

## Production–teaching–research of a Commercial Aircraft Corporation in the Chinese Industry Chain

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**Abstract:** For the future development of a commercial aircraft corporation , this paper focused on the research and technological innovation model in an industrial chain and explored how to promote the sustainable development of technological innovation on the basis of the Chinese aviation industry. It puts forward several ways to reinforce cooperation , such as strengthening policies and regulations , government's support for research cooperations , accelerating construction of the production–teaching–research oriented public technology platform and service system , and firming the industry awareness of universities and research institutes , and so on.

**Key words:** industry chain; production–teaching–research; promotion strategy; technology innovation

### 1 Introduction

In the airline industry , which is a technology intensive industry , technology innovation is not only the industry continuous vitality but also the decisive factor of promoting the industry forward. The airline industry cluster should insist on innovating dependent on the support of a production–teaching–research mode so it can develop fast and steadily under the market economy condition.

The Commercial Aircraft Corporation of China , LTD ( hereinafter referred to as CAC) as a new company , must attach great importance to the construction of key technical links in the construction of independent development and technology innovation in its vast industrial chain link in order to stand out in the fierce market competition and apply to practice in order to im-

plement diffusion and spillover of innovation knowledge. Only in this way can we improve our own technology strength and market competitiveness.

### 2 Analysis of present situation

#### 2.1 Technology innovation status of the aviation industry

China's aviation industry has a certain dependence on the introduction of technology and its scientific research capability is less than the United States and other developed countries which results in the inadequate re-innovation on the basis of introduction. Therefore , how to improve the aviation industry and technological innovation capability is an important issue. Technology innovation is the core competitiveness of enterprises while the inadequate re-innovation and small number and low level of technologies and products of independent intellectual property rights weaken core competitiveness directly which affects the development of the aviation industry. The present condition of technological innovation of the aviation industry enterprises includes the following areas: First , the pressure of technological innovation is heavy. Second , research funding is relatively small and lack of high-level personnel. Third , there is a lack of innovation motivation. Fourth , technology innovation incentives and the corresponding service system are imperfect.

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## 2.2 Development status of commercial aircraft corporation

CAC is an aircraft manufacturing enterprise; its industry chain mainly includes a technology chain which contains supply, manufacturing and after-sales service, capital chain and talent chain generally. The manufacturing chain is the core of the technical industry chain link and is also the largest growth in value and the highest content in the technology of the industry chain.

CAC with Beijing research and design center as the main body joints has various forms ownership enterprises, scientific research institutions, universities, supplier R & D center abroad and product customer etc, forming the organization system and network to guarantee effective research and development. In the meantime, the company should strengthen its soft power construction from the R & D and design ability, assembly manufacturing capability, marketing ability, customer service ability, airworthiness forensics ability and supplier management ability, especially the construction of R & D and design ability and assembly manufacturing capability. This is also the prerequisites for technical innovation in the industrial chain link.

The key to technology innovation is to see whether there was a breakthrough in the manufacturing chain contained in the technology chain for aviation enterprises. It's the same for CAC. So technology innovation of CAC in the industrial chain links must also be focused on the manufacturing chain to stay competitive, taking the road to independent innovation.

Independent innovation includes three aspects concretely: First, obtaining scientific inventions and patents mainly through independent research and original innovation. There are two features: one is innovative, namely the results did not exist previously, the other is breakthrough, and that is to say innovation achievements have significance in its field<sup>[1]</sup>. Second, making secondary innovation combined with our own needs when digesting and absorbing the introduction of foreign advanced technology fully. Third, strength-

ening integrated innovation through integrating different kinds of relevant technology effectively, then form our own feature products that have certain market competitiveness. Integrated innovation is a question on the issue that how a system solves the application and industrialization of basic technology and invention<sup>[2]</sup>.

The practice shows that it is necessary for enterprises to play its dominant function in technology innovation while strengthening the independent innovation capacity-building and taking the road of production-teaching-research cooperation take full advantages of the scientific research capacity and possess high level interdisciplinary talent of universities and research institutes at the same time.

