Research on the Cluster-level Architectural Knowledge

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Abstract:
The cluster-level architectural knowledge is the source to maintain sustainable competitive advantage of clusters. To develop the knowledge-based theory of clusters, we choose Dalian Software Park as the object of study, and work strictly according to scientific research process of the case study method. Firstly, we put forward the research questions and established the subject of the study according to the relevant literatures, and made a scientific study design to ensure the reliability and validity of the case study. Secondly, we collected research data and materials by the interview. Thirdly, the case analysis was carried out. Based on interview’s materials and secondary data analysis, we explored the content of the cluster-level architectural knowledge, discussed the roles played by different types of architectural knowledge in the development of industrial clusters and the impacts on the maintaining the competitive advantage of the clusters. Our contribution is exploring the contents of the cluster-level architectural knowledge, which includes recognition of the strategies, convention, mutual benefit, industrial atmosphere, collective reputation, and institution.

Introduction
Cluster is defined as a geographically proximate group of inter-connected companies and associated institutions in a particular field, linked by commonalities and complementarities (Porter, 2000), and it has industrial property and geographic concentration characteristics (Marshall, 1920). The competitive advantage of cluster is that it is capable of not only lowering transaction cost, improving production efficiency, but also creating group wealth such as new knowledge and reputation (Lawson & Lorenz, 1999).

Architectural knowledge is common understanding and industrial atmosphere, owned by cluster as a complete system, which cannot exists independent of cluster (Porter, 1998), providing cluster members with tacit understanding of rules of game (Cook & Brown, 1999). Architectural knowledge is the major wealth of the entire members, the knowledge-based theory of clusters regards clusters as a platform for strengthening knowledge creation (Maskell & Malmberg, 1999), considering cluster can supply both the entire and members with sustainable competitive advantage by the architectural knowledge (Maskell, 2001; Tallman et al., 2004).

China local cluster need independent innovation and the multinational knowledge spillover cannot directly promote the business growth of local cluster enterprise (Wu, 2008). Therefore, fostering local cluster innovation and sustainable competitiveness is of great significance, architectural knowledge, however, as the source of maintaining sustainable competitive advantage, is worth studying. Through an analysis of DLSP (Dalian software park), this study explores the content dimensions and characteristics of architectural knowledge expanding and deepening the understanding of the concept of industrial architectural system and based on this, knowledge content of six dimensions of cluster system are generalized.

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Literature Review

Henderson and Clark (1990) proposed the concept of proponent and architecture from product development perspective, and they divided knowledge into component knowledge and architectural knowledge, among this, the component knowledge was the core design concept and its implementation of the knowledge in a specified component, while the architectural knowledge referred to linking the component knowledge into a coherent overall aspects of knowledge. Matusik and Hill (1998) further divided the knowledge into component knowledge and architectural knowledge from organization level. They noted that component knowledge is concerned with the discrete knowledge of subroutine or the whole organization in the operation which was a part or component instead of overall knowledge, such as knowledge of the new product development, inventory management, customer billing, which was only one aspect of the company’s knowledge structure and architecture knowledge just showed the opposite, it was associated with the organization as a whole, related to the practices and routines within organization, coordination with the component knowledge and its application into the production.

Architecture knowledge is the understanding of reciprocity and reputation on the level of industrial cluster through the network interactive, mutual dependence and practices of the common interests among the cluster members, and it is recognized by the members of the cluster but a tacit rules of game (Tallman et al., 2004). Component knowledge is relatively clear and used to describe the integral part of a body of knowledge which can be distinguished, on the contrary, the architecture knowledge is mutual understanding and industrial atmosphere, owned by the cluster as a complete system, and cannot exist independently (Porter, 1998), and also, it has the feature of non-clarity and causal ambiguity, path dependence and rooted within the born system (Cook & Brown, 1999) which can provide sustainable competitive advantage to the organization (Tallman et al., 2004). The concept of architectural knowledge is first proposed by Marshall, and also, he proposed the notion of industry atmosphere in 1891 which is described as something in the air (Marshall A., 1891), besides, the competitive advantage it brings exists only in the specified region, and others are not readily available. A crucial reason for the failure of imitating the U.S. Silicon Valley from all over the world is the background-dependent knowledge which is accumulated by the common social culture and experience of cluster members (Brown & Duguid, 2000). The collective knowledge of the cluster which has a binding effect on people’s behavior largely become a culture of industrial cluster in a way, and it does affect our choice unconsciously (Spencer, 1996). Cluster enterprises sharing common cultural background will be easier to reach a strategic consensus on production operations and market opportunities (Free, 1994), to produce similar commercial understanding, competitive mode, etc., which in the end generate the architectural knowledge naturally. In the process of evolution of knowledge, architectural knowledge has the path-dependent characteristics, and no two enterprises with the same architectural knowledge (Matusik & Hill, 1998).

