African Journal of Business Management Vol.6 (46), pp. 11446-11456, 21 November 2012
Available online at http://www.academicjournals.org/AJBM
DOI: 10.5897/AJBM12.605
ISSN 1993-8233©2012 Academic Journals

Full Length Research Paper

The knowledge-creating process in an industrial cluster

Fu Xinshuang

School of Management, Shanghai University, Shanghai, China. E-mail: gracief@126.com.
Tel: (8621)13661922233. Fax: (8621)50318950.

Accepted 3 October, 2012

This paper aimed at developing a model for knowledge creation within an industrial cluster on the basis of a case study of a cluster of shanzhaied cell phone producers. The paper examined the knowledge conversion process, the structure and forms of ba, the evolution of knowledge assets of different players, and the nature and the role of leadership in the operation of the shanzhaied cell phone cluster. Next, the paper developed a cycling model of knowledge radiation and evolvement. This model could facilitate the creative utilisation of existing knowledge efficiently, and made Nonaka's framework of knowledge creation obtain a concrete form in an industrial cluster.

Key words: Industrial cluster, knowledge-creating, shanzhaied operation.

INTRODUCTION

Since Marshall discussed about “industrial atmosphere” in a cluster (Marshall, 1927), many scholars have analysed the role of a cluster as a knowledge source. Along the horizontal dimension of the cluster, it is by watching, discussing and comparing dissimilar solutions—often emerging from everyday practices—that firms become increasingly engaged in the process of learning and continuous improvement; along the vertical dimension, different players can co-ordinate and bridge communication gaps resulting from heterogeneous knowledge endowments more easily. By reducing the costs of co-ordination and by overcoming problems of asymmetrical information, the process of clustering tilts the balance in favour of further specialization so that a higher level of knowledge creation might be obtained (Maskell, 2001). The local buzz or local broadcasting (Bathelt et al., 2004), namely the information and communication ecology, consisting of specific information and continuous updates of this information, intended and unanticipated learning processes in organised and accidental meetings, the application of the same interpretative schemes and mutual understanding of new knowledge and technologies, as well as shared cultural traditions and habits within a particular technology field, which stimulate the establishment of conventions and other institutional arrangements, makes actors continuously contribute to and benefit from the diffusion of information, gossip and news by just ‘being there’ (Gertler, 1995). But how do the clustered firms transform the obtained knowledge into their own knowledge assets and performance? And, how do they contribute to the evolution of the cluster? These questions concern the knowledge creating process of a cluster and its member firms. For the knowledge-creating process of an organization, Nonaka et al. (2000) proposed a unified model that conceptualised the activities of knowledge creation and integrated three elements: ba, knowledge conversion and knowledge assets. As far as an industrial cluster, spatial clustering functions significantly. Correspondingly, some scholars (Corno et al., 1999; Kostiainen, 2002; Nonaka and Takeuchi, 2006) analysed potential ba in a cluster, the functions of a cluster as different ba, and specific forms of some sample clusters' ba. On the one hand, these studies present the guidelines at a high level of generality. On the other hand, the number of studied objects---sample clusters, is still limited. Further, are there different features and functions in different clusters' ba? What is the connection between the ba of a cluster and the ba of different members? Based on the context of ba, how is the knowledge conversion of the clustered actors fulfilled? And, how do the knowledge assets of the cluster and the actors evolve? Namely, the knowledge-creating process of a cluster as a whole, has not been researched sufficiently.

Empirical research on this issue is particularly scarce, though some scattered achievements have concerned partial elements (for example, knowledge conversion) (Gregorio et al., 2008; Alsones et al., 2008).

Products from “shanzhai” have attracted an increasing amount of attention in recent years, particularly in relation to the production of cell phones. “Shanzhai” is a Cantonese word that refers to unlicensed workshops or small factories that are able to rapidly imitate famous-brand products to meet the needs of customers at middle or low ends of their various market. In the way they have evolved in recent years, and, their characteristic activity is imitating innovation. The cell phones coming out of “shanzhai” have progressed through three different stages: crude imitation, exact imitation, and functional improvement or external form innovation. In 2007, the sales of cell phones coming out of “shanzhai” had surpassed 20 millions in China, and a growing number of them were exported to southeast Asia, Africa and other regions (The Fifth Electronics Institute in Guangzhou, 2009, the investigating report about the “shanzhai” phenomenon in the electronic industry). The advances in knowledge productivity and sales seem surprising.

There is a need for theoretical explanations for the success of shanzhaied producers, while the cluster of shanzhaied cell phone producers constitutes a sample for probing the knowledge creating process of a cluster. This paper provided an exploratory case study of the industrial cluster of shanzhaied cell phone producers that was consistent with the basic knowledge creation model of Nonaka. This paper aimed at probing the knowledge-creating process of a cluster as a whole to propose a model for it, and to bridge the gap of existing literature or to find directions for further research. Also the paper tried to provide practical implications for relevant managers of clusters.

The structure of the remainder of the paper is as follows: The basic knowledge creation model of Nonaka was presented in the immediately following area, followed by the research methods. Next, the management process in shanzhaied cell phone producers and corresponding elements of the knowledge-creating process of the industrial cluster were analysed, and a cycling model of knowledge radiation and evolvement was proposed. Related leadership features and efficiency in the cluster were also discussed. The final aspect provided a discussion and conclusions.

THE BASIC MODEL OF KNOWLEDGE CREATION

The basic model of the knowledge-creating process was proposed by Nonaka et al. (2000). This model consists of three elements: (i) the SECI process; (ii) ba; and (iii) knowledge assets.

