ISSN : 0974 - 7435 Volume 10 Issue 16

2014

BioTechnology

An Indian Journal

FULL PAPER

BTAIJ, 10(16), 2014 [9177-9182]

# Anshan high-tech zone innovation system based on enterprise cluster CAS perspective

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## ABSTRACT

In recent years, with increased competition, innovation and complexity, increase the difficulty, resource constraints, and gradually adopt corporate division of labor between Anshan High-tech Zone, the sharing of resources and complementary advantages, etc., for product development and technological innovation, in order to intense competition in the domestic and international markets in a dominant position, forming clusters innovation system prototype, created favorable conditions to enhance the international competitiveness of industries. Currently, the sustainable development of Anshan City, the national economy, we must rely on to promote technological innovation, give full play the central role of technological innovation in transfer mode, adjust structure. Anshan High-tech Zone enterprise cluster development, there is insufficient investment in technological innovation, scientific and technological personnel training introduction insufficient capability of independent innovation, insufficient application of scientific and technological achievements, technological innovation and industrial chain is not complete and other deep-seated contradictions and problems can not be ignored. By analyzing the high-tech enterprises cluster innovation Anshan complex environment and power factor, high-tech design principles of clear performance indicators enterprise innovation system innovation system, establish performance evaluation index system of innovation. DEA results using the northeast part of the innovation performance evaluation of high-tech development zone, proposed creating innovative systems can function to enhance strategies for promoting the development of high-tech enterprises in the zone cluster to provide the appropriate theory and policy support.

## KEYWORDS

High-tech industrial development zone; Cluster innovation; Complex adaptive systems (CAS); Data envelopment analysis (DEA).



## BACKGROUND

Throughout the developing world, every one of economic growth and technological revolution is always accompanied each round of technological innovation will stimulate and trigger a new round of economic growth. High-tech industry has become a strategic leading industry of the national economy, the construction of high-tech industrial development zone is a major strategy to promote national science and technology is developing rapidly and closely integrated with the economy, the national high-tech zone has become the leading national high-tech industry the main battlefield, become structural adjustment, to the way an important force for the transformation of economic development and foster economic growth the county has made a positive contribution to the healthy operation of the national economy played a supporting role.

In the 21st century, Anshan City, firmly grasp the revitalization of northeast China and other old industrial bases in the rare opportunity to put forward the "Northeast China, Anshan first" strategy slogan, technology and innovation to promote economic and social development and the achievement of the overall revitalization of important power, using technology innovation to lead the new industrial structure adjustment, adhere to the "innovation to promote industrial upgrading," the strategic orientation, focus on improving the capability of independent innovation, increased support for key technologies of major efforts to promote science and technology industrial base to features and specialization development, improve the competitiveness of leading industry technology, fostering the growth of strategic emerging industries, and improve the economic contribution of technological innovation. Practice has proved that using high technology to transform traditional industries is the overall revitalization of old industrial bases in Anshan, Anshan realize the only way to advance the goal.

Currently Anshan High-tech Zone has now been brought together 80 percent of the city's high-tech enterprises, high-tech output value accounted for about 35 percent a year to achieve the city's GDP, and cultivate a large number of modern development concepts, science and technology has a certain level of senior creative talents. By the end of 2013, there are 18 high-tech zones Anshan technology has reached the international advanced level, 25 technology in a leading position as the most Anshan vigor and vitality of the new economic growth point for the economic development of Liaoning Anshan even provide scientific and technological support.

## ANSHAN HIGH-TECH ENTERPRISE CLUSTER INNOVATION BASED ON CAS THEORY

The most basic concept of CAS theory is adaptive body, which is characterized by both "learning", will "grow up", which is CAS theory and the theory of the fundamental differences between the previous system. One full of uncertainty, randomness, diversified, vibrant spontaneity of the world, is the root of the complexity of the socio-economic system, globalization and rapid economic development of technology, making the development of knowledge and technology to become the engine of the modern economy and the core elements of the regional economic development. As a typical knowledge-intensive organizations, high-tech clusters in which the environment is extremely complex, non-equilibrium, randomness, unpredictability, mutation, edge, uncertainty, leading to the main cluster behavior and organizational boundaries blur, integration of dominant and recessive relationship network entity makes cluster innovation network broke the previous linear innovation model, showing diversification, innovative interactive system network complexity and other significant features.

