



## Review: Application of Complexity Theory in Industrial Cluster Evolution

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**Abstract:** Complex networks describe a wide range of systems in nature and society, but it is not that widely used on economic issues when compared to physics or computer science. This paper first looks back to industrial cluster theory, and then analyzes its benefits and deficiency. After reviewing the traditional methods, this paper introduced the complexity focusing on how complexity theory alter the view of old economic problems and in which way this could lead to.

**Keywords:** complexity theory, industrial cluster, complex network

### 1 Introduction

The industrial cluster theory is believed to have originated from the study of industrial agglomeration; Neoclassical economists have made a wonderful discussion of industrial agglomeration phenomenon. Marshall was in the "Principles of Economics" made in the three elements of the regional industry gathering explanation: the labor market share, intermediate inputs and technology spillover (Marshall, 1890)<sup>[1]</sup>. Czamanski (1974)<sup>[2]</sup> first introduced the concept of the industrial cluster economic category, and through quantitative method to cluster are compared with those of the industrial complex. Weber (A.Weber, 1909)<sup>[3]</sup> from the perspective of industry theory industry gathering in-depth research, and for the first time put forward the concept of agglomeration economies, and in its "industry theory," a book devotes a large section of the aggregate economy the formation, classification and production advantages to do a detailed analysis. Peroux(1950)<sup>[4]</sup> and Myrdal (1957)<sup>[5]</sup>, and other development economists and interpretation of regional economist continue to explain the region gradually become active again. Arthur W. B (1988)<sup>[6]</sup>, Krugman (1991)<sup>[7]</sup>, STORPER (1992)<sup>[8]</sup>, NELSON (1993)<sup>[9]</sup> and others to the further development of the cluster theory gradually become frontier problem in economics, In Porter (1990)<sup>[10]</sup> after the link industrial clusters and regional competitive advantage, the cluster concept gradually caused high attention.

Industrial cluster theory to the research scope of mainstream economics, and led to prosperity. Traditional industrial cluster study emphasizes the importance of industry, economic externalities (economies of scale and

economies of scope), as well as natural resources, capital, labor, and other physical features. Modern industrial cluster theory absorbed the knowledge management, the development of multiple subjects such as biology, sociology, even more highlighted intangible factors such as knowledge, technology, system and culture in the process of cluster development, while expanding the deepening of the industry research clusters, no longer limited to the concept of industrial clusters, causes, research the decisive factor, cluster identification and mutual competition between industrial clusters with an equal balance area. But the traditional economics lacks a dynamic method to explain the inspection process of industrial cluster system, and complexity science showed obvious superiority in this respect. This article is from the traditional economics, to study the possibility and significance of complex economic framework. Due to the division of labor among enterprises lead to increasing returns and transaction cost saving become the ultimate cause of enterprise cluster, but division of labor is limited by the market scope and size of the market point of view as Smith's theory of regret. Then Young (1928)<sup>[11]</sup> broke the limited range of views on the market, the first rigorous proof of the market range, roundabout production and dynamic enterprises positive feedback mechanism.

### 2 Industrial cluster theory

#### 2.1 Division of work

Analysis of inter-industry division of labor has actually become the genesis of modern industry gathering theoretical foundation, Inter-industry division of labor is actually related to the transaction issues and intermediate products extend the industrial chain. Subsequently's "division of labor determines the division" It is because of the size of the market caused by the division of the myth and lead the market scale of such a cycle accumulated evolution of reciprocal causation.

His successor Myrdal (1957)<sup>[12]</sup> proposed the "circular causality" of the industrial division of the multiplier thought. Nonlinear "super marginal analysis method" to the division of labor and specialization of thought science and modular analysis. New economic geography school of thought in the imperfect

competition, increasing return of scale, and differences between the products and production factors flow conditions, such as think of local enterprises and labor gathered together can get higher returns, the elements of local dialect scale increasing, return of scale reward the spatial pattern of evolution of industrial production, the end result will be industrial agglomeration. Industrial concentration of power is that economies of scale, transportation costs, the size of the market as well as the benefits brought by the correlation effect and external effect.