Component knowledge is related with industrial technology in the cluster, rather than a kind of background knowledge, and it is relatively easy to be defined, besides, this type of knowledge normally reflects the objective natural and social phenomenon and laws, regardless of the development history of the organization. What’s more, component knowledge lose easily since it is more transparent and easy to transfer, and the competitive advantage component knowledge provide is short-term in the industrial clusters (Tallman et al, 2004). Architectural knowledge however can provide a sustainable competitive advantage to both the whole cluster and its members through the creation of architectural knowledge which is the significant asset of all the members of cluster (Maskell, 2001; Tallman et al, 2004).

Companies are willing to share knowledge in a cluster of industrial diversity, because it is a benefit other than a threat to their competitive position, and it will get access to the diversified external knowledge which is conductive to both exploratory innovation and the achievement of the commercialization of its own knowledge (Arikan, 2009). The organizational contact contributes to knowledge transfer only when the geographic proximity between organizations exists, or the friendship of employees will play a significant role in the knowledge exchange between organizations (Bell & Zaheer, 2007). Geographic concentration of cluster is conductive to inter-enterprise exchange
of knowledge, information and resources through the network, besides, network centrality and the geographic concentration influence the enterprise innovation complementarily (Whittington et al, 2009).

From existing literature researches, there is no clear specific content, form of expression and its characteristics of architectural knowledge, which hinder and limit the further study of the mechanism of knowledge creation, function and evolution. It will have a large significance and value on the theory and practice of knowledge management of industrial cluster if we can determine the content dimensions of architectural knowledge.

Study design
(1) Object of study -- the Dalian Software Park (DLSP)
In this paper, a typical case study method, the object of the paper—the architectural knowledge, which is used to analyze the specific content dimension of architectural knowledge is scientific and operational. The selected object of the case study is DLSP, the high-tech industrial park which is following the mode of official to help run, and also in support of the Dalian municipal government officials. DLSP as the research object has the following two reasons:

One reason is DLSP meets the typicality and representativeness requirements. Dalian Software Park, a typical high-tech industry cluster with software and service outsourcing for industrial orientation and 12-year development history, is the Asia-Pacific center of software and service innovation. Dalian Software Park is therefore the ideal for the study on architectural knowledge, and software enterprises in DLSP have frequent interactions, more knowledge spillover channels, perfect knowledge sharing platform, higher knowledge flow efficiency and strong industry innovation and academic atmosphere, forming architectural knowledge with a certain rooted cultural characteristics and typical characteristics of research.

Dalian Software Park has more than 500 enterprises including 42 global top 500 enterprises with 39% of foreign investment until the end of 2010, also has more than 60,000 employees accounting for above 50% of the total number of employees of software enterprises in Dalian, and its sales revenue achieve over 28 billion, more than half of the total revenue of the software and outsourcing industry in the whole city. Therefore, DLSP, the largest domestic exports of software and service outsourcing and the highest proportion of foreign investment in the software park, is undoubtedly becoming the leader of software industry in Dalian. Cluster experience of DLSP has the value of reference and representative, whose successful business model and experience, known as Dalian mode, has been widely recognized and duplicated, and those software parks, such as Wuhan Optical Valley, Suzhou Software Park and Tianjin TEDA Service Outsourcing Industry Park, operate successfully under the guidance and mode of Dalian Software Park.

