Cultivating technical capabilities of enterprises is an important task of the Sutong Bridge project

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Abstract: The paper analyzes existing state of innovation system in the field of public infrastructure construction in China and elaborates on the duty and role of owner in establishment of a technical innovation system with enterprise as the main body following the process of production-education-research. This paper also claims that the key project construction is an important resource to enhance national capability of innovation and accordingly puts forward an effective approach to cultivate the core competitiveness of leading enterprises on the basis of practice in the Sutong Bridge project.
Key words: Sutong Bridge; project; innovation; enterprises

1 Introduction

In the 5th Plenary Session of the 16th Central Committee of the Communist Party of China, it was decided to "establish a technical innovation system that regards enterprises as its main body, orients its development by market demands, and integrates industries, colleges and universities, and research institutes, and form a basic framework of self-initiated innovation". For this purpose, government at all levels has promulgated some policies and measures to further support enterprises to improve their innovation capabilities. In the field of project construction ("project" in this paper means infrastructure projects), there are concrete issues we need to study, such as how to implement the strategy of technical innovation centering on enterprises, how to observe relevant government policies and guide and promote the enhancement of innovation capabilities of enterprises. On the basis of practices in the Sutong Bridge project, the author thinks that in the field of infrastructure project construction, building of a technical innovation system centering on enterprises and cultivation of enterprise core competitiveness in technical innovation require not only the support of government policies and the society but also more actions from proprietors.

2 Position of proprietors in the building of technical innovation system

Infrastructure projects involve public services that the government provides for the society. Large-scale transportation facilities like highways, bridges, and tunnels are all public infrastructure facilities. Some big projects represent the image of a region, an industry, and even a nation. In general, the government shall be the proprietor of public facilities and be directly involved in the technical innovation system of a project construction field. However, in the existing system of infrastructure construction in China, the government is merely a policymaker and a body keeping the order of the construction industry. Particularly in the field of transportation construction, government departments are not necessarily proprietors, as market mechanisms are introduced in large projects and project financing, construction, and operation are carried out by companies in the mode of project legal person. Though most project proprietor companies are state-owned in nature, they are business operators who pursue maximum corporate interests and profits. Hence, the proprietor's target interests may not align with those of the government and market mechanisms suffer failure in the process of technical innovation in enterprises. Project companies, as proprietors, are actually government agencies in nature. Introduction of market mechanisms does not necessarily change the public nature of infrastructure facilities. In addition, technical innovation covers two levels, the enterprise level and the state level, and needs joint efforts of the government, proprietors, and the society. Proprietors shall fully observe their duties and responsibilities in public infrastructure construction as specified by the government. Proprietors shall assume the governmental functions in major

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technical innovations and act as "government organs" in the technical innovation system that regards enterprises as its main body and integrates government, industries, colleges and universities, and research institutes. Currently, the problem is that, in front of heavy tasks of key project construction, proprietors usually think little of and even neglect the important duty of cultivating enterprise capabilities of technical innovation. And the status, to some extent, results in failure of the government to guide and cultivate technical innovation of enterprises in big projects.

The goal of Sutong Bridge construction is "safety, high quality, high efficiency, and innovation". Innovation is an impetus and a route for bridge construction. The technical innovation work of Sutong Bridge focuses on construction of a high-quality bridge, dependency on integrated application of science and technology, solutions to technical difficulties in the project, and formation of some technical fruits in the process; and also orients itself toward the state level, aiming at promoting the international competitiveness of bridge technologies in China. We shall regard cultivation of enterprise innovation capabilities as an important part of the construction work, rely on Sutong Bridge to set up an international platform, gather domestic enterprises and use international resources to break through one or two world class technical difficulties, form core technologies and technology packages through self-initiated innovation, bring up leading enterprises of transportation construction, bring up senior bridge engineers, and contribute to the leaps of bridge technology development in China. Facts show that goals of the Sutong Bridge project have clear guiding effect on technical innovation of contractors.

Sutong Bridge Construction Commanding Department (CCD) takes the roles of guidance, service, and cultivation in the innovation system. CCD regards as its own responsibility promotion of the national core competitiveness in bridge technologies, uses the colossal project of Sutong Bridge to encourage and support self-initiated innovation among contractors, tries to create high-level platforms, vigorously helps enterprises and acts as road and bridge for enterprises to enhance their innovation capabilities.