(i) The SECI (namely, socialisation, externalisation, combination and internalisation) process involves the process of knowledge conversion from tacit to explicit knowledge. The first term, socialisation, deals with the conversion of new tacit knowledge through shared experiences. In this process, skills, mental models, mutual trust and world views can be created and shared. Externalisation refers to the articulation of tacit knowledge into explicit knowledge. Externalisation involves the sequential use of metaphor, analogy and a model. Combination refers to the conversion of explicit knowledge into more complex and systematic units and may also involve the `breakdown' of concepts. Internalisation refers to the process whereby explicit knowledge is incorporated into an individual’s tacit knowledge and becomes a part of the individual’s repertoire of shared mental models or technical expertise. The movement through the four modes of knowledge conversion can be depicted in the form of a spiral which becomes larger in scale as it moves up through the ontological levels.

(ii) Ba is defined as a shared context in which knowledge is shared, created and utilised. Ba provides the energy, quality and location for individuals to perform the knowledge conversions and to move along the knowledge spiral. Ba is a concept that unifies physical space such as an office space, virtual space such as the internet, and mental space such as shared ideals. There are four types of ba (namely, originating ba, dialoguing ba, systemising ba and exercising ba which correspond to the four modes of knowledge conversion.

(iii) Knowledge assets are the inputs, outputs and moderating factors of the knowledge-creating process. Knowledge assets can be categorised into four types: experiential knowledge assets, conceptual knowledge assets, systemic knowledge assets and routine knowledge assets. All the three elements of the model are illustrated as shown in Figure 1.

In summary, using its existing knowledge assets, an organisation creates new knowledge through the SECI process that takes place in ba. The knowledge created through this process subsequently becomes a part of the knowledge assets of the organisation, which in turn becomes the basis for a new spiral of knowledge creation.

To lead the knowledge creating process, top and middle managers should provide the knowledge vision, develop and promote sharing of knowledge assets, and create and energise ba to enable and promote the continuous spiral of knowledge creation. To energise ba and give energy and quality to the SECI process, knowledge producers must supply the necessary conditions, such as autonomy, creative chaos, redundancy, and requisite variety. Love, care, trust and commitment are also necessary. The unified model

provides a base and a starting point for exploring the knowledge creation model inside an industrial cluster.

RESEARCH METHODS

Case study

The overall research objectives of this study were not only to develop a conceptual model of knowledge creation inside an industrial cluster but also to establish an empirical foundation for this understanding in accordance with ‘‘grounded theory’’ approach (Martin and Turner, 1986). Therefore, a case study approach was adopted because it is suitable for exploratory, theory-building research of this nature (Yin, 1994). The subject of case study was an industrial cluster of shanzhaied cell phone producers.

The numerous shanzhaied cell phone firms, part suppliers and other supporting businesses located in Huaqiang North Road in the Shenzhen City constituted a typical cluster. As of 2007, the cluster contained 140 shanzhaied cell phone firms, 36 design houses, 140 printed circuit board (PCB) developers, 50 external form and structure designers, and almost 300 factories for bluetooth equipments. In addition, there were many distributors, including approximately 250 national agents, more than 1260 provincial agents, 150 retailers, 100 supermarkets and 20 trading companies. There were also up to 150 logistics firms (The Fifth Electronics Institute in Guangzhou, 2009, the investigating report about the “shanzhai” phenomenon in the electronic industry). All types of shanzhaied cell phones were produced through the cooperation of all these firms. In addition, certain multinational companies that produced cell phones and certain domestic brand-name cell phone companies and producers of other electronic products (such as electronic books and learning machines), had a presence in this area. The producers of all of the products could draw on the abundant productivity of part suppliers in the Pearl River Delta. As a result of the collective efficiency attained by the firms operating in the cluster, the shanzhaied cell phone producers had attracted an increasing degree of attention both domestically and abroad.

Research questionnaire and data-collecting method

Some investigating reports and materials posted in websites (for example, an analysis on the status quo and the tendency of China's shanzhaied cell phone industry, 2009, http: // wenku.baidu.com/ view/ b930596648d7c1c708a14550.html) had described the basic features of shanzhaied operation. For example, the investigating report about the “shanzhai” phenomenon in the electronic industry from the Fifth Electronics Institute in Guangzhou (2009) had analysed the general process of the open development, main types of relative players, supporting context, the efficiency of shanzhaied operation and so on. Based on these description, the researcher interviewed some typical players to explore the knowledge conversion and corresponding knowledge assets’ evolvement, while confirming the operating process of shanzhaied cell phones, and field observing the interaction among different players and the corresponding context that included office buildings, cell phone stores and large markets for communication products and related paraphernalia in Huaqiang North Road in the Shenzhen City. In accordance with the basic model of knowledge creation proposed by Nonaka et al. (2000), interviewing, confirming and field observing aimed at exploring the knowledge creating process of the cluster as a whole.

Since the industrial cluster consisted of firms and supporting businesses located within the cluster, the interviewed subjects included both the cell phone producers and the supporting businesses. Universities, institutes or venture-capital firms etc. had not provided information or knowledge directly for shanzhaied cell phone producers. Thus, the research questions and the data collecting method adopted in this study were as follows (Table 1).