## 2.2 The main point of economic location theory

Thunen (1826)<sup>[13]</sup> from a hypothetical, geographically isolated city, analyzing how the city periphery homogeneous crops on the land, is actually a system considering the location problem of agricultural production. he deduced the famous "the Von Thunen model", of rent, location, and the allocation of resources is given its own interpretation in the book, he thinks that the regional agricultural type and the distance of the mode of operation depends on the production and market; Close distances from the center of the market area of land rent is expensive, appropriate planting large transportation costs or high output value per unit area of crops, Far away from the market center of the region should grow small transport costs or land-intensive crops. In addition to transportation cost analysis, Thunen also explored the industrial concentration of cohesion and repulsion, and analyzed attraction effect, correlation effects between industries and knowledge spillover effects of market demand. Agricultural location theory is further developed by scholars, such as Dunn, August Loesch, Theodor Brinkman and so on. The differences are mainly about the rent function.

Lawn Hart used nodal analysis method in the enterprises network location problem, in paper "determining reasonable location businesses" (1882)<sup>[14]</sup>, he assumed transportation cost is proportional to the unit weight of product. On condition that land supply and land demand, through minimizing transportation costs to determine business location. At the same time, Lawn Hart also explores the impact of workers' wage and technical proficiency on business location choice. Weber (1927)<sup>[15]</sup>, also from the perspective of industrial location, discussed the phenomenon of industrial clusters. Enterprises assembling can make specialized services and facilities, such as a machine repair shop, specialized labor market, public infrastructure and so on. The gather of upstream and downstream firms will make companies be closed to the place where raw materials supply. These factors led to cluster economy. Meanwhile Hoover also studied the relationship between agglomeration economies and geographical markets. He believed the agglomeration which brought scale economy can reduce production costs, but excessive agglomeration will bring diseconomies of scale, and noticed optimal scale of industrial cluster.

In the "economic space order," Loesch (1939)<sup>[16]</sup>

summed up location theory of agricultural and industrial, by drawing on Christaller Central Place Theory, he extended the static, unilateral agricultural and industry location theory to the dynamic, spatial economic theory. Not only extending the research objects to location system, the market area, the economic zone, the division of labor, regional economics and international trade logically, but also containing the location choice, regional plans, urban planning and other aspects of the methodology.

H.Hotelling(1929)<sup>[17]</sup> Get rid of the past regional selection, introducing the stability of spatial competition for the spatial duopoly and analysis Ice- cream- vendor-on- the- beach model, which lay a foundation for the theory of regional competition's development. In addition, he proposed shoreline model, which supposes consumers equally distributed in space, consumer demand is unlimited and non-elastic for goods, production costs, products freight rates are equal in all regions, producers sell product according to the manufacturer's price, and freight paid by the consumer. Under this assumption, Hotelling get the conclusion that production location will gather to the center of the market. But EHChamberlin thought interpretation of Hotelling's theory is not credible. If demand is elastic, meaning the prices impact on sales, business will show the trend of decentralized distribution. There are still a lot of researches based on the Hotelling model, such as Salop (1979)<sup>[18]</sup> extended Hotelling linear market to round market, Tabuchi T and Thisse JF (1995)<sup>[19]</sup> assumed the probability density function of consumer demand to be triangular.

In the development process of Location theory, we have to mention Melvin L Greenhut, Issard, H.O.Nourse, DMSmish and other scholars. Isard through substitution principle fell geographical factor into shipping, processing fees, the demand factor, cost reduction factor and income increases factor. Cost reduction factor refers to some interest due to agglomeration or dispersion, such as the external economy. And income increasing factor refers to the various forces which cause gather and dispersion. This thought develops thinking for the study of complex systems later.

In addition, the Green Hart also analyzed personal profit that got by through personal relationships, meaning the factors of Individual fee reduction and revenue increase. The theory has exhibited behavior characteristic of location theory. Nas in book "local economics" published in 1968, from the micro and macro perspectives to research on urban systems, industrial location model, land use, and economic growth in trading income and public policy. Smith combined space cost curve by Weber and space revenue curve by Losch, through space boundary analysis to find the best location.

Smith said location factors include factors related to the production process, such as land, capital, raw materials, labor, tax , supply and demand related to the market, transportation costs and agglomeration and external economy, public policies and programs,

historical accident and personal behavior. During the process of Smith studied of variable cost model, assuming that the behavior of enterprise production is for obtaining profits, but not necessarily for maximizing profits, which has appeared the thoughts of biological economics.