### High-tech enterprises cluster innovation environment

High-tech industry with contemporary cutting-edge technology to produce high-tech products industries, high-tech enterprise cluster as part of the economic system, dependent on the existence of the market. Complex changes in the market environment, to promote clusters with adaptive shift. Within this complex group of systems, clusters and the external environment, including the exchange of energy, material and information between the economic, political and social systems from time to time. Nonlinear complex adaptive system and its operation, the formation of a broad path dependence. Under certain environmental conditions, some of the factors that could cause the cluster to produce the same environmental change, especially once the mutation cluster network resiliency beyond the tolerance range, it may cause a cluster of deconstruction. Since the cluster unit is rooted in the local social environment rather than a great change isolated individual, therefore, market, technology, systems, resources and other environmental impacts of cluster innovation, and collaborative innovation to strengthen the cluster innovation path dependence.

### Factors driving force of innovation clusters

### Innovators driving behavior

High-tech enterprise innovation system identified by innovators, both technological innovators, but also includes management innovators, as the basic suitability of their main cluster system, is considered to be a cluster of innovation. In practice, the market and technology innovators face external risks and uncertainties, are often asked to make decisions, which requires the innovator in the market, technology, risks, opportunities with a degree of certainty can keenly understand, identify judgment and analysis, and respond quickly.

**Heterogeneity based competition and cooperation**

In many companies, due to excessive competition becomes homogeneous enterprises have to face the harsh reality of homogeneity does not have the qualities and sustainability, corporate profit margins in the competition is extremely compressed, resulting in decreased competitiveness and shrinking living space, this situation is relatively common in the non-high-tech enterprises. Heterogeneity and relatively homogeneous, reflected power is generated things, structure, behavior and effect of the difference. From space, multi-dimensional vector characteristics heterogeneity has, not only high-tech enterprise cluster technology, marketing and innovation space has been broadened, but also interconnected between the main network, so that high-tech companies to compete focus on innovation, convergence weakened due to the formation of excessive competition, reducing the system's internal innovation entropy, expanding the innovation space, forming a positive-sum game, and enhance the degree of coupling innovation to achieve the innovation model diversification.

**Joint drive technology market**

In the knowledge-intensive high-tech industries, competition and cooperation between enterprises, and external information exchange cluster, cluster innovation in the technology market conditions, showing that cross multiple, non-linear dynamic process loop feedback. High-tech enterprise cluster as a regional open system, synergy and innovation in the interactive environment, and its function, structure, goals showed significant plasticity and flexibility. As a knowledge-intensive innovation cluster, a cluster of high-tech innovation is not their way of demand-pull and technology push power mode. Closely associated with market-oriented technology and the cumulative effect of cyclic interactions between diversification, as well as many other factors by technology and market junctions, so that the high-tech cluster innovation process reflects the characteristics of the network of nonlinear dynamics.

**Living environment of uncertainty**

The high-tech enterprises cluster innovation is concerned, there is a close relationship which generates a dynamic path and evolution process, and innovation environment. Double the sensitivity of high-tech enterprise technology market and demand of the market, as well as the uncertainty of the market environment and technology environment has, unpredictability and uncontrollability, often in clusters so far from equilibrium state. External uncertainties, the limited diversification of competing technologies in the field of internal resources and other environmental conditions, making relatively independent body within the cluster adaptability - companies have to attach importance to their own capacity constraints, and actively seek opportunities for innovation and collaboration, promote the cluster expansion, increasing the likelihood of corporate concentration and innovative body geospatial proximity, derivative and promote social proximity and industrial proximity, and gradually build character and regions have not mimic the embeddedness enterprise clusters.

**CAS-based high-tech enterprise clusters emerge mechanism**

In the new economy, high-tech enterprises cluster innovation is uncertain and open non-equilibrium, balance and is no longer determined by the combination of new production function and set up the Perspective with path dependence, locking and height the initial sensitivity characteristics. Under the constraint technology, resources, markets, institutions and other real-world conditions, the formation of clusters of innovation systems is a decisive randomness, chance and necessity coexist spontaneous evolution of the generation process, has emerged from the micro to the macro feature. Is a breakthrough innovation cluster path path dependence as a starting point, after nonlinear conduction and catalytic produce symmetry breaking, and then toward the edge of chaos, this time, the system of long-range diffusion of violent disturbances associated with the occurrence, to be a breakthrough critical region to achieve self-organization in non-equilibrium behavior under. Due to the inherent irreversibility of time, the interaction between the environment and the main goal of innovation, guided cluster innovation path generation and evolution trends, determine the organizational boundaries cluster innovation system and the behavior of the boundary.

