Research on the mechanism of collaborative innovation based on the platform ecology - taking Glodon as an example

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Abstract. With the rapid development of information technology and increasingly competitive environment, the whole process engineering consulting mode has become a new trend of industry development. It is of great necessity for traditional engineering consulting enterprises to build a digital platform with the advantage of long-term accumulated knowledge and skills, and gradually to build a platform ecology with platform enterprise as the core, elemental synergy as the support and main body synergy as the guarantee. This study analyzes the practice process of platform transformation of Glodon Company Limited and puts forward the mechanism of collaborative innovation based on platform ecology, i.e. traditional engineering consulting enterprises should take enterprise development into consideration based on digital platform, and implement the double collaborative innovation strategy of elements and subjects from four perspectives of competitive cooperation, symbiotic win-win situation, dynamic adjustment and collaborative governance, so as to fully utilize the network effect, realize value co-creation, and maintain the healthy development of the platform ecology.

Keywords: platform ecology; collaborative innovation; whole process engineering consulting.

1. Introduction

With the continuous development of Internet technology and increasingly fierce competition challenges, the traditional engineering consulting industry has entered the stage of high-quality development after decades of rapid development. The "fragmented" consulting service in the past fragmented the internal connection of projects, increased the management difficulty and management cost of consulting units, and made it difficult to provide high-quality and complete consulting services. Therefore, under the development situation of new normal, the traditional rough development mode is no longer applicable, and the whole life cycle management and whole process engineering consulting have become the development trend of construction industry and engineering consulting industry[1]. In order to better meet the cross-stage, integrated and comprehensive demands of the clients, it is necessary for traditional engineering consulting companies to break their own development limitations, solidly promote digital change and transform to the direction of platform ecology. While changing the existing organizational model, this new model of "platform + ecology" can further break the boundaries of enterprises and challenge the business logic of traditional enterprises[2]. Therefore, traditional engineering consulting companies need to rely on the platform model, collaborate and innovate with all stakeholders, and gradually form a mutually empowering, symbiotic and win-win platform ecology[3].

Glodon Company Limited was selected for this paper (hereinafter referred to as Glodon). In the era of whole-process consulting and digital economy, Glodon has gradually transformed from a section-based organization to a platform-based organization with the help of digital construction platform, and has continuously collaborated and innovated with its partners to build an integrated and developed platform ecosystem[4]. Through an in-depth analysis of the basic situation and transformation plan of Glodon, this paper elaborates the process of digital collaborative innovation of traditional engineering companies based on platform ecology, and analyzes its formation mechanism in detail to enrich the relevant research on platform ecosystem with a view to providing a reference path for the transformation of traditional engineering consulting enterprises to platform enterprises.

2. Literature Review

2.1 Platform Strategy Theory

A platform is a space that can exist in the real or virtual economy and helps facilitate transactions between two or more parties[5]. The concept of platform model has only been noticed by many management scholars since it was applied to the automobile manufacturing industry in the 1990s, which led to the rise of platform strategy theory and gained widespread attention [6]. Initially, scholars focused on platform strategy in high-tech enterprises, distinguishing different types of platforms and discussing the corresponding governance approaches by researching their industrial innovation processes[7]. Enterprises can carry out fundamental organizational innovation through "drift" or "jump" mode[8], and transform into platform enterprises after industrial value chain restructuring. The "same-side effect" and "network effect" can be used to discover new business opportunities and achieve winner-takes-all[9]. Under the platform model, enterprises need to balance the issues of platform competition and compatibility [10], commit to platform innovation and openness, quickly adapt to different types of markets, and facilitate the interaction between platform enterprises and users.

Under the background of the new trend of platform-based competition [11], as a "hub and spoke" form of organization[12], platforms need to continuously break the boundaries of enterprises, connect stakeholders with platforms, and build platform ecology. Platform ecology refers to linking the products and services of platform enterprises and other stakeholders to the network to meet the needs of multiple parties and create added value[4] , and there is interdependence between platform initiators and participants. Since the business categories involved in the platform ecology can span the whole industry chain to meet the diverse needs of customers[13], this new model is more agile and adaptable than traditional business models[14]. To better meet users' needs and match supply and demand, each stakeholder in the platform ecosystem needs to develop a robust innovation strategy[15] and obtain positive effects through collaborative innovation[16]. Therefore, it is necessary to clarify the mechanism of collaborative innovation in the platform ecosystem.

