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The role of local innovation capacity in the emergence of a SME-based medical device industry Cluster: an experience in Taiwan

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The role of local innovation capacity in the emergence of a SME-based medical device industry cluster in STP : An experience in Taiwan

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Summary

With an aim to enhance innovation capability of a new established Science Park, The Southern Taiwan Science Park (STSP) Administration has tried a novel method of promotion. The purpose of this paper is to introduce a model whose mechanism is an interaction among government, academy, research institute, health-care institute, and industry. Representing an integration of local innovation capacity, the model could explain how the role of local innovation capacity could play in the emergence of a new industry cluster. The concept of the model came from the experience in promoting the Medical Device Special Zone, located at Kaohsiung Science Park in Taiwan. The decision-making process of STSP Administration is also described in this paper. The authors hopes the new model may inspire our counterpart some innovative idea and thus enriching the missions of Science Park.

Keywords:

Local Innovation Capacity, Medical Device Special Zone, Kaohsiung Science Park, Southern Taiwan Science Park, Medical Device Industry

1. Introduction

The contribution of Science Park to the development of high-tech industries and regional economy in Taiwan has been widely acknowledged (Liu et. al, 1998; Lai and Shyu, 2005; Chen et. al, 2006). Hsinchu Science Park (HSP), located at the northern part of Taiwan, is the first science park established in Taiwan and has already achieved remarkable worldwide reputation for its semiconductor and computer industry clusters. Encouraged by the successful experience and to balance regional development, the second science park Tainan Science Park (TSP), located at the southern part of Taiwan, was established in 1993 and rapidly renowned for its semiconductor, photo-electronic and biotechnology industry clusters. However, demand for more industrial land continued to increase. In response to the demand, the Taiwan government decided to expand the scope of TSP to more southern part of Taiwan and thus the Lujhu Science Park, renamed as the Kaohsiung Science Park (KSP) later, was established in 2001. In the same time, Science Park seemed to be booming all over the world and competition from other science park is increasing. Being the administrative institute of TSP and KSP, Southern Taiwan Science Park (STSP) Administration was pondering what added-value that KSP may offer to outperform other Science Park and attract investment.

In an era of rapid changing in technology and growing tendency of globalization, the STSP Administration realized that innovation capability of firms in Science Park is key to sustain competitiveness in the twenty-first century. In addition, a new type of competition seems to occur, that is competition between regional clusters (Carrie, 2000). Incorporating the trend and referring to literature related to the experience of developing industry cluster or science park all over the world (Dohse, 2007; Geenhuizen and Reyes-Gonzalez, 2007; Trippl and Tödtling, 2007; Bernstein and Singh, 2006; Fennelly and Cormican, 2006; Adeoti and Adeoti, 2005; Nosella et al., 2005), the STSP Administration asserted that KSP is not merely an extension of TSP but a new generation of science park with its own unique attributes. To achieve this vision, a more intensive relationship among government, local innovation capacity and industry shall be built. Hence, how to inject local innovation capacity into KSP became a strategy issue that STSP Administration has to put into practice. The Medical Device Special Zone Project, triggered in 2005, was a touchstone for STSP Administration to realize its strategy.

As a result of nearly three year's effort, the STSP Administration found a solution to solve the aforementioned problem during the executing period of the Project. The solution is a sophisticated process, which has been integrated as a practical model, of organizing local capacity into a platform. The purpose of this paper is to introduce this new model and explain how it works in the emergence of a new industry cluster without high-technology base; as well as how it transforms regional industry structure from traditional industry into high-technology industry.

This paper is organized as follows. Section 2 reviews the background of Medical Device Special

Zone Project. Section 3 describes the difficulty in promoting KSP. The model and its elaboration are placed in section 4. Two cases to illustrate the mechanism of the proposed model are described in Section 5. The conclusions are presented in Section 6.

2. An Overview of Medical Device Special Zone Project

Medical device industry is a branch of biotechnology industry by definition. Since the Taiwan government has identified biotechnology industry as a star industry of the 21st century, a great deal of resources has been allocated to strength the competitiveness of Taiwan's biotechnology industry as well as medical device industry.

