Research on Collaborative Innovation of General Aviation Industry Based on Industrial Chain

Yun Li, Hong Zhen Lei, Ning Hui and Junna Sun
International Business School, Shanxi Normal University, Xi’an 710119, China
13537624@qq.com

Keywords: General Aviation; Collaborative Innovation; Industrial Chain; Value Analysis

Abstract. The development of general aviation industry has been regarded as the strategic emerging industries of national priority. With many related industries and strong employment promotion, the industry can promote the upgrading of consumption and the development of regional economy. Mainly based on the industrial chain perspective, the article analyzes the development of general aviation industry development, and constructs the collaborative innovation model of aviation industry development chain, discussing the characteristics, influencing factors and evolution process of the general aviation industry collaborative innovation and putting forward the corresponding policy recommendations.

1. Introduction

With the development of economy and society, general aviation industry has received increasing attention, and its characteristics of long industrial chain, high input-output ratio and obvious employment-enhancing effect make it the position of strategic emerging industries gradually. In recent years, general aviation industry has drew attention from emergency rescue, official flight, people's livelihood operations, medical assistance, tourism and other activities. It breaks the objective restrictions on social and public services, economic construction and growing consumer demand, so its status, role and awareness from the social and economic perspective have been rising constantly.

Restricted by local policies, local airspace resources, supporting facilities and the lack of professional personnel constraints and other factors, at present, China's general aviation industry development is far behind the developed countries. At present, the developing trend of the general aviation industry in China is that the development of the east is better than that of the middle, and the middle is better than the west. The place where old aviation industry enterprises locate promotes work in all areas by drawing upon the experience gained on key points. As a developing mode of Military and civilian integration, general aviation industry undertakes the needs from the military to civilian and the needs from the community's collaboration as well.

The development of general aviation industry has become an important force to promote the upgrading of industrial structure, and the development of an industry cannot be separated from the collaborative promotion of multiple subjects. The upgrading of industrial structure also comes from the inside of the industry. Related industries continue to innovate, and influence and promote each other in their self-forming subsystems surrounded by multiple subjects, then forming a comprehensive collaborative innovation system. However, there is a huge collaborative innovation difference between different industries in different development stages and a few literatures on collaborative innovation in the general aviation industry exist. Therefore, based on the theory of collaborative innovation, this paper discusses the characteristics, influencing factors and evolution of collaborative innovation of general aviation industry from the perspective of industrial chain development, and finally draws the conclusion and policy suggestions.

2. The Connotation and Characteristics of Collaborative Innovation

Peter Gloor (2006) first proposed the concept of collaborative innovation [1], and he believes that collaborative innovation is a network group formed by self-motivated staff with collective vision.
They exchange and share information and working conditions through internet, and work together to achieve a common goal. After that, scholars in this field focus on the same innovation concept and expand their studies. Serrano and Fischer (2007) [2], Chen Jin (2012)[3], Wu Yue, Gu Xin[4] (2012) and so on explore collaborative innovation from different aspects. Among them, He Yubing[5] explores the theoretical framework of production and research collaboration, and Wang Zilong[6] studies the evolution of collaborative innovation from the perspective of game theory. This paper argues that collaborative innovation is a process of optimizing the allocation of resources and realizing multi-subject win-win result. It involves an integrated system evolved by the result of a number of subsystems multi-influencing, which has subject-oriented and continue to carry out value creation and ability enhancement with associated industries, and finally continue to maximize regional economic benefits.

Thus, the characteristics of collaborative innovation can be summarized as follows:

Firstly, Integration. Collaborative innovation cooperation is the organic combination of the respective subsystems of the main industry, and become orderly under the dynamic cooperation and competition, forming its unique competitive advantage, and effectively playing its collaborative effect of 1 + 1 greater than 2.

Secondly, Openness. Innovation comes from the ability to maintain and continue to create value. Only when innovative collaboration system keeps the information, resources and other free flowing with the external environment can it full of vitality.

