

Analysis of Factors Influencing the Growth of Hi-Tech Industries Based on Industry Technology Innovation Strategic Alliance

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Abstract—This paper systematically analyzes the connotation of the hi-tech industries and of their growth, classifies the hi-tech industries and analyzes the internal factors influencing the growth of hi-tech industries based on Industry Technology Innovation Strategic Alliance (ITISA) from several aspects including the development strategy of ITISA, the benefits of ITISA, the risks of ITISA, the ability gap among members of ITISA, the confidence among members of ITISA, the commitment among members of ITISA, the communication among members of ITISA, the conflict reduction among members of ITISA, the protectionism of ITISA, the cultural synergy of ITISA, the shared vision of ITISA, etc. It also analyzes the external factors influencing the growth of hi-tech industries based on ITISA such as the social culture and education factors, the policy and legal factors, the technological progress factors and the social and economic factors.

Keywords—*Industry Technology Innovation Strategic Alliance (ITISA), hi-tech industries; growth, factors*

I. INTRODUCTION

Today, the global economy and the development of science and technology have stepped into a new era characterized by intensive development and innovation of high technologies with numerous important discoveries and inventions constantly emerging all over the world. The hi-tech industries have advantages of less consumption of material resources, intensive knowledge and technology, good comprehensive benefit and big potential of growth, so it's one of the important forces leading and driving the whole situation of the global economy

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and its long-term development. Xi Jinping, General Secretary of CPC Central Committee of and President of China, emphasized that in order to build a scientific and technological power, we must make great efforts to develop high technologies, to improve our scientific and technological innovation ability and to further build and complete our national scientific and technological innovation system.

Ministry of Science and Technology indicates in its Implementing procedure for impulsing the development of Industry Technology Innovation Strategic Alliance of December 2008 that the ITISA is the carrier of implementing the national technological innovation project. We should aim at forming the industrial core competitiveness and realize the effective combination of universities, enterprises and scientific research institutions in strategic level. It is clarified in the Third Plenary Session of the 18th Central Committee of CPC that to implement the strategy of innovation driving development, we should impulse the healthy development of hi-tech industries, make large enterprises to play their backbone role in innovation and reinforce the dominant position of enterprises in technological innovation. Being an innovative type of cooperative organization, ITISA built a bridge linking the industrial circle, the scientific and technological circle and the political circle together in a high-level cooperative mode to promote the development of hi-tech industries.

In today's network economy environment, due to huge risks, the resources invested in a single hi-tech industry are limited, consequently, it's necessary to realize complementation of advantageous resources with other organizations to reinforce its own core ability. Facing different levels of intermediary service, different government policies, different levels of scientific and technological development and different demands of market, founding an ITISA around the core of hi-tech industries among the organizations under the contractual guarantee may solve the problem of scarcity of resources of a single organization by conditionally using others' resources and may help to learn from and complement with each other in different aspects and drive the development of other industries[1].

From the above, it's very significant to combine the development of hi-tech industries and the important scientific and technological innovation mode of ITISA and to study them.

It was R Nigel and J Hoplandg that first put forward the concept of “strategic alliance”. The concept of ITISA came later progressively as a new type of technological innovation organization formed by enterprises, scientific research institutions and universities to make joint development and to share benefits, advantages and risks. From current studies on ITISA, it turns out that there is still not a unified theoretical frame abroad. The studies of strategic alliance theory in China mainly focus on the initial investigation from the angles of its connotation, characteristics, operation mode, risk management mechanism, operation management mechanism, knowledge management and relationship management. The studies on the selection of cooperative object of the alliance and the understanding of industrial demand are not sufficient. Although the operation mode of ITISA is divided in multiple angles, no study has been made on the development of the alliance and the growth of the members of the alliance by integrating all factors from the point of view of systematical analysis.