Technology, market, institutional caught three self-catalyzed cross-catalytic and inheritance and evolution of sex. Only from the perspective of evolution, the formation of clusters of innovation that is bound technology, markets and systems, with limited self-catalyzed cross-catalyzed generation process, cluster innovation system is the technology, marketing, systems with dynamic boundary value system. Now given the evolution of high-tech enterprises cluster innovation profile, in order to reflect the evolution of clusters of innovation, evolution mechanism and network structure.

**Path dependence and lock**

High-tech enterprises cluster innovation system is the randomness and decisive, dynamic generation process of chance and necessity cycle alternating irreversibility of time-dependent innovation and boost the randomness of the system, induce instability, making cluster showing far from equilibrium characteristics of the initial state and a highly sensitive and path dependent. In the time dimension, path dependence, including forward and backward linkages associated; presence in the state, path dependence, including implicit and explicit dependence dependence. With respect to the explicit dependence and lock, hidden and locked widespread reliance wider, deeper degree. Gelabohe believes that lock-in effect locking contain functional, cognitive and political lock to lock three ways, and the path dependence and one of them exist, will hinder the deconstruction of the reorganization of the system. Visible, structural change and environmental change innovation systems are often not synchronized, which means that when you change the internal structure of innovation networks, rigid environment may continue to exist. Nonlinear operating mechanism and the initial cluster with sensitivity, and complexity

associated with dynamic innovation system, forming a broad path dependence, showing the effectiveness of the dynamic front and aftereffect.

**Deconstruction and the path of innovation**

Environmental mutations in complex situations, the path dependence and lock easily lead to the existence of high-tech clusters and clusters occurring endogenous recession deconstruction restructuring. Based on actual high-tech clusters, face uncertain environment, it is necessary to carry out multi-dimensional concept, behavior patterns, cognitive model, "Deconstruction" and "combination" adaptive body linkage mechanism in order to achieve and go to the experience of dependent on technology, innovation path from the path dependence to change and improve the environment of the active and dynamic adaptability. By decomposing the curing mode locking, releasing innovative DOF main innovation, pioneering breakthrough innovation space.

**Nonlinear conductivity and catalytic**

High-tech enterprise clusters with geographical proximity, technical relevance, diversity and other modes of communication heterogeneity, ease nonlinear flow of knowledge, technology, information and technology show high sensitivity, high-frequency characteristics of information exchange in a dynamic on functional performance and information in order to reduce transaction costs, economies of scale and scope to improve efficiency and enhance the penetration and cluster information flow capacity, so that clusters of information, resources are relatively complete, the face of uncertainty in the cluster market when capable of rapid response and continuous adaptation. Meanwhile, the beneficial integration of technology, ideas, culture, system, formed in the interaction of the atmosphere to facilitate learning and exchange, opened up space for the cluster innovation potential. Technology, marketing, systems both their inheritance, but also has its own track changes, but there are significant cross-catalysis between them to form autocatalytic set at different stages, and the catalytic reaction would cause more spontaneous autocatalytic separatist groups, thus promoting the evolution of the entire cluster.

## BASED ON CAS THEORY ANSHAN HIGH-TECH ZONE CLUSTERS INNOVATION PROMOTION STRATEGY

**Foster innovation subject, releasing innovative DOF**

Innovator in high-tech enterprises, including personal and business clusters in two main areas, each enterprise constitute a cluster as an actors, all with independent judgment, capacity, interactivity and adaptability. Moreover, companies in the individual, it may become the subject of innovation. For enterprise cluster innovation system, its core function is to promote the knowledge cluster creation, storage, transfer and application, thus improving innovation output within the cluster. Cluster Innovation Network is both the most important economic unit, but also to create value and most direct actors value added, stimulate business innovation initiative, the cluster core economic and regional economic development priorities. In the study of the behavior of enterprise innovation, investment in innovation is crucial compensation mechanism, then as stimulating innovation and the dynamic mechanism of the core elements of income is innovation behavior. High-tech Industrial Development Zone, in practice, the mutual differences between the various enterprise architecture related behavior and morphology of the division of local enterprises clusters, have a decisive influence on the micro-enterprise innovation and motivation, the key transmission mechanism of this effect is the effect produced innovation investment compensation mechanism. Select imitate or cooperation, select process innovation or product innovation, choose incremental innovation or breakthrough innovation, choice and acts as a sort of motivation, and community structure of each cluster is associated enterprises, dependency status, income and other innovative forms of distribution are closely related. Innovation involves diffusion of innovations DOF, induction, innovation specialization and cooperation, innovation and benefit sharing of innovative behavior and risk sharing, integrated innovation system. Appropriate to change the corporate property rights theory, limited economic freedom and economic systems environment based environment, society can effectively transform the form of property ownership arrangements.