2.2 Collaborative Innovation Theory

The concept of synergy was first proposed by Harken, and it was defined as the efficient cooperation among the components of a system to achieve high efficiency and high value that cannot be achieved by a single subsystem[17]. Based on this, the concept of collaborative innovation was born. Initially, scholars analyzed collaborative innovation from two perspectives: "factor-centered innovation" and "subject-centered innovation"[18]. The factor-centered theory believes that, in order to achieve the overall synergy effect, collaborative innovation should focus on improving the degree of synergy through the interaction of technology, service and other innovation-related elements[19]. The subject-centered theory considers that, under the bridging role of information technology intermediaries, collaborative innovation refers to the process of innovative resource allocation, decision, and consultation among various stakeholders in the system to form synergistic relationships[20]. Later, some scholars integrated these two concepts, i.e., collaborative innovation refers to the process of generating overall synergistic effects through shared resource and complementary elemental advantages based on common interests of each subject[21].

Collaborative innovation has the characteristics of wholeness and dynamism[22]: the wholeness is reflected in the fact that the synergistic effect is not only the simple sum of all parties' capabilities, but also includes the added value created by sharing resources; and the dynamism is reflected in the fact that the platform ecology is a system full of variability, with other platforms joining or withdrawing at different times, or with enterprises joining or withdrawing within the platform. Therefore, the theory of collaborative innovation reflects the transformation of managers' thinking from closed to open, and reflects the latest trend of today's scientific and technological development [23].

Combining the above-mentioned scholars' studies, it is clear that enterprises need to focus on the idea of collaborative innovation when building platform ecology, that is, as collaborative subjects, platforms and enterprises need to maintain consistency in innovation awareness, concepts and behaviors based on the concept of mutual cooperation and mutual benefit, and carry out elemental collaboration at multiple levels such as resources, services and technologies[25] , so as to continuously enrich their own independent innovation content to adapt to the new normal development trend and achieve sustainable development.

Figure 1 is the research idea diagram.

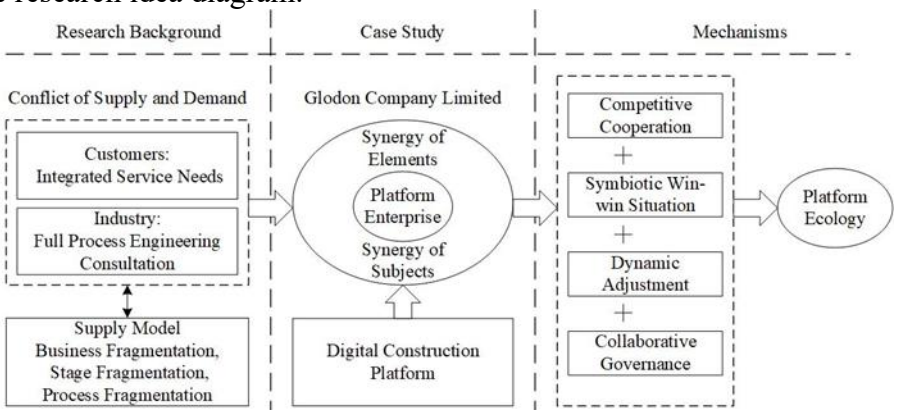

Fig. 1 Research idea diagram

3. Case Study of Eco-collaborative Innovation of Glodon Digital Platform

3.1 Basic information of Glodon

Founded in 1998, Glodon is a digital platform service provider offering specialized services in the construction industry. To meet the complex needs of customers for systematic, integrated and dynamic projects and achieve high-quality development, Glodon took the initiative to change its business model and announced its strategic transformation in 2015 to build a "construction industry Internet platform service provider" based on professional applications and big data. As an Internet platform for the construction industry, the digital construction platform is based on the digital twin and uses digital technology as a means to establish a multi-directional connection of all participants in the project, penetrate the whole process of the project, upgrade all elements of the industry, and systematically optimize the resource allocation of the industry chain. As a result, Glodon has gradually turned into a platform-oriented enterprise.