II. ANALYSIS OF CONNOTATIONS OF HI-TECH INDUSTRIES AND THEIR GROWTH

A. Analysis of Connotation of Hi-Tech Industries

To satisfy the demand of development of Chinese high technologies, Ministry of Science and Technology published the Accrediting conditions and methods for national hi-tech industry development zones and hi-tech industries to define the scope of activities of current hi-tech industries. At present, hi-tech industries in China are divided into two forms: emerging hi-tech industries and transformed hi-tech industries according to the above-mentioned standard. The constitutive elements of hi-tech industries may be divided into two categories: basic elements and derivative elements. The formation and the development of the basic elements and the derivative elements are inseparable. The basic elements play a decisive role in the enterprise while the derivative elements play an important specific role in the hi-tech industry system.

1) *The basic elements include technology, fund and management ability:* Technology is the foundation of hi-tech industries, so compared with general industries, hi-tech industries have much higher requirements for technology. Sufficient fund can ensure the enterprise to get other necessary resources. An enterprise without capital guarantee is hard to succeed. The management ability is the ability of people to realize the target by coordinating resources.

2) *The derivative elements include employees, products, premises, equipment, organization rules, etc.:* The employees are undertakers of all activities of an enterprise. The normal operation of an enterprise needs all kinds of employees. An enterprise shows its functions and values through its products or services. The hi-tech industries need premises for high-standard production which can be obtained by multiple means. Meanwhile, hi-tech industries need sophisticated instruments and equipment. The organization rules are the clear tenets and objectives of an enterprise to standardize behaviors of its members. Complete rules and regulations are the soul of hi-tech industries.

B. Classification of Hi-Tech Industries

The hi-tech industries (manufacturing industry) studied in this paper refer to the manufacturing industries in which the R&D expenditure represents a higher percentage of the main business income, including 6 categories shown in Table I.

TABLE I. HIGH TECH INDUSTRY (MANUFACTURING) CLASSIFICATION

Name	China National Economy Classification Codes
Medicine manufacturing industry	27
Chemical medicine manufacturing	2710
Manufacturing of raw materials of chemical medicine	2720
Manufacturing of chemical medicine preparation	
Processing of Chinese herbal pieces	2730
Manufacturing of traditional Chinese medicine	2740
Manufacturing of veterinary drug	2750
Manufacturing of biopharmaceuticals	2760
Manufacturing of hygienic material and medical supplies	
Aviation, spacecraft and equipment manufacturing industry	
Aircraft manufacturing	3741
Spacecraft manufacturing	3742
Aerospace related equipment manufacturing	3743
Other aerospace craft manufacturing	3749
Repair of aerospace craft	4343
Electronic and telecommunication equipment manufacturing industry	
Electronic industrial equipment manufacturing	3562
Fiber and cable manufacturing	3832
Li-ion battery manufacturing	3841
Telecommunication equipment manufacturing	392
Telecommunication system equipment manufacturing	3921
Telecommunication terminal manufacturing	3922
Radar and ancillary equipment manufacturing	3940
Computer and office equipment manufacturing industry	
Computer manufacturing	3911
Computer parts manufacturing	3912
Computer peripheral equipment manufacturing	3913
Other computer manufacturing	3919
Medical instruments and instrumentation manufacturing industry	
Medical equipment and device manufacturing	358
Medical diagnosis, monitoring and treatment equipment manufacturing	3581
Medical laboratory and medical disinfection equipment and apparatus manufacturing	3583

Artificial limbs, artificial organs and implanted (interventional) devices	3586
Instrument and meter manufacturing	
Industrial automatic control system device manufacturing	4011
Drawing, calculation and measurement instrument manufacturing	4013
Experimental analysis instrument manufacturing	4014
Test machine manufacturing	4015
Instrumentation and other general-purpose instrument manufacturing	4019
Environmental monitoring special instrument manufacturing	4021
Agriculture, forestry, animal husbandry and fishery instrument manufacturing	4024
Geological exploration and seismic special instrument manufacturing	4025
Teaching equipment manufacturing	4026
Nuclear and nuclear radiation measuring instrument manufacturing	4027
Electronic measuring instrument manufacturing	4028
Information and chemicals manufacturing industry	
Information and chemicals manufacturing	2664

