Innovation Platform as the Tool to Shape the Environment for the Emergence of Flagship Firm - the Case of Medical Device Industry in Kaohsiung Science Park

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Abstract

The aim of this paper is to analyze how to incubate the flagship firm by innovation platform. Flagship firm is still an important driver in the formation of industrial cluster; however, it is not easy for the young science parks to attract them. Kaohsiung Science Park (KSP) as the second site managed by Southern Taiwan Science Park Administration (STSPA), was facing this situation before 2008. In order to solve this problem, the way of KSP is to construct an innovation environment to shape and strength their advantage in which the model of innovation platform is the important tool to realize this idea. The concept of this model is to provide a public space to integrate resources and knowledge, and to stimulate collaboration with different actors. Science parks administration cooperating with local research institute as a "gatekeeper" is the centre of this model. The gatekeeper should have the capacity with R&D capacity, transferring and diffusing different type of knowledge, and organizing social network. The design of innovation platform could be based on reducing negative externalities within the production chain. We think the model of innovation platform could be the practical tool to realize the triple helix idea.

Key words: Kaohsiung Science Park (KSP), Innovation Platform, Flagship Firm, Medical Device Industry

1. Introduction

Taiwan has been vigorous with building science parks since 1980s. Besides the successful experience in Hsinchu Science-Based Industrial Park (HSIP), Tainan Science Park (TSP), which was established northeast to Tainan City in 1997, expanded and renamed as Southern Taiwan Science Park (STSP) in 2003, already become an important high technology industrial district in Taiwan and one of the world-class TFT-LCD industrial clusters no more than 10 years. Based on our previous study, we found that CHIMEI, local flagship company in chemical products, cooperating with different actors, played an important role in the formation of industrial clusters.

Kaohsiung Science Park (KSP), the second site managed by Southern Taiwan Science Park Administration (STSPA), was still struggling of how to attract firms tenanting in the park due to the regional economic depression in southern region and threat of Central Taiwan Science Parks (CTSP) which cut off the firms migrating from northern region to southern region. Therefore, STSPA tried to apply the successful mechanism of formatting the TTF-cluster into the upgrading projects.

Medical Device (MD) industry is chosen under the trend for upgrading because it has the opportunities to combine different field's high-tech technologies with metal, precise machine, chemical, and plastic industry in which it has high reputation in manufacturing sector. However, it is failed in the early stage, and there are only 3 firms tenanted in 2009. After the policy of innovation platform with strategies to formalize flagship firm was proposed, there are 22 firms approved to enter in the KSP in 2010 in which there are 10 firms already tenanted and four of them are upgrading from traditional industries. How this transformation happen is still an unclear issue for the policy maker and urban planner.

Therefore, the aims of this paper are trying to use the KSP as the case to analyse why the past experience of TFT-LCD is not be applied and how the KSP can attract local industries and stimulate upgrading by innovation platform. In our finding, flagship firms are still the important driver for the formation of industrial clusters and the growth of firms in science parks. However, KSP is still at relatively young status; and then it is not easy for them to attract them. We think that the main task for a young science parks is how to construct an environment to attract it or even to shape it from existing firms in local area or related sectors. Therefore, innovation platform was developed by STSPA in 2009 as the tool and environment to integrate resources and knowledge, and to stimulate collaboration with different actors.

In the following passages, Section 2 will describe the important mechanisms for the formation of TFT-Clusters in TSP. Section 3 will analyse why the KSP want to develop the MD industry and why it failed in the early stage. Section 4 will construct the theory of how to shape the environment for the emergence of flagship firm. Section 5 will describe the design idea and function of innovation platform. Section 6 will analyse how the innovation platform could be worked to promote the formation of flagship firm in terms of institution operation, interaction among actors, and the flow of innovation resources. Section 7 concludes and summarizes the paper.

2. The important mechanisms for the formation of TFT-Clusters in TSP

The original industrial target for TSP was to develop three industries: microelectronics and precision machinery, semiconductors, and agricultural biotechnology; and they were expected to be geographically co-located in three specialized zones (National Science Council, 1996[1]). For each target industrial cluster, a list of featured sub-industries was prepared and at a further level of detail, several promising products or technologies within each of these industries were also highlighted. Thus, the "industrial cluster" was the underlining concept of TSIP industrial development planning. This is different from HSIP, where no explicit expression concerning "industrial cluster" can be found in its early planning document. However, semiconductor and agricultural biotechnology industries couldn't be developed very well and embedded in local economic development in the beginning which developed successfully in the northern region. Kung

[1] National Science Council (1996) *Tainan Science-Based Industrial Park*, National Science Council, Taipei. (in Chinese).

and Chen (2008)[2] found that none of the largest three industries in 1986 and 1996 can be regarded as having strong linkage with STSP target industries and similar with local industrial structure.

Different with original plan, TSP already become a one of the world-class TFT-LCD industrial clusters. The output of Opto-Electronics industry is about 34 trillion US dollars in 2005 in which TFT-LCD industry occupied about 55 % of its output value and ranked number 2 all over the world. No more than 10 years, TFT-LCD already can compete with IC industry in Taiwan which developed over 20 years until now. Based on the study of Kung and Yen (2009)[3], there are two important mechanism.

1. Firstly, it will be easier to promote industrial upgrading and industrial clusters from choosing right local industries and local firms which have focused on related industries. For example, Chimei Corporation is a local enterprise in Tainan county and has been famous in chemical products all over the world. Because the raw materials to produce TFT-LCD are coming from chemical products, it will be easier and beneficial for Chimei to enter the TFT-LCD market.