Medical devices industry in Taiwan have developed over forty years and the annual quantity of many products have entered the top three of the world ranking, such as electric scooter, ear thermometer, electronic sphygmomanometer, etc.. Currently there are 484 medical device manufacturers in Taiwan (ITIS, 2006). The advantages of medical industry in Taiwan include complete laws and regulations of medical devices, superior doctor techniques and hospital level, excellent quality management and logistics capabilities, high technology base, like ICT, advanced materials, precision processing and mold & die technologies. These facts indicate that medical devices industry in Taiwan has quite sound industrial basis and global competitiveness. Taiwan is, therefore, very suitable to develop the medical devices industry.

KSP has an excellent geographical location surrounded by abundant research resources including three teaching hospitals and a medical center, namely Chung-Ho Memorial Hospital, E-DA Hospital, College of Medicine National Cheng Kung University and Chi Mei Hospital, ten public and private universities or colleges, such as National Cheng Kung University, Kaohsiung Medical University, and a non-profit research institute, Metal Industries Research and Development Centre (MIRDC). Besides, there are two industrial parks nearby to formulate a complete supply chain supporting KSP. Therefore, KSP is evaluated as a quite suitable base to develop medical device industry. By making an assessment according to the geographical strengths, characteristics of regional industry system and national technology policy, the STSP Administration came to a consensus that medical device industry is an appropriate industry to develop in KSP. An idea of "Medical Device Special Zone (MDSZ)" thus emerged. For further feasibility study, the STSP Administration decided to initiate Medical Device Special Zone Project (denoted as the Project in following text). With the purpose to induce local innovation capacity, the Project was subcontracted to MIRDC to execute.

Though the goals of the Project were to recruit investment, it was not met at the first year. A lot of unexpected difficulties frustrated the Project team. However, an achievement that the Project team was proud of is to establish a committee contains members coming from regional government, local academy, local health-care institute and local medical industry to promote MDSZ. This committee represents the possibility to integrate local innovation capacity.

3. Difficulty in Promoting Medical Device Special Zone of KSP

The difficulty was related to the characteristics of medical device manufacturers in Taiwan. According to the name list provided by Association of Taiwan Medical Device Industry and the Yearbook of Taiwan Medical Device Industry (2006) (IT IS, 2006), more than seventy percent of the medical device manufacturers in Taiwan are small and medium sized enterprises (SMEs) and more than ninety percent of them are not located at the southern part of Taiwan (See Table 1). Besides, most of them are confined to manufacturing low-risk classified as Class one product with little resources devoted to new product development. The characteristics of Taiwan's medical device industry limit the competitiveness of the industry and increase the difficulty in recruiting investment. Though many SMEs in this industry, other mature industry as well, are eager to upgrade product level by placing more emphasis on higher value-added activities, such as research and development (R&D) and innovative product development, they do not have enough resource nor advice about how to make the first move.

Table 1 The distribution of medical device manufacturers in Taiwan

Criteria	Percentage
Capital (in New Taiwan Dollar)	
> 1 Billion	3.9%
100 million 1 Billion	22.7%
From 50 million to 100 Million	12.0%
From 30 million to 50 Million	9.6%
From 10 million to 30 Million	24.1%
Less than 10 million	27.7%
Location	
Northern Taiwan	70%
Central Taiwan	18%
Southern Taiwan	11%

Note: Corporate with capital less than 80 million NT$ is defined as SME in Taiwan. The exchange rate of New Taiwan Dollar to US dollar is about 32 to 1.

Source: Association of Taiwan Medical Device Industry, 2006

To rescue these SMEs from the aforementioned dilemma and to attract them to cluster in MDSZ by meeting their needs, the STSP Administration and the Project team had outlined a "push strategy" to steer them to high-technology industry step by step.

The first step is to identify the potential investors. To further understand the problems of medical device manufacturers in Taiwan have encountered, the Project team had made a comprehensive investigation on the current manufacturers and distributors by means of interview and questionnaire. After analyzing the data collected from more than fifty samples, the Project team found that manufacturers equipped with the following characteristics are more likely to invest.