**Improve the innovation network, reducing the risk inherent random**

In reality, high-tech enterprises cluster innovation network is an overlay network relationships by various properties from the composite network, the existence of complex relationships between various network rather than the simple sum, can not physically split in mutual penetration, mutual premise, interaction and co-evolution process, promote the evolution of cluster evolution and innovation network. Meanwhile, the network is the sum of the various relationships between the various actors exchange resources and transfer resources to the process established by mutual contact, there is competition and collaboration between the various networks, emerging out of the randomness of risk. Against deliberate attacks from network systems, the need to improve the network structure of the building. There are many theories based CAS, optimization and innovation network, comprising: first innovation internalize externalities. This will reduce transaction costs between the various aspects of innovation and reduces the conversion time, but also improve the quality of innovation through internal feedback system. The second is to strengthen the network interoperability, enhance network flexibility and tension, reduce system stochastic risk. Three core values is to optimize the network. Formed by the cluster members to guide the orderly competition, to achieve positive interaction between internal members to maintain homeostasis within the cluster knowledge spillovers and knowledge to control. Fourth, improve the agency, public service agencies, such as cluster hardware

infrastructure support network controlled environment. Five is to effectively play the role of government, to strengthen internal systems knowledge and contact with the outside market, improve mandatory and guide policy mechanisms.

**Optimize the industrial chain, enhance innovation network adaptability**

Enterprise independent innovation, independent research and development does not mean that all technology, but also often do not have that kind of ability and strength. It is important to grasp the core technology companies to key in hand. As assistive technology outsourcing R & D can be completed through the multi-collaboration, innovation to achieve the best results. Subcontract important way is to use all advantages of resources, protection of technological innovation to complete the non-critical innovation activities completed through outsourcing, and corporate functions just proposed indicators, which helps reduce the cost of innovation, shorten innovation time to make innovation activities more flexible, more efficient and external capacity to adapt to a rapidly changing competitive environment is also stronger. Technical cooperation is a resource sharing, complementary advantages of cooperation, help to optimize the industrial chain, enhance innovation capability. Cluster member companies should be highly aware of the importance of innovation, aimed at cutting edge of technology, look for opportunities for innovation, strengthen the joint with universities, research institutes and other intelligence agencies, improve the innovation incentives. Enterprise clusters is necessary to focus on the internal division of labor, but also concerned about the division of labor and cooperation, and to prevent the risk transition path dependence caused by a single technology, to achieve diversification innovation path. Companies want to maintain a sustainable competitive advantage, the need to strengthen cooperation with other enterprises and relevant institutions and organizations. Western corporate network theory, market and business are not mutually antagonistic, but interconnected and mutual penetration, and led to a variety of network structures and institutional arrangements among enterprises complex.

Nonlinearity is the internal formation of complex adaptive systems ordered complex structure, and the body is the source of nonlinearity initiative and adaptability generated. Porter believes that can be configured and coordination in global competitive advantage, and can overcome organizational barriers to play this advantage of the company from all aspects of the value chain, will be the next winner of the international competition. With the innovative elements flow technology, culture, knowledge, resources, etc., diffusion and penetration accelerates, the need for companies to carry out and participate in the global value chain cluster innovation, to avoid "lock" to bring the system closed and rigid, so that clusters of high-tech enterprises by path-dependent changes in the path of innovation. Cluster Innovation Network in on the "two resources" and "the two markets' in the configuration process, showing the organizational characteristics of openness, enterprise cluster generation and cluster advantages obtained depends on the interaction between the various actors and orderly further expand regional innovation space, access to long-distance knowledge, configuration complementary resources to achieve a reasonable chain outside the cluster together. innovation cluster is actually open to the inside and outside, good interaction between the subject and the overall innovation evolving, this openness determined the necessity to carry out the enterprise global value chain of innovation in order to enhance innovation and competitiveness cluster, you must use an open network, connectivity, heterogeneity, growth and robustness, and gradually improve the innovation network a full range of adaptability, and actively participate in global value chains compete, active docking with the international market, solicit advanced innovative resources, seize market opportunities in the fierce competition to occupy a favorable position.