The organisations with representatives who were interviewed included 2 shanghaied cell phone firms, 1 core plate producer, 3 collective agencies, 2 part suppliers, and1 design house. Among the organisations listed above, the primary focus was on the shanzhaied cell phone firms. 2 interviewed firms had both launched several kinds of products successfully; Core plate producers were of the most knowledge-intensive part supplying industry. The interviewed core plate producer was a domestic company, and its market share ranked second; The collective agencies were bridges between individual firms and relevant governmental agencies, and they usually regulated the cooperative functions of individual firms. The interviewed collective agencies included the Mobile Communication Producers’ Union of in the Shenzhen City, the Cell Phone Industrial Association of in the Shenzhen City and a network organisation named sjoem.com; The design house was established to provide hardware structure solutions for both shanzhaied firms and normal ones. 2 part suppliers were partners of the interviewed shanzhaied cell phone firms. All of the informants were general managers in their respective organisations who were able to understand and interpret the industrial context and the management process of their organizations.

The open questions in the research questionnaire meant topics related to knowledge conversion and evolvement of knowledge assets. In interviewing, anything relevant to the analysis focus could be talked about in real time. Data collection was conducted between July and December of 2009 but primarily in July and August.

CASE ANALYSIS AND FINDINGS

The operating process of shanzhaied cell phone producers and their knowledge conversion

The operations of shanzhaied cell phone producers involved several core issues: product identification, core plate design, hardware structure design, software design supporting the functions of the cell phone, externals design, purchase of components and parts or management of outsourcing arrangements, and project control. Except in the case of Nokia, where the operation was subjected to vertical integration, all of the shanzhaied firms operated openly in a way that drew on the specialized competencies of supporting organisations in the area. MediaTek from Taiwan offered the shanzhaied cell phone firms turn-key solutions including silicon chips and related software. The solutions defined all types of functions to be chosen. Design houses decided the styles, sizes and forms of all kinds of parts, including circles of PCB, or integrated sets of PCB and related parts. These designers also designed specific operational software to satisfy the preferences of specific customers. Industrial designers offered solutions related to the externals of the phones. Shanzhaied cell phone firms were mainly in charge of product identification and project management, and were responsible for integrating different parts and solutions. Agents of electronic products in various regions distributed the cell phones to different domestic and foreign markets (The Fifth Electronics

Table 1. Interviewed entities and research questionnaire.

Interviewed entities	Research questionnaire	Focus of analysis
2 Shanzhaied firms	What is the operating process of shanzhaied cell phones? How does your firm select various types of suppliers or partners?	Basic structure of SECI, knowledge communication and change of knowledge assets
1 Producer of core plate	Can you explain the basic change of the core plate market and the choice of your firm?	
3 Collective agencies	What are your existing services? How were the services established? What are the objectives in the near future?	
2 Part suppliers	What about the knowledge communication between the suppliers and the purchasing companies? Have the cooperation with the shanzhaied cell phone firms increased your knowledge?	
1 Design house	What is the co-operating course between design houses and shanzhaied cell phone firms? With the development of shanzhaied cell phones, how have you improved your solutions, skills or technologies?	

Institute in Guangzhou, 2009, the investigating report about the “shanzhai” phenomenon in the electronic industry).

The operations of shanzhaied firms typically progressed through 4 steps as follows. The first step involved forming a new cell phone concept; The second step involved the selection of designers who would decide on the PCB, the hardware structure and the externals; The third step involved making moulding and selecting part suppliers; and The fourth step involved assembly of the cell phones. The operations were clearly dominated by the knowledge conversion process as would be explained.

At the first step, representatives of the firms integrated all the knowledge from diverse sources by roaming sale plazas or exhibition halls and communicating in many ways with partners, customers, suppliers and peers. This communication might be face to face, or it might be through reading periodicals about the industry and probing the expertise embodied in existing products through reverse engineering.

Many stores of communication products, sale plazas of relevant electronic products, and office buildings of shanzhaied cell phone producers gathered along Huaqiang North Road. Thus the shanzhaied cell phone producers could conveniently observe and probe all kinds of relevant products and parts, such as branded cell phones, shanzhaied cell phones, learning machines, key-boards, screens, etc. Usually there were several relevant exhibitions in a year, which could show the managers all kinds of new products and new technologies. Obviously this kind of observation and communication constituted the departure point of reverse engineering. A manager of a shanzhaied firm said about a kind of cell phone which could play music wonderfully, “I cracked the know-how and re-used it here, and the sale of the cell phone is very good.”

Regarding face to face communication, the interviewing and the field observing of the researcher manifested that there were frequent and far-reaching communication between the managers of shanzhaied firms and suppliers not only in the office buildings but also at the meetings in leisure time. In fact, the interviewing for 2 part suppliers was completed just in the offices of the integrating firms of shanzhaied cell phones.

Apart from aforementioned sources, several perio-dicals, such as “communication world”, “communication information” and, “digital network information”, could freely provide plenty of industrial information.

It was just through the direct or indirect communication above with various players within the region that the shanzhaied cell phone producers finished the socialisation of knowledge. Next, these producers integrated all kinds of obtained knowledge and information to conceive new cell phones. When the managers of the producers discussed about the concepts with colleagues, trusted friends or partners, improved them by rethinking (self-transcending) and articulated them, the externalisation of knowledge was fulfilled. The explicit concepts of new cell phones were the outcome of this socialisation and externalisation process.