Thirdly, Dominance. Collaborative innovation system is a process where a main body makes connections with its related industries or enterprises, and collaborative innovation evolution process is to achieve the supply. However, the status and innovation methods of innovative subjects may change during the evolution process.

Fourthly, Interactive. Collaborative innovation system is not simple gathering, and it is synchronized with the changing external environment. Good matching and interaction between systems often improves the efficiency of the entire system by representing the resource sharing, optimal configuration, and results sharing.

According to different ways, collaborative innovation has been divided into internal and external one. Internal collaborative innovation is described above, while the achievement of external innovation depends on the interaction between industrial organization and other related subjects. This paper will also examine the internal and external collaborative innovation of the general aviation industry chain. From the internal point of view, the general aviation industry is developed from the traditional research, manufacture, operation and service, forming a complete industrial chain. Meanwhile, related industries are derived from every aspect of the industry chain so as to enhance the value of the industrial chain; from the external general aviation industry point, to achieve good developing trend of the industry is closely linked with the government policy support, research institutions’ research support and auxiliary service from intermediary institutions. The most important is concerned with the market demand and the strong desire to upgrade consuming from consumers. How to refer to the power from the government, research institutions and intermediaries to quickly seize the opportunity, seize the market demand, innovate business model and realize the general aviation industry really soars; so as to promote the development of regional economy needs to be researched.

So research scholars in the field of collaborative innovation are often started with the technology elements innovation and technology innovation to study industry internal coordination innovation, and with existed organizational innovation and model innovation to study the external coordination innovation. This paper discusses the collaborative innovation of general aviation industry, which is, on one hand, basing on collaborative innovation among enterprises of upstream and downstream. Namely, suppliers, distributors, service providers and customers in upstream of each node in the industrial chain realize all-round cooperation and achieve the maximization of interests of each participating in the process of product design, manufacturing, transportation and marketing and others, so as to improve the overall competitiveness and collaborative innovation vitality of the
general aviation; the other side is based on the cooperative innovation between the overall general aviation and the external objective environment, that is, the process of exchanging information and value with related external objects.

3. Innovation of General Aviation Industry Based on Industrial Chain

3.1 Analysis of General Aviation Industry Chain

There are few literature on the research of general aviation industry, and most of the previous studies are on the security system, technology, policy and other aspects, while the general aviation and socio-economic development research articles in recent years has gradually increased, and the number of qualitative researches is more than that of quantitative researches. The reasons for this situation are as follows: first, as a new industry, people need to have a gradual process to deeply understand general aviation industry; second, it is difficult to obtain relevant statistical data, and this is caused by the statistical lag of emerging industries, as well as the technically restricted general aviation activities by confidentiality requirements, and all of them also increase the difficulty of data acquisition. However, there are few researches on the general aviation industry chain. At present, scholars including Wang Xiaoning, and Wang Yi (2016) wrote a paper named Research on the Coordinated Development of China's General Aviation Industry from the Perspective of Industry Chain. Based on the analysis of the general aviation industry chain node, this paper discussed the development of the general aviation industry chain path[7]; Dong Nianqing (2014) discussed the present situation, difficulties and countermeasures of general aviation in China[8]; and based on the analysis of China's general aviation industry chain cooperation opportunities, Ren Jianhua et al. (2015) built a strategic alliance to promote the coordinated development of the whole industry chain, and they held that the role and interaction of the alliance can construct the strategic alliance of the whole industry chain[9]; Feng Chao (2014) wrote an article named Study on the Development of China's General Aviation Industry, which analyzed the huge development space of China's general aviation industry in the overall scale, market demand and employment; while based on the perspective of vertical industry chain[10], therefore, it can be said that due to the special nature of the general aviation industry, people have formed a consensus on the development of the general aviation from the perspective of industry chain development.