### 2.3 main viewpoints on externality theory

Alfred Marshall in the book "Principles of Economics," firstly proposed the concept of external economic and internal economy. The current researches on industrial cluster theory of externalities include currency externalities, technological externalities and knowledge spillover theory. Viner (1932)<sup>[20]</sup> first distinguishes between external technical economic and external monetary economics, Myrdal (1957) point the view of "circular causation" on the basis of economies of scale, Hirschman (1958)<sup>[21]</sup> further summarized as "pre-linked" and "after linked to" the accumulation cycle, Arthur (1989) put this accumulation cycle summed up as "positive feedback mechanism", the competition model combines Krugman (1991) to this mechanism and Dixit-Stiglitz monopolistic proposed center - periphery model, noted that the economies of scale of a larger area, the front and rear will be a self-perpetuating phenomenon manufacturing focus to the contact, the greater the economies of scale, focus more obvious. The lower transport costs, the greater the manufacturing sector's share in the economy, the economies of scale at the firm level, the more obvious, more conducive to agglomeration. However, if taking the factor mobility into account (Krugman and Venables, 1995)<sup>[22]</sup>, the distribution of the relationship between trade and business zone will appear an inverted U-shaped, that is to say at the costs of neither high nor low, the firm will exceed in proportion to gather and have a larger market area.

Knowledge spillover theory belongs to one part of externality theory, Marshall also talked about the importance of knowledge externalities in the analysis of technology spillover. Knowledge spillovers and sharing the labor market, the difference of the middle of specialized inputs lies that the latter two having the space itself, and therefore the theory to explain the formation of clusters through knowledge spillovers are trying to explain the spatial knowledge spillovers. By establishing a dynamic game model, Bouguezzi (2011)<sup>[23]</sup> and Gersbach analysis the dynamic effects of knowledge spillover of intra-industry enterprise spatial layout from the micro-level. Audrestsch (2005) and Feldman (2005)<sup>[24]</sup> research the behavior of German high-tech enterprises by empirical methods, found high-tech enterprises tend to choose the site near research institutes, using the advantages of cooperation and personnel flow to obtain the new technology. Kesidou and Romijn (2008)<sup>[25]</sup> pointed out that local knowledge spillovers between the cluster enterprises in developed countries are the main driver factors of regional innovation and industrial development.. They analyzed the data of

Uruguayan software industry by researching labor mobility, by-products and the potential of the complex relationship between enterprise knowledge transfer, know that local knowledge spillovers have a significant positive impact for the innovation and development of industrial clusters.

### 2.4 The main points of competition economics

One of the important manifestation of industrial agglomeration effect on the economy lies in its great significance for productivity, the productivity improvement of the industry depends on the competitive situation, from this perspective, a motive that forming the industry cluster lies in that it can improve competitiveness and productivity, allowing companies tend to flow to the enterprise concentrated number of regions, so that further expansion in this region. According to the view of Porter (1997) in the "competitive advantage", "Competitive Strategy", "Competitive Advantage of Nations", Industrial agglomeration enhancing the internal competitive advantage lies in the following areas: First, the rich material source around the cluster, as well as enough information can be exchanged to each other, and perfect infrastructure improve productivity; Secondly, the competitive effects within the cluster can improve the enterprise incentive and performance assessment; Again, competition within the cluster can stimulate the production of knowledge, and improve the rate of innovation; finally, external cluster reduces barriers to the entry of new enterprises, have effect on the cluster itself, promote the development of clusters. The framework of Porter includes not only the upstream and downstream enterprises, but also includes government and other institutions (Porter, 1998).

### 2.5 The main points of Industry relevance theory

Looking at the formation of industrial zones from the perspective of historical factors, it means that a status quo industrial zone depends on its past history to accumulate comprehensive path, various historical factors "circular cumulative" determines the formation and evolution of the industrial zone, industrial relevance Theory including industrial consortium theory, regional production complex theory, growth pole theory, industrial relevance theory began to focus on the connection between enterprises in industrial clusters. As it can be seen from Krugman (1991) of the text, labor mobility and diversification of demand are an important factor leading to the expansion of market capacity and increasing product range, but also emphasizes the relationship between the industrial chain, but it did not specifically analyze this relationship in the course of a specific industry cluster formation mechanism. This relationship was later called industry vertical coupling effect by Venables (1996)<sup>[26]</sup>, this effect can also expand the market capacity of an area and attract more industry concentration, in fact, there must be a division of labor within the industry problems among different enterprises,

