

A Functional Analysis of Canada NCE's Technological Innovation Management

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Abstract: *As China is rapidly rising as a international member of technological innovation, it is practical to analyze Canada NCE's innovative function, particularly from a systematic perspective. As network organization NCE manages the innovation cooperation according to the network organization agreement. Key points enhancing the innovative function include the network management of technological innovation, the system structure guided by collectivist value, and especially the dual innovation structure that integrates innovative elements. The innovative function of the dual innovation structure in promoting innovation cooperation, managing innovation resources efficiently, and fostering a collaborative environment for technological advancements is emphasized for high level of independence and self-improvement.*

Keywords: Structure; System analysis; NCE (Networks of Centers of Excellence); Innovative function.

1. INTRODUCTION

Canada NCE as abbreviation, is the Networks of Centers of Excellence of Canada, is a cooperative organization established in 1989 to promote innovation. It is jointly managed by the Canadian Institutes of Health Research (CIHR), the Natural Sciences and Engineering Research Council (NSERC), the Social Sciences and Humanities Research Council (SSHRC), and Industry Canada [1]. It provides Canada with a self-organizing, self-developing, and self-replicating innovation mechanism and platform, supporting the government, industry, and academia play a key role in constituting the high-tech industry. And it assisted in the technology transfer from Canada to China, and in the field of science and technology cooperation. As China is rapidly rising as a member of technological innovation, intensifying the high-tech competition between countries, especially with the United States, and further intensifying the protectionism of international high-tech industry cooperation [2]. Furthermore, human society is transforming systematically into a society of networks [3]. Therefore, to achieve a high level of independence and self-improvement, it is highly practical to analyze the innovative function of Canada's NCE, especially from a systematic perspective. From the perspective of systems theory, the function of a system depends on its elements and structure. To analyze the innovative function of the Canadian NCE system, it is necessary to explore the innovative elements, and to examine its structure in details.

2. THE NETWORK MANAGEMENT OF TECHNOLOGICAL INNOVATION

Technological innovation resources of labor products such as scientific and technological achievements, under the condition of socialist market economy, are commodity. As to commodity producers, the significance of commodity use value is that it is the material undertaker of value, and all goods for consumers, is supposed to obtain its use value, required to give according value out for exchange. As to the subjects of technological innovation, in order to obtain the use value to carry out innovation, it is inevitable to pay according price to transfer the value to providers. This adds a transfer link for innovation management, resulting in a series of problems, such as how to calculate the value, by what terms to pay, and the settlement of disputes, etc. The transfer link inevitably increases the cost of innovation, such as management costs and time costs. To swiftly handle these problems, it is critical to carry out systematic innovation cooperation, organize various innovation resources to concentrate and share according to the agreement, calculate the price according to the frequency of use and the effect feedback, and then arrange all kinds of documents for the subjects to pay from the innovation fund to the innovation resource provider. These are all swiftly handled by NCE in a way of network management, similar to a special direct exchange of objects, so that the innovation subjects can obtain what he needs comprehensively, and enjoy rapid access to innovation resources, hence make full use of them.

In today's intelligent productivity, exemplified by economic globalization and technological information, the network, as a high-tech media, can ensure the orderly and efficient operation of innovative practice, and can then

be combined with management innovation to carry out the network cooperation of technological innovation. The success of NCE is a proof not only for the technology innovation platform, expand the resources, but also for the output of high quality innovative talents and technology, and becomes a model, especially innovation operation model, is widely cloned in the starting Center of Excellence of Commercialization and Research (CECR), and successfully conducted the Business Leading Network Center of Excellence (BL-NCE), operated Industry Research and Development Internship program (IRDI). "Technological innovation can obtain information platforms, institutional platforms and organizational platforms from successful network organizations.[4]" Canada NCE belongs to the "network organization", which manages the innovation cooperation efficiently according to the network organization agreement.

3. THE SYSTEM STRUCTURE GUIDED BY COLLECTIVIST VALUE

3.1 Collectivist value unites the goals of innovation management

Innovation management is to provide services for the creative practices based on interests and increasing the total amount of benefits, such as creating an innovation atmosphere, preparing the innovation conditions, and straightening out the innovation mechanism. Studies have shown that if the innovative leadership and management system, innovative research and working atmosphere are not available, more and more investment is meaningless [5]. This reveals the innovation management plays decisive role, no matter how much money is invested. Canada NCE enhances the innovation management, creates an atmosphere of innovation by focusing on the organizational goals, and implements the network organization agreement with collectivist value.