Michael E. Porter (1985) believed that value chain is ubiquitous in economic activities. An industry value chain between the upstream and downstream enterprises exists, and the link among each business unit of the enterprise forms the value chain of the whole enterprise. Each value activity in the value chain will have an impact on how much value the enterprise can finally achieve. The industrial chain of the general aviation industry is complex, whose horizontal respect involving many departments, such as government, scientific research institutes, universities and agencies, and so on, while vertical respect involving research and development, production, operation and service, and many other links. Due to the existence of the value overflow of the downstream industry chain, the industrial chain of the general aviation will further extend to the end consumer. Therefore, it is necessary to carry out further research on the collaborative development and innovation of the industrial chain.

3.2 Current Development Status Quo of the Collaborative innovation in General Aviation Industry

Relevant literatures concerning study on innovation synergy between enterprises are as follows. Zhang Xumei [13] put forward connotation and the operation process of the supply chain enterprise based on collaborative innovation during the product life cycle and put forward the implementation strategy to solve the existing problem of collaborative innovation between enterprises; Combined with industrial cluster theory, coordination theory and technology innovation theory, Zhang Zhe [14] conducts a comprehensive study of innovation in the industrial cluster system, cooperative game process, performance evaluation and coordination degree evaluation for enterprises; Zhang Bo [15] analyzes the main causes affecting the innovation of small and medium-sized enterprises of our
country, and put forward the main mode of collaborative innovation of small and medium sized enterprises. Pan Xiyang and Li Jianqing [16], according to the status and function of different subjects in the collaborative innovation process, put forward "rocket" model of the regional collaborative innovation, aiming to integrate regional decentralized innovation resources, and to achieve a seamless connection between knowledge chain, industry chain and value chain. In order to improve the competitiveness of cluster innovation ability and enhance the cluster in the global industrial chain, Ou Guangjun, Liu Yebiao [17] use collaborative theory to analyze the realization of cluster innovation and construct the modular operation of value creation, network system and innovation integration.

General aviation industry involves R & D, manufacturing, operation, service and other aspects, so collaborative innovation not only occurs in the above four links, and it will occur in every link. It can be said that collaborative innovation formed in the aviation industry chain, but also services the industrial chain. Therefore, collaborative innovation occurs not only in the coordination of each node, but also between each node of the upstream and downstream industries, as well as between the industrial chain and the external objective environment. In a word, the collaborative innovation within and between must be collaborative innovation in order to complete the enhancement of the entire industry chain innovation ability. The process of collaborative innovation is influenced by the subjective will and the objective ability of the innovation subject, and also influenced by the external environment such as technology, market and policy. These factors will jointly promote the innovation and evolution of the industry.

At present, more researches are about the internal collaborative innovation and less on collaborative innovation of the external enterprises, industry chain between enterprises as well as enterprises and the objective environment, while the researches on external and internal collaborative innovation of the general aviation industry chain are less and less. At present, the general aviation industry is just an emerging strategic industry. In the era of the new normal supply side structural reform, its supporting contribution to local economic is obvious. Therefore, this paper based on the perspective of industry chain, conducts analysis and thinking of collaborative innovation in the development of general aviation industry, and first established internal and external collaborative innovation model of the general aviation industry.

3.3 Cooperative innovation model of aviation industry chain development.

![Cooperative innovation model of aviation industry chain development](image)

In this paper, the general aviation industry collaborative innovation is explained as: the industrial system collaborates with each innovative subjects, so that production factors and resources of the industrial chain can get more optimized configuration through the organization of elements of innovation and the impact of the objective environment, which can promote the emergence and diffusion of new technologies and improve the new organizational system and innovative environment, so as to enhance the competitiveness of the entire industry.
3.3.1 Enterprises of collaborative innovation subjects

The development of general aviation industry is inseparable from the enterprise, government, research institutes and universities and related intermediary organizations, so collaborative innovation will occur in all aspects and different subjects of general aviation industry. Enterprises expect to integrate resources through effective synergies, reduce risks and costs, seize market demand and improve economic efficiency, so enterprises will do everything possible to work closely with local governments, intermediary structures, research institutions and universities in order to break through their own limitations, and gain access to talent, technology, capital, policy and other supports, improve efficiency, so as to achieve leapfrog development.