division means it exists rely problems of industrial chain among enterprises, the forming of the cycle accumulation of which will also lead to the enterprises continually accumulate to a concentrated area. Then Porters (2002)<sup>[27]</sup> re-uses game theory to put forward that if transport costs are high enough, the downstream business will not buy from upstream middle goods, then the middle products enterprises will select be concentrated in one area with downstream enterprises; if transport costs are moderate, the downstream business will tend to disperse concentrated in two regions and provide consumer goods to their respective regional groups; if transport costs are very low, the downstream enterprises will be focused on two region centers, and also provide goods to the two regions.

Fujita and Hamaguchi (2001)<sup>[28]</sup> put the cause of industrial agglomeration from demand diversification into middle product diversification, Amiti (2001)<sup>[29]</sup> then makes the model of Fujita and Krugman (1995) for further expansion, that the number of middle products enterprises will increase with the increasing yields of its downstream business (manufactures enterprises), increasing yields will result in finished goods enterprises continue to enter, while increasing the demand for middle goods, middle goods enterprises will further enter, resulting in middle goods prices fall, which further encourages the finished products enterprises to enter, and such feedback mechanism make one area industries continue to focus and expand. Pontes (2005)<sup>[30]</sup> think that the monopoly in the production of middle goods, the higher cost of transportation of middle goods and final products will drive business to a regional focus, if these cost reductions will lead to business location choice tend to disperse, and if the transport cost is a middle value, multiple equilibrium will exist.

Ciccone and Hall (1996)<sup>[31]</sup> put the motives of industrial association effect resulting industry concentration attributed to Thick- Market effect, which is, to focus on the upstream and downstream enterprises can achieve specialized inputs at low cost and improve output and yields so as to promote capital accumulation (O'Sullivan, 2003)<sup>[32]</sup>. Moreover, this coupling effect can lead to diversification of product range (Paul and MacDonald, 2003)<sup>[33]</sup> as well as enhance productivity overflow between enterprises continually (Cohen and Paul, 2005)<sup>[34]</sup>. From the industrial association effect to consider industrial agglomeration effect is actually a further deepening of external economic currency.

## 2.6 Main points of Socio-cultural theory

From a cultural perspective to explore the cluster evolution has been accompanied by the development of cluster theory and development, Weber analyzed this issue earlier, and most schools also mentioned this factor, Schumpeter's innovation theory accelerated the scholars' study on this issue. Current research on social factors specifically focused on three aspects: cultural capital, entrepreneurship and social capital. Now industrial cluster theory is too much emphasis on natural resources,

labor, technology, capital elements, externalities, while ignoring the cultural elements, information elements and that is rooted in the industrial clusters, one of which is a natural advantage gather force, including the first is natural resources, resource combination advantage and externalities due to the combination of natural resources advantage and economic advantage, but this relative advantage is gradually weakening; the second is overflow intelligence gathering force, in which the increasing importance of intellectual spill overflow based on knowledge and skills-based is larger than the physical spill overflow generated from chain coordination and process reengineering; the third is the growing importance of cultural cohesion, cultural cohesion brings about more non-contract deal than contract deal, cultural cohesion is an important source rooted in the cluster. As a structural social resource, social capital is with the sharing symbol, it is owned by all individuals in the relationship network, any individual has not or has the ability to have exclusive ownership. By analyzing the literatures of social capital clusters formed by embedding, social networks, norms, trust and other cultural characteristics of social capital on cluster analysis. Social capital is a relational capital, and social relations depend on the access to contact (Peter Blau, 1977)<sup>[35]</sup>, which defines the spatial extent of social capital, and this proves high efficiency of the flow of labor, capital, information and other production elements of regional flow, and social capital increases regional production and innovation efficiency. But the impact of social capital on the evolution of the cluster has two sides, network relationships between subjects are important inputs of cumulative innovative ability, but too close network of relationships may hinder the spread of new ideas (David Keeble etc., 1999; Angel, 2002)<sup>[36]</sup>.