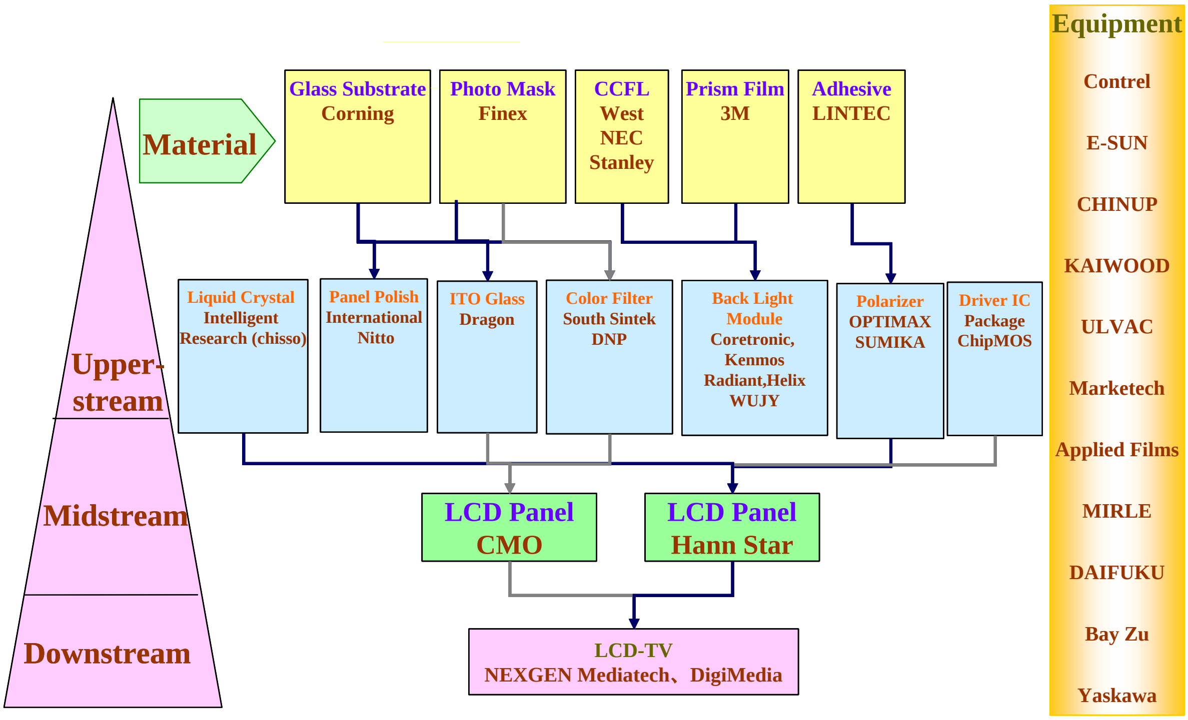

Figure1: The structure of TFT-LCD cluster in STSP

[2] Kun, S. F. and Chen, C.-W. (2008) Role of Science Parks in the Formation of High Technology Industrial Clusters – the Case of Southern Taiwan Science Park, XXV IASP World Conference on Science & Technology Parks.

[3] Kung, S.-F. and Yen, Y.-C. (2009) A Sustainable Planning Approach for Science Parks: A Case of Southern Taiwan Science Park, *WIT Transactions on Ecology and the Environment*, 120(1): 141-150.

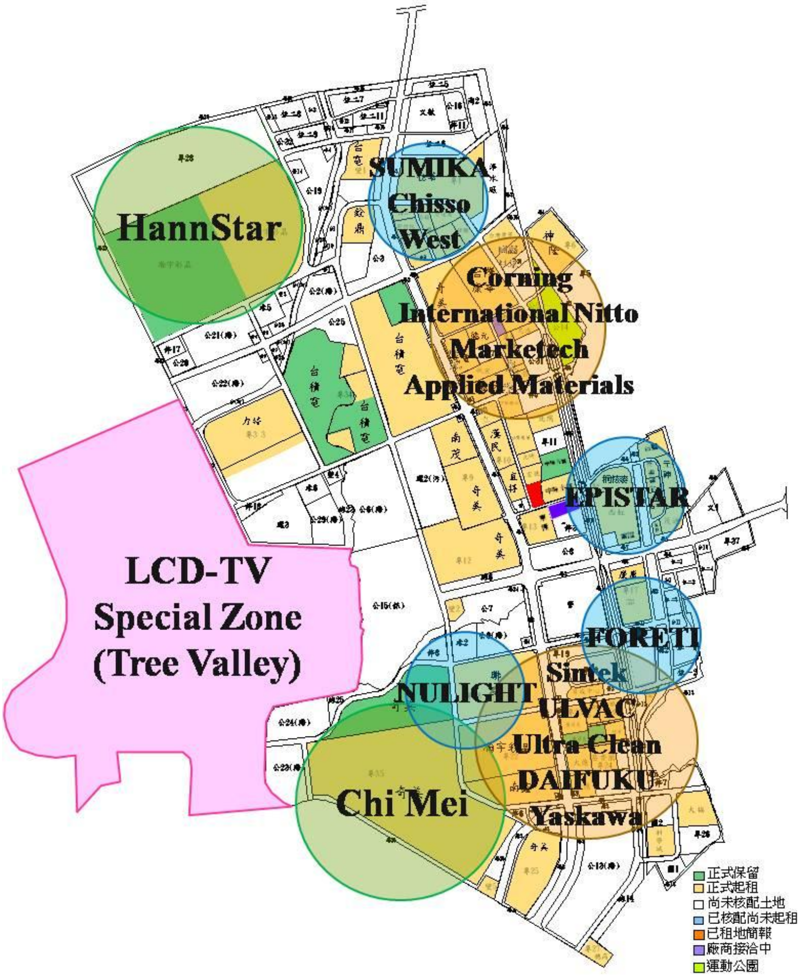

Figure2: The firm’s location of TFT-LCD cluster in STSP

2. Secondly, it is also important to strategically attract firms based on the structure of industrial cluster and provide parcels of lands with spatial proximity. From the figure 1 and figure 2, we can found there are complete TFT-LCD clusters locating in STSP including material, upstream, midstream, and equipment. Moreover, most of them are close to each other.
3. CMO was established in 1998 on a 19-hectare southwest corner site in TSIP, and the total employees exceeded 17,000 in Taiwan and 32,000 globally in February 2008. It is now the second largest TFT-LCD producer in Taiwan, and the leading firm in the STSP TFT-LCD industrial cluster, whose total revenue in 2007 was approximately USD 10 billions. Therefore, the most important reason why upstream and downstream firms tenant in STSP, is because of the CMO, the flagship firm who plays the driver to persuade their related firms migrating into STSP.

3. THE development of MD industry in KSP

The KSP is established in 2003 as the second site managed by Southern Taiwan Science Park Administration (STSPA). The distance between KSP and TSP is about twenty kilometres, there had been ideas of utilizing KSP as a spill-over site for the fast expanding TFT-LCD industry in TSP several years ago, however, the stronger calls from both local communities and STSPA expected that KSP should construct some core industries of its own, preferably, some new industries that may have closer relationships with the existing industries and may act as catalyst to transform local economy. During this period, KSP was still struggling of how to attract firms tenanting in the park due to the regional economic depression in southern region and threat of Central Taiwan Science Parks (CTSP) which cut off the firms migrating from northern region to southern region.

Before the establishment of KSP, Southern region of Taiwan were famous for its complete steel and chemical clusters. Kaohsiung has been the major steel and petrochemical industrial centre in Taiwan since the completion of three major economic construction projects: China Steel Corporation, China Ship Building Corporation and the petrochemical plants in the late 1970s. With the variety of materials and the convenience of the biggest harbour of Taiwan, metal works and precision machinery SMEs have clustered in Kaohsiung and the southern Taiwan region, and are still a significant industrial sector in the early 21st century (Yen and Kung, 2008[4]). Yet, with the uprising industrial competition from China and ASEAN countries, many of these SMEs have to find new ways of production or higher value-added and more sophisticated products if they choose to stay instead of moving out to other lower cost countries. Therefore, STSPA tried to apply the successful experience of formatting the TTF-cluster into the upgrading projects.