## 3 Technological innovation in the industrial chain

### 3.1 The meaning of production-teaching-research cooperation

Production-teaching-research cooperation is based on enterprises, universities and research institutions. It operates according to certain mechanisms and its rules are established by operation organizations that take output sharing and complementary advantages as their basic principles. All the government, technology intermediary service agencies, financial institutions and other related main bodies participated, forming a coalition independent entity which develops new technology R & D and application together, promoted technological innovation and advancement of society and made positive effects on other relevant factors<sup>[3]</sup>.

Universities, research institutions and enterprises have different division of labor and functions. With the development of society, the technological innovation plays a more and more important role in the development of social economy. There exist closer complementary relations to each other among universities, research institutes and enterprises. Such a complementary relationship is mainly embodied in the following aspects: First, the complementary relationship in technical innovation in the value chain. Independent

innovation should contain knowledge innovation and technological innovation<sup>[4]</sup>. University and scientific research units are the subject of knowledge innovation, enterprise is the subject of technological innovation. So their orientation in a technology innovation chain is different, but on the other hand they complement each other and compose a complete innovation chain<sup>[5]</sup>. Thus, production-teaching-research cooperation is docking and coupling with technical innovation from top to bottom<sup>[6]</sup>. Second, the three goals and objectives are complementary. Talent and technology are the basis of an enterprise to make profit while its profit in turn can support the development of talents and technology. So the three goals are mutually beneficial. Going the way of production-teaching-research cooperation is what an enterprise takes as its subject and requests. Universities, research institutions and enterprises to cooperate mutually is the inexorable trend of the technological innovation mode. For example, CAC needs science and technology innovation and talent development; it has advantages in economic strength, applied talents development and technical innovation ability. In terms of Northwestern Polytechnical University (NPU), discipline construction, talent cultivation, and broadened sources are demanded, and it has an advantage in basic research and talent cultivation. This complementary function provides the foundation of win-win cooperation with the objective basis. The relationship of the production-teaching-research cooperation innovation mode of CAC is shown in Figure 1.

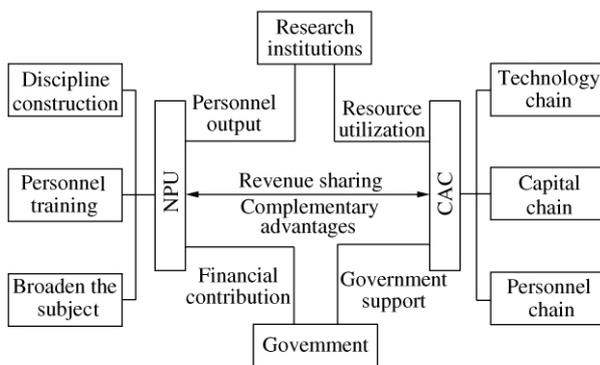


Figure 1 Relationship of production-teaching-research cooperation innovation mode of CAC

Production-teaching-research cooperation is able to play their respective comparative advantages fully and improve production efficiency greatly, making full use of resources. In the term of long time, we should not be limited to short-term interests but to coordinate businesses, schools and research institutions in order to maximize the benefits, take the best way for the development of the whole industry under the related support policies from the government. The development of CAC can learn from the successful experience of foreign cooperative innovation and explore a suitable innovation model according to its own characteristics.

### 3.2 Technology innovation mode of production-teaching-research cooperation innovation

The production-teaching-research cooperation innovation mode is the product of development of the market economy; there is no fully mature pattern to follow. The centre of production-teaching-research cooperation is the technology innovation and transformation of the achievements and the impetus is market demand and policy guidance and the key to success is operation mode and mechanism. There are five cooperation modes from experience at home and abroad: they are government-pushed production-teaching-research combination, build R & D base together, build technology park together, technical trading and combination of strategic alliances.

#### 3.2.1 Government-pushed production-teaching-research combination mode

The government-pushed production-teaching-research combination mode is government organization's large-scale joint action that aims at resolving the major issues and key issues in the development of technology and economy. The characteristics of government-pushed production-teaching-research integration pattern are as follows: it's provided a platform by the government, and funded and invested by the financial department, raising money through multi-channel so as to invest for the production-teaching-research association by means of setting a science and technology development fund; the initial funding mainly supports the public welfare or hi-tech projects of high risk and investment, which are compliance with a local econo-

my, the needs of social development and the rationality of industrial structure<sup>[7]</sup>.