At the second and third steps, part suppliers, design houses and externals designers entered into discussion with representatives of the integrating firms. Together, they broke down the new cell phone concepts and then two kinds of knowledge combination emerged. The first

one was the suppliers and the designers combined the needs of the new concepts with their existing explicit knowledge to devise new solutions. The second one was the shanzhaied cell phone producers (namely, the integrating firms of shanzhaied cell phones) integrated the solutions from different suppliers and designers to make sure the new cell phone could launch successfully. When the suppliers and the designers put the new solutions into practice, their employees must internalise the necessary new skills or new know-how. Internalization of knowledge was thus completed inside the suppliers or designers. Conversely, it was sometimes possible to simply use existing solutions if they were already sufficient. In these cases the combination and internalization of knowledge might not come into play. For shanzhaied cell phones, many parts were enjoying mature manufacturing processes, but designs of hardware structure and externals needed ever-lasting improvement.

Ba where shanzhaied cell phone producers thrived

As Nonaka et al. (2000) explained, Ba unifies physical space, virtual space and mental space. Support for this point could be inferred from the empirical data obtained from the cluster of shanzhaied cell phone producers.

Regarding physical space

Many integrating firms of shanzhaied cell phones, surrounded by their agents and industrial designers, clustered together in Huaqiang North Road in the Shenzhen City. This geographical proximity facilitated mutual communication and enlightenment among different players. MediaTek, several multinational companies and domestic-brand cell phone firms, many design houses and several public agencies relating to the industry were all located in the neighbouring area. These firms were also surrounded by many producers of electronic parts and components, such as computer screens, keyboards, microphones, bluetooth equipments, batteries, cameras, casing and so forth, which were also located in the Pearl River Delta.

Without leaving that district, core plate producers, design houses, externals designers and many kinds of part suppliers could all find their customers. The public agencies were also able to observe and communicate with different players, to perceive their common needs, and to take steps to improve their own services further. Regulation of the industry by government agencies was thus concentrated in that area.

Regarding virtual space

SJOEM.COM offered an electronic platform that all kinds of players in the cell phone industry could use to communicate and transact business. As of 2009, more than 2000 firms had registered with that company. In addition to that electronic platform, several periodicals, such as “digital network information”, “communication world”, “communication information” and “communication resources”, also functioned as virtual channels to share information or knowledge.

Regarding mental space

A number of the common values or the mental models held by the relevant players in the cell phone industry could be inferred from their habitual behaviour or by the interactions among individuals. The following is a few common expressions of this mental model:

1) Time meant money, and efficiency meant life. This slogan originated in the Shenzhen City in 1980s. Its essence had rooted in the behavior habit of people there. Their quick rhythm of talk and behavior showed the extreme importance of efficiency for them. An interviewed manager said, “Now, my workload in two months almost equals to all the workload in one year in inland cities”.

2) It was not necessary to abide by the existing systems and regulations. For example, these companies avoided the official inspecting procedure, which took up too much time, and they side-stepped a government regulation specifying a threshold for entering the industry. This managerial style might seem abnormal, but it was precisely this kind of abnormality that facilitated the surprising innovation.

3) An intention to innovate and the one to absorb knowledge from all sources were both important. The integrating firms were manifestly sensitive to knowledge from all the relevant players, regardless of whether it was explicit or tacit. This interest in innovation and new knowledge created demand for the training market that sprang up in the Shenzhen City. The training covered many fields, such as new tendencies in industrial design, all kinds of new management methods, physical and psychological health, and education for children at home. “There are too many training courses to be chosen. I have chosen the studies of Chinese ancient civilization.” A purchase manager said. “The lectures deepened our understanding for many phenomena”, a bottom manager stated. Meanwhile, the new cell phone concepts of shanzhaied firms came from integrating their own insights regarding the demand of specific customers with their understanding of information from external sources regarding relevant technologies and know-how. Only the innovation could be accepted by the market with specific functions and styles which met the specific customer requirements.

4) Informal communication and trust were especially important. On the one hand, the managers of shanzhaied firms were not willing to communicate with the persons outside their own “inner circles” because they felt a need to safeguard themselves against burdensome super-vision by government agencies and against fierce competition. On the other hand, to survive in the challenging industrial environment, the managers needed to be able to discuss the issues they were facing with trusted partners, peers or friends. When the researcher tried to interview some managers, the managers avoided the interviewing because the researcher is not of their “inner circles”. Through confidential connection, some managers accepted interviewing, but their friends reminded them of safeguarding themselves. “Now and then, some officers from governmental departments come into the office buildings to investigate or punish some firms. So all the managers have to be careful at any time.” A manager said.

5) In general, all of the relevant players were able to understand and to accept to some extent the abnormal management of shanzhaied firms. The government agencies, relevant multinationals and domestic-brand cell phone producers all appreciated the need to imitate innovation to satisfy customers at the middle and low ends of the markets, and they considered the imitation innovations to be a necessary stage for growing firms.

As Kanazawa (2000), (the empirical study on ba for knowledge creation- case study of company-N business communication headquarters, NTT Communications Corporation, http://iceb.nccu.edu.tw/proceedings) stated, "the office itself is not ba. Ba will be created when a person re-defines the designed office actively and in situation through the interaction with it." The above physical space itself was not ba. Ba was created when the shanzhaied firms and relative players re-defined the space and in situation through the interaction with it. The common values and mental model gave all the players common behavioural rules, and Internet and periodicals were instruments for interaction. Just through all kinds of interaction, different types of ba were created in the cluster.

Regarding ba of each of shanzhaied cell phone producers. In the light of aforementioned SECI of shanzhaied operation, originating ba formed in the interaction between the integrating firms of shanzhaied cell phones and the relative players; dialoguing ba existed in the interaction between the managers of the integrating firms and the limited players including relative colleagues, trusted friends or partners etc; Systemising ba existed in the interaction between the integrating firms and the suppliers or the designers, also inside the suppliers or the designers; and the corresponding exercising ba existed inside the suppliers and the designers.