After more than 20 years of development, the business field of the company has gradually developed from the initially single engineering project costing service to providing whole-process engineering consulting services around the whole life cycle of engineering projects, and the software products and services have expanded from a single to multiple business modules such as digital engineering costing. Among them, the main business of Glodon is the digital costing business and the digital construction business[24]. The digital costing business segment mainly provides project costing services, including the provision of tool-based software and related data services. After more than 20 years of development, it has become a mature business with a high market share in China, and is the main source of profit for the company with obvious competitive advantages. The digital construction module mainly provides solutions for the construction industry, sells self-produced software products and provides systematic services for the digital transformation of construction enterprises in the platform, and the segment is still under steady development.

With the digital construction platform, Glodon provides full lifecycle solutions including digital products and related services for construction, design, suppliers and other related enterprises around the whole life cycle of engineering projects, linking finance, investment and mergers and acquisitions. Glodon carries out platform, digital and ecological changes, develops digital

construction platform to integrate ecological resources, helps the construction industry transform and upgrade, enables stakeholders to coordinate development, mutual benefit and win-win, and jointly builds the construction industry platform ecology.

3.2 Analysis of Digital Collaborative Innovation of Glodon

3.2.1 Collaborative Innovation of Elements

With many years of experience in the industry, Glodon has significant competitive advantages in terms of expertise, resources, talents and other elements. Under the new requirements of the digital era, Glodon follows the trend and carries out strategic transformation to develop digital infrastructure with the help of digital construction platform. Glodon regards data as an important production factor and digitizes key elements such as "talent, machine, material, area and technology" in engineering projects through the digital construction platform, realizing real-time interconnection between live engineering site and digital virtual site in the cloud, and building a digital twin smart site.

For the market with huge potential and fierce competition, Glodon mainly adopts the following strategies to achieve digital collaborative innovation of key elements. For the talent element, the company adopts a "people gathering" approach, i.e., using information technology products to bring all professional positions, front-line workers and other participants in the project into the platform to bring into play the power of cooperation and achieve collaborative innovation. For machine elements, Glodon collects process data from various machine operations through its digital construction platform, and uses data-driven artificial intelligence to diagnose them, identify problems and make recommendations for decision-making, so as to realize the transformation from machine operations to automatic operations. For engineering materials, Glodon adopts the "aggregation" approach, i.e., by centralizing all production materials to reduce intermediate business links and transferring the bulk procurement between buyers and suppliers to Wangjia.com to reduce procurement costs and optimize resource allocation[27]. For the construction area, Glodon centralizes the construction site and building operation and maintenance by "site-circling" and "building-circling" to optimize the construction process, and uses intelligent hardware and other information technology for the construction site and applies it to the operation and maintenance process to effectively reduce energy consumption and enhance space utilization. For the construction process, Glodon, as an engineering consulting company, needs to connect with construction companies with different industry characteristics and construction processes, and it connects with different stakeholders through "one construction", i.e., library construction. To realize the connection between all parties in the industry.

In short, Glodon uses the transformation strategy of "two clusters, two circles and one construction" to carry out the synergy of key production factors, i.e., enterprises and stakeholders in the platform ecology interact with each other's resources on the basis of healthy competition and cooperate with each other to enhance core competitiveness. Each party in the industry chain dynamically adjusts its innovation strategy according to the internal and external environment of the ecology, transforms its inherent technology and management model, ensures the steady development of the platform, and gradually builds the platform ecology.

3.2.2 Collaborative Innovation of Subjects

Building a new industrial ecology and achieving collaborative innovation require the joint efforts of four types of operators. These four types of subjects are: first, platform enterprises as the core subjects, i.e., Glodon connects all parties in the industry chain with the digital construction platform and enables them to collaborate and innovate through multilateral networks; second, associated enterprises, including construction eco-chain enterprises such as builders, manufacturers and suppliers, especially the leading construction enterprises representing the highest productivity of the industry; third, external experts, i.e., individuals or units with professional skills and knowledge in the engineering consulting industry and capable of providing professional services; and fourth,

customers, i.e., the final owners and users of the construction. These four types of subjects possess core resources such as "human, machine, material, method and environment", and at the same time are equipped with capabilities such as whole process consulting ability and whole life cycle management ability.