First, they are willing to develop toward high-risk classified products and have a strong will to stay in Taiwan.

Secondly, they are manufacturers of traditional industry with sufficient capital and also have a strong will to cross the boarder of medical devices industry.

Thirdly, they have geographical proximity to Southern Taiwan.

Fourthly, their value chain activities, like new product development and manufacturing, have strong reliance on local innovation capacity.

Once the targets have locked, the second step is to select the potential and proper products best fit the local innovation capacity as well as the regional industry system. Some considerations had led the Project team to make the choice in this step. A prior consideration is the opportunity and time for the product to be commercialized. The second consideration is the extent of connection for the product to the local R&D resources and regional industry system in technological aspect. Since most heavy industries are located in Southern Taiwan, metal and chemical related products, like dental and orthopedic implant, surgical instrument and precision medical devices, are suitable to produce in KSP. At last, the product must be high value-added, which means high-risk and classified as Class II or Class III product per Food and Drug Administration regulations, and hard to mimic. Consequently, the STSP Administration had selected dental and orthopedic product as the prior products to develop.

The third step is to make the linkage between local innovation capacity and firms which are potential to invest in Science Park. The key success factor of this step is the design an incentive that could push both sides to contact. Together with local government, research institute, universities and medical center, the STSP Administration searched the support from central government to devote additional budget to fulfill the strategy. A complementary project, namely “Project to Develop Dental Industry Cluster around Medical Device Special Zone of Kaohsiung Science Park”, was approved to develop high value dental product with an attendant requirement that final research results must be commercialized and transferable to private enterprise. This project was subcontracted to MIRDC again. As project leader, MIRDC was obliged to coordinate local innovation capacity and to work in collaborative ways.

The last step is to make sure the product prototype and process techniques are completely

transferred to the firms joining the project and assist the firms to enter Science Park. The above processes constitute the conceptual structure of the model in the following section.

4. The Model

Etzkowitz and Leydesdorff (2000) have proposed a Triple Helix Model of University-Industry-Government (See Figure 1). However, considering the characteristics of medical device industry in Taiwan and integrating the steps mentioned in the previous section, we have modified the model by adding public research institute and health-care institute and the result is a pentagonal innovation model as Figure 2 shown.

In this model, the importance of each entity is not equivalent and might adjust a little according to the product and capabilities of the firms. In the sphere is a brief description of the roles that each entity plays. The Government basically plays a role as policy maker, resource administrator and facilitator to trigger and support innovation process. The Government-funding-project is an incentive and positive driving force to start the cooperation among research institute, industry, academy, and health-care institute.

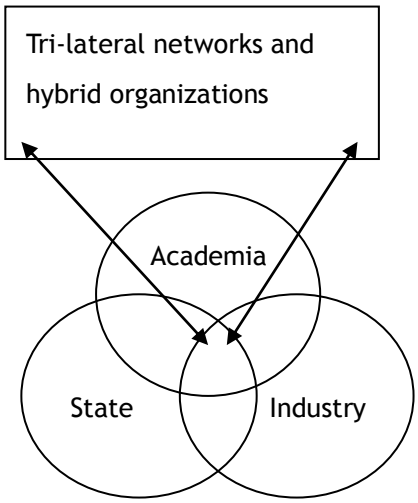
The research institute is the most important role in this model, which is responsible for the first three tasks in a typical new product development (NPD) process (See Figure 3). Academies, primarily universities in this model, are subcontractors of the firm as well as research institute. It is a little different from the cases that most papers had mentioned. The reason for this phenomenon is that the purpose of this program is to develop medical devices which could be commercialized as quickly as possible, which might contradict to the missions of universities. Therefore, academies act as auxiliaries in the model since they are good at researches of advanced technologies and have access to various specialists.

Private enterprises coming from medical device industries have participated in the project from the beginning but not for free. They are required to share part of the NPD budget and promise to invest in KSP. They received the techniques developed by research institute through joint R&D. Health-care institutes are invited to join the program because they could provide precious clinical information in the NPD process. Medical practitioners working in the health-care institutes are users of medical devices; and therefore their immediate feedback can help the engineers to improve the product at the early stage. Most important of all, their validation is an essential step of commercialization for medical devices.