Regarding ba of the cluster as a whole. In terms of physical space, the originating ba, the dialoguing ba and the systemising ba, were all located in Hauling North Road and its neighbouring area, whereas the exercising ba was located in the manufacturing bases in the Pearl River Delta. The exercising ba was similar to the one in Ishikawa Prefecture (Corno et al., 1999), which enjoyed "superior process management and planning capability-involving explicit knowledge through combination and internalisation", and poor“softer” skills – more directly linked to socialisation and externalisation".

Apart from a large quantity of shanzhaied cell phone producers, other players obviously could utilise the public context to form their own new concepts. For example, core plate producers could conceive new plate ones, and public service agencies could design new service projects. In fact, they did as described in 4.3. Therefore, there was public originating ba for different relative players, just where the indirect and direct interaction among different players were completed as described in 4.1. The public originating ba was similar to the ba in the Silicon Valley discussed by Nonaka and Takeuchi (2006) which involved public language, culture, values and physical space, as well as a specific industry or a region.

Totally, every player integrated its dialoguing ba, systemising ba and exercising ba into its own project ba. Thus, the public originating ba and different project bas constituted the industrial ba. So the interaction among all the relative players formed "ba across different ontological dimensions" (Brannback, 2003).

About the specific forms of different ba, we could list as follows based on the aforementioned analysis and the field observation of the researcher.

The forms were different from "the potential ba in the development network of an urban region" (Kostiainen, 2002). They were less various and less organised. Also, information technology was less incorporated into them. After all, shanzhaied cell phone was an emerging phenomenon (Table 2).

The evolution of knowledge assets in shanzhaied operation

There is no doubt that the millions of shanzhaied cell phones sold domestically and abroad were an outcome of knowledge from all of the relevant firms. Other knowledge assets of different players also developed tremendously, as would be described.

Shanzhaied firms

The managers of shanzhaied firms were usually investors in different industries before they entered the cell phone industry. By the knowledge conversion process described earlier, they launched the products of various styles of

Table 2. The specific forms of different ba.

Originating ba	Wandering about Communication in offices; Forums Reverse engineering Knowledge sharing in exhibitions Informal meeting Public lecturing
Dialoguing ba	Communication in offices informal meetings
Systemising ba	Discussing about different solutions
Exercising ba	Learning by doing

shanzhaied cell phones for distribution in the domestic and foreign markets. By observing the success and failure of different cell phone projects in recent years, they were able to understand the advantages (that is, high efficiency) and disadvantages (that is, vicious competition, difficulty in accumulating core competencies) of shanzhaied management. Managers became increasingly aware of the importance of deeper innovation and normal management. Thus, many shanzhaied firms obtained licenses, and certain managers initiated countermeasures to offset the disadvantages of traditional shanzhaied management. So their knowledge about the industry's developing trend, knowledge about mobile phone product and knowledge about management of shanzhaied firms ever-lastingly evolved over time.

Suppliers of core plates

With the development of telecommunication technology, MediaTek, Huawei Hisilicon Co. and Shanghai Spreadtrum Co. all managed to develop intelligent core plates for shanzhaied cell phones. This new technology promised to promote new generations of shanzhaied cell phones as the functions of the phones were mainly embodied in core plates.

The collective agencies

SJOEM.COM provided an electronic platform for all the suppliers and shanzhaied firms to enable them to communicate and complete transactions. The Union of Mobile Telecommunications Producers had also been improving the services for its members and organised a channel for industrial investment in India.

Suppliers of different parts

Though the interviewed managers of two suppliers did not perceive exchange and increase of knowledge, another manager from a shanzhaied cell phone firm said, "to counteract the grim competition among shanzhaied firms, managers have become increasingly stringent in their selection of suppliers. Their demands for both lower cost and better quality will necessarily force the suppliers to improve their technical processes and management continuously."

Knowledge suppliers

Dialogue and cooperation with ever-changing shanzhaied firms made it necessary for PCB designers and designers of hardware structure and externals to improve or innovate in their solutions and designing process. In this way, they could increase the accumulation of their knowledge base. "Competition has made the relevant software more sophisticated and friendlier to users. While cell phones get thinner and thinner, also cheaper and cheaper, integration of different functions must get more intensive. So all the relevant integrated circles have to evolve with the need." A manager of a design house said.

In general, the operation of the shanzhaied cell phone businesses provided experiential knowledge assets, such as basic managerial skills, trust among partners and insights into trends in the industry, to all of the players. Based on these experiential knowledge assets, the players could form their own concepts, such as concepts for new cell phones, new core plates, new technical processes, and new services. These concepts were the outcome of conceptual knowledge assets. Once the concepts were put into practice, systemic and routine knowledge assets were formed in the relevant players. As a result, the players might be able, for example, to devise new solutions by combining existing explicit knowledge, and to incorporate new business processes or expertise through the internalisation of new explicit knowledge. With the co-evolution of different players, public routine knowledge, such as new values or new standards for specific product functions that were accepted by many firms, could be cultivated. The different players and the knowledge assets that they could obtain are illustrated in Table 3.

Table 3. Different players and their obtained knowledge assets.