In order to strengthen the integration of all parties in the industry chain, Glodon mainly strengthens the main body of collaborative innovation through the following methods. First, the platform enterprise leads the governance. As the core subject of platform ecology in engineering consulting industry, Glodon plays a leading role at a strategic high level, and the digital intelligence platform it provides attracts all parties with its multilateral market attributes, and enables all participating parties to cooperate closely and compete benignly with the help of digital technology empowerment[28]. For the ecological chaos of the platform, it adopts such means as deducting margin, adjusting price structure, and strengthening reputation mechanism to implement regulation[29] and realize value co-creation. Second, multi-body collaborative innovation. Affiliated companies continuously improve their governance capacity within the platform standards, supervise the factors that are not conducive to the development of the platform, assume the responsibility of maintaining the healthy development of the platform, and continuously expand their governance network to adapt to the development of the digital era through digital upgrading and virtual operation. External experts brainstorm and make suggestions for the orderly development of the engineering consulting industry. To effectively protect the interests of owners and ensure project quality, Glodon initiatively invites customers to directly participate in the supervision and management work through the digital construction platform, so that they can strictly supervise the construction work and construction specifications to promote the orderly construction of buildings.
In short, these four types of subjects, with the platform enterprise as the core subject, implement the strategy of "platform enterprise leading governance, multi-body collaborative governance", so as to make efficient use of multiple resources, effectively reach a symbiotic and win-win strategic relationship, break the enterprise boundary, and gradually build the platform ecology.

3.3 Analysis of collaborative innovation mechanism of Glodon based on ecological platform

In the context of the call for the development of new infrastructure and the rapid development of Internet technology, in order to solve the contradiction between supply and demand for better development, as an engineering consulting company, Glodon needs to digitally innovate and transform the original infrastructure to develop digital infrastructure. By building a digital construction platform, Glodon achieves synergistic cooperation of subjects and optimal allocation of elements, thus building a digital platform ecology, realizing double synergistic innovation of main bodies and elements, and finally forming a new ecology of engineering consulting industry. The digital collaborative innovation practice process of Glodon has the following key points:

First, close competition and cooperation within the platform ecology. In order to bring into play the power of cooperation and achieve collaborative innovation, the platform enterprise Glodon, as the core subject, centralizes key elements such as "talent, machines, materials, methods and environment" with the help of digital platform. For the same type of affiliated enterprises such as the construction side, the construction products and services they provides have a high degree of similarity, but because of personalized and diversified needs of the clients, if the same type of enterprises want to provide complete service solutions, they should cooperate closely on the basis of healthy competition, constantly interacting with each other in the construction process, sharing talent and machine elements, effectively reducing substantial time and capital costs caused by resource overlap and acquiring new resources. For platform companies and affiliated companies, the competition between Glodon and other participating companies is not strong, so the two often use a complementary model to achieve a reasonable allocation of resources. With the digital platform, Glodon provides a collaborative innovation environment for the participating enterprises to gather production materials, construction sites and other elements, giving full play to its strategic leadership. The affiliated companies apply their own technologies and capabilities to complement

each other and build up strength for the construction industry and the engineering consulting industry, thus enabling Glodon to grow.

Second, companies need to dynamically adjust their strategies according to the internal and external environment. Since the establishment of Glodon, the enterprise's digital costing business has grown considerably based on the construction industry. However, since 2015, construction enterprises have been facing high procurement costs, shortage of funds, and high factor costs, which have led to prominent conflicts in informationization, and the informationization systems provided by software integration enterprises have scattered and single-point considerations, making it difficult to provide a complete system to achieve interconnection between businesses. In order to solve the problems brought about by the sudden changes in the external environment of enterprises, Glodon implements the strategy of " two clusters, two circles and one construction " to transform into a "construction industry Internet platform service provider", and helps suppliers and other partners in the value chain to acquire, accumulate and integrate resources by building a BIM-based component library, in order to meet the development needs of the digital era. Other affiliated enterprises are also constantly upgrading their digitalization under the platform mode, optimizing their own organizational structure and dynamically adjusting their chosen strategies to better adapt to the development environment and trend of the platform ecology according to the actual situation of enterprise.