Entrepreneurs play an important role in the dynamic mechanism of cluster formation and development. Leslie and Kargon (1994)<sup>[37]</sup>, and MP. Feldman and J. Francis (2002)<sup>[38]</sup> treat the entrepreneur as a key factor in the formation of clusters, and the study of entrepreneurship as a decisive factor. Social Capital Theory, which is about how to influence the development of high-tech clusters, has been one of the core theories of new economic sociology since the 1970 s. It was first put forward by Coleman (James Coleman), a master in sociology from University of Chicago in 1988. He thought that social capital and financial capital, human capital are all productive, which can promote the development of social capital through the interpersonal trust and cooperation, the constraints of the invisible norms, and can promote organization and individual performance growth at the same time. Industrial economic development needs industrial entrepreneurship, which is shown through the entry and exit of enterprises, the industrial evolution, industry transfer and industrial undertaking, etc. The corresponding theoretical basis includes A - U model (Utterback and Abernathy, 1993)<sup>[39]</sup>, which is research on enterprises' entry and exit from the perspective of technology innovation, the product life

cycle theory (Klepper, 1996) <sup>[40]</sup> researching into entry, exit, market structure and how to make innovation according to the product production cycle, and industry transfer theory, the theory of industrial undertaking, etc. Audretsch, Keilbach and Lehmann (2006) <sup>[41]</sup>, put forward that areas with abundant knowledge will produce more entrepreneurship, bringing a wider range of entrepreneurial opportunities; and areas with poor knowledge will produce less entrepreneurial spirit, having a narrower range of entrepreneurial opportunities. Entrepreneurship capital theory (Keilbach and Audretsch, 2004) <sup>[42]</sup> thought that entrepreneurship capital is the social ability of establishing a new company, entrepreneurship capital have a positive impact on economic output and economic achievements, which can improve regional competitiveness and promote the growth of industrial cluster.

## 2.7 Summary

From the literature review, analysis of the formation of industrial agglomeration is around three basic threads, which are the division of labor theory; Krugman (1991 a) core-periphery theory; the transaction cost theory. Three methods of analysis have proved that there is a self-reinforcing mechanism between the spatial agglomeration of economic activities and economic growth. Industrial agglomeration not only facilitates knowledge spillover (Rosenthal and Strange, 2004) <sup>[43]</sup>, human capital accumulation and innovation, lower the cost of competition and opportunism tendency (Paniccia, 2002) <sup>[44]</sup>, but enhances the competitive advantage of the enterprise (Porter, 1998). These views are based on different assumptions aiming at explaining the phenomenon of industrial cluster from different perspectives, which is of great significance for our deep understanding of the nature of industrial agglomeration, and even further into the policy orientation.

As core-periphery theory and transaction cost to get a large number of theoretical and empirical support, which makes the new economic theory get fast development, the following literature is mostly along imperfect competition, the increasing scale, product diversification, while combining the externalities, transportation costs, and historical factors and new growth theory to further detail the core-periphery theory research. The research is now developed into the new international trade theory, and industrial cluster, location, transportation costs, increasing return factors have all been integrated into the analysis framework of international trade, so as to enrich the industrial agglomeration, regional specialization and international trade theory, and make up for the externality theory of Marshall and Weber. But the core-periphery theory and transaction cost theory, in large part can only be called location model, which is about how the enterprise arrange its production in different areas, and the starting point is based on why the existing enterprise will agglomerate in a particular area, without explaining how the enterprise forms and evolves in a certain region.

From the point of endogenous industrial concentration, it depends on the relevant costs and benefits, but only division of labor theory analyzes completely into the biochemical part, in which the enterprise's endogenous formation is the driver of agglomeration, and the deepening of division and evolution of enterprise jointly determine the scale and level of the industrial agglomeration. To explore the mechanism of industrial agglomeration from the perspective of division of labor inevitably involves how enterprises form and evolve within the area spontaneously.

To some extent, whether the core-periphery model, the transaction cost model or model of labor division, the assumptions still can't help to understand the reason why industry cluster exist and its evolution path .David f. Batten (2009) <sup>[45]</sup> took NEMSIM plan as an example, the simulation based on Agent could make potential industrial factors in the industrial ecosystem better cooperate with each other, allowing the whole system to evolve in a more effective and economical direction. Complex system theory actually brings another means of thinking about the behavior of the system, and the development of simulation technology helps us to give each main body their own complex system characteristic to observe the rule of their evolution, rather than under a single assumption, using linear perspective to think of the problems of industry agglomeration.