**Play the role of government, to strengthen support system**

Experience shows that the development of high-tech park, the development of high-tech industry, not only by the power of the market mechanism, government intervention is indispensable. In this system, the government is innovation network organizer, coordinator and supporters at boot cluster innovation economic freedom can promote the formation of "social capital" (such as trust and cooperation) of the innovation network, providing innovative network infrastructure facility services, contributed to the flow of the innovation network personnel. Meanwhile, the high-tech industry is the one involved in research and development, achievements, industrial development to intellectual property protection, technology market building, an industrial scale and other aspects of systems engineering, must form a complete set of industry support policies and incentives, the establishment of appropriate industry support system. Anshan development of high-tech enterprise clusters grow, until the industrial park by the start-up to maturity, are dependent on the institutional environment of continuous improvement and creation, which requires attention to the leading role of the government in order to improve the policy system based on incentives for building focus on strengthening support innovation system as a means to enhance innovation capability Anshan High-tech enterprise Cluster to provide a solid institutional environment protection.

**Strengthen park management and improve the efficiency of cluster innovation**

Improve the high-tech industry cluster innovation capability depends on the system external environment, in which the park management system and its mode of operation has a direct relationship. Park management is a general term referring to the management system, operation mechanism and other management forms for the park to maximize innovation capacity taken. As well as China's Anshan, Liaoning old industrial base, there is the inertia of the old regime. Return to circumvent the old system, the new system innovation, the need to create a suitable environment of high-tech industrial development within the park. From a management perspective, you need to do the following: First, strengthen the unified leadership, play a guiding role. Guide the direction of the park, the use of economic and legal means to regulate the production and operation of enterprises and innovation activities. The second is to carry out a closed service, simplify procedures as much as possible,

improve efficiency, enhance service. Third, improve facility management, the implementation of the integrated management model park infrastructure, improve enterprise production environments. Four is to optimize intermediary services, reduce the cost of innovation, innovation activities play a bonding function, and gradually establish organizational networks, social functions, service industry of intermediary service system. Government to live in a cluster area public agencies, contact through intermediaries stimulation and adjustment between high-tech enterprises and individuals, enhance trust between high-tech enterprises, high-tech common behavior coordination between enterprises, and guide the cluster different body together form a network relationship between competition and cooperation. One of the basic experience of China Development Institute summarizes the success of high-tech park in the world is the park has developed the perfect intermediary service system. Anshan High-tech Industrial Development Zone has become the prototype of intermediary service system needs to be further improved, in order to promote business innovation. Fifth, pay attention to ecological and environmental protection. Hi-tech park construction can not just GDP, can not talk about economic benefits and pay for environmental damage, in the introduction of the project and layout, the firm can not take the pollution first, treatment later old, should take a long-term view of the construction of environmental protection facilities, good all-green environment of the park, for innovation and development of enterprise clusters provide a better environment. Six is the emphasis on culture. Hi-tech park construction in rooted in regional characteristics, we can not ignore the cultural patterns of innovation, each park not only have their own core industrial location, but also has a unique cultural heritage and cultural identity, to create a new cultural environment, to show the unique culture of the park charm.

## CONCLUSIONS

Clusters have the combined effect of high-tech enterprises, network effects, economies of scale, and many other advantages, to play in the regional economic development and enhance the competitiveness of the overall science and technology an important aspect of lead, demonstration, role in promoting regional economic development become sustainable driver of growth pole. Achieve the development of high-tech enterprise clusters, cluster innovation should increase the intensity of attention. Based on CAS theory, discusses the mechanism of formation and innovative high-tech enterprises cluster. According to an open, non-linear, multi-level nature and far from equilibrium features such as high-tech industry cluster innovation system, from the perspective of complex adaptive systems, systems analysis of the high-tech enterprises cluster innovation systems in complex environments, dynamic factors discussed innovation mechanism and characteristics of enterprise clusters, designed an innovative performance evaluation system and evaluation methods were targeted empirical analysis, innovative features of the system implementation and park development strategy.

The formation and development of high-tech enterprises of different clusters, shorter time, relevant theoretical and practical study also inadequate, some aspects such as innovation and innovation under the laws of interaction between the various elements within the system as well as other perspectives or dimensions of the innovation system mechanism and other aspects need to be thorough in order to promote innovation and constantly improve the mechanism of the system.

## ACKNOWLEDGEMENTS

This work was supported by a grant from AnShan Science and Technology Bureau (Project Title. Small Micro-enterprise Financing Constraints and Service System Construction).

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