Players \ Knowledge assets	Experiential	Conceptual	Systemic	Routine	
Managers of Shanzhaied firms	Basic managerial skills, trust among partners and insights into trends in the industry, etc.	New cell phone concepts	Combined documents of different solutions	New skills	New values, new standards etc.
Suppliers of core plates		New core plate concepts	New designs and new manufacturing plans	New skills, new know-how or new business process	
The collective agencies		New service concepts	New service project plans	New skills of collective management	
Knowledge suppliers		New solution concepts	New solutions	New skills, know-how	

Among all the knowledge assets, systemic assets and routine assets must be paid more attention. As previous studies (Nanaka, 2000; Chou and He, 2004) showed, systemic assets means systematised and packaged explicit knowledge, such as product documents, specifications, manuals, database, patents and licenses. Usually, they are from combination of different explicit knowledge inside organisations. But in the current cluster, the systemic assets of shanzhaied cell phone producers exceptionally formed by combining the solutions of different partners. As of the routine assets, they existed in two levels, though they meant tacit knowledge routinely embedded in actions and practices as Nonaka et al. (2000) and subsequent scholars (Chou and He, 2004) stated. In the first level---different organisations, they were know-how in daily operations, organisational routines and organisational culture; In the second level---the cluster, they meant new skills for managing cooperating networks, new values or new product standards (for example, common views for new configuration of product functions) etc.

Integrating above three elements (SECI, ba and knowledge assets), we could depict the knowledge creating process of the cluster of shanzhaied cell phone producers as follows.

As Figure 2 showed, all kinds of knowledge in the originating ba were absorbed by different players; Next, the players finished their knowledge conversions and manufacturing of new products or new services; Then new knowledge assets returned into the originating ba with the new products or related individuals and became the knowledge sources of subsequent new knowledge creation. So we could call the process a cycling model of knowledge radiation and evolvement.

Although there were only four project bas in the Figure 2, a large quantities of project bas from different kinds of players, including shanzhaied cell phone producers, part suppliers, design houses, core plate producers, and collective agencies and so on, could constitute a continuum in fact. Every cycle could renew the knowledge assets in the originating ba from which every player only absorbed specific knowledge assets corresponding to its new product or new service.

About the leadership effects in the cluster

As stated by Nonaka et al. (2000), the role of top and middle managers as leaders involves providing a knowledge vision, creating and energising ba, and enabling and promoting the continuous knowledge creation process. In fact, there was a common knowledge vision to synthesise all kinds of knowledge that could be obtained among the shanzhaied firms to meet the needs of customers at middle and low ends of the markets. Precisely because of that vision, the relevant technologies, skills, expertise and information to produce different kinds of cell phones were rapidly spread and shared among the firms; However the vision and the spread and share both came from the voluntary practice of the players, rather than from the specific governors of the cluster, since the existing collective agencies, such as the Industrial Association of Mobile Phones Producers or the Union of Mobile Telecommunications Producers, had never functioned as vision providers.

In regard to the physical space and mental space in the ba described earlier, one could assume that the general productivity levels in electronics firms in the Pearl River Delta and the specific values and behavioural habits that prevailed in the Shenzhen City had developed through several decades of experience under reform and an open economy. The conditions to energise the ba, as would be listed, also seemed sufficient. Every shanzhaied firm was an independent entity. The large number of cell phone firms, and electronic product firms and suppliers that were all agglomerating in the same area offered sufficient information regarding various issues. Diverse experiences in innovation and a widespread practice among

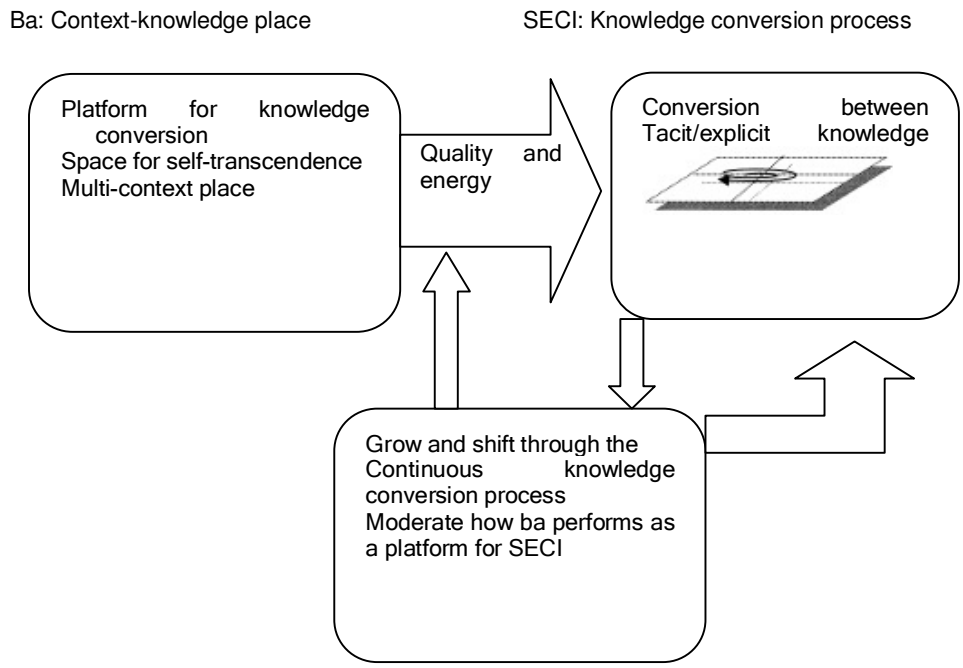

Figure 1. Three elements of the knowledge-creating process.