MD industry is chosen under the trend for upgrading with the three main reasons. Firstly, MD industry has the opportunities to combine different field's high-tech technologies[5] with metal, precise machine, chemical, and plastic industry in which it has high reputation in manufacturing sector. Secondly, the MD industry is comparatively a new industrial sector all over the world, even the major associations in the USA, for example, MDMA and MassMEDIC, have been established only since the 1990s. Thirdly, it is widely recognized as very potential in the future, basically because of the global increase of ageing population as well as the rising awareness of the value of health. Different research estimated the global market of medical devices at about 200 billion US dollar per year between 2006 and 2008, with an annual growth rate between 6-9%. In Taiwan, the medical device industry was also assessed as one of the very promising industries that Taiwan may feature in the global market, and the central government of the Republic of China has included it in the list of new and strategic industries (MOEA, 2008[6]).However, it is failed in the early stage, and there are only 3 firms tenanted in 2009. According to the interview, we found that there are three main reasons.

Firstly, in order to produce high-level MD products needs firms to upgrade their original technology or develop a new technology, and to get the market information and consumer needs, which often takes long time and large investment to integrate complex idea, technologies, and researches. Take example of the supply side of MD market, it needs to combine diverse technologies coming from HI, TI, and medical industries (MI) (Figure 3). However, as shown in Table 1, in the HI like electronics and IT, knowledge inputs are often derived from reviews of existing research, and knowledge generation is often radical in nature and based on the application of widely shared and understood scientific principles and methods through formal R&D activities. In contrast, the innovation of TI is often based on the application or novel combination of obtainable knowledge with low levels of R&D. They are largely incremental and often arise from the firms' persistent efforts to satisfy requests from customers. In addition, MI has high professional and closed-market characteristics; and then it is very different in the distributing and sharing knowledge with the other industries. Therefore, although most of them are located in the southern region, it is also involved with different expertise and belonged to very high closed-market and different approach for innovation.

[4] Yen, Y-C and Kung, S-F (2008) An Empirical Study of Identifying Regional Cluster in Southern Taiwan, *Journal of City and Planning*, 35 (1): 51-78. (in Chinese)

[5] From the semiconductor, opto-electrics, biotechnology, and service design.

[6] Ministry of Economic Affairs (2008) *Taiwan Medical Device Industry Analysis and Investment Opportunities*, Taipei: Ministry of Economic affairs.

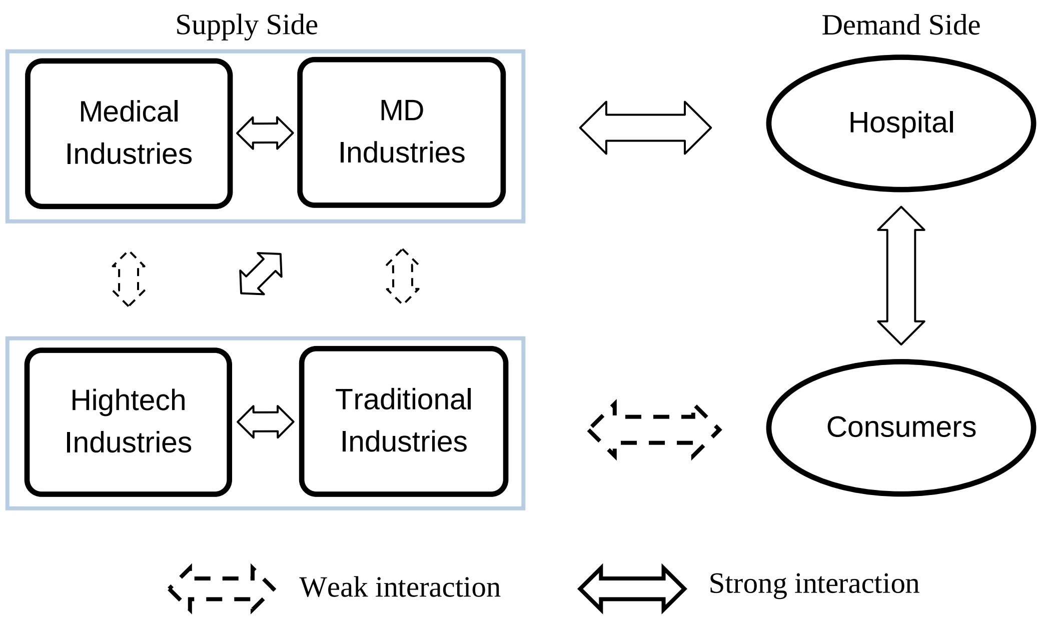

Figure 3: The relationship between supply and demand sides in the MD industry

Table 1: The comparison of characteristics of different industries

	Traditional Industry (TI)	Medical Device Industry (MD)	High-tech Industry (HI)	Medical Industry (MI)
Place Characteristic	. Old Industrial region . Peripheral region	Metropolitan region	Metropolitan region	Metropolitan region
Technology	Low and Medium	Low and Medium	high	high
Absorptive Capacity	Low and Medium	Low and Medium	high	high
Learning Capacity	Low	Low and Medium	High	High
Knowledge Type	Tacit	Tacit	Explicit	Tacit Explicit
Knowledge Infrastructure	Many Close	Few Close	Many Open	Many Close

From the demand side, doctors, hospitals and consumer are the main user of the MD products. Clinical information about patients is highly complex, not easily codified and prone informal transmission (Gittell and Weiss, 2004[7]). Therefore, the development of MD products needs to work with medical industry such as hospital. There are significant gaps in culture, knowledge type, and industrial characteristics. Unless MI, HI and TI also doesn't have channels to connect with them. How to cooperate them with trust is still a big problem until now. Therefore, although Taiwan has

[7] Gittell, J.H. and Weiss, L. (2004) Coordination Networks within and across organizations: A Multi-Level Framework, *Journal of Management Studies*, 41(1), 127-153.

high reputation of manufacturing in product quality, complete industrial chain and international production network, the relationships between each other have less intersection and the knowledge type is also very different. Moreover, it is difficult to find the proper channels to cultivate human resource and technological innovation. This also caused the so called structure hole.

Secondly, industrial upgrading in traditional industries is like the radical innovation or disruptive innovation in technology base and business model in which it needs to invest many resources and capital (Christenson, 1997[8]; Davila et. Al., 2005[9]); however, most of them are small and medium sized enterprise (SME) with low capital; it is not easy for them to forecast the future market trend and connect the technology resources such as university, research institute, large firms and multinational corporations (MNCs) by themselves. According to the Kung and Chen (2009), as shown in figure 4, CMO has strong interaction with their actors (research institute, National Cheng Kung University (NCKU), upstream and downstream industries); in contrast, the upstream and downstream industries of TFT-Clusters in TSP has weak or no interaction with NCKU and research institute. It means that CMO, the local flagship company, is a large-sized and international enterprise with the ability to attract international and domestic enterprise of his upstream and material industries tenanting in STSP in which most of them didn't have interaction with each other. The famous products in MD industry such as electric scooter for handicapped or elderly people, ear thermometer, electronic sphygmomanometer, etc, belong to the production-oriented and low-and medium- technology (LMT). In other words, the same scale flagship firm does not exist now in the MD and metal industry.