## 3 Complexity

Traditional complexity system theory is based on generative theory ,the main idea of which is the behavior of each microcosmic body is decided by the external environment and their own behaviors. Under a few simple rules the microcosmic behavior can reflect large scale system characteristics.

The development of the complexity system theory, develops from dissipative structure theory of simple giant system, coordination theory, mutation theory, fractal theory and hypercycle theory, to the theory of complex adaptive system.

The use of complexity system theory in the study of industrial cluster evolution is mostly based on dissipative structure theory, coordination theory and the cluster evolution research in the theory of complex adaptive system. The self-organization theory is most widely used and the evolution of industrial cluster based on complex adaptive system theory research is also gradually carried out.

In 2011 EU proposed Future ICT plan, aimed to understand the complex relationship of global society, in order to improve the social prediction ability of the global crisis. It promotes the development of complexity science, also tells there are many blank area to be explored.

Bernake said that "I just think it is not realistic to think that human beings can fully anticipate all possible interactions and complex developments. The best approach for dealing with this uncertainty is to make sure

that the system is fundamentally resilient and that we have as many fail-safes and back-up arrangements as possible”, which is also the route we followed to explore complexity science.

Now the complexity is mainly explored from three perspectives:

(1) From the characteristics of complexity systems "distributed nature, openness, nonlinear and disequilibrium, emerging and self-organizing, adaptive behavior and evolution" (Ron Martin and Peter Sunley, 2007)<sup>[46]</sup> they used the empirical method to study the complex system. Although the research system is in line with the characteristics of the complexity system, but this approach is, in fact is still not out of the old paradigm of economics. And when the economic elements cannot be described by means of statistics data, such as described in section 2.6 of the social and cultural factors, entrepreneurship, this method usually is not a satisfactory solution.

Ron, Martin (2007,2010)<sup>[47]</sup> compared the complexity method and the traditional economic method, and put forward the application of complex science theory. First the theory is about the evolution of economic geography ontology. Second the theory close to complex social ontology approach, rather than the current dominant complex scientific method. Third the theory claims theory and empirical research on must clearly define the connection between the complexity and space. Fourth the theory order the research to explain the spatial structure and feature is only the result or its itself is a complicated system. Fifth the theory has to explain how the geography -economic space are is shaped by growth and knowledge transformations.

Chiles(2004)<sup>[48]</sup> drew on complexity theory to explain the emergence of a new organizational collective, and provided a much needed empirical test of the theory at the collective level of analysis. Taking a case study approach, they used four dynamics of emergence posited by complexity theory's dissipative structures model-fluctuation, positive feedback, stabilization. to explain how a collective of live musical performance theaters in Branson, Missouri, came into being and periodically transformed itself over a 100-year period.

Complexity economists (Foster, 1997)<sup>[49]</sup> claims that their method is based on the macro perspective and the evolution of the theory of natural selection methods. They (Wakeley, 2002)<sup>[50]</sup> (2006) Beinhocker<sup>[51]</sup>, believe that their method doesn't rely on formula and theorem, and it only needs case analysis to express the mechanism of evolution. Although it is a way to study evolution, but gradually grows out of the scope of the mainstream.

(2) From the perspective of network. Complex networks as the general abstract, descriptive method of complexity system and structure form, can highlight topological characteristics of the system structure. Research methods of industrial agglomeration inherited some perspectives of location theory and industry associations. Watts and Strogatz (1998)<sup>[52]</sup> proposed a small world (WS) model, depicting real network have

big clustering and short average path distance .Barabasi and Albert (1999)<sup>[53]</sup> proposed scale-free model (BA).

Generally speaking, industrial cluster is a system combined of many industries and associated enterprises. Among them ,there are service agencies ,industry system and environment system elements .In the process of industrial cluster formation, the connection between cores is the converging point of scale-free networks. Outside the cores or related enterprises cores attract the new points and form enterprise's geographical spatial links between them because of resource or other advantages. Under such developments the cores grow gradually and the system becomes more intensive.