3 Roles of proprietors in cultivation of enterprise innovation capabilities

Enterprises shall play a dominant role in the technical innovation system. However, currently most large enterprises in the transportation industry have problems of fund and human resource shortage, low technical innovation capability and low core competitiveness. Enterprises are usually more interested in short-term gains and have not given due importance to innovation and lack the activeness to promote their competitiveness through technical innovation. Main reasons lie on business environment and system. In China, construction enterprises in particular still remain in the lowest level of the technical industry chain. The first thing they consider is how to survive. Fierce competition forces them to search for and strive for businesses. Enterprises, both big and small, struggle for one piece of cake. They are eager to lower their prices, but fail to obtain reasonable profits. They often suffer losses in event of risks and do not have much fund for investing in innovation capability building. This condition severely restricts the development of transportation technologies in China to higher levels and affects the international competitiveness of transportation engineering enterprises. Enterprise innovation capability and motive problems have become a bottleneck in the implementation of transportation industry development strategies and major tasks of the Eleventh Five-Year Plan in China.

Over the years, the government has been giving powerful policy support to encourage self-initiated innovation of enterprises. But the problem lies on weak implementation of these policies. Certainly enterprises themselves are partly responsible for the problem. Yet generally speaking, proprietors are the key elements in this problem. Engineering and technical innovations are mainly processes of science and technology application as well as fruits that creatively integrate technical, economic and management elements. Technical innovation in the construction field appears more oriented by market, customer demands and project requirements than that in product producing enterprises. Project buyers are proprietors. Proprietors guide the market and also demand the market. Proprietors' values and their requirements on project functions, appearance, quality, economy and beauty will surely guide their project demands. Project construction, in nature, is a kind of service. Proprietors' demands in projects cover their requirements on engineering innovation. Seen from innovation goals, the proprietor and the enterprise are in line with each other. But, seen from resource inputs and interest aspects of innovation, they have considerable conflicts. In actual practice, this basic issue is easily neglected.

At the beginning of this year, after the National Science and Technology Conference, the State Council promulgated *Supporting Policies for the Outline of the State Planning of Middle and Long Term Science and Technology Development* (2006 – 2020) and offered specific policy measures in aspects of science & tech-

nology investment, taxation incentive, financial support, and government purchase, which provide all-round guarantee and support for building an innovation-oriented nation and encouraging self-initiated innovation. Government departments at all levels also release their measures for policy implementation and show their powerful guidance. Proprietors shall stand at the level of the nation and the government, while trying their best to carry out large construction projects, regard cultivation of technical innovation capabilities of enterprises as their irrevocable historical mission and responsibility, carry out true implementation of government policies, create conditions for enterprises to make important contributions to project construction and also make project construction a school for them to enhance their technical innovation capabilities.

Enterprise cultivation requires that proprietors shall not only regard enterprise technical innovation as an important goal of project construction but also provide their service and support. In large and complex projects, a number of industries, disciplines, and technologies require to be integrated, resources need to be gathered and conflicts solved across regions. But enterprises are not fully capable of systematic integration and require proprietors to act on behalf of the government and help integrate resources. Enterprise cultivation also requires that proprietors shall give more and ask for less, make innovation fruits available to enterprises, make enterprises fully own their innovated intellectual properties and also entitled to investment and schedule reduction benefits brought by technical innovation. Proprietors are only beneficiaries of innovation fruit applications and they shall not try to assume principal roles in innovation and shall exercise more care to avoid using their privileges to obtain innovation fruits, honors, or benefits.

4 Cultivation of core competitiveness of leading enterprises in key projects

Building of enterprise innovation capabilities needs the guidance of government policies and more the drive from key construction projects and their innovation tasks. Key projects, as the most precious strategic resources, provide soil for technical innovation and the best opportunities of practice for the cultivation of technical innovation teams in enterprises. So bigger platforms should be built for domestic enterprises that have basis of self-initiated innovation, and for cultivation of senior talents and leaders. In comparison with similar projects around the world, Sutong Bridge is unique in a number of its crucial techniques which have no ready solution internationally. Moreover, many technical issues in this project need further research. Solutions to them must rely on self-initiated innovation of domestic enterprises. Sutong Bridge is a large-scale and complex transportation project and also a big platform for big enterprises to improve their technical innovation capabilities.

With a platform in place, we still need cultivation. For the building of an engineering and technical innovation system centered on enterprises, the key lies on cultivation of enterprises. It is possible for enterprises to really become the main body of technical innovation only when the government executes its strategic guidance and creates better environment for innovation, and proprietors assist the government to fully and directly guide and support technical innovation and help enterprises improve their innovation capabilities and core competitiveness.

