leads to the complexity of digital system and generate economic characteristics that differ from classic Internet platforms. In complex manifestations, successful digital transformation reflects the typical configuration characteristics of innovation-driven, business

integration, and data-driven. In the three configurations, on the one hand, the system requirements of human-machine integration and business integration make the platform owners and business providers deeply integrated, and it is difficult to exert transaction leverage; on the other hand, in the situation where transaction leverage can be observed, either the result of business integration often promotes the play of production leverage and innovation leverage, which is reflected in the characteristics of innovation-driven, or the mature system derives a multilateral platform through the value-added of digital services, and its essence is that the transaction leverage is still triggered by production leverage and innovation leverage. Therefore, in the complex manifestations of digitization, network effects are difficult to become the core driving force of the platform approach.

Data Availability

Data are available on request from the corresponding author.

Conflicts of Interest

The authors declare that they have no conflicts of interest for publication of this work.

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