As Figure 2 indicates, the intersection part of each sphere is a platform constructed by government, local universities, public research institute, heath-care institute, and private enterprises. The platform in the model possesses three functions. First, it provides a direct access to the local innovation capacity. Secondly, it builds a bridge for communication of each entity. Information and

knowledge from each entity will converge to the platform and could share with each other. In the process of knowledge sharing and learning, some new ideas to create more innovative products may originate. Therefore, it is also a seedbed of creativity. Thirdly, it is a virtual incubator of new business. Similar concept has been introduced in some literature; the platform is more realistic, however, as compared to the case of Taguspark. (Durão et. al., 2005). Government funding contributes a lot at the emerging stage of this platform. The platform shall find its own business model to search for financial support, mainly from private sectors, to keep on running eventually.

Figure 1. The Triple Helix Model of University-Industry-Government Relations



Source: Etzkowitz and Leydesdorff, 2000, The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university-industry-government relations, *Research Policy*, Vol. 29, p.111

Figure 2. The Pentagonal innovation model for a SME-based science park

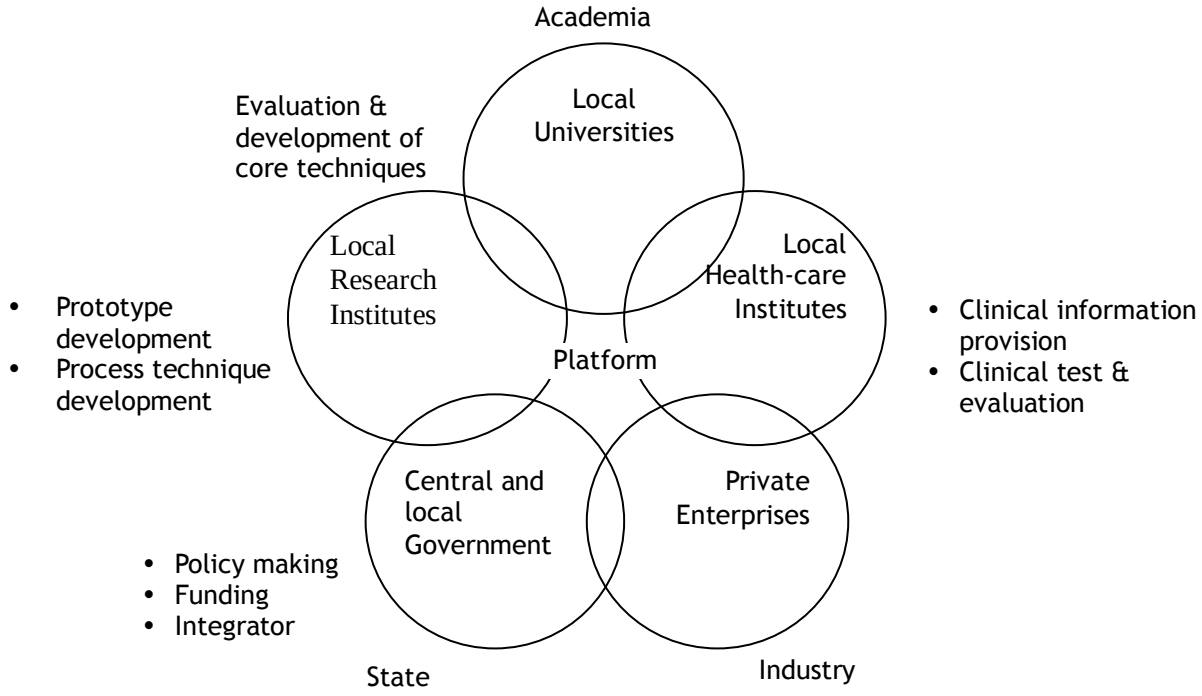
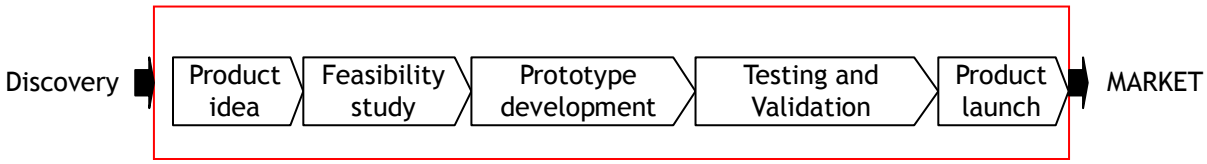