The other reason is DLSP meets the operational and research requirements. The selection of DLSP as the object of case study has the favorable edge of geography, connection with campuses, and easy to get talents. Geographically close is beneficial to the higher efficiency and quality of data collection through keeping track of surveys and direct observation; the frequent interaction between Software Park and University, the close relationship among production, learning and research, is one of the indispensable part of research, so that in-depth analysis of the object of the study is meaningful. In addition, obtaining the first hand and second-hand information on the knowledge management through the formal and informal exchange of internal staff in Software Park guarantees the authenticity of the information, the reliability and validity of the study and the persuasion of the conclusion.

In summary, DLSP prove to be the object of study on architectural knowledge with the characteristics of representative, typicality and value. This paper is structured as follows: we establish the research questions firstly, and the following part is the summary of the theoretical basis, we then do the preliminary field research, in-depth interviews for data collection and the analysis and organization of data, and finally we present the improvement of the theoretical framework and findings.

(2) Research Data Collection
In the use of case study, multi-channel sources can confirm each other which will help researchers get the full range of inspection, grasp the problem and draw more convincing conclusions (Yin, 1994).
We use the methods of in-depth interviews, observation and documents collection (source is given in table 1) on the basis of evidence triangulation (Sieber,1973;Yin,1982).

Table 1, case study source

<table>
<thead>
<tr>
<th>Collection method</th>
<th>Data type</th>
<th>Data sources</th>
<th>Data advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literature collection</td>
<td>Literature</td>
<td>(1) shared documents: newspapers, journals, papers; (2) shared sites: Dalian high-tech industrial zone website; DLSP operational and management of business parks website; Union of High-tech zone in Dalian website; CNKI; government data; (3) internal data: brochures and periodicals within the software park; the feasibility analysis report of DLSP</td>
<td>(1) enable to verify the interview information (2) as a derivation basis, to provide clues for further research (3) easy to store, can be used as written evidence</td>
</tr>
<tr>
<td>Interview</td>
<td>Interview records</td>
<td>Face-to-face interview</td>
<td>(1) targeted, closely linked to the topic (2) more in-depth research, obtain more detailed information than literature (3) authenticity</td>
</tr>
<tr>
<td>Observation</td>
<td>(1) direct observation (2) participant observation</td>
<td>(1) auto-vision information: depth-understanding of the industrial atmosphere and cluster culture through the observation of the internal construction and environment of the software park (2) internship</td>
<td>(1) theory with practice, to understand in greater depth (2) better authenticity, to obtain first-hand information</td>
</tr>
</tbody>
</table>

Case studies
(1) Research topic
Some preliminary research topics such as the architectural knowledge creative ability, architectural knowledge evolution and the analysis of high-tech architectural knowledge were emerged in the process of preliminary research interviews, literature review and organize and discussion between teachers and students. However, dimensions of the contents of the architectural knowledge was finally determined as our research topic after discussion with a number of experts, so that we will make some theoretical explorations in the field of architectural knowledge management starting from the research on the dimensions of contents of architectural knowledge.

(2) Data compilation
The interview records and second-hand materials were sorted, compared, conceptualized and classified based on the research topic, in addition, recurring key words and related concepts were also summarized, induced and extracted from the data, then classified into related research topic (as shown in table 2).