The long-term goals of Canada NCE are: First, to accelerate the convergence and use of scientific research achievements through network cooperation to serve the economic and social development. Second, to attract and maintain world-class scientific research talents and high-quality human resources in key fields. Third, generate a multi-disciplinary and multi-level scientific research team. Fourth, develop the talent pool and improve the international reputation. It is obvious that the purpose of accelerating the convergence and use of scientific research results of network cooperation and serving economic and social development is to focus on rationalizing innovation mechanisms. To attract and maintain world-class scientific research talents and high-quality human resources in key fields is to focus on creating an innovative atmosphere. To generate a multi-disciplinary and multi-level research team is to focus on preparing innovation conditions. Furthermore, to develop talent pool and improve international reputation is to directly realize collective goals.

The innovation value guidance of collectivism embodied also in its short-term goals: First, to strengthen the cooperation of domestic and foreign scientific research network. Second, to achieve applicable cutting-edge scientific and technological achievements. Third, to establish a national multi-disciplinary, multi-level and multi-sectoral cooperation. Fourth, combining the economy, society, environmental protection and moral character, to provide multi-disciplinary and multi-level value-added training. These four short-term goals reflect the collectivist value as well. This kind of value guidance of innovation management is rooted in truly understanding that the determinant function of the collective to the individual, so as to advocate collaborative innovation based on organizational goals guiding by collectivist value.

3.2 Flat organization ensures the collaboration of innovation subjects

Solely with the guidance of collectivist value and specific organizational goal of innovation, it is not necessarily capable to effectively serve the technological innovation. It is also necessary to build a technological innovation system to deal with the interest relationship between the innovative individual and the collective, in order to achieve innovation synergy. Canada NCE being a mature technology innovation system with the support of the government, attracted all kinds of innovation resources by flat-style organization. This innovation system is a dynamic system organized by the specific innovation elements according to the requirement of flat organization, which deffer pyramidal organization. The flat organization is efficient at sharing resources and expertise: The NCE promotes the optimal allocation of resources and the exchange of specialized knowledge by sharing facilities, technologies, and talents from participating institutions or personnel. It reflects the innovative function of serving innovation activity in the interaction with the domestic and foreign scientific research environment, and forms a specific boundary through the network agreement to distinguish it from the environment. The flat organization tends to reduce management levels to promote more efficient communication and decision-making. This structure usually helps to improve the efficiency of collaboration within the organization, speed up the flow of information, and be able to respond faster to changes in the market and technology.

Its innovation subjects mainly include the competent department (Canadian health institute, natural science and engineering research committee, humanities and social science research committee to join the Canadian industry), the innovation organizers (can provide place, financial accounting conditions of colleges and universities, scientific research institutes, etc.), and the innovation power linked by the network organization agreement (universities, enterprises and other innovative organization and scientific research personnel). Innovation media incharge of the network organization agreement, includes NCE Standing Committee members (including Vice Minister of Industry, Fund Chairman, and Executive Officer), NCE Secretariat, NCE Fund, Supervisory Committee, comprehensive expert panel, and non-profit NCE project organization. The main objects of innovation are technology and tangible products, but also include some technological concepts and intellect such as business model. Considering the openness of Canada NCE's innovation organizational goals guided by collectivist value, it is rational to believe that with the integration of science and technology, science and technology and engineering, as well as humanities and social sciences, its innovation target will expand to all science, technology and engineering and their tangible products that can improve people's living standards. For example, the Tel-learning Network of Centers of Excellence (TL • NCE) located at Simon Fraser University has received funding from the Natural Sciences and Engineering Research Council of Canada (NSERC) and the Social Sciences and Humanities Research Council of Canada (SSHRC). With funding from three Canadian research foundations, including the Medical Research Council MRC (McCormick Rankin Corporation) and the Canadian Department of Industry, and the collaboration and support of 121 research institutes and business partners around the world, it developed into the forefront of distance learning research and application, forming a consensus group to strengthen and expand lifelong learning opportunities, supporting the development of Canada's learning society and knowledge economy. This is achieved by interdisciplinary research team consists of experts from Canadian universities, social sciences, computer science, and engineering.

