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## STUDY ON OPERATION MECHANISM AND NETWORK OPTIMIZATION OF COLLABORATIVE INNOVATION ECOSYSTEM IN EMERGING TECHNOLOGY INDUSTRY

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### ARTICLE DETAILS

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### ABSTRACT

In analysis of operation mechanism and environment of collaborative innovation system in emerging technology industry from the perspective of ecology, it is believed that operation of the "direct interest driven mechanism" needs perfect "knowledge information sharing environment", operation of "indirect interest driven mechanism" requires "environment guidance by interest foresight", while operation of "canyon spanning driven mechanism" demands "open and inclusive external environment." The government has played a very important role in the environment construction, which is referred to as "key operation element." On this basis, it is believed that network structure can be optimized to foster good collaborative innovation network by improvement of initial network according to characteristics of different emerging technology industries in view of different types and characteristics of the network.

#### KEYWORDS

Collaborative innovation, ecosystem, operation mechanism, network optimization.

### 1. INTRODUCTION

With the continuous deepening of innovation and openness, and increasing uncertainty in technology and markets, a growing number of scholars have found that promotion role of relevant participants such as intermediaries and financial institutions is overlooked in the traditional university-industry cooperation. Meanwhile, the pull effect of users as innovative source on technological innovation is not valued. Therefore, it is necessary to carry out production-research collaborative innovation on the basis of the traditional university-industry cooperation, which will help us cope with the decentralization of innovation resources and the closure of scientific research activities in the new economic environment as a key link for our enterprises to further improve independent innovation capabilities in the future [1-3]. In the development practice of production-research collaborative innovation, innovation network provides a major development model which receives systematic study in many literatures [4-6]. However, the network itself is so far still a black box. Meanwhile, in terms of development model of collaborative innovation network, less study discusses the optimization results of collaborative innovation network from the perspective of ecosystem. Hence, this article will analyze the collaborative innovation ecosystem against the above issues, and further discuss netting type and optimization path of collaborative innovation network, with a view to providing theoretical guidance for enterprises, governments, and related innovation entities to better carry out collaborative innovation.

### 2. RELATED RESEARCH FOUNDATION FOR COLLABORATIVE INNOVATION ECOSYSTEM IN EMERGING TECHNOLOGY INDUSTRY

Ecosystem refers to a whole body composed of biological communities and their environment within a certain time and space. In the whole body with a certain size and structure, the system members are related, mutual-influencing and mutual-dependent by virtue of energy flow, material cycle and information transmission, forming a complex with self-organizing and

regulating functions. The organisms in this system both compete and coevolve, while biological communities form an overall dynamic evolution through material exchange with the environment. The organizational theorists have established the theory of organizational ecosystem under the inspiration of biosphere ecosystem, of which, technological innovation ecosystem is an important branch. The technological innovation ecosystem means synergy and integration through which individual companies integrate respective products to form a coordinated set of customer-oriented solutions. It is an ecosystem composed of technology, knowledge, funds, innovative organizations, innovative objects, enterprises, cooperative developers, competitors, financial institutions, governments, social public and external environment and operation mechanism for technological innovation [7]. The relationship between the system elements reflects mutual cooperation more than competitiveness, which is different from the enterprise technology innovation system [8].

It is worth noting that in China where studies on collaborative innovation are still in infancy, there are relatively few theoretical and empirical studies on production-research collaborative innovation ecosystem, even less study on collaborative innovation ecosystem in China's emerging technology industry. However, it is generally believed that collaborative innovation efficiency in strategic emerging industries can be improved by constructing a symbiotic innovation system of knowledge innovation chains, while innovation ecosystem is an important way to realize collaborative innovation in strategic emerging industries [9-12]. However, in a general view, collaborative innovation ecosystem in emerging technology industry is still more macro-studied from ideology, concept and framework, and systematic studies are insufficient on the collaborative ecosystem in emerging technology industry in terms of specific forms of cooperation among various elements, cooperative mechanism between a key subject with its elements and other subjects with respective elements, operation conditions and operation process of collaborative innovation mechanism.