Table 2 typical data compilation and classification
<table>
<thead>
<tr>
<th>Level One Subject</th>
<th>Level Two Subject</th>
<th>keywords</th>
<th>Related concepts</th>
<th>Typical data</th>
</tr>
</thead>
</table>
| Architectural Knowledge Content | Tacit Knowledge | recognition of the strategies | Similar values, Shared vision, Business understanding, Strategic coordination, Similar cognitive mode, Strategic consensus, Tacit understanding | (a) DLSP internationalization strategy has been widely recognized by enterprises in the park;  
(b) The common goal of enterprises in DLSP is to create the world-class technology and services;  
(c) Enterprises in DLSP reach a consensus on service outsourcing, mainly determined by the domestic software market and the R&D level in the park;  
(d) Software park will make efforts to achieve industry high-end technology and diversification and improve the independent innovation capability;  
(e) Enterprises in DLSP accept the strategic adjustment if Software Park |
| | | Collective reputation | Impression, credit, reputation, trust, Corporate image, public praise, fame, customer satisfaction | ① Dalian has already formed a software and service outsourcing industry cluster with scale effect and a certain international popularity and reputation.  
② The good reputation of DLSP helps to promote investment.  
③ The collective sense of honor makes the internal enterprises feel proud. |
| | | mutual benefit | Complementary, win-win, risk-sharing, Direct benefit, indirect benefit, cooperation, mutualism | ① Enterprise cluster attracts more customer and partners;  
② Enterprises in the DLSP cooperate with each other;  
③ Mutual cooperation makes win-win situation; |
| | | Industrial atmosphere | Competition, cooperation, freedom, Innovation, open, active Regional culture, Common language, Interaction. | ① The industrial atmosphere of open and active in DLSP  
② Strong industrial atmosphere  
③ Frequent exchanges and cooperation between enterprises |
| | | convention | Code of conduct; unspoken rules; work style; subconscious autonomy; habitual; universality; predictability | ① Foreign companies: more specific and detailed division of labor, the pursuit of quality and efficiency;  
② Chinese companies: overstaffing in organizations; unclear responsibilities; paying more attention to human feelings and... |
③ Work overtime has become the unspoken rules in some enterprises.
④ Business owners have a similar mode of thinking in dealing with certain issues.

<table>
<thead>
<tr>
<th>Architectural Knowledge Content</th>
<th>Explicit Knowledge</th>
<th>institution</th>
<th>Laws and regulations, public policy, industry norms and standards, management systems, preferential policies, constraints, incentive</th>
</tr>
</thead>
<tbody>
<tr>
<td>① Software Park companies must comply with the legal system as well as the park's public policy.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>② Enterprises in DLSP will be access to the preferential policies, such as taxes, duties and talents, etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>③ Perfect software park system.</td>
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</table>

From the collection of interview data and second-hand material we see that the architectural knowledge includes both tacit knowledge and explicit knowledge, but mostly tacit. Tacit architectural knowledge mainly includes recognition of the strategies, convention, mutual benefit, industrial atmosphere, collective reputation.

(a) recognition of the strategies
After 13 years of experience accumulation and cultural precipitation in the rapid development of the industry of global software and service outsourcing, companies in DLSP have a consistent vision of world-class software technology and services and they work together to build up China Green Silicon Valley of international software and service outsourcing, which is widely supported, recognized and followed by enterprises in the Software Park. The next major task of the Software Park, said Gao Wei, the president of DLSP, is to achieve the high-end and the diversification of the software industry, and to improve the independent innovation capability.
First of all, the software industry, a sunrise industry and even a green industry of low-power, high-tech, high value-added, and high-quality human capital, which also has broad development prospects, attracts more and more companies to join in. Besides, the international strategy of the Software Park enables enterprises to establish clear objectives, strengthen confidence, merge foreign software companies, acquire R&D technology and innovation resources from abroad, and motivate the development and innovation of the corporation. In addition, enterprises in the Software Park reach a consensus on the overall strategic adjustment of the Software Park, because of which, they have engaged in strategic transformation and also, the software service outsourcing enterprises are taking efforts to transform from BPO (Business Process Outsourcing) to BTO (Business Technology Optimization), and finally close to the high-end of software industry chain. Enterprises in the Park have formed a similar cognitive model, that is their understanding and judgment of the market are nearly consistent under the long-term cooperation and interaction. Most companies approve and even follow the overall development strategy of Dalian Software Park, and they also achieve strategic synergy for the complementarity of resources between upstream and downstream enterprises. It is the strategic identity that improves the ability to resist risks in the entire industry cluster.

(b) Convention
In addition to follow the laws and regulations of the state and the public policy of the Software Park, enterprise interaction and communication should also take the impact of some unwritten conventions into consideration. When dealing with internal affairs and external relations, enterprises in the Park will use some recognized traditional way or the pattern we know very well. Such practices or unspoken rules are spontaneously formed, widely recognized and repetitive behavior patterns under the influence of the long-term local culture.
Enterprises in DLSP are virtually affected by foreign management thoughts, especially Japan and South Korea, since the foreign enterprise ratio there is up to 39% and the major customers of software services outsourcing are foreign corporations. Compared with Chinese companies, that is mostly overstaffing in organizations, making unclear responsibilities, paying more attention to human
feelings and relationships, the division of labor in foreign enterprises is more specific and detailed, also they pursue quality and efficiency. The implementation of international strategy in Software Park makes them pursue international norms and standards, change their business style—more working under the constitution, less black-box operation.