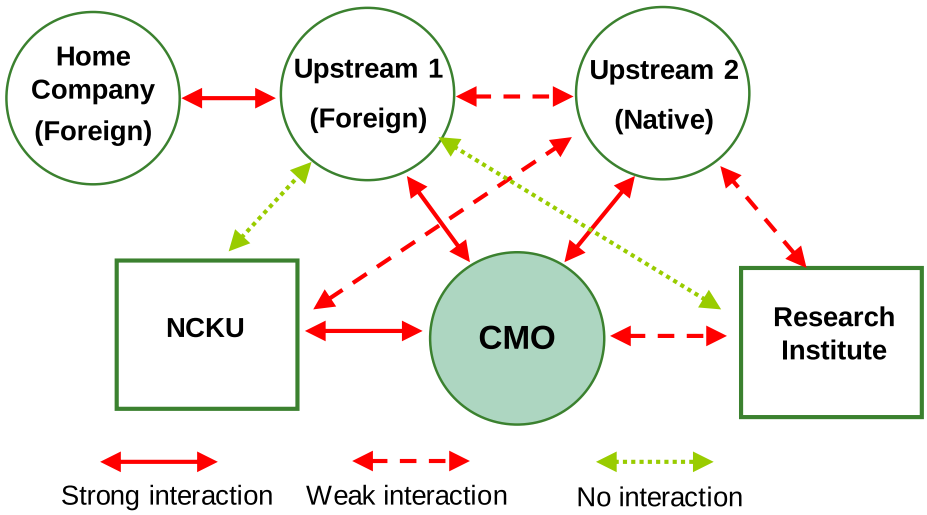

Figure 4: The relationship between CMO and others actors of TFT-Clusters

Thirdly, it is very important for the MD industry to consider safety and efficiency carefully since it is going to be used in human body for the life-saving and working. Due to the high product certification and competition, it is not easy to estimate whether the product can pass the examination and when the product can enter the market. It will cause the high operation cost, low survival rate and high entrance barrier of the small and medium sized firms in the early stage.

4. How to shape the emergence of flagship firms: providing innovation environment

In our point, flagship firm is still the important driver for the formation of industrial clusters and the growth of firms in science parks. However, KSP is still at relatively young status; and then it is not easy for them to attract them. Therefore, we think that the main task for a young science

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[8] Christensen, C.M. (1997) *The Innovators Dilemma: when new technologies cause great firms to fail*, Harvard Business School Press, Boston, Massachusetts.

[9] Davila, T., Marc, J. E. and Robert, S. (2006) *Making Innovation Work: How to Manage it, Measure it, and Profit from it*, Upper Saddle River: Wharton School Publishing.

parks is how to construct an environment to attract or even to shape the flagship firms from existing firms with related sectors.

From the theoretical perspective, based on the theory of location choice and regional economic development, innovation environment are gradually regarded as one of the important factors for the firms to choose their location, and innovation is also widely seen as the driving force of industrial growth and competitiveness. From the empirical studies, it has indicated that science parks are an effective way to encourage knowledge transfer and technological innovation between academic institutions and "knowledge-intensive" establishments, thereby resulting in start-ups and growth in science-based or high-technology sectors (Komninos, 1998[10]; Phillips, 2002[11]). These parks have also demonstrated the potential to enhance economic growth in the region (Cooke, 2001[12]). However, some studies stated evidences in contrast, which is science parks tend to fail in delivering the following widely expected benefits: tenants' research productivity (Siegel et al., 2003[13]), employment growth in high-tech sectors (Shearmur and Doloreux, 2000[14]), extraordinary growth or performance of R&D-intense firms situated in the park, and the development of strong and operational ties between firms, university research, national laboratories and other research institutions (Bakouros et al., 2002[15]).

One of the important reasons for this the difference is they believe that geographical proximity between sources of knowledge and local firms is sufficient to foster the widespread spatial diffusion of information, technologies and new ideas (Vedovello, 1997[16]). In common terms, a science park is defined as a geographical area in which firms and knowledge institutions such as universities and research institution have a common location such as Silicon Valley, Stanford Research Park, and Cambridge Science Park. Their effect could be explained on the researches such as knowledge spillover, spatial proximity and agglomeration economies (Audretsch and Feldman, 1996[17]; Audretsch, 1998[18]; Saxenian, 1994[19]) and collective learning process (Keeble and Wilkinson, 1999[20]). They think that proximity to university laboratories and other research centers as providing nearby firms with easier access to scientific expertise and research results, and then it will facilitate transfer of research into commercial application.

Actually, this concept could be work because some of international cases are developed by the universities or research institution; therefore it is easier for the firms to connect the research resources. However, different from these parks, Taiwan's science parks are developed by the central and local government and belong to production-oriented site especially in the STSP. The primary goal to development STSP is to provide lands for the firms which are from northern region to produce high-technology products in southern region, and after that STSP will cause the spillover effect of local economic development and industrial development automatically. From the Kung and

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[10]Komninos, N. (1998) After technopoles, in: J. Simmie (Ed.) Innovation, Networks and Learning Regions?, London: Jessica Kingsley Publishers.

[11]Phillips, R. G. (2002) Technology business incubators: How effective as technology transfer mechanisms?, *Technology in Society*, pp. 299–316.

[12]Cooke, P. (2001) Regional innovation systems, clusters, and the knowledge economy, *Industrial and Corporate Change*, 10, pp. 945–974.

[13]Siegel, D.S., Westhead, P., Wright, M. (2003) Assessing the impact of university science parks on research productivity: exploratory firm level evidence from the United Kingdom, *International Journal of Industrial Organization*, 21: 1357–1369.

[14]Shearmur, R., Doloreux, D. (2000) Science parks: actors or reactors? Canadian science parks in their urban context. Environment and Planning 32(6): 1065–1082.

[15]Bakouros, Y.L., Mardas, D.C., Varsakelis, N.C. (2002) Science park, a high tech fantasy? An analysis of the science parks of Greece, *Technovation*, 22, 123–128.

[16]Vedovello, C. (1997) Science parks and university-industry interaction: geographical proximityamong agents as a driving force, *Technovation*, 17(9):491–502.

[17]Audretsch, D, and Feldman, M. (1996) R&D Spillovers and the geography of innovation and production, *American Economic Review*, 86(3):630–640.

[18]Audretsch, D.B. (1998) Agglomeration and the location of innovative activity, *Oxford Review of Economic Policy*, 14(2), 18–29.

[19]Saxenian, A. (1994) *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*, Cambridge, MA: Harvard University Press.

[20]Keeble, D. and Wilkinson, F. (1999) Collective learning and knowledge development in the evolution of regional clusters of high technology SMEs in Europe, *Regional Studies*, 133(4):295-303.

Yen (2009), STSP failed in the early stage because central government's policy didn't understand the regional industrial structure and characteristics; they just followed the experience of HSIP.

Moreover, the reason why firms require proximity to each other and technological infrastructure in science parks is that they want to improve their competitiveness through learning and competition. However, industries in different market stage, technology base and learning capability need different resources and types of knowledge for the innovation that knowledge institution typically can't provide it for all condition. In addition, knowledge is asymmetries, and the process of knowledge creation requires a larger variety of knowledge sources and inputs, and needs a dynamic interplay and transformation between tacit and codified forms of knowledge within and between diverse organisations. Therefore, the collaboration between knowledge institutions and firms does not develop overnight and the interaction between each other is determined by specific local setting and the social, historical, cultural and institutional factors that each part has followed in the past.