Third, there is a symbiotic and win-win relationship among all participants. Glodon connects multiple interests through the digital construction platform, effectively connects and integrates ecological resources, provides data-driven intelligent services to the construction industry, and ensures the stable operation of the platform ecology. Affiliated enterprises interact with each other through a multilateral network whose core is project, ultimately forming a full-factor, full-process and full-participant interconnection of everything, realizing collaborative innovation, coexistence and win-win, and building a balanced platform ecology of supply and demand. This model helps the construction industry achieve "four layers" of change, which is reflected in the industry empowered by the digital construction platform to significantly improve the efficiency and quality of the job operation layer, promote lean management at the project layer, realize intensive operation at the enterprise layer to improve resource allocation capability, promote digital management at the industry layer, and finally realize the collaborative innovation of all parties in the whole platform to improve the operation effect. The symbiotic and win-win relationship between Glodon and affiliated enterprises not only reduces the cost of acquiring resources and developing innovation, but also gives full play to the network effect to promote the steady development of the industry.

Fourth, multi-participating subjects collaborate in governance. On the basis of symbiosis and win-win situation of each subject, in order to maximize the network effect, the platform ecology of engineering consulting industry adopts the strategy of platform enterprise leading governance and multi-body collaborative innovation. Glodon, as the core body, based on strategic high position, leads the participating subjects to cooperate closely through digital construction platform empowerment, adopts methods such as deducting margin and adjusting price structure to supervise the unstable factors within the platform ecology and guarantee the normal operation of the platform ecology. On this basis, other participating entities work in concert. Associated enterprises continuously improve their own governance capabilities and complement each other's resources to achieve optimal resource allocation. External experts provide effective solutions and suggestions for the efficient operation of the platform ecology, and owners take the initiative to participate in the supervision and management work. This kind of strategy with platform enterprise as the core and multiple subjects collaborating in governance gives full play to the advantages of digital platform in terms of high efficiency, high coordination and high integration, and promotes good implementation effect of whole-process engineering consulting.

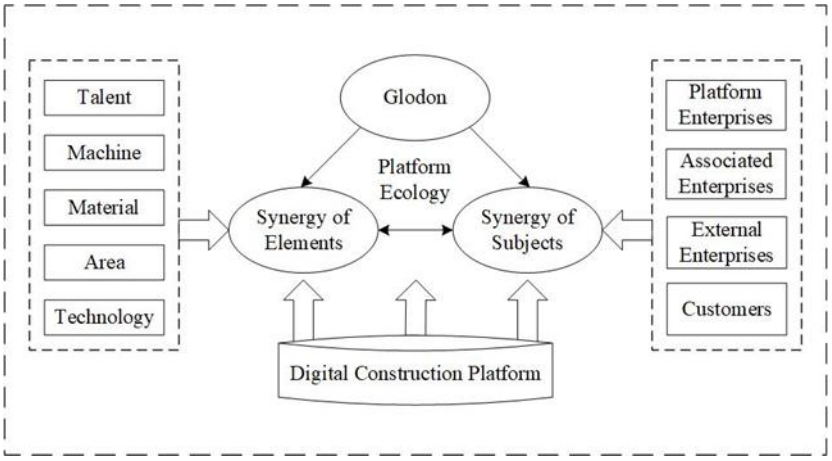

Fig. 2 Ecological diagram of Glodon platform

4. Collaborative innovation mechanism of platform ecology

4.1 Competitive Cooperation

Each stakeholder in the platform ecosystem needs to formulate corresponding competitive strategies according to market changes to constantly renew itself and maintain its core competitiveness. At the same time, the strategic alliance can be formed through the synergistic cooperation among the subjects, so as to realize the complementary advantages of resources to give full play to the network effect and scale effect, improve the management ability and technical strength of each subject in the platform system, and create more value. In order to ensure the smooth implementation of enterprise strategies and give full play to synergy in the digital era, the following two modes of competition and cooperation can be adopted among the subjects in the platform ecology.

One is the competition and coexistence model. Although there is an independent interest relationship among enterprises, there is a win-win cooperation relationship among them because they are connected to the same system by the digital platform. Companies that are suitable for this model often have characteristics such as high homogeneity of products and technologies, differentiated solutions and similar corporate strategies. For example, the builders of the above-mentioned digital building platform will provide similar products to the owners to gain benefits, but different builders will develop different construction solutions to meet the owner's needs. Therefore, enterprises need to cooperate with each other while competing with each other, that is, the same type of enterprises in the platform ecology form a group to achieve technological breakthroughs and innovations, optimize resource allocation, reduce production, operation and management costs, and achieve a win-win situation for all parties through the complementary integration of different technologies and solutions. Enterprises need to pay attention to the following two points to implement this model: First, the premise of mutual trust. As enterprises in the same industry face the same customer group, there is inevitably competition in the market competition and resource division, so enterprises should be based on trust, reasonable allocation of market resources and timely communication of emerging conflicts of interest. Secondly, we should achieve mutual understanding and learning. Since different enterprises have unique competitive advantages in management or technology, cooperative enterprises should maintain an active attitude of learning and cooperation, and strive to achieve innovation in the field of operation.