C. Analysis of Connotation of Growth of Hi-Tech Industries

The growth of hi-tech industries may be measured in multiple dimensions such as improvement of production capacity, expansion of scale and reinforcement of competitiveness, but it is usually measured in three dimensions of scale, knowledge and institution. In the dimension of scale, the hi-tech industries need three capacities to expand their scale: (1) perspective of product market and strong competitiveness; (2) administrators with enough management and control ability; (3) reasonable and effective allocation of resources owned by the enterprise. In the dimension of knowledge, the support of specialized knowledge is indispensable for the existence and development of hi-tech industries. The growth of hi-tech industries is based on the acquisition of external knowledge competition strength and the improvement of internal knowledge efficiency of the enterprise, so it is a kind of qualitative growth of which the connotation is knowledge. In the dimension of institution, analyzed from the angle of institution and change of institution, the sustainable growth of hi-tech industries is influenced by multiple factors, so the enterprise should first establish a reasonable strategic direction and a dynamic mechanism, promptly correct and adjust them in development and continuously optimize them according to the actual situation so as to provide a good institutional guarantee for the sustainable growth of the enterprise.

III. ANALYSIS OF FACTORS INFLUENCING THE GROWTH OF HI-TECH INDUSTRIES BASED ON ITISA

A. Analysis of Internal Factors Influencing the Growth of Hi-Tech Industries Based on ITISA

The nature of the growth of hi-tech industries based on ITISA is to integrate and share the advantageous innovation

resources of main members of ITISA, so it's very important to study the internal factors influencing their growth. These internal influencing factors include the following types:

1) *Development strategy of ITISA*: The strategy is the systematical understanding and practice of the problems such as development direction, objective, method and tactic to realize the objective and is the plan to guide the overall situation. The alliance strategy isn't a simple aggregation of respective strategies of all members of the alliance, but a comprehensive strategy to help all factors organically combine and mutually couple with each other. Led by the alliance strategy, the participant members of the alliance reach a consensus on a strategic objective and contribute respective resource capacity to realize the appreciation of value, gain their corresponding benefits and take their due risks as per the stipulated rules. The participant members of the alliance establish an interdependent strategic relationship but don't lose their independence. The whole process is not related to any long-term formal legal obligation, so it will better guarantee the consistence of the objectives of the participants and their relative independence.

2) *Benefits of ITISA*: The benefit produced by ITISA is the new value brought to the participant members of the alliance by their synergy. If a member considers other members' strategic positioning less valuable than its own strategy in some aspects, without sufficient incentive compensation measures, this member might not voluntarily negotiate the consistence of strategies with them. In addition, if the potential value of co-development benefit of a member of the alliance is very difficult to evaluate or judge, the initiatives of this member and other members will be discouraged to some extent.

3) *Risks of ITISA*: The risks of the alliance come from the uncertainty in several aspects. On the one hand, the uncertainty of external environment (technological development, demand of market and asymmetry of information); on the other hand, the uncertainty of internal partners including their behavior and capacity, for instance, as the objectives of co-development of participant members of the alliance are different, a single member might be tempted somehow and change its strategic intention suddenly or refuse to execute the signed agreement so that other participant members will take unexpected risks and losses.

4) *Capacity gap among members of ITISA*: The capacity of members of ITISA is the key factor to continuously increase the surplus value of consumers and producers. This capacity is the foundation of a member's existence and can guide its future development. This capacity is unique and impossible to reproduce by competitors in a short time and may help to realize and improve the customer value. The difference and the imbalance of growing path and capacity development of participant members of the alliance may affect the relationship of members such as mutual confidence and effective communication[2].