Therefore, not all industries and local industries are the same in respect for their needs for an educated workforce or scientific knowledge. In addition, science parks are located in spatial setting with different culture, knowledge infrastructures, and political institution. Innovation is a collective process that entails the coordination of distributed knowledge across diverse organizations. There is little understanding of how the knowledge and resources of innovation can be distributed across diverse organizations, and to what extent public policy may affect this process.

There are more and more evidences showing that the development of innovation is gradually toward to the type of network-centric innovation or open innovation model, such as regional innovation system or triple helix (Cooke and Morgan, 1998[21]; Etzkowitz, 2008[22]; Nabisan and Sawhney, 2008[23]). The regional innovation system is understood as a system of innovation networks located within a certain geographical area, in which firms and other organisations are systematically engaged in interactive and collective learning through an institutional milieu characterised by social-economic linkage (Cooke and Morgan, 1998). The member of linkage may come from the global or local actors. Both strong and weak linkages are important to innovation. Strong linkage (formal and informal relationship) includes a common language and high level of trust, whereas weak linkage (formal relationship) enables the flow of novel information to the system. Triple helix thinks that innovation is a resultant of a complex and dynamic process related to interactions between academia, industry and government, in a spiral of endless transitions in which university is a leader of the relationship with industry and government, to generate new knowledge, innovation and economic development.

Based on the theory, we could use region as a specific area to construct a regional innovation environment in which the university, industry and science parks administration (government) are important actors. However, in practice, innovation is a collective process that entails the coordination of distributed knowledge across diverse strong or weak linkages, when they have the big gap or difference in trust, place characteristic, firm characteristic, knowledge type, and knowledge infrastructure (figure 5), this model could result in a "structure hole" (Kallio et al., 2009[24]; Tödtling and Trippl, 2005[25]; Viljamaa, 2007[26]).

We think that science parks in Taiwan should not only provide lands, hard infrastructures and one step services, it still could play a strategic role in the formation of innovation environment and

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[21]Cook P. and Morgan, K. (1998) *The Associational Economy: Firms, Regions and Innovation*, Oxford: Oxford University Press.

[22]Etzkowitz, H., 2008, *The triple helix: university-industry-government innovation in action*, NY: Routledge.

[23]Nambisan S &Sawhney M, 2008, *The Global Brain, Roadmap for Innovating faster and smarter in a networked world*, New Jersey, Pearson Education.

[24]Kallio, A., Harmaakorpi, V., and Pihkala, T. (2010) Absorptive Capacity and Social Capital in Regional Innovation Systems: The Case of the Lahti Region in Finland, *Urban Studies*, 47 (2): 303-319.

[25]Tödtling, G. F. &Trippl, M. (2005) One size fits all? Towards a differentiated regional innovation policy research, *Research Policy*, 34 (8): 1203-1219.

[26]Viljamaa, K. (2007) Technological and Cultural Challenges in Local Innovation Support Activities—Emerging Knowledge Interactions in Charlotte's Motor Sport Cluster, *European Planning Studies*, 15 (9): 1215-1232.

the innovative performance of firms by supporting, stimulating, and increasing the number of channels through which knowledge develops at a local or global level., In other words, STSPA could be a "gatekeeper" within the structure hole for the formation process of collective learning system such as A→B→D, A→C→D, B→D, and C→D (figure6). The role of gatekeeper is like a "public good" and "intermediary" (Baxter and Tyler, 2007[27]; Lester and Piore, 2004[28]). The goal of the gatekeeper is to provide a "public space" to integrate diverse resources, to break different boundaries, and reduce the waste of the transaction cost, negative externalities and risk of failure in the structure hole.

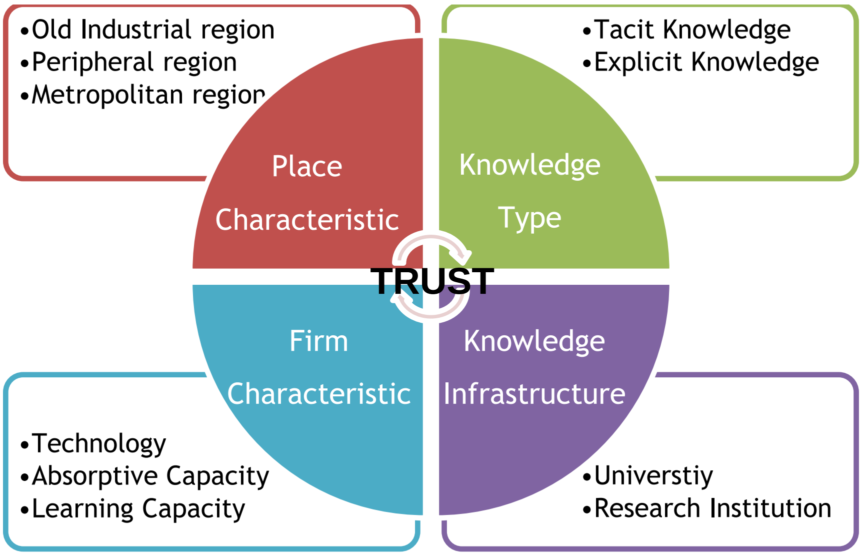
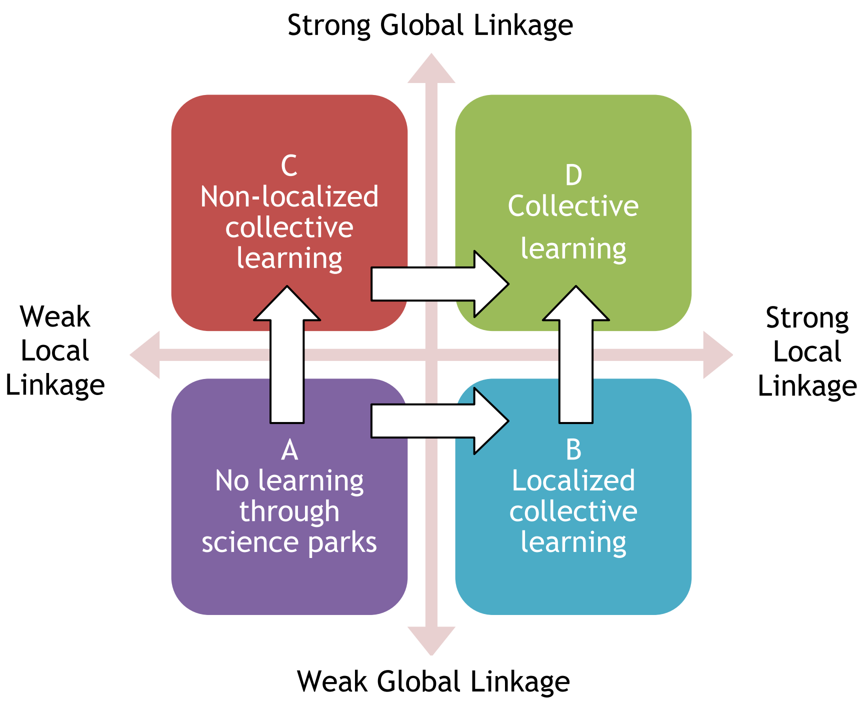


Figure 5: The attributes affecting the operation of innovation system



[27]Baxter, C. and Tyler, P. (2007) Facilitating enterprising places: the role of intermediaries in the United States and United Kingdom,
[28]Lester, R. K. and Piore, M. J. (2004) *Innovation: The Missing Dimension*, Cambridge, Mass.: Harvard University Press.