Another model is the advantageous complementary model. That is, the platform enterprises and the participating enterprises implement complementary strategies based on the platform ecology to improve competitiveness and achieve optimal allocation of resources. With its leading position and profound experience in the platform ecology, the platform enterprise has strong influence, and it provides a collaborative innovation environment for the participating enterprises, so that each

enterprise can complement and share different technologies and capabilities. The participating companies also rely on each other to achieve breakthrough innovation and contribute to the development of the platform enterprises. Each subject mainly realizes experience sharing and product flow in the platform ecology. The former means that multiple enterprises should share their advanced experience in production, technology and operation to reduce costs and increase efficiency, while the latter means that since there is no competition between these two types of entities, they should share their products among different enterprises to increase product exposure and continuously upgrade product innovation. This model can help partner enterprises reduce the cost of resource acquisition, reduce the difficulty of achieving technological and development breakthroughs, and help solve the problem of uneven development of enterprises in the platform ecology by optimizing resource allocation to maximize value.

4.2 Symbiotic Win-win Situation

There are two types of main enterprises in the platform ecology, i.e. platform enterprises as the core subject and affiliated enterprises. In order to maintain the healthy and stable operation of the ecology and ensure their long-term benefits, the platform enterprises should implement the platform strategy based on the actual development situation, integrate the ecological resources with the dominant position and realize the enterprise value. At the same time, based on the connection channel established by the platform enterprises, the participating enterprises will seek their own development and profitability through a synergistic way of co-production and win-win situation. For example, the digital construction platform provided by Glodon achieves a symbiotic win-win situation between Glodon and construction eco-chain enterprises such as builders, manufacturers, and suppliers, and promotes common progress among enterprises by connecting to integration, thus reducing the cost of resource acquisition and collaborative innovation and giving full play to the high performance brought by the network effect [30] .

The implementation of symbiotic win-win strategy requires enterprises to focus on the following three points. First, the internal processes and resources of enterprises should be clearly planned in advance. If the platform enterprises do not standardize their internal processes before linking with the participating enterprises, they will be unable to provide standardized products and other problems, which will bring great risks to the normal operation of the whole platform ecology. Therefore, the platform enterprises need to establish an easy-to-implement process system, optimize and implement it, and communicate with the participating entities in a timely manner to optimize and upgrade the system to ensure the normal implementation of the collaborative innovation mechanism. Second, deep cooperation around the owner's demand. The platform enterprises should establish common vision and goals with the participating enterprises, establish good coordination and cooperation relationship according to the needs of customers to adapt to the ecological changes, truly solve the painful problems of owners, and create a stable and compatible service environment for them to live together. Third, optimize the governance mechanism of the platform ecology. In order to avoid possible risks in advance, platform enterprises need to establish an audit mechanism to review the hardware and software conditions of each participant in the platform ecology, such as reviewing the organizational settings, talent resource allocation and other conditions[6] ; at the same time, platform enterprises should focus on the trust relationship among platform participants and use the "reputation mechanism" and "signal mechanism" of information transmission to restrain the behavior of platform participants to avoid opportunistic tendencies[1]. In conclusion, if platform enterprises want to achieve rapid development in the digital era, they need to develop platform governance mechanisms to clarify the rights and obligations of platform participants, and on the basis of ensuring the stable operation of the platform ecology, they need to weaken the control to a certain extent to stimulate the innovative vitality of platform participants and jointly serve to build the platform ecology.

4.3 Dynamic Adjustment

Since the internal organizational structure and external development environment of enterprises have different characteristics at different stages, enterprises need to dynamically adjust their collaborative innovation strategies to adapt to the new development environment according to their specific business conditions during the operation of the platform ecosystem. When implementing collaborative innovation strategies, enterprises should not only grasp their own development situation in a timely manner, but also carefully consider the selection of partners according to specific situations, i.e., make strategic adaptation based on task-related criteria and cultural adaptation based on partner-related criteria[31].