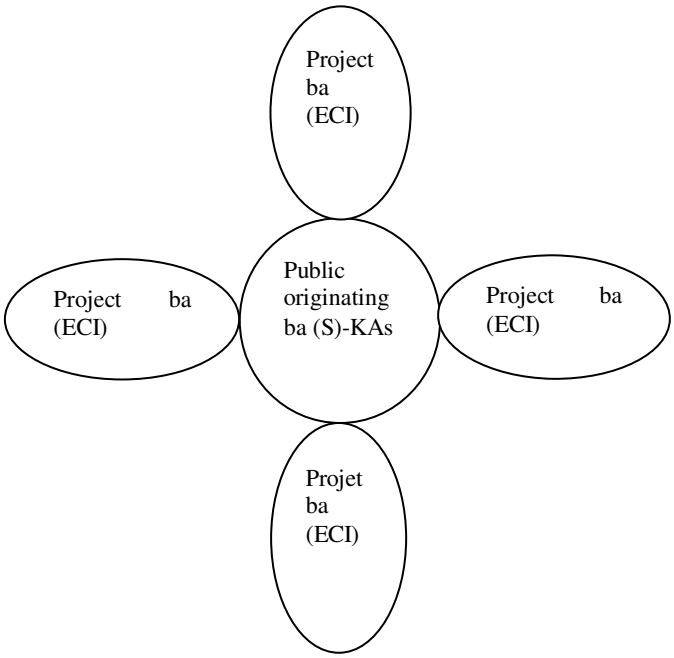

Figure 2. The knowledge-creating process of the cluster of shanzhaied cell phone producers.

shanzhaied firms to side-step the official regulations or procedures had resulted in a chaotic context.

It was fair to conclude that the requirements for strategic intent, autonomy, creative chaos, information redundancy and requisite variety were all adequately satisfied. Conversely, there were no concrete governors of the industry working as leaders. The satisfaction seemed to be the result of self-organizing of the industrial

cluster.

In this study, the role of the relevant government agencies must be mentioned. Certain regulations stimulated the development of shanzhaied cell phones. For example, to be official a company must have registered capital amounting to more than 200 million, and inspection of a cell phone took from one to three months and cost more than 200 thousand RMB. These regulations became the obstacles that shanzhaied firms had to circumvent (the Fifth Electronics Institute in Guangzhou, 2009, the investigating report about the "shanzhai" phenomenon in the electronic industry). But the criterion of infringement set by the government was an important guide for shanzhaied firms to design cell phones. The interviewed managers of shanzhaied firms were familiar with the criterion. The prosperity of shanzhaied cell phone firms was completely unexpected by the relevant government agencies.

The efficiency of shanzhaied operations

Generally, shanzhaied operations were much more efficient than the ones of the brand-name cell phone companies, which were vertically-integrated . 1) A kind of shanzhaied cell phone project, from project positioning to assembly, could be completed in 40 days, but for brand-name cell phone companies with vertically-integrated operations, it usually took 90 to 100 days to reach the same level; 2) Shanzhaied cell phones launched into the markets had increased greatly in the Shenzhen City. As of August in 2009, the number had reached 30 million every month. Of that total, 15 million cell phones were exported to the countries in ASEAN, East African, North African and the Middle East (The Union of Mobile Telecommunications Producers in the Shenzhen City, 2009,personal communication).

DISCUSSION AND CONCLUSIONS

While division and exchange of knowledge is considered to promote the formation and competence of industrial clusters (Bell and Albu, 1999; Morosini, 2004; Hakanson, 2005; Boschma and Anne, 2007; Pinch et al., 2003; Bathelt et al., 2004; Maskell, 2001), many scholars have probed the knowledge-creating process of industrial clusters from different perspectives, especially the study about ba has made some achievements. Corno et al. (1999) think industrial clusters can function as originating ba, dialoguing ba, systemizing ba and exercising ba, but different industrial districts have different advantageous ba; the specific forms of all kinds of ba are also different across different industrial clusters or across different ontological dimensions (Kostiainen, 2002; Brannback, 2003). But little literature has concerned the complete knowledge-creating process of an industrial cluster. The current study tried to explore the issue.

Through exploratory case study, the study examined the knowledge conversion, the structure and forms of ba, and the knowledge asset evolvement of different players in the industrial cluster of shanzhaied cell phone producers. Then it proposed a cycling model of knowledge radiation and evolvement in an industrial cluster. In the model, Huaqiang North Road and its neighboring areas was the public originating ba of the cluster to socialise all kinds of tacit knowledge, thus it became the source of knowledge radiation of the cluster. Based on it, different players could select different partners to interact with, and construct different project ba to finish their own knowledge conversion. Next, they could offer new products or services embodying the outcome of knowledge conversion------new knowledge assets which returned into the originating ba constituting the knowledge sources of new knowledge creation. With the cycles, the knowledge assets of different players were richened, and the ones of the cluster as a whole could also evolve ever-lasting, such as common values, public routines, etc. At the same time, the growing public services were a part of the knowledge assets for the whole cluster.

Because the knowledge from the public originating ba could be simultaneously distributed to many different players, innovation utilising existing knowledge can be efficient so that the performance of the cluster were surprising. This provided a supporting evidence inside a cluster for the findings by Li et al. (2009) about the positive effect of knowledge-creating processes on the performance of an organization.