### 3.2.2 Build R & D base together

This mode focuses on enterprise leading, requiring resource shared among companies, universities and scientific research institutes and take common development, complementary advantages and mutually beneficial as a principle. Under the mode, human, material and financial resources will be concentrated together for overall planning, centralized management and unified use around the common goal. Participants set up cooperation platforms jointly aiming at R & D and exchange technology R & D center, key laboratory, teaching research base and so on. Practice has proved that the benefits of collaborating with academia are unambiguously positive from a private-sector perspective<sup>[8]</sup>. Its advantage is that it can make full use of internal resources of universities and research institutions and maximize enterprise industry competitiveness.

### 3.2.3 Build technology park together

Building a technology park together requests the universities, research institutes and high-tech zone to found a university science park jointly, transform high-tech achievements, hatch high-tech enterprise, culture technology and management talents and develop a high-tech industry<sup>[9]</sup>. The science park mode is dominated by enterprises and is launched by a university which unites enterprises and government to participate generally, mainly engaged in high-tech transformation of achievements and R & D of related technology products. The university as the innovator is also promoting technical transformation of achievements. Enterprises in the park provide fund supports and achievements, obtained places, parties with property right as a link to expect to create high yield and high value by high-tech property right. The entire process participates, in joint development scientific research belongs to a research-economy-market integration development route which has high-tech and strong anti-risk ability<sup>[10]</sup>.

### 3.2.4 Technical trading mode

Technical trading is the business side that purchases

the science achievements and bears all the risks in commercialization of technological achievements and enjoys profits<sup>[11]</sup>. In this mode, the universities and research institutions establish relations of cooperation and clear rights and obligations of the contracting parties under the principles of equality and voluntariness. With high technology transfer agreements in accordance with legal procedures and mode. The party providing technology is responsible for technical feasibility, teaching of technical projects and technical testing. Companies choose appropriate results according to achieve its transformation. In this mode, the universities and research institutes do not need to put more manpower, material and financial resources. There is no great risk, but probably because they can not keep abreast of market demand, resulting in research results into productive forces can not be smooth and waste resources. While enterprises can quickly access their needed technology, and will pay a relatively high price since the results are produced by uncertainty, companies will bear the greater risk.

### 3.2.5 Combination of strategy alliance

Combination of strategy alliance is a new model of research cooperation exploration based on the condition of our country. The Ministry of Finance, Ministry of Education, the SASAC, and the other six departments issued the "on the promotion of industrial technology innovation and build strategic alliances guidance" jointed in 2008 points out that industrial technology innovation and strategic alliance is based on the common interests of all parties, aimed at enhancing the industrial technological innovation and protecting the contract with legally binding force by enterprises, universities, research institutions or other organizations, forming joint development, complementary advantages, benefit-sharing and risk-sharing technology innovation cooperation organizations.

## 3.3 Technology innovation mode of CAC

Due to the complexity of production-teaching-research cooperation, each cooperation and the different interests of each subject, production-teaching-research cooperation in China still has problems like underpowered, short-term profit driven and efficiency is not

high and so on. Combining with the various conditions of CAC , and analysis of opportunity and challenge , advantage and disadvantage , this part explores

the leading industrial production innovation model in different stages of CAC based on the existing mode. It is shown in Table 1.

Table 1 Dominant production-teaching-research cooperation innovation mode in industry chain

Mode	Technology chain( Discipline construction)	Capital chain( Broaden the subject)	Talent chain( Personnel training)
Led by CAC	Government-pushed production-teaching-research combination mode	Build R & D base together	Build technology park together
Led by NPU	Combination of strategy alliance	Build R & D base together	Technical trading mode

The CAC Company should make full use of various resources and try to carry out a cooperation innovation mode; it also should strengthen independent innovation ability in a technology link and improve the application rate of technological achievements to form a virtuous cycle among industry , academia , and research. Finally , it will form a civil aircraft development platform that can compete with advanced international aviation enterprises and domestic aircraft product series and international first-class specialized talented people , to improve core competitiveness comprehensively. All those lay the foundation for airline industry cluster formation and creat a international first-class aviation enterprise.