Figure 6: The Model for the Science Park to construct collective learning environment

5. Case study: the innovation platform in KSP

From the theoretical discussion, we know that innovation is an important factor for the local firms to upgrade as the flagship firms. The most important task of the science parks is to provide an innovation environment such as a “public space” to integrate diverse resources, to break different boundaries, and reduce the waste of the transaction cost, negative externalities and risk of failure in the structure hole in which who is the gatekeeper also plays an important pole in the success of innovation environment. In the following section, we will use KSP as the case to analyse how the innovation platform could be worked like a public space and how to choose the gatekeeper to fill in the structure hole, to integrate and distribute different innovation resources, and to promote the localized collective learning (A→B) or non-localized collective learning (A→C). By providing the good innovation environment and services for innovation, it will make the firms become the flagship firms and attract outside firms to ternate in science parks.

5.1 The planning idea of the innovation platform

We use how to make the real product as the final target to think about how to planning the function and organization of the innovation platform. By analysing the MD production chain, there are at least three big gaps (Figure 7) which are very difficult for a single small or medium-sized firm to deal with alone.

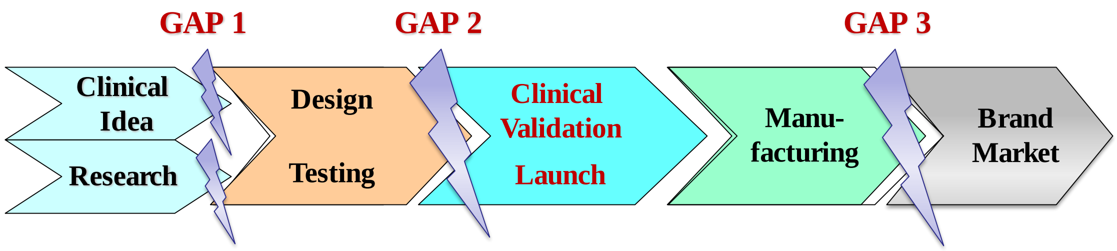


Figure 7: The gaps in the production process of MD products

5.1.1 Gap 1

To produce high-level MD products needs firms to upgrade their original technology or develop a new technology, and to get the market information and consumer needs, which often takes long time and large investment to integrate complex idea, technologies, and researches.

5.1.2 Gap 2

It is very important for the medical product to consider safety and efficiency carefully since it is going to be used in human body for the life-saving and working. US and EU have set up many regulations and legal procedures to ensure proper inspection, verification and management of the quality of biotechnology and medical products before they enter the market. In Taiwan, it is getting more serious because there are so many firms and research institutes knowing how to apply these complex procedures from different counties, although we have a lot of experiences to apply patents of high-tech manufacturing in different foreign counties. Therefore, due to the high product certification and competition, it is not easy to estimate whether the product can pass the examination or when the product can enter the market. These may result in high operation cost, low survival rate and high entrance barrier for the small and medium sized firms in the early stage.

5.1.3 Gap 3

In the past, Taiwan has fought very hard to gain market access to the world through its capacity in OEM/ODM production; such as the steel and metal products in the traditional sector and electronics and IT products in the high-tech sector (Amsten and Chu, 2003). It has also learned through sweaty practice that marketing and branding are even harder than manufacturing. Yet, the MD industry of Taiwan is still in the emerging stage, not even a major OEM/ODM manufacturer in the global market. With the much stricter regulations on MD products, without a brand name that is familiar to the hospital or major end users, the gap between manufacturing and selling could be very wide.

5.2The Innovation Platform and its gatekeeper

In the Silicon Valley and Cambridge Science Park, university is like a gatekeeper to foster the innovation and spin-off. In contrast, in Taiwan, take KSP as the example, the developers are the central and local and government, and the goal is also different with them. STSPA can't work like a gatekeeper such as the university played in the Silicon Valley or Cambridge Science Park because they are the government officer with less flexibility like private sectors. But it is easy for STSPA to get the trust between different actors in the region. The question is how to make good use of this advantage to fix the breaks of production chain and integrate different resources to foster innovation. In order to solve these two problems, STSPA developed an innovation platform in KSP and cooperate with local institution, Metal Industries Research & Development Centre (MIRDC), as the gatekeeper. The goal of the platform is to bridge the break for the formation of production chain by organizing and coordinating different innovation actors and finite resources (figure 8).

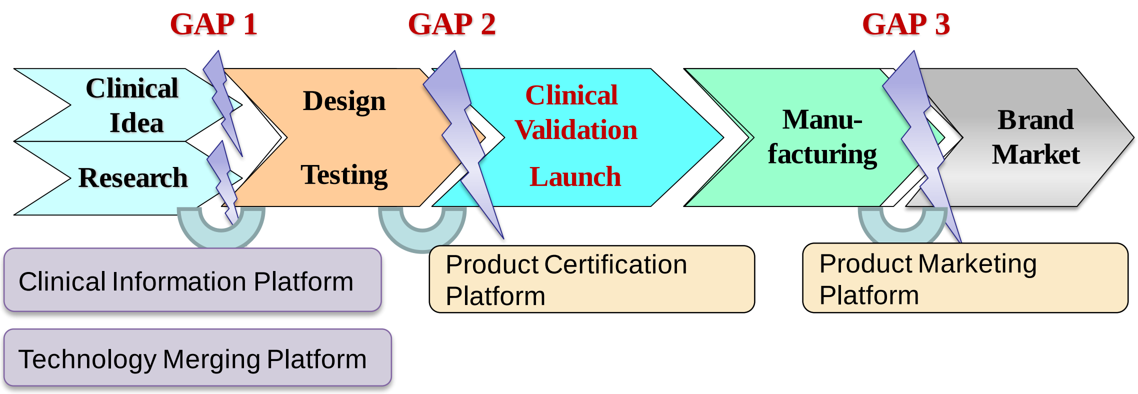


Figure 8: The relations between platforms and production chain of MD industry

The platform encompasses the set of components and rules employed in common in most user transactions (Table 2). Components include:

A. Platform providers:
   National Science Council (NSC) and Ministry of Economic Affairs (MOEA)
   - Providing the fund to support the operation of platform..

B. Gatekeeper:
   Planning office (PO) composed of STSPA and MIRDC.
   - Responsible for determining who could participate in a platform network,
   - Contracting that specify terms of trade and the rights and responsibilities of network participants,
   - Developing its technology,
   - Setting up operation rules such as how to govern information exchange, innovation resources, and knowledge transfer.

C. The core systems:
   Technology Service and Product Service System. The subsystems are
   - Clinical Information Platform;
   - Technology Merging Platform;
   - Product Promotion Platform;
   - Certification Platform.