3.3.2 Government of collaborative Innovation

The government hopes that more investment and well business development will drive local economic development, stimulate employment and form good social benefits, so it will inevitably improve the environment. It is necessary to provide policy support and other measures to promote collaborative innovation, and guide innovation resources to be gathered in the general aviation industry to support the further development of the industry.

3.3.3 Scientific research institutions of collaborative innovation

Scientific research institutes and universities play a huge role in the enterprise's technological innovation, and constantly promote the enterprise's technology research and development to meet market demand. Technological innovation has a crucial impact on industrial collaborative innovation, so scientific research institutions and universities play a major role in industrial collaborative innovation.

3.3.4 Agency of collaborative innovation

The intermediary plays a role of in the innovation of organizational factors in the shipping industry. To establish the main cooperative relationship, in the industry development and market demand in the enterprise cohesion, break their own limitations, play the role of bridge to establish collaborative ties with all parties, especially when the collaborative innovation is influenced by external environmental factors, each of the main goal and value orientation, the distribution of benefits is different, to form an effective matching, to achieve a win-win situation, intermediary organizations play an effective role in the regulation.

Agencies play a lubricant role in the innovation of the general aviation industry organization elements. It plays a link role in the establishment of the main cooperative relations, in the industrial development and market demand convergence, and in the process of enterprises breaking through their own limitations and establishing synergies with the parties. The main objectives, value orientation and distribution of benefits are extremely different, especially when collaborative innovation is affected by external environmental factors. Agencies play an effective regulatory role in order to form an effective match to achieve a win-win result.

3.4 Collaborative innovation evolution of General aviation industry

According to the theory of industrial life cycle, combined with the industrial dynamic process model and the actual development of the industry, this paper divides the evolution process of the general aviation industry into three stages: incubation period, development period and maturity stage. Interaction degree and evolutionary characteristics of the three periods will be analyzed one by one.

Incubation period: As an emerging industry, the development of general aviation industry lacks concern, law of operation, and perfect infrastructure and supporting facilities. Military and civilian integration is low and basically rely on the resources of original aviation industry enterprises. With no or small general aviation airports, general aviation activities mainly stay in the social function stage, to serve the field of people's livelihood activities. General aviation industry has not yet formed a coordinated development trend, so the innovation of this stage is mainly concentrated on all aspects of the internal business with less collaborative innovation.

Development period: General aviation activities gradually begin to operate regularly. With a substantial increase in social attention, airport construction and supporting facilities have sprung up at
this period. Military and civilian integration increases. The industrial chain gradually extends, and the synergistic effect comes to light. The linkage effect of the industry begins to emerge, and gradually forms the regional cluster development. The collaborative innovation begins to form its own unique pattern. Government, agencies and other support systems are gradually involved. The general aviation industry occupies the strategic industrial development location. Research institutions and universities conduct more research and make many efforts, so the economic efficiency of general aviation industry continues to increase.

Maturity period: The operation scale of general aviation activities is growing, and connections crossing the geographical interval and the industry interval are getting more and more frequently. Airport construction and supporting facilities gradually improve, which is able to meet the general aviation industry operational needs. Industrial chain further extends and gradually upgrades. Industrial linkage effect is more obvious, and the degree of collaborative innovation is higher. The development of general aviation industry plays a more and more prominent role in creating values in the regional economic activities. Government support service capacity has been strengthened.

It can be seen that the collaborative innovation of general aviation industry is the innovation subject composed of market, government, scientific research institutes, universities and agencies. The innovation is achieved constantly in the process of general aviation industry R & D, manufacturing, operations and services. Through the effective coordination, industry linkage effect continues to show, and resource allocation has been optimized.