5) *Confidence among members of ITISA*: On the basis of mutual confidence among member organizations of the alliance, the partners of the alliance may relax their guards on each other. Without precautions against other members' opportunistic behavior all the time, everybody will be more voluntary to share their resources and technological knowledge so as to promote the communication of information and expertise to a larger extent. Only on the basis of mutual confidence among members of the alliance, the top managements of the members will exchange their knowledge with each other. The agreement established on the basis of common understanding and confidence will better ensure the smooth co-development and promote the interaction[3].

6) *Commitment among members of ITISA*: The commitment reflects the attitude of key decision-maker in top-management toward the future behavior of the enterprise and his acceptance of the objectives established within the alliance and the values of participant subjects of the alliance, and of course, his intention of resource investment in the following cooperation. In reality, the commitment is often incorporated in the fact that a participant member invests a lot of assets in itself or invest in other participant members to realize the investment based on mutual confidence among members and to ensure that the benefit is owned by all members of the alliance so as to create new market opportunities on this basis.

7) *Communication among members of ITISA*: The extent and the sufficiency of communication among participant members of the alliance reflect the openness and the transparency of the alliance as well as the intention and ability of the members of the alliance to share their information or technological knowledge. Insufficient communication among them is very unfavorable to the co-development and may cause distrust and suspicions among them.

The information sharing is the direct result of communication among participant members of the alliance. The fruits of information sharing reflect the efficiency of knowledge creation by members of the alliance through dynamic network. The mutual respect among the members of ITISA is the foundation of forming the alliance. Their interaction may promote their communication within the alliance and promote the co-development of the members on this value chain.

8) *Conflict reduction among members of ITISA*: The conflict generally exists in the cooperation among members of the alliance and is a potential factor to prevent their smooth co-development. Acquisition, application and transmission of knowledge is an important reason for all the members to choose to participate in and form ITISA. Their interaction is frequent. The effective reduction of conflicts among members of the alliance can ensure more effective communication of information and resources so as to further ensure the effectiveness of transactions.

9) *Protectionism of ITISA*: ITISA provides an important protection mechanism for the participant enterprises to acquire external knowledge. But malicious reproduction or

embezzlement of other members' expertise by members of the alliance might imperil the competitive advantages of other subjects. Consequently, ITISA must keep a balance between the improvement of core capacity and the protection of core intellectual property.

The knowledge protection mechanism may filter the information and limit the circulation of information crossing borders, which will affect the honest and open cooperation to some extent. From this point of view, the protectionism reduces the quantity of exchanged information and may cause uncertainty and conflict. The protectionist act and the partnership have a negative correlation, because the existence of protectionism will surely increase the cost of supervision and coordination among members of the alliance and will limit the circulation of knowledge and reduce the level of cooperation and interaction to some extent.

10) *Cultural synergy of ITISA*: As an internal environment system shared within the alliance, the organizational culture of ITISA has an influence on the behavior of the participant members of the alliance to a large extent. The cultural synergy can ensure that the relationship of the alliance is the least disturbed and destroyed and help to reduce the contradiction and conflict among members so as to reinforce the continuity of mutual behavior.

11) *Shared vision of ITISA*: The shared vision refers to the common objective and ideal of the members of the alliance. If they have the shared vision, the participant members of the alliance can reduce their suspicions and have a smoother communication among them, which is more favorable for the members to acquire information, knowledge and capacity and to avoid lots of potential benefit frictions. The shared vision can provide a relatively unified driving objective to the participant members of the alliance so as to promote the mutual fusion of resources among different organizations and to realize a more effective combination of technologies and knowledge among them. Consequently, the shared vision may be regarded as a very effective mechanism that can promote the effective combination of knowledge and other resources among the participant members of the alliance and promote mutual learning and interaction in other aspects[4].