D. Supply-side users of the platform:
   Universities, medical schools, medical research centres, hospitals, and regional and local research institutes.

- Offering complements employed by demand-side users in tandem with the core platform.

E. Demand-side users of the platform:

- Firms from TI, HI and MD industry, commonly called the end users.

F. Other support system:

- Capacity building, technical training and educational activities.

Table 2: The responsibility and information of innovation platform

Core system	Subsystem	Mission	Supply-side users
Technology Service	Clinical Information Platform (CIP)	• Increase the information exchange during R&D • Setting up the professional team • Evaluation the clinical testing	• MC • HO
	Technology Merging Platform (TMP)	• Analyse the key technology in developing MD industry • Studying and selecting proper firms • Merging the proper firms • Explaining and diffusing R&D results	• UNI • RI • Firms
Product Service	Product Certification Platform (PCP)	• Setting up one window operation model • Integrating the existing certification resource • Setting up GLP laboratory • Setting up GLP certification	• RI • UNI
	Product Marketing Platform (PMP)	• Participating the international exhibition and information exchange • Raising the industrial image • Setting the common marketing mechanism • Planning the product exhibition site	• RI

MS: Medical School; MC: Medical Center; HO: Hospital; UNI: University; RI: Research Institute

6. Operational mechanism of the innovation platform

A tentative model of the innovation platform in the KSP may be described as Figure 9, and the major operational mechanism is composed of the following parts:

6.1 STSPA use innovation platform as the environment to integrate different resources (fund, idea, and services) from different actors to reduce the negative externalities (structure hole) from production to marketing

The innovation platform could be seen as the practical model to realize the triple helix idea in which research institute as the centre of government, industry, and academia (Figure 9). Moreover, the gatekeeper is composed of the MIRDC from the research institute side and STSPA from the government side. Therefore, the gatekeeper has the political power to get the trust between different actors and has the ability to identify, integrate, and to transmit the knowledge.

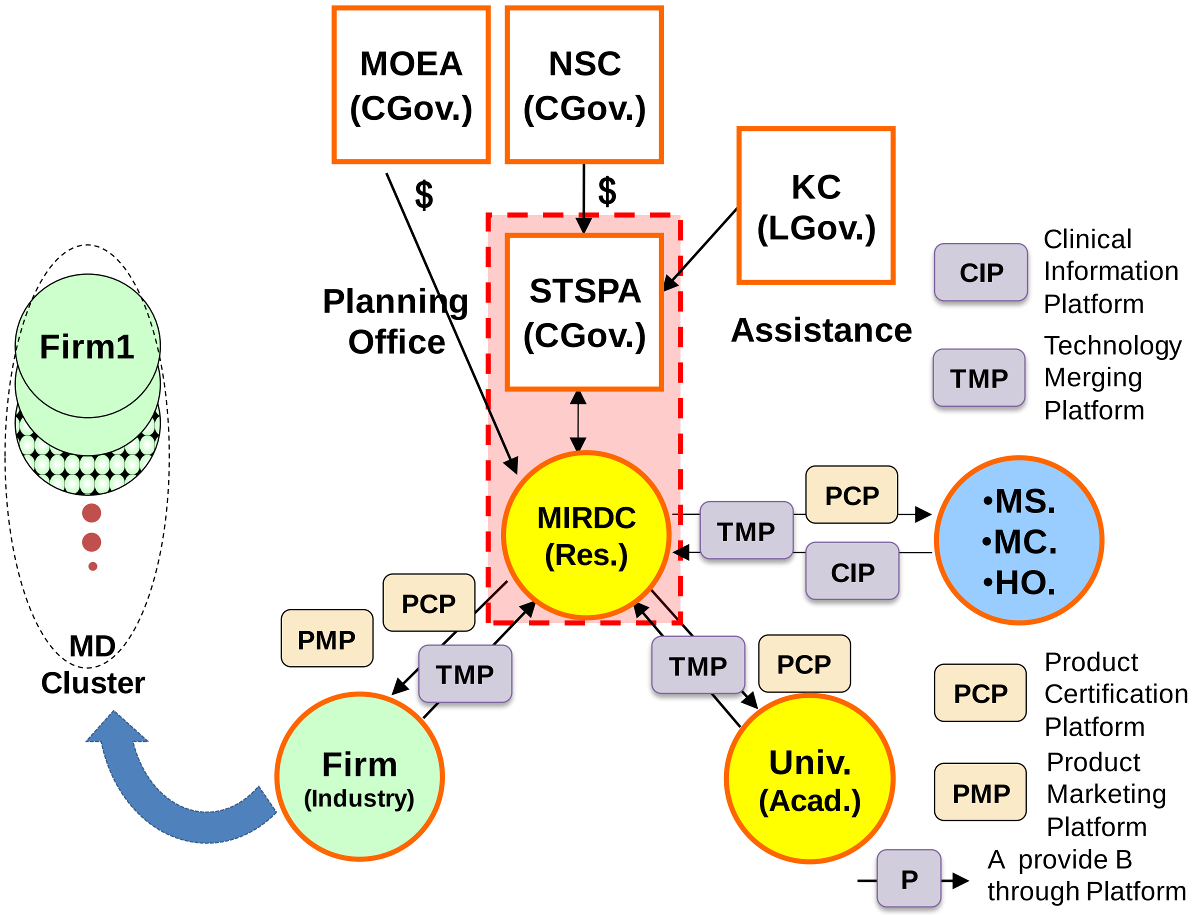


Figure 9: Operational mechanism of the innovation platform for KSMD

6.2 STSPA choose right local research institution with capacity of running R&D by themselves, transferring and diffusing different type of knowledge, and organizing social network as the gatekeeper to fill in the gaps within structure hole

MIRDC is the only actor who can use the CIP to collect the clinical needs. MIRDC is sponsored by central government and established for over 45 years in southern Taiwan region for researching and developing the leading technology of metal and its related industries in Taiwan. They have highly contacts and trusts between local mental firms and local government, and have full information about their technology base and development.

Moreover, most of their researchers are coming from the National Cheng Kung University (NCKU) or other National Universities; and they also can connect the knowledge infrastructures. In the operation of innovation platform, they use the social network to construct the relationship with hospitals such as NCKU Hospital, Kaohsiung Medical University Chung-Ho Memorial Hospital (KMUH) and E-Da Hospital to get the right information from final product users, and to cooperate with them to develop the native MD products.

Not only the social network they need to have, but also the capacity of R&D, transferring and diffusing different type of knowledge to evaluate what the feasible direction to develop MD products and technologies is, and whether the proposals is workable and deserving to invest. Therefore, choosing proper local research as the gatekeeper is a critical factor to fill in the breaks within structure hole and to guarantee the success of the innovation platform.