Good practices promote cluster development, and even can develop into a kind of culture of the cluster, the ill conventions, though, may hinder the development. A few enterprises in the Park, in which working overtime has become the unspoken rules of employees, are not conducive to the health of employees and work motivation and work efficiency, undoubtedly, the vicious cycle will be formed, which will weaken the corporate image and operational efficiency of the company itself directly and of the whole Park indirectly. Therefore, the Software Park try the best to advocate a fair and reasonable market transactions, strengthen the supervision system and standard and lead enterprises to cultivate a good practice.

(c) Collective Reputation
After 13 years of development, DLSP has enjoyed a high reputation in both domestic and international extent, and the internal enterprises also have the feeling of pride, forming the collective senses of honor. What’s more, DLSP has won lots of honorary titles, including the National Torch Plan Software Industry Base, the National Software Export Base, the Software Industry International model city core base, China's software export projects in Europe and America pilot base, China Service Outsourcing Base City Demonstration Zone, China Sourcing excellent industrial park, China's software and service outsourcing Outstanding Park, United Nations International Garden Community. Dalian has formed the software and service outsourcing industry cluster with scale effect, possessing certain international popularity and reputation, highly praised by the Group of Experts in the selection of the top ten economic events in China’s information industry, 2007.

Favorable collective reputation has brought many benefits to the development of Software Park. First of all, attracting more international enterprises, adding new ideas and techniques for the development of the Park, and improving the management satisfaction of the internal corporations is realized now; Besides, the good fame and reputation contribute to the investment and raise money and resources for the enterprise expansion and development; Thirdly, it help to attract talents and enhance the quality of human capital in the Park; finally, it also in favor of stimulating employees, forming the collective sense of honor and enhancing working motivation.

(d) Mutual Benefit
Mutualism is the best survival mode for enterprises surviving in a common area in the process of the development of software industry globalization. They can realize the corporate mutually indirect reciprocity, since benefits of some enterprises will indirectly benefit others, such as upstream and downstream businesses, in the trade contacts with corporations outside the cluster, also, the cooperative relationship among enterprises within the cluster can help to achieve a direct reciprocity. Cluster enterprises with the advantage of geographical proximity have more opportunity to communicate, which virtually shorten cognitive distance, easily produce a common language and finally establish trust and mutually beneficial cooperation relationship. As to the reason why enterprises in the Park choose the mutually beneficial cooperation is that cooperation can achieve complementarity between resources and capabilities, and realize a win-win situation, risk sharing and cost reducing.

It is thus clear that mutually beneficial cooperation will directly and indirectly benefit enterprises, and also, cooperation between companies in Software Park and the internal trade contacts are frequent. For example, Hewlett-Packard (HP) provides IT support for many companies in the Park including Pfizer and Ryan, in addition, Genpact, Accenture, and other Fortune 500 management consulting firm provide management consulting and business outsourcing services to corporations in the Park. The long-term commercial contacts improve the recognition and trust among enterprises in the Park and form an intangible or tangible trust system and cooperation mechanism, further, such direct and indirect reciprocity bringing more and more benefits for the development of the Software Park, is the major asset to the whole Park.

(e) Industrial Atmosphere
Dalian Software Park Co., Ltd, the operation and management of DLSP company, actively create a gathering and collective environment in the Software Park, which encourages innovation and cooperation. Enterprises within the Park grow together, create the industry atmosphere of freedom, open, competing and innovation, and realize a win-win through the complementary cooperation on the vertical industry chain and competitive collaboration on the horizon. The perfect institutional system including laws and regulations, public policies and government preferential policies build industrial atmosphere of fair, reasonable and attractive.