Figure 3. A typical new product development (NPD) management process



Source: Vuola and Hameri, Mutually benefiting joint innovation process between industry and big-science, *Technovation*, Vol. 26, 2006, p.5

5. The cases: tenant enterprises of Medical Device Special Zone

Two companies incubated by the model (for commercial confidentiality reason, the name of the company could not be revealed and denoted as Company A and Company B in this paper) have successful gained the entrance approval. The profile of these two companies is listed as Table 2 shows. Founded in 1982, Company A started from trading business of dental medical device and expanded its business scope to cover the development and manufacturing of dental instrument with own brand. The "Dental clinic technique evaluation and training simulation system" is an advanced product used to train future dentist and has great market potential all over the world. In spite the existing technology basis, Company A did not possess the core techniques, including spatial

positioning and simulation, necessary for developing the target product. However, through the introduction of platform, Company A joined the project and outsourced the research to local university. By joint R&D with local capacity, a prototype was successfully developed in less than one year. With no geography proximity to KSP, the boss of Company A had no intention to run another business at Southern Taiwan initially. Attracted by the mechanism of platform, the boss of Company A has decided to invest in KSP so as to maintain the linkage with local innovation capacity.

Unlike Company A, Company B is completely strange to medical device industry. The situation that Company B faced is severe competitiveness of current product from developing countries. Eager to search for a high value-added product, Company B approached the platform actively. Since the core technique of Company B is metal forming and machining, the platform suggested the company to join the dental implant developing project. This program covered the whole value chain activities, including design, manufacturing, surface treatment, testing, certification, packaging, logistics and marketing, necessary for launching a dental implant to the market. In this case, the platform played a role as incubator. After 120 hour's classroom training and practice lasting for about nine month, the engineers of Company B are capable of designing dental implant and the first product prototype has come to shape in less than one year. The management of Company B is quite satisfied with the service of local innovation capacity and is now preparing to enter science park aggressively.

Table 2. Profile of Case Company

	Company A	Company B
Capital (in US dollars)	650,000	5,900,000
Employee (persons)	41	140
R&D personnel (persons)	11	12
R&D Budget (in US dollars)	300,000	160,000
Main Product	Dental medical devices and instruments	Screw, bolt, nut
Location	Taipei (Northern Taiwan)	Kaohsiung (Southern Taiwan)
Business Model	Dental and medical devices and instruments trading and repair service	Original Equipment Manufacturer (OEM)
Target Product	Dental clinic technique evaluation and training simulation system	Dental implant

Source: This Study.

6. Conclusions

Confronting the challenge in the future, the STSP Administration has identified innovation capability as the core competitive element to outperform other Science Park all over the world and has adopted a revolutionary way to promote KSP. In this paper, we have disclosed the methodology to incorporate local innovation capacity so as to assist the SME-based medical device industry in Taiwan to reinforce its R&D capability and to upgrade its product level. The methodology has been integrated into a model. The model is elaborated in this paper and two successful cases are introduced to demonstrate how the model works. The experience of driving the model in Taiwan might not be universally applicable. Further study and more verification of this model might be needed as well. Nevertheless, the authors believe the model has suggested a different proposition that other Science Park authorities may refer to. Right now the MDSZ Project is still in progress while another complementary four-year project is about to launch in next year to strengthen local innovation capacity around MDSZ. There are still a lot of work to do for the STSP Administration in the coming years, such as securing the support of regional government and maintaining the connection to local innovation capacity. Anyway, the authors hopes the new model may inspire our counterpart some innovative idea and thus enriching the missions of Science Park.

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