In order to build a stable and orderly platform ecology for healthy development to adapt to the market development environment and realize collaborative innovation of all parties, the choice of strategy needs to be constantly and dynamically adjusted according to the implementation situation. The adjustment of collaborative innovation strategy mainly includes two types of emergency adjustment and regular adjustment.

Emergency adjustment refers to the feedback obtained by the strategic planning department through continuous assessment of the internal and external environment of the enterprise, and all kinds of subjects in the platform ecology make emergency response plans to ensure the normal operation of the platform ecology in response to the sudden changes in the external environment and internal structure, and adjust the synergistic strategy in time to adapt to the changes in the development environment. Regular adjustment refers to the time cycle of strategy implementation, i.e. monthly, quarterly and annual company meetings to discuss the strengths, weaknesses and problems in the current business development and cooperation with the platform participants, so as to evaluate and revise the strategy. Currently, most companies choose to adjust their future collaborative innovation strategies on a rolling basis at the end of each year, i.e., they revise their strategies in comparison with the strategic requirements set at the beginning of the year to better adapt to the development environment and trends of the platform ecosystem. Dynamic adjustment of strategy not only helps enterprises maintain their original advancement and leadership in their own field, but also enables them to maintain close contact with all the subjects in the platform ecosystem, so as to avoid the problems of disconnected development and fragmented strategy implementation among subjects.

4.4 Competitive Cooperation

The platform ecology is a high network effect system built by all stakeholders based on the common vision and goals, and the implementation of collaborative innovation strategy requires close cooperation among subjects, which requires the joint role among platform enterprises, participating enterprises, owners and external experts in order to achieve the stable operation of the platform ecology and accomplish the final goal[33]. In order to maximize the value, the stakeholders in the platform ecology adopt the strategy of collaborative governance of multiple participating subjects led by the platform enterprise[34]. In the context of digital development, platform enterprises need to apply modern new information technologies such as " Cloud Computing, Internet of Things, Mobile Internet, Big Data, Smart City, Blockchain technology" to the platform ecological governance process, and lead the participating enterprises to systematically configure their respective responsibility and right structures and actively participate in collaborative governance, so as to ensure the stable development and common governance of the platform ecology. With the digital construction platform, Glodon plays a leading role in building a platform ecosystem for associated enterprises such as builders, external experts and owners to achieve mutual collaboration and joint governance of multiple subjects. The implementation of collaborative governance strategy needs to focus on the following two points.

First, the platform enterprise leads the governance. In the process of building and running the platform system, the platform enterprise occupies a key position, so it needs to advocate the concept of value co-creation, continuously improve the platform governance regulations, formulate the

self-restraint mechanism of the participating subjects, and adopt a number of incentive mechanisms to lead bilateral or multilateral to act in accordance with the law and take the initiative to participate in governance[28]. Especially in the context of digitalization becoming a new trend, platform enterprises should fully apply information technology to the governance process, set up a digital platform that meets the characteristics of their own enterprises by setting up a cooperative architecture system of governance subjects, realize the full elements, the whole process, and the panoply of participants to connect for the platform ecological chaos, break the original isolation between enterprises and enterprises, links and links, and effectively play the network effect.

Second, the multilateral subject collaborative governance. Multilateral subjects mainly include three types of stakeholders: affiliated enterprises, external experts and owners, which can collaborate with each other in the governance within the standards set by the platform enterprises. Since the customer groups faced by the multilateral entities have a high degree of overlap and the products they hold are homogeneous, vicious competition will inevitably occur. In order to maintain the stable operation of the platform ecology, in addition to the standards set by the platform enterprise to lead the healthy competition among the participating enterprises, the multilateral entities also need to monitor the factors affecting the operation of the platform ecology, take the initiative to digitally upgrade to better adapt to the system environment, and collaborate with the platform enterprise in governance to jointly promote the construction of the platform ecology and produce a linkage effect.

Collaborative governance requires not only efficient multi-departmental collaboration within the enterprise, but also external collaboration between enterprises through complementary advantages and resource exchange, resulting in extensive and efficient joint effects and ultimately forming a strong collaborative governance force. An efficiently operated platform ecosystem requires platform enterprises to play a leading role in governance with the help of digital platform, and at the same time requires multiple subjects to give full play to their subjective initiative and carry out activities within the scope of standard requirements, but also be able to take the initiative to create value for the platform ecosystem and maximize value through collaborative governance.