Software Park has made significant contributions to the creation of an interactive communication environment, with the organization of lots of knowledge and information exchange platform including guilds, annual meetings, forums, trainings and software trade event. For example, Dalian has successfully held China International Software and Information Service Fair nine times from 2003 to 2011, and especially in 2001, more than 50 enterprises, such as Neusoft Group, Hisoft, SAP, Ufida and Intel, joined the fair and set up their own exhibition stands to show the innovation development of technology, business, philosophy and service, and thousands of visitors met what they need. What’s more, the software trade event in which countless experts, businesses, government and industry associations get together to express a variety of opinions and suggestions in more than 80 series of industry conferences, forums etc., was valuable and precious, and according to this, inspired participants knew much more about the industry development tendency, enterprises promoted communication and cooperation with others and it also helped to build a bridge of communication between business and government.

Beyond that, DLSP has made a lot of efforts in the construction of culture to create a comparative active industrial atmosphere. The establishment of clubs including manager club, work culture club, etc. allows 70% enterprises in the Park to participate different kinds of sports, activities and competitions held by the club. Such exercises provide opportunities for information exchange, promote cooperation between members within the cluster, facilitate the government-enterprise integration and integrate social resources. In the end, build an open, free industrial atmosphere is an important development strategic measure due to the uniqueness of industrial atmosphere which is difficult to obtain and imitate from outside.

Tacit architectural knowledge has made important contributions to maintain the sustainable competitive advantage of the Software Park. However, the vital role of explicit knowledge in the development of the Park should not be ignored either.

Many public policies and codes of conduct developed jointly by members of DLSP play a significant role in maintaining the stability of the Park, promoting communication between enterprises and enhancing trust relationship among enterprises in the Park. Some intermediary organizations closely related to the industrial development of DLSP, including Dalian High-tech Zone Management Committee, Dalian Software Industry Association and Dalian High-tech Zone Trade Unions, draw up some public policies and regulations in favor of the park development, such as encourage intellectual property rights and development assistance approach, Dalian High-tech Industrial Park Management Ordinance and other regulatory policies and so on which have great policy supporting effect on the protection of intellectual property rights of the Software Park enterprises, the preserve of market order of fair competition and the encouragement of independent innovation.

Lots of preferential policies involving taxes, tariffs and talents attract enterprises to enter in and cooperate with the Park, and stimulate innovation and development of enterprises in the park, in addition, such policies to a large extent help to lower business costs and risks, improve profit margins, promote the quantity and quality of human capital and offer a driving force for the development of Software Park. In short, the architectural knowledge of DLSP is mostly explicit, made according to the specific circumstances of the Park and confirmed in the form of rules and regulations, which is conducive to cluster members to learn, disseminate, share knowledge and internalize into the behavior of enterprises finally. This allows enterprises to on the one hand constrain corporate behavior and inspire the innovation and development on the other hand.

Discussion and conclusion
This paper mainly explores the content dimensions of architectural knowledge, by case study method. Our study found that cluster knowledge is composed of component knowledge and architectural knowledge from the perspective of knowledge liquidity. Architectural knowledge is the understanding of reciprocity, practice and system which refers to the level of industrial cluster, formed by network interaction, interdependent with each and practice of common interests. Moreover, architectural knowledge including tacit knowledge and explicit knowledge, has six content dimensions of recognition of the strategies, convention, mutual benefit, industrial atmosphere, collective reputation, and institution.

(1) Recognition of the strategies
Cluster enterprises share common regional cultural background, tangible resources and information such as infrastructure and intangible resources including knowledge. Further, enterprises in cluster realize the complementary advantage of resources, cultivate similar value and cognitive model and promote the consistent commercial understanding in production operations and market opportunities through integration of resources and learning of knowledge by division of labor and cooperation. The guidance of strategic mechanism of industrial cluster is easier to work together because of the geographical proximity of firms in cluster, therefore, in the call of intermediary organizations containing government, industry associations, etc. enterprises in cluster put heads together, achieve strategic consensus and enhance strategic identity. The consistent strategic understanding and synergy, formed by long-term interactive relationship between enterprises in cluster, not only improve strategic acceptance but also virtually generate shared, implicit and cognitive knowledge.