3.3 Dual Innovation Structure Integrates Innovative Elements

The guidance of innovative goals and the participation of innovative entities are not enough. It is also necessary to organize innovative elements according to the optimal structure and work together towards the innovation goals. Canada NCE has a dual innovation structure that efficiently aggregates innovation resources. At the first level, NCE Secretariat contacts various innovative media to summarize, standardize, and communicate information from all parties, such as providing bidding announcements (including bidding summaries and analysis summaries) prepared by the Standing Committee (leading the overall situation) and final decisions; Contact industry experts, designate evaluation committee members by the standing committee, and ensure fair comprehensive evaluation and recommendation according to standards. Then, the standing committee will decide whether to provide funding and the level of funding based on the recommendation; The NCE Secretariat also assist in establishing committees and a board of directors (which must have one-third of independent directors) for the NCE project organization and management. Starting from 2009, we will also decide to organize an expert team investigation or terminate, suspend, or retain funding based on the annual review recommendations of the supervisory committee. In terms of innovation management, the NCE Secretariat also designates a panel of experts to inspect formal applications, provide inspection reports to standing committee members and applicants, and supervise the panel to select a chairman or spokesperson responsible for answering questions and providing information consultation.

The second level is organized by the non-profit NCE project organizer (Network Host), with the support of various innovative media, to contact and integrate various scientific research forces, sign network cooperation agreements to regulate the rights and obligations of all parties (reporting standards, fund use, intellectual property, and dispute resolution, etc.), and provide innovation services according to NCE's standards, such as providing financial services for the distribution and payment of funding as authorized by the Standing Committee; Assist researchers in writing a letter of intent for funding applications (outlining the proposed issues, innovative capabilities, and methods), and then have the NCE Fund assist in preparing a formal application (including various budgets, innovative plans, etc.) for expert review. The organizer namely Network Host, must also establish a board of directors and committees to organize and manage, assume responsibility, and ensure that innovative personnel in online cooperation obtain scientific research permits and conditions. Through environmental assessment (one vote veto system), provide environmental protection annual reports and scientific research annual progress reports, and prepare conditions for applying for management funds. In addition, the organizers are demanded to provide the Administrative Center of the Network Cooperation for multi-sectoral operation. The Network Host provides venues and assists Scientific Directors in their organizational and daily work, such as providing new collaborative members according to standards and recruiting Network Managers for network collaborations.

This two-level innovation management structure can be named dual innovation structure, not only adheres to market orientation, enterprise center, and multi subject network cooperation innovation, but also integrates innovation resources, creates an innovation atmosphere, and forms an innovation mechanism efficiently. This structure enables NCE effectively concentrate and share various innovative resources according to agreements, allowing innovative entities to quickly obtain innovative resources and engage in independent innovation. It is such a dual innovation structure combined with the network organization agreement that integrates various innovation elements, so that Canada NCE can give full play to its innovation service function, mobilize and organize scientific research talents from all walks of life in Canada to develop the economy and improve the quality of life. The main innovative services enhanced by the dual innovation structure are as follows: Firstly, support scientific research talents and enterprise elites effectively, to transform and apply knowledge to generate economic and social benefits. Secondly, unite private sector, public sector and non-profit sectors at home and abroad swiftly, to integrate and utilize talents from academia. Thirdly, expand the interdisciplinary knowledge frontier globally, to explore and implement comprehensive solutions for Canada to handle comprehensive problems. For example, Canadian foundations have jointly supported the robot and intelligent system network center through this platform, which has improved the ability of Canadian industry to master, receive and use artificial intelligent systems. There are more than 220 network members in the gene therapy research network for allergies, including 40 enterprises, 147 public sectors and 41 scientific research institutions; and long-term mechanism for the cooperation of the network of allergy and immunization experts has been established. At the same time, joint pharmaceutical enterprises have provided more research and development opportunities for graduate students, reducing the sensitivity and related immune diseases nationwide and globally [6].