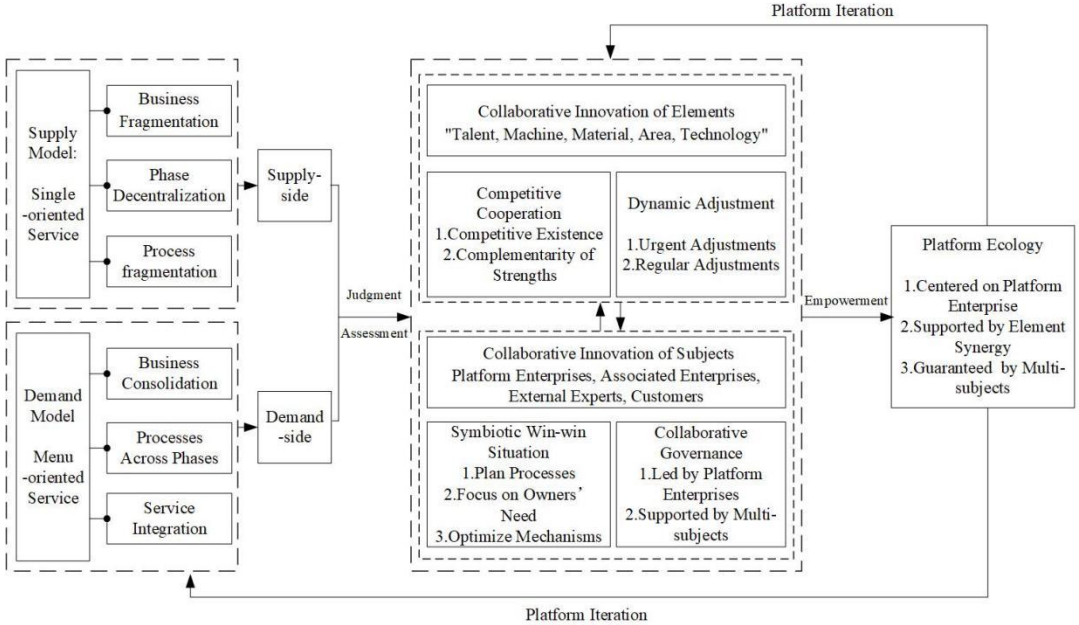

Fig. 3 Analysis of the mechanism of collaborative innovation based on platform ecology

5. Conclusion

Under the increasingly competitive environment and the new normal development situation, the "fragmented" service mode provided by traditional engineering consulting enterprises in the past has severed the intrinsic connection between projects and enterprises and can no longer provide

high-quality consulting services. Therefore, in order to meet the cross-stage, integrated and comprehensive needs of clients and the characteristics of the new stage of high-quality development, enterprises need to break the boundaries of enterprises, promote digital transformation, collaborate and innovate with all stakeholders, realize efficient allocation of resources and elements, and gradually build a symbiotic, win-win and mutually empowering platform ecology. Through the experience of successful practice of Glodon's platform transformation, this paper proposes the mechanism of collaborative innovation based on platform ecology, i.e. competitive cooperation, symbiotic win-win situation, dynamic adjustment and collaborative governance, with a view to enriching the theoretical research related to platform ecology and helping engineering consulting enterprises' digitalization, platform transformation and high-quality development of the industry.

The first is competitive cooperation, which refers to the competition and coexistence of enterprises in the same industry, and the complementary advantages of platform enterprises and participating enterprises to maximize the optimal allocation of resources; the second is symbiotic and win-win, under the supervision of the perfect audit mechanism of platform ecology, all kinds of subjects take the owner's demand as the core, reasonably plan the internal process and structure, and strive for the linkage of all parties to achieve symbiotic and win-win; the third is dynamic adjustment, each stakeholder needs to quickly perceive the changes of internal and external environment, and adopt the methods of emergency adjustment and regular adjustment to dynamically adjust the strategic plan, so as to build a stable and orderly platform ecology; fourth, collaborative governance, based on the realization of collaboration among multiple departments in the enterprise, constructing a new management paradigm of platform enterprise leading governance and collaborative governance of multiple participating subjects.

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