## 4 Strategic analysis to enhance production-teaching-research cooperation

### 4.1 Strengthen the dominant position in innovation of CAC

The CAC as a strategic business in the aviation industry should establish its position in technological innovation , take the task to be the body of technology innovation investment in research and development and decision-making , establish a commercial flight to take the initiative , government subsidies to promote science and technology service system technology linkage innovation and operational mechanism gradually and form a group of aviation industry enterprises which have complete independent innovation capacity. CAC is always adhered to the main innovation body to achieve truly independent innovation , strengthening the international competitiveness of the company in

the aviation industry. At the same time , the government should increase scientific research investment and knowledge property protection and other policies for the airline industry enterprise to encourage enterprises to become the subject of technological innovation.

### 4.2 Speed up the construction of public university-industry cooperation oriented technology platform and service system

We must speed up the construction of the public university-industry cooperation oriented technology platform and service system mainly from the following aspects: First , strengthen construction of the information platform of production-teaching-research cooperation and solve the problem of asymmetric information; Second , accelerate the technical services for the transformation of the achievements of scientific research and shorten the construction of a supporting platform between enterprises supply and demand distance; Third , accelerate the construction of an intellectual property information service platform and provide information for university-industry cooperation development services; Fourth , promote the development of combining professional agencies actively and guide it to display information communication , technology assessment , legal consultation , organization and coordination , intellectual property services intermediary function and improve the service level; Finally , play industry association advantages in this industry , strengthen organization and coordination of university-industry cooperation<sup>[12]</sup>.

### 4.3 Strengthen industry awareness of universities and research institutions

If universities, research institutions and enterprises are out of touch, not only the advantage of university research can not play, but the companies can not access to new technology timely to improve technological innovation ability. Strengthening industry awareness of universities, and research institutions and the cooperation with enterprises can make companies receive timely support, can broaden the sources of research funding and improve educational conditions for the training of personnel to provide superior environment for universities and research institutions.

### 4.4 Establish government-production-teaching-research strategic alliance to support industry development of the CAC

Strategic alliance based on the combination of industrial clusters in China has three main forms: production-teaching-research strategic alliance based on project, production-teaching-research strategic alliance based on building research institutions and production-teaching-research strategic alliance based on building business entity<sup>[13]</sup>. In the term of participating subject of government-production-teaching-research strategic alliance, it is no longer merely the school-enterprise cooperation; the government also became one of the main bodies. With the government's joining, both the feasibility and validity will be strengthened. On the other hand, strategic alliance widened the cooperation significance.

### 4.5 Improve policies and regulations related to research cooperation and increase government support

Government as an important role to provide a good environment for production-teaching-research cooperation should strengthen the legal system and develop "Cooperative Law" and other relevant laws and regulations, take production-teaching-research into legal management, use laws and regulations to limit bad behavior in production-teaching-research cooperation and protect the legitimate rights and interests of all parties to protect the interests of the innovator's innovation, especially the protection of intellectual proper-

ty<sup>[14]</sup>. In addition to formulating relevant policies, laws and regulations, the government's economic regulation and guidance for cooperation also offers many opportunities. Economic instruments are mainly reflected in the establishment of various funds, such as "risk fund" that is likely to have a significant technological breakthrough, when research projects with more risk and investment that an enterprise can not bare; it is supported by the government with a "risk fund" to give interim financing<sup>[15]</sup>.

## 5 Conclusions

This paper mainly studies the CAC production-teaching-research innovation mode on its industrial chain technology innovation based on the current situation of the CAC. It suggests several strategies to intensify the technological innovation mode. It also discusses the importance of the CAC, as the main subject of implementing national large plane major projects and large aircraft projects, to choose right and suitable production-teaching-research cooperation innovation modes in the background of implementing big plane strategy in China. At last, it points out that it is an effective way to raise the CAC's technical innovation ability and gain international competitiveness if we take the right production-teaching-research cooperation mode.

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