4. THE DUAL INNOVATION STRUCTURE HANDLES INTERNAL AND EXTERNAL CONTRADICTIONS SWIFTLY

4.1 The Dual Innovation Structure Solves Internal Contradictions

It can be observed above that the main reason for the success of NCE is to make comprehensive use of the network organization agreement and the dual innovation structure to solve the contradictions between the elements, structure and innovative function of the innovation system. It is The dual innovation structure enables Canada NCE embrace the functional characteristics of serving innovation, which also lies in the handling of its own secondary and external contradictions. In terms of handling its internal contradictions, for example, problem-based scientific research adapts to international cooperation and exchange, and facilitates cross disciplinary and comprehensive interdisciplinary research; The information platform of the innovation center improves the knowledge flow and innovation communication, and promotes the division of labor and cooperation of innovation; The system platform encourages and standardizes the innovation process and ensures the continuous development of various innovations; The organizational platform strengthens the sharing of innovation resources and improves the linkage mechanism of innovation subjects.

The dual innovation structure of NCE tends to be flat. The Canadian government provides support and guidance for the innovation system through policy formulation, capital investment, and regulatory frameworks, constantly adapting to new technological developments and social needs. This helps to improve decision-making efficiency and response speed, promoting direct communication and cooperation among all participants. Through the dual innovation structure, NCE establishes clear boundaries through agreements and intellectual property arrangements: although the innovation system has extensive interactions with the external environment, it sets boundaries through cooperation agreements and protection of intellectual property rights to safeguard the interests of the innovators. While protecting the interests of the participants, it also ensures the reasonable distribution and application of innovative results.

4.2 The Dual Innovation Structure Solves External Contradictions

In terms of handling external contradictions, for example, the flexible characteristics of the market and the collaborative advantages of the innovation system are integrated through network organization; Straighten out the interests between the sources of innovation funds and the innovation system; Based on domestic actual needs, serve innovation from a global perspective, etc. It is precisely because it can properly deal with external and secondary contradictions and optimize the environment for innovation management that Canada NCE can better handle internal and primary contradictions, highlighting the comprehensive function of collaborative innovation. Thus, Canada NCE not only has the ability to concentrate innovation funds, resources and talents, but also has a significant function of promoting innovation. Thus, Canada NCE has integrated a large number of innovative

resources, such as the sensitive gene therapy research network (<http://www.allergen-nce.ca>), a number of partners were united, such as the global European Network on allergy and asthma, the karinska Institute, the World Health Organization, the international tuberculosis and lung alliance, and the St. John School of public health and outpatient research.

The main innovative functions of handling external contradictions are as follows. Firstly, multi-sectoral innovation organization: including research institutions, universities, enterprises, government departments, and non-governmental organizations, these elements interact within the system to jointly promote innovative activities. Secondly, international innovation resources: exchange and cooperation with domestic and foreign scientific research institutions and environments to absorb new knowledge and technologies, while sharing global innovative achievements. Thirdly, systematic innovation management: emphasizes the importance of serving innovation, that is, applying new concepts, methods, and tools to service design and management to improve service quality and efficiency.

5. CONCLUSION

The key elements of the dual innovation structure in Canada NCE include two levels. At the first level, the NCE Secretariat contacts various innovative media to summarize, standardize, and communicate information from all parties, such as providing bidding announcements, contacting industry experts, and assisting in establishing committees and a board of directors for the NCE project organization and management. The second level is organized by the non-profit NCE project organizer (Network Host), with the support of various innovative media, to contact and integrate various scientific research forces, sign network cooperation agreements to regulate the rights and obligations of all parties, and provide innovation services according to NCE's standards, such as providing financial services for the distribution and payment of funding, assisting researchers in writing funding applications, and establishing committees to organize and manage. The dual innovation structure of Canada NCE can provide us with the inspiration of network innovation that is: under the guidance of innovation objectives, it integrates innovation elements with agreements and dual innovation structures, constructs a technological innovation management system, so as to straighten out the relationship between the rights and obligations of innovation, standardizes the innovation process, strengthens the sharing mechanism of innovation resources. Therefore, we can efficiently handle the contradictions, optimize innovation mode, and enhance the innovation ability. With the universal trend that human society is beginning to enter a new historical period dominated by knowledge production, information production and intellectual production- Intelligent period [7], the dual innovation structure will be more and more worthy of our reference.

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