4.1 Raising the access qualifications and cultivating enterprises' capability of attracting talents

First, improve the measures of market access, further polish the measures of tender and bid assessment, and create market environment beneficial to the development of self-initiated innovation and grant big domestic enterprises more opportunities. For big projects, the access qualifications must be raised for prevention of vicious competition. In bidding invitation for large complex projects, proprietors shall not only observe the principles and the guidelines in the Tender Law, but also emancipate their mind, mainly use comprehensive bid assessment, prioritize technical innovation capability as an important element, increase assessment items for this element and reasonably set its weight in the assessment score. In Sutong Bridge project, access requirements are heightened through intensified qualification examination, detailed bidding conditions and requirements, and compulsory items as clearly defined as possible in major construction tasks. For example, design of relevant temporary large facilities and its review, key construction equipment, and project interfaces, etc. are specified. In addition, assessment of complex bid sections mostly uses the score weights of 70 % for technology and 30 % for price to make enterprises prioritize technical schemes and innovation, thus creating a competition between technical giants rather than an insignificant and superficial game and eventually reaching the goal of choosing the strongest among the good and the best among the strong.

The drive for technical innovation in engineering and construction enterprises mainly comes from competition demands and pursuit of profits. Benefits of technical innovation consist of two aspects—immediate eco-

nomic benefits and long-term benefits (such as improved capabilities of market expansion and innovation). With the presence of heightened access requirements, super big construction enterprises are able to free themselves from ordinary work. Large enterprises can rely on their technologies and management advantages for higher added value in production instead of relying on labor profits. In this way, large enterprises will gain reasonable profit and sufficient economic strength to maintain its human resource team, attract more talents to join them and enter into the industry, build stronger teams and bring up elite troops for their technical innovation and management.

4.2 Expanding the platform and making enterprises capable of integrating resources

Chinese bridge builders are diligent and clever and they have abundant engineering experience. Since the Eighth Five-Year Plan, scores of large-scale river and ocean bridges have been built. All these bridges were built under the domination of domestic enterprises and many technology innovations have reached the world's leading level. We shall have confidence in domestic teams. However, we shall also see that, domestic leading enterprises of bridge construction still lag far behind large foreign enterprises in resource integration and innovation capabilities and need to practise and improve themselves to bigger platforms.

General contract and joint contract are both popular ways of dealing in the international construction market and have significant merits in cost, time, and quality and also provide broad space for technical innovation. Construction enterprises in developed countries and regions are good at general contract and joint contract while those in China are not. Although the state government vigorously promote general contract and general contract is applied in many industries, the system of infrastructure construction in China still poses obstacle to the application. Further studies are needed to solve this problem. In particular, it is necessary for proprietors to consider the overall picture of their projects and make bold breakthroughs through scientific organization.

General contract capability, directly reflecting the capabilities of an enterprise in resource and technology integration, is a basic skill for participation in international competition and a core competitiveness element in the field of project construction. It is also an important route for accelerating the establishment of an innovation system that regards enterprises as its main body and integrates closely industries, colleges and universities, and research institutes. Proprietors shall vigorously practise general contract, make bid sections bigger in order to form bigger platforms for contractors to focus their technical strengths on technical integration and innovation activities. During the application of general contract in the Sutong Bridge project, we insist that domestic enterprises dominate the project and we regard contractor enterprises as the main body, emphatically cultivate their capabilities of technical resource integration, put as more construction-related design work as possible into the contract content, accelerate the cultivation process, and try to realize the transformation from government-driven and proprietor-initiated integration to market-driven and enterprise-initiated integration.

4.3 Raising the platform and cultivating international competitiveness of enterprises

Bridge construction industry in China has technical advantage around the world and is presently at its vital stage of developing from a follower to a leader. A basic guideline for a quicker improvement of core competitiveness is to become excellent in prioritized fields. On one hand, we shall gather necessary resources, take stronger measures, and promote the formation of capability of self-initiated innovation. On the other hand, we shall continue to maintain the open policy, extensively learn from other countries, and try to integrate international intellectual resources. There are many fields in foreign countries worth learning, such as their standards and codes, design and research methods, construction machinery and management. To improve our international competitiveness, we must first stand at the cutting edge of technologies in the world. For example, for the 75 m span continuous box girder structure in Sutong Bridge B2 bid section, we imported the technology of cantilever assembling of short line prefabricated girder sections and we gradually grasped crucial technologies of geometrical control analysis, framework design and bridge girder erection machine design. In the future, these technologies on the basis of digestion and absorption will be innovated. Practice has proved that technology import and international technical cooperation are good for accelerated improvement of innovation capability of enterprises.

The Sutong Bridge project establishes an open platform based on self-initiated innovations. Through strengthened international cooperation and the import of advanced foreign technologies and management practices, domestic bridge building experts and enterprises have the opportunity to work and communicate with international bridge experts and enterprises, showing each other's strong points and finding their own shortcomings. They are also able to actively absorb these advanced concepts and technologies, make further in-

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