Alderman, n. (2004)<sup>[54]</sup> take Argentina and Britain's long-term project as the research object, and find products and services innovation will lead to the spread of industry internal knowledge. Chun - Hua Fu (2007)<sup>[55]</sup> from the perspective of network competition within the cooperation relations, describes the complexity system. The researches before are mainly based on the research complex network, competing relationship between enterprises, or from the perspective of industry of scientific research innovation, knowledge overflow. But now the industry relations become more complex. Under the impact of the financial crisis, the system is unstable from external factors.

David I. Alderson (2010)<sup>[56]</sup> from the perspective of the basis of network center theory, put forward the demand to weigh the robustness and the relationship between the emergence of vulnerability. Since then, Chi, and Wu, b. (2011)<sup>[57]</sup> on the basis of industry cluster, constructed the enterprise financial crisis contagion network model. They put forward a framework of network risk assessment method, from the perspective of the system's robustness and vulnerability, and used industry data in Shaoxing ti confirm the validity of the framework .Felix H.F. Liao (2012)<sup>[58]</sup> studied China's Guangdong province space gathered imbalance by dynamic allocation method and spatial markov chain .They believe in guangdong province there is a poverty trap and self-reinforcing accumulation effect in the process of development. And the government should use the balance of policy mechanism and guide foreign investment in the direction of comprehensive development.

The advantages of this approach is embodied in: (1) as the network technology and transportation technology developed from the traditional concept, the meaning of the original location is weakened. The advantage of using industrial network structure to study the significance of industry development is more obvious(2) When risk come out, in the traditional way network with the complex changes is not convenient to be studied. But the network structure can be simulated, to some extent we can prevent or control the risk. About the structure and properties of complex networks researchers have made a lot of progress, but about synchronization control progress of complex networks is still limited .Only when the basis of understanding the network structure, and in

view of the structure of the possibility of mutation and to prevent the influence of the external environment, we can put forward relevant industrial policy, and make the evolution of the industrial system healthy.

(3) Within the framework of complex adaptive system, the system of each subject in the interaction with the environment from the following general "stimulus - feedback" model, the main body can be constantly interacting with the environment and other subjects in the "learning" and "experience". According to the knowledge of the "experience", the main body constantly change their structure and behavior, to constitute the adaptability. John H. Holland and John H. Miller (1991)<sup>[59]</sup> proposed artificial adaptive subject to solve the complexity problem in the economic system. Arkan, AT (2010)<sup>[60]</sup> by used complexity system theory to study the regional entrepreneurial transformation, and pointed out (1) nonroutine actions by pioneering actors from different subsystems of the regional economy; (2) brokering actors who bring pioneering actors from different subsystems together; (3) early idiosyncratic success stories created by pioneering actors; and (4) social networks and media as information dissemination mechanisms, These characteristics of main body is the main reason why they grow. Marin (2012)<sup>[61]</sup> under the inspiration of complex adaptive system theory, puts forward the concept of "flexibility", the flexibility of the regional economic development is defined as among elements of the regional economy through mutual debugging and common evolution to ensure that the regional development ability and the adaptability of industry which makes a whole system. His thinking on promoting the adjustment of industry structure after the financial crisis and transformation, its absorption, learning, and the influence of the crisis solution is quite valuable.

On the subject about the artificial adaptive modeling process, the rules, ways and methods about how the system works must be clear. Under this premise, the creator of the system should avoid the subconscious cultural assumptions and social prejudice, and at the same time objectively consider the cultural and social environment of industrial cluster.

## 4 Conclusion

This article is from the original basis of economic theory, studies its theoretical structure and summarize the development of "complexity". At the same time, combined with the theory of complexity system, the paper discusses the future to build a complete complexity system of economic theory. In our opinion, even the theory is not so complete that can be used to describe economics. But from the interdisciplinary perspective, complexity, will become a hot topic in The future. As the scope of the activities of the international trade gradually extended to the global scope, economic organization develop to two directions: economic globalization and localization. The latter one showed a more tenacious

vitality, in the form of cooperation networks form a new type of industrial agglomeration and thus in the globalization competition it won a special obvious competitive advantage. That is to say, industrial agglomeration formed by dynamic collaboration and virtual alliance has become the most important ways of gaining competitive advantage. So, the application of the theory of complexity system research of agglomeration will be the trend of the future.

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