### 3. OPERATION MECHANISM AND ENVIRONMENT OF COLLABORATIVE INNOVATION ECOSYSTEM IN EMERGING TECHNOLOGIES INDUSTRY

Collaborative innovation means a relatively complex form of innovation organization where each innovation entity and element plays different roles in the system. The ecosystem operation performance depends not only on whether the role of the various entities and elements is given full play to, but moreover, whether these entities and elements can be organically integrated and mutually coordinated. This means in-depth study is required for operation mechanism of collaborative innovation systems. In general, some entities and elements are in a central position in a complete collaborative innovation ecosystem, and collaboration between them is based on mutual benefit and sharing of knowledge and resources in between. For instance, companies, universities, research institutions and users play a direct role in development and evolution of an emerging technology, and mutually cooperate either by sharing knowledge, talents, information, resources, or by improving and enhancing respective interests. Such operation mechanism is referred to as "direct interest driven mechanism". Such entities as technology agencies, financial institutions, and basic innovation platforms lack direct interest relations in cooperation with the above entities but play important helping role in cooperation between the entities and improvement in operational performance of the entire collaborative innovation ecosystem, so participation of other elements is needed to fulfill docking between the two types of entities in the specific operation process. The government plays a role not to be overlooked in this regard by designing specific policy measures so that these entities can share cooperation interests while playing the helping role, thus guaranteeing the realization of "indirect profit-driven mechanism".

The operation of the above two mechanisms can guarantee the completion of a technological innovation activity to a certain extent. However, whether the technological innovation activity can span the "canyon" and grow into an emerging technology depends on social, political, economic, cultural factors and even innovation resources and factors in other industries. Government also plays a very important role in the bonding of these environmental elements and exogenous elements with the above-mentioned main elements. The mechanism is referred to as "canyon spanning driven mechanism" here. The operation of the emerging technology collaborative innovation ecosystem depends on the successful operation of the above three operation mechanisms. Thus, we need to understand the necessary and sufficient conditions for the operation of different operation mechanisms based on the characteristics of emerging technologies and improve the collaborative innovation ecosystem by constructing suitable conditions and environment. Operation of the "direct interest driven mechanism" needs perfect "knowledge information sharing environment", operation of "indirect interest driven mechanism" requires "environment guidance by interest foresight", while operation of "canyon spanning driven mechanism" demands "open and inclusive external environment." The government has played a very important role in any environment construction, which is referred to as "key operation element."

### 4. NETTING TYPES AND OPTIMIZATION OF COLLABORATIVE INNOVATION NETWORKS IN EMERGING TECHNOLOGY INDUSTRY

In general, for modern enterprises, knowledge and technology are the main input factors, and the formation of technological innovation capability is the key to their survival and development. Therefore, to acquire technology externalities, rich and fast-moving knowledge and information, and shared high-level labor market, companies prefer to collaborative innovation. The links between companies and universities, research institutes, intermediaries, and governments are far closer than those between companies in the innovation network. However, for different industries with different technological innovation methods and market environments, the degree of participation of various innovation entities, the relationship between them and their roles in the resulting collaborative innovation network differ. For example, for the biopharmaceutical industry, its collaborative innovation is essentially a process of continuous coupling, elevation and benign cooperation of external motivational forces such as scientific research, venture capital,

traditional large companies, governments, and intermediaries driven by market demand and innovation culture. The biopharmaceutical industry has rare dependence on science compared with other emerging technology industries, and has unmatched need for intermediaries and venture capital institutions owing to the great risks in scientific research and pilot testing. Such characteristics make biopharmaceutical industry significantly different from the traditional technology industry and even other emerging technology industries.

Usually, we can analyze cooperation modes of different innovation entities and environmental factors from the scope, size, and contact frequency of collaborative innovation network in emerging technology industry and define network types from relationships between the innovation entities, the supporting effect of auxiliary factors on innovation entities, the network environment and reliance on external factors. Every network type differs in terms of number of participants, frequency of contacts between the entities, central nodes in the network, number of small groups, and structural holes. We can improve the initial network by adding points, adding edges, reducing or increasing the length of feature paths, reconnecting or not reconnecting broken chain so that new network can be formed, which serves as important ways to further optimize the network structure and foster a good collaborative innovation network.

### 5. CONCLUSIONS AND PROSPECTS

In this article, the operation mechanism and environment of collaborative innovation system in the emerging technology industry are analyzed from the perspective of ecology, the operation mechanisms are classified into "direct interest driven mechanism", "indirect interest driven mechanism" and "canyon spanning driven mechanism", normal operation of these mechanisms is believed to need perfect "knowledge information sharing environment", "environment guidance by interest foresight" and "open and inclusive external environment", and government is considered to play a very important role in the construction of these environments. Meanwhile, this article also discusses the type division and improvement methods of collaborative innovation network in the emerging technology industry, in the hope of providing guidance for the optimization and cultivation of collaborative innovation network in the emerging technology industry. However, this article only serves as theoretical exploration, relevant empirical research is needed in the future particularly with respect to optimization of the collaborative innovation network in the emerging technology industry, so as to better guide the development of collaborative innovation systems and networks in emerging technology industry.

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