6.3 Evaluating the feasibility to imitate the existing products by combining or upgrading with the technologies from existing firms based on the concept of industrial clusters and technology base

From the Asian experience, we found that imitation is an easier way to enter a new product market. Someone may say it is lack of creativity and innovative; however, most of them ignore imitation also needs their own absorptive, learning, manufacturing capacity to make better quality and cheaper product, and all of which are the base for the further innovation. Moreover, semi-public research institutes and universities play an important role in supporting technology and knowledge during this process. We found that Taiwan already have the technology base to produce the high level MD product according to our manufacturing capability. The problems are how to decide the products we could produce and would have the advantage, and how to integrate different resources and actors. In the development of KSP's case, we evaluate it by considering the feasibility to imitate the existing product by combining or upgrading the existing Technologies based on the concept of production chain and technology base. This strategy not only could reduce the cost and shorten the schedule of development, but also could construct the complete production chain.

6.4 Planning Office has dense connection with final product user such as Hospital and Medical Centre to understand and make sure the firm's future market.

Final consumer is the important driving sources to understand customer's needs and foster innovation (von Hippel, 1998[29]). Moreover, hospital is also the main purchasing group for MD products. However, both of them are very close and not easy to access especially for the TI firms. In addition, substitute products emerge faster (Fennelly and Cormican, 2006[30]). CIP provides the channel to gather and discuss the information from doctors in hospital and medical center. This strategy makes firms having confidence to enter KSP to develop and produce their products.

6.5 Transferring the direction of some university's research from fundamental research to innovation of production technique;

Some of the researches in university of Taiwan can't be applied into solving the real production problems. There are three possible reasons. First, some researches pay more attention on the public interest and fundamental research different with needs of the private sector. Secondly, there are less interaction, communication and cooperation between universities and enterprises. Thirdly, the boundary barriers between different fields in university are clear. Therefore, in order to avoid these situations and to use resources efficiently, in the platform, it is encouraged to apply the projects with different actors from diverse field, and to produce the real products

6.6 Activate, rather than passively waiting for, the leading manufacturers in the domestic market to apply industry-academy collaboration projects;

Planning Office will acknowledge and persuade the industry side to apply the industry-academy collaboration project to promise, upon the completion of the project, to invest and establish production plant in the KSP.

6.6 The incubation of high technology business is not, as traditional, through the innovation centre as incubator, but rather using the science park as the incubator directly.

Judging from the result, the innovation platform seems to have yielded some positive effect. In 2010, there are 22 firms approved to enter in the KSP, and within these 10 firms actually engaged in plant construction and production, and four of them have been upgrading from traditional industries. It is maybe too earlier to conclude, and the authors' have just started the examination of the platform since the mid-2010, there are still much to be learned.

[29]Von Hippel, E. (1988) *The Sources of Innovation*, New York: Oxford University Press.
[30]Fennelly, D. and Cormican, K. (2006) Value chain migration from production to product centred operations: An analysis of the Irish medical device industry, *Technnovation*, 26(1), pp 86-94.

7. Concluding Remarks

The value of science parks may be evaluated from different perspectives. In the case of Taiwan, albeit with a success in the development of a fast growing high technology industrial community in the HSP, it had been often criticised as the prosperity at the cost of creating a divided region in the early stage. Therefore, the science park builders and researchers have been continuously trying to make sure that the prosperity is not reserved within the park alone. Much of the effort in the construction and development of the TSP has been paid to the local concerns. However, how to develop new and high technology industries within the existing local industrial base is a continuous challenge; and this is perhaps a widely shared issue to many other science parks in the world.

On the other hand, many industry-academic collaboration programs have been created and transplanted to many places in the world or even adapted to suit local situations, yet, how to realise the potential of the innovations generated from these programs in the market place terms is still much waited. The case of the innovation platform for the medical device industry at the KSP as has been described in this paper, and may be attributed as a collective wisdom simultaneously evolved among the STSPA, the MIRDC, the local industrial communities and the regional HEIs may shed a light on the development of the concerned principles and good practice. We know that innovation platforms in KSP is still the working experiment and this concept still need to be examined by the theoretical thinking; but it could be a possible model to promote industry upgrading with innovation and to create the good environment for the formation of flagship firms. From our study, there are four important findings of how the innovation platform could be worked to promote innovation and formation of flagship firm.

Firstly, innovation platform can be regarded as practical model to realize the triple helix idea in which research institute are the centre of government, industry, and academia. In this model (figure 10), research institute-science park-university is responsible for the innovation management; research institute- university-company is focused on the innovation of new technology to produce new products; research institute- university- science parks is responsible for the innovation service.

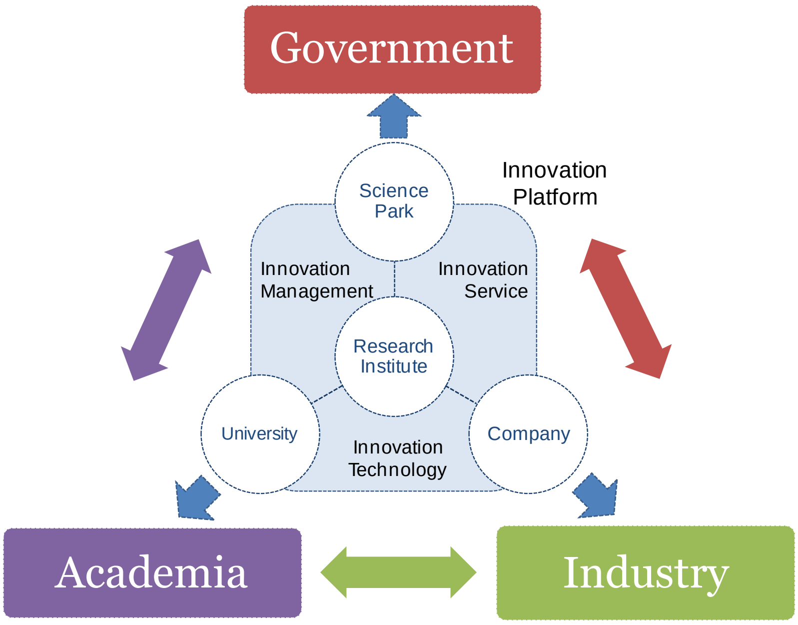


Figure 10: The idea of innovation platform combing with triple helix model

Secondly, Innovation and learning environment in the science parks is greatly regarding as the important factors to attract business investment. However, innovation is a distributed and collective learning process generated through interactions among heterogeneous agents. This complex process will cause “structure hole” which is the main reason for the failure of innovation. It needs communication space to understand the characteristics between each actor, to integrate different resources, break organization boundaries, and to transfer different type of knowledge. The main advantages of flagship firms are their ability to avoid structure hole by constructing international network, integrating different resources from different countries, and to occupying the market.

Thirdly, the main purpose of innovation platform is providing an environment to fill in the structure hole for the firms to grow up as flagship firms in the early stage. The important mechanisms for designing the innovation platform are as follows: (1) gatekeeper should have the capacity with R&D capacity, transferring and diffusing different type of knowledge, and organizing social network. (2) Reducing negative externalities based on the production chain from idea to product launch.

Fourthly, within the innovation platform, science parks cooperating with local research institution could provide, such as the public communication space, and could be a “gatekeeper” who is like a public good for constructing the innovation environment and promoting the formation process of collective learning system. Under this environment, firms can avoid the negative externalities and can grow up as flagship firms with advantage ability.