The cycling model of knowledge radiation and evolvement had several implications for management. Attention to the model could help the government learn how to upgrade the public ba and relevant knowledge assets within an industrial cluster. For example, the government could advocate initiatives to improve public information utilities in order to facilitate knowledge combination of different firms inside the cluster. As the mobile phone industry became more technology-intensive, more specialised databases or knowledge bases were needed for knowledge combination, but it was difficult for such public information facilities to be established by the increasingly important middle or small-sized firms (Philippe and Denise, 2008). With the help of relevant experts, the government departments could also forecast trends in the industry and subsequently disseminate their own intentions in regard to relevant policies to promote a common knowledge vision (Tuomo et al., 2005). Still these departments could improve the specific forms of different kinds of ba to facilitate self-transcending of different players (Alexander and Birgit, 2010; Tuomo et al., 2005). For example, relevant departments could organise industrial forums to discuss different problems, and coordinate the policies of different countries in the fields of international trade and

investment. To lead the shanzhaied firms effectively, informal leading should be combined with formal controlling measures, such as punishment for infringement of intellectual property rights. For this purpose, the collective agencies might be able to exert influence through informal leading initiatives in the role of quasi-leaders.

However, the study had some limitations. The interviewees were drawn primarily from shanzhaied firms and the relevant players. The most important characteristics of the firms examined in the study related to their success in imitating innovation based on the 2G or 2.5G telecommunication technology.

To improve the effectiveness of the model further, the sample firms that are studied should be expanded widely to include producers of branded products or more innovative firms. Longitudinal comparative research in a different technological context will also be helpful, which will become possible in the coming years with the tendency of shanzhaied operation of intelligent mobile phones based on some operating systems, such as android or window moble etc. (He, 2012, Shanzhaied operation of the intelligent cell phone is coming into play. http://tech.cnr.cn/list/201206/t20120615_509919673.shtml) Empirical studies of clusters in other industries are also needed.

ACKNOWLEDGMENTS

The author would like to express her deep gratitude to all of the executives and managers of companies and collective agencies who participated in the interviews. Also the author wants to acknowledge the financial support from the Shanghai Committee of Science and Technology and to thank her mentor, Professor Liu Yuanzhang for her guidance. Finally, the author appreciates the valuable comments and suggestions she received from two reviewers and several of my colleagues and students.

REFERENCES

Alexander K, Birgit F (2010). Creating a ba for generating self-transcending knowledge. J. Knowl. Manag. 14:928-942.

Alsones B, Lilia MV, Pierre F (2008). Knowledge creation in small-firm network. J. Knowl. Manag. 12:94-106.

Bathelt H, Malmberg A, Maskell P (2004). Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation. Prog. Hum. Geogr. 28(1):31-56.

Bell M, Albu M (1999). Knowledge systems and technological dynamism in industrial clusters in developing countries. World Dev. 27(9):1715-1734.

Brannback M (2003). R and D collaboration: role of Ba in knowledge-creating networks. Knowl. Manag. Res. Pract. 1:28-38.

Boschma RA, Anne LJTW (2007). Knowledge networks and innovative performance in an industrial district: The case of a footwear district in the south of Italy. Ind. Innov. 14(2):177-199.

Chou SW, He MY (2004). Facilitating knowledge creation by knowledge assets, Proceeding. 37th Hawaii Int. Conf. Syst. Sci. pp.1-10.

Corno F, Reinmoeller P, Nonaka I (1999). Knowledge creation within industrial systems. J. Manag. Gov. 3:379-394 .

Gertler MS (1995). 'Being there': proximity, organization and culture in the development and adoption of advanced manufacturing technologies. J. Econ. Geogr. 71:1-26.

Gregorio M-de-C, Pedro LS, Jose ENL (2008). Processes of knowledge creation in knowledge-intensive firms: Empirical evidence from Boston's Route 128 and Spain. Technovation 28:222-230.

Hakanson L (2005). Epistemic communities and cluster dynamics: on the role of knowledge in industrial districts. Ind. Innov. 12(4):433-463.

Kanazawa S(2000). An Empirical Study of Ba for Knowledge Creation: A Case Study Study of NTT East's Business Communications Headquarters. Master's Thesis, Graduate School of Knowledge Science, Japan Advanced Institute of Science and Technology.

Kostiainen J (2002). Learning and the'ba' in the development network of an urban region. Eur. Plann. Stud. 10(5):613-631.

Li YH, Huang JW, Tsai MT (2009). Entrepreneurial orientation and firm performance: The role of knowledge creation process. Ind. Mark. Manag. 38:440-449.

Marshall A (1927). Industry and trade: a study of industrial technique and business organization; and their influences on the conditions of various classes and nations (third edition). London: Macmillan.

Martin PY, Turner BA (1986). Grounded theory and organizational research. J. Appl. Behav. Sci. 22:141-157.

Maskell P (2001). Towards a Knowledge-based Theory of the Geographical Cluster. Ind. Corp. Chang. 10(4):921-943.

Morosini P (2004).Industrial clusters, knowledge integration and performance. World Dev. 32(2):305-326.

Nonaka I, Takeuchi H (2006). The Spiral of knowledge creation---theory and cases, Beijing：The press of intellectual property rights.

Nonaka I, Toyama R, Konno N (2000). SECI, Ba and Leadership: a Unified Model of Dynamic Knowledge Creation. Long Range Plann. 33:5-34.

Philippe B, Denise JL (2008). Knowledge domains and knowledge conversion: an empirical investigation. J. Knowl. Manag. 12:67-78.

Pinch S, Henry N, Jenkins M, Tallmen S (2003). From 'industrial districts' to 'knowledge clusters': a model of knowledge dissemination and competitive advantage in industrial agglomerations. J. Econ. Geogr. 3(4):373-388.

Tuomo U, Helina M, Vesa H (2005). Incorporating futures research into regional knowledge creation and management. Futures 37:849-866.

Yin RK (1994). Case Study Research: Design and Methods, Sage, Thousand Oaks, CA.