B. Analysis of External Factors Influencing the Growth of Hi-tech Industries Based on ITISA

The external influencing factors of ITISA mainly refer to the external factors that have direct or indirect influence on the alliance, mainly including the following aspects:

1) *Social culture and education factors*: The development of social culture and education, on the one hand, offers a good atmosphere of development for all the fields of the society and on the other hand, offers new knowledge, skills and hi-tech talents for everybody, which both give powerful support to the growth and development of the alliance. Consequently, a good social culture and education environment is favorable for the alliance to smoothly and efficiently implement the technological innovation activities so as to guide the development of the alliance in a better direction.

2) *Policy and legal factors*: Policy factors act on the co-development of the subjects of ITISA mainly in two aspects: limitation and incentive. The state launches relevant policies to adjust the industrial structure by encouraging or limiting the development of some industries that may affect the formation and establishment of ITISA; the government will decide the investment of funds, technologies and personnel in ITISA according to its operating situation and decide whether to increase its support and assistance to improve the healthy and efficient operation of the alliance[5]. A perfect legal environment is very helpful to encourage enterprises to join the alliance and to motivate the initiative of the members of the alliance and is favorable to fully guarantee the benefits of participant members of the alliance.

3) *Technological progress factors*: The regional environment for scientific and technological development of ITISA offers a platform for the technical innovation activities of the members of the alliance. This platform provides more technological knowledge resources for technological innovation of the alliance and impulses the members of the alliance to learn more and to adapt themselves to the changing technological environment[6].

4) *Social and economic factors*: ITISA is a product of social and economic development to a certain stage. As the society and the economy develop faster and faster, the frequency of product upgrading is accelerated, which requires every modern enterprise to be based on the market demand and to continuously learn and master the most advanced science and technology[7]. It's very difficult for a single enterprise to follow up the requirement of the time for technological innovation ability with its own capacity, so ITISA was born at the right moment as a new form of network organization[8]. The social and economic progress will impulse the co-development of the members of the alliance

and become the powerful backbone in the development of ITISA.

IV. CONCLUSIONS

This paper takes hi-tech industries for object of study, borrows the theory of industry technology innovation strategic alliance and the enterprise growth theory and studies the connotation of the growth of hi-tech industries based on ITISA and the factors influencing their growth so as to provide the theoretical basis for combining the theory of industry technology innovation strategic alliance and the theory of hi-tech industries and for expanding their application in the growth of enterprises. It also provides a realistic reference for further evaluation of the situation of growth of hi-tech industries in network economy.

REFERENCES

- [1] Amour, H. W., and Teece, D., "Vertical Intergration and Technological Innovation," *Review of Economic and Statistics*, no. 62, pp. 470-474, 1980.
- [2] Hamel, G., "The why, what and how of management innovation," *Harvard Business Review*, vol. 84, no. 2, pp. 72-84, 2006.
- [3] Damanpour, F. and Gopalakrishnan, S., "Theories of organizational structure and innovation adoption: the role of environmental change," *Journal of Engineering and Technology Management*, no. 15, pp. 1-24, 1998.
- [4] Roy, R., "Successful Industrial Innovation: Critical Factors for the 1990s," *R&D Management*, vol. 22, no. 3, pp. 221-239, 1992.
- [5] Tom peters, "The Sixth Discipline - The Art and Practice of Innovative Organization[M], Yanbian: Yanbian People's Publishing House, 2003.
- [6] Joe Tide, JohnBessant, Keithpavitt, *Managing Innovation: Integrating Technological, Market and Organizational Change[M]*. Translated by Chen Jin. Beijing: Tsinghua University Press, 2002.
- [7] Xu Xiangyi, Xu Yingji, "Research on the Synergy of Technological Innovation, Institutional Innovation and Sustainable Growth of Enterprises," *Dongyue Luncong Journal*, vol. 29, no. 2, pp. 80-85, 2008.
- [8] Joseph Schumpeter, *The Theory of Economic Development[M]*, Beijing: The Commercial Press, 1990.