(2) Convention
Firms in cluster easily produce a series of solidified, repetitive and predictable behavior pattern in the long-term interaction, that is, convention (Nelson & Winter, 1982; Feldman, 2000). Convention is mainly close to tacit knowledge related to rules, traditions, strategies and culture which is owned by the whole members and applied constantly in cluster enterprises (Levitt, 1988). The operating mechanism of convention is actually the process of applying knowledge, and during the unawareness of the existence of knowledge, they have already initiate to choose behavior patterns actively for cluster members themselves, however, it is hard to use language to describe how to complete after the implementation of cluster enterprise activities. Convention is widespread in industrial cluster and it will gradually be convergent until the formation of practices and rules applied consistently and then provide a competitive advantage for the entire cluster.

As enterprise genes (Nelson & Winter, 1982), convention tends to have some stability to a certain extent (Wang, 2010) and have ability of self-replication and inheritance, and actually, the convention generally believed as a satisfied one among cluster enterprises will be selected and inherited in the course of evolution. Though convention is known as genetic material relatively unchanged, yet in the whole evolutionary process, it has to face the evolution similar to the survival of the fittest in natural selection which bears persistent change and the impact of market selection mechanism. Cluster enterprises will search for new convention, some through imitation and others through creation, if the existing one cannot meet their requirements. Actually, compared with innovation, the cost of imitation is lower, but it will bring about sluggishness, the disappearance of innovation power to maintain competitive advantage and even the shrinkage of the entire cluster (Wang, 2010). Therefore, the research and development of new convention or the combination of existing conventions is indispensable to maintaining the competitive advantage of cluster. We can see that convention, relatively stable but absolutely changing tacit architectural knowledge, plays a significant role in development and evolution of cluster.

(3) Collective reputation
The collective reputation of industrial cluster, which is generated by the accumulation during the long-term operating management and trade interaction and related to the capability and attractiveness of the entire cluster, is a comprehensive cognitive judgment (Herbig, 1993) on past behaviors as well as future expectations of firms in cluster (Fomburn, 1996) made by stakeholders after the comparison with enterprises outside cluster. Collective reputation is an important intangible asset of industrial cluster, and firms in cluster possess the motive and need to pursue good reputation. Only if internal members of cluster reach a good reputation, the promotion of a favorable fame of the whole cluster
became reality. Collective reputation will attract more investors and enterprises, expand the size of the cluster, benefit the establishment and maintenance of trade relations, strengthen the sense of belonging and loyalty and form a huge driving force to cluster members. In addition, collective reputation, the major strategic resource for preserving sustainable competitive advantage in industrial cluster, is important to not only promote but also restrain corporate behaviors, considering the good reputation can bring profits, bad reputation however produces big loss (Keller, 1974; Matthews, 1984; Riahi-Belkaoui, 1992). Some businesses affected by the faith of opportunism, are only concerned about the immediate interests for example, enterprises do things with bad faith and violations. Frankly, such behaviors may bring short-term benefits, but in the long run, enterprises with short vision must pay the price and damage their corporate images finally. In industrial cluster, all businesses may be influenced with no good reputation of the cluster and instead of getting help and support from other enterprises, even have to subject to the exclusion of corporations with preferred reputation. Therefore, violations and disobedience to law will be punished in industrial cluster. With the comparison and balance between the long-term interests and short-term interests, cluster members find that short-term benefits, produced by faith of opportunism, are far less than benefits in long-term, and members are virtually suffer from the constraint impact of reputation. It follows that favorable collective reputation, the vital strategic knowledge asset in industrial cluster, plays an increasingly important role in maintaining cluster image and promoting the competitive advantage of cluster.

(4) Mutual benefit
Industrial cluster is essentially a community of interests composed of corporations with mutualism, connection and endeavor to achieve the common target. Members in industrial cluster are limited and different in terms of resources, knowledge and abilities, so mutually beneficial cooperation can achieve win-win although competition exists necessarily. Reciprocity is conductive not only to the realization of the complementary of resources, knowledge and abilities but also to lower costs and diversify risks. The geographical proximity of firms in cluster greatly reduces trade costs and opportunity costs, besides, enterprises in cluster improve the overall anti-risk capability due to mutual help and support in the environment of reciprocity. It is thus clear that the total benefits obtained by mutually beneficial corporations are greater than the independent situation and even the simple sum of the independent enterprise revenue. Reciprocity, one of the important properties for the creation of cooperative and trustful atmosphere has a major impact on boosting collaboration and benefit coupling in cluster.