4. Conclusion and Policy Suggestions

At present, the general aviation industry drew great concerns, becoming the strategic emerging industry. Its upstream and downstream industry chain linkage development creates a large number of employment opportunities. At the same time, under the new normal state of supply-structural reform, general aviation industry integrates with manufacturing and service industry in-depth. In today’s world of information and network, with the establishment of large data platform to capture market demand, it also ushers in a great opportunity for development. Therefore, innovation will inevitably occur within and between the nodes of the general aviation industry chain, covering technological innovation, organizational innovation, factor innovation, business model innovation and other aspects. The process of innovation must be a collaborative development process, for which the following policy suggestions are put forward:

4.1 Collaborative innovation of internal industry chain of general aviation industry

First of all, to adhere to the strategy of technological innovation is suggested. There is a certain aviation industry foundation, which can be used to build the aviation industry base. The manufacturing-driven approach to promote general aviation industry collaborative innovation can be taken. Strengthen the integration of military and civilian development, accelerate the transformation of scientific and technological achievements, and achieve an effective combination between
technology and market demand are expected. Areas with weak aviation industry foundation can rely on the existing airport and their own advantages, to effectively play the airport economic benefits.

Secondly, to adhere to organizational innovation and factor innovation is suggested. The government will provide policy support to support the development of related industries of general aviation, guiding the resources to be gathered in the general aviation industry. Encourage the establishment of various industry organizations to provide professional services for the development of general aviation industry, promote exchanges, focus on the main innovation and increase product added value and introduce private capital to promote navigation development are expected.

Thirdly, to adhere to market demand-oriented and innovative business model is suggested. General aviation industry is currently widely used in social and economic construction. To meet the industrial and agricultural needs, logistics, flight experience, aviation and entertainment projects have also been accepted by the public. Therefore, innovating business model is to extend the value chain of the general aviation industry, in line with market demand, in order to win the competitiveness of industrial development.

4.2 Collaborative innovations between general aviation industry and objective environment

Currently, the traditional industry area is saturated. The development of general aviation industry attracts general attention from the government and every social circle. The development of general aviation industry is listed as the strategic emerging industry to gain support. Compared with the developed countries, the development of general aviation is relatively far behind. With the growing market demand and great attention of government, government will actively promote collaborative innovation with internal industry in the aspects of policy support, the park construction and the improvement of infrastructure and other aspects.

A complete general aviation industry chain, which concludes products, talents, technologies and services, etc..., is expected to be built by closely meeting the global market demand with the general aviation manufacturing industry leading enterprises as the core. Intermediary institutions should cooperate with the relevant government departments to provide professional services, encourage cooperation, promote exchanges and achieve interoperability, build a platform for developing general aviation and innovative business model, in order to jointly promote the development of general aviation industry in China.

The network of general aviation industry chain is expected to be weaved densely by meeting the market demand, so as to promote the interior of the navigation industry innovation and improve product added value and by integrate and subdividing the industry chain, so as to promote and extend the general aviation industry chain extended to consumers.

Further integration between aviation industry and aviation service industry needed to be promoted in the general aviation industry chain. Through collaborative innovation to achieve value-added manufacturing sectors, and through intensive and meticulous operations better meeting consumer demand, development of related industries which is general aviation as the theme would be derived to meet the growing consumer demand of consuming upgrading.

In short, the general aviation industry collaborative innovation process is not a simple cooperation, and also cannot be achieved overnight. The essence of collaboration is to break the limitations of the main body, to achieve the sharing of resources, exchange needed goods, integrate resources effectively, and achieve a win-win result.

5. References

[1].Peter A. Gloor, Swarm Creativity: Competitive advantage through collaborative innovation networks [M], Oxford University Press, 2006.


[4]. Wu Yue, Gu Xin. Research on Knowledge Synergy process of collaborative innovation[J], China Science and technology forum, 2012(10).

[5]. He Yubing, Theoretical Model of Collaborative Innovation[J], Science Research, 2012.2

[6]. Wang Zilong, An Evolutionary Game Analysis of Political Science Research Collaboration Innovation[J], Technology and economy, 2013.4


[10]. Feng Chao, China General Aviation Development Space and Industry Chain[J], Chinese circulation economy, 2014. 5.