(5) Industrial atmosphere
Industrial atmosphere will get more and more strong and active with the expansion of the scale of industrial cluster, the increase in the number of enterprises in cluster and the enlargement of the gathering strength. Compared with enterprises outside the cluster, cluster members are more familiar with each other under the background of the common culture, so that it will be easier for them to form a cluster unique common language through complying with the uniform practice, system and rule in interactive contact and achieving unified coding in the flow of information and knowledge. As to the common language, it contributes to the increasing of the exchange frequency, the improvement of the quality of cooperation and exchanges between enterprises in cluster and the decreasing of the contradiction and conflict owing to understand deviation and differential expression which invisibly reduce the transaction costs of enterprises. The stronger the industrial atmosphere in cluster is, the more intense cooperative attitude and willingness to collaboration between enterprises in the cluster are. Besides, larger gathering scale and intensity will bring about more obvious scale effect, more profit and more cooperation between enterprises. The long-term cooperation reinforces trust and dependence within the cluster, then the long-term trust will shape the good reputation of the cluster and also, the preferred reputation, in turn, is bound to bring more cooperation, and the virtuous circle is formed finally. Above all, industrial atmosphere, the major part of the architectural knowledge, is unique in any cluster and plays an important role in keeping the competitive advantage of the whole cluster.

(6) Institution
The institutional environment of firms in cluster mainly includes two types: the formal system and the informal system. The formal system refers to officially and consciously established series of policies and regulations, etc. The informal system, however, is values, practices and codes of conduct, etc. which is formed through unconscious interaction and the accumulation of history and evolution (North, 1990), such as collective reputation, strategic identity and practices, etc., which have already discussed above, so here focuses on the formal system.

The architectural knowledge of formal system is mainly referred to the knowledge related to laws and regulations, public policies, industry norms and standards and financing credit management system, etc. compiled by cluster members together and such architectural knowledge primarily includes restrictive institution knowledge and inducible institution knowledge (Ren, 2004). The restrictive system is the compulsory laws and regulations proclaimed by government, which can reduce the occurrence of opportunistic behavior through constraining cluster corporate behavior. But the indictable system is closely related to the preferential policies, the public policies used to attract and motivate enterprises, which is specifically proposed by the government and industry associations. System can lower the transaction cost of cluster enterprises, on the one side, it is able to promote businesses to gather and produce economies of scale (Zhang & Chen, 2008), and it is also conducive to the encoding of information and knowledge (Li et al. 2003) on the other side, which is beneficial to form the common language, reduce the conflicts and contradictions, enhance the trust and communication between enterprises and promote the cooperation further. By reducing the risk of cluster enterprises, leading enterprises to prevent, avoid and deal with risks, increasing vigilance against risks and creating a relatively stable industrial environment, we can prove that systems has a role of regulation and guidance in cluster enterprises. Such specific rules and regulations in cluster which is beneficial to establishing and reinforcing the trust relationship within cluster members has an important supporting role in the process of shaping competitive advantage of the cluster (Lundvall, 1992; Morgan, 1997).

Research Prospect
Making clear the contents and main expression forms of the architectural knowledge can play a positive role in the creation of architectural knowledge and the acquirement of sustainable competitive advantages. Certainly, our study still exist some limitations and we will improve them in the follow-up studies. In the selection of the subject of case study, Dalian Software Park is selected for its advantage of human resources and great geographical location, so that the data collection has a certain provincial characteristics, so the future research will be more convincing if our study can extend to more cases. In terms of theoretical content, this paper mainly studies the content dimensions of architectural knowledge, but this is only preliminary exploration on the architectural knowledge, and it will make a greater contribution to the architectural knowledge management if we can propose the creation mechanism and evolution pattern on this basis.

Literature References
39-41.


