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QNCC | 19th – 22nd October

THE COOPERATIVE MECHANISM FOR THE STSP INNOVATION SERVICES PLATFORM TO LINK UP WITH ENTERPRISES AND ACADEMIA

PLENARY SESSION 3

Cooperating with knowledge creators: Models of collaboration with universities and R&D

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The Cooperative Mechanism for the STSP Innovation Services Platform to Link up with Enterprises and Academia

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Executive Summary

How to promote effective cooperation between academia and enterprises has long been an important issue of governmental policy study, and the challenges lie in imbalance between the focus of academia on advanced technology, academic research, and research institutions, and enterprises. Thus, more pragmatic work is required to help communication between the public and private sector. Innovation services platform is a commonly addressed theme, but it lacks effective discussions on how to implement and combine the planning of science parks. This study attempts to examine and understand how the Innovation Services Platform did to promote the cooperation among academia, the industry, and the medical circle and lead to successful market entrance from the development perspective of dental implants and solutions provided by the Innovation Services Platform during the operation process by examining the case Hung Chung Bio-S. Co., Ltd., at the STSP.

Keywords: Southern Taiwan Science Park (STSP), Medical Device, industry cluster

1. Introduction

Methods to promote effective cooperation between academia and enterprises have long been an important issue of governmental policy study. Challenges lie in the imbalance between the focus of academia on advanced technology, academic research, and research publication as well as the emphasis of enterprises on the application of mature technology, short-term profit making, and market competition. Hence, barriers and the failures to communicate between both parties arise accordingly and indirectly hinder overall national industrial development. As shown in the literature review, one of the main purposes for establishing science parks is to serve as an interface platform to promote cooperation between the above two parties, academia and the industry. Unlike the research and development-based model of science parks adopted by the US and Europe that are mostly set up with the aim among academic institutes or private units to facilitate cooperation between academia and the industry, science parks in Taiwan, at present, operate with the main goal of providing a supplementary function of manufacturing with research and development functions while the central government plays the core role of initiating research and development. Thus, in terms of the facilitation of cooperation, more pragmatic work is required to serve as a bridge to promote communication between public and private sectors in order to respond to their unique responsibilities and work content.

Established in 1997, the Southern Taiwan Science Park (STSP) consists of Tainan Science Park (TSP) in Tainan and Kaohsiung Science Park (KSP) in Kaohsiung, respectively. Although KSP was originally designated to be the cluster site for the optoelectronics industry, due to the overall climate and resource competition, great barriers were encountered at the initial development stage and after

considerations of local resources and technologies, the future development objective of the Southern Taiwan Science Park Bureau, Ministry of Science and Technology (STSPB), city governments, and local academic and research institutions changed to focus on the biomedical device industry. The concept to develop the biomedical device industry was inspired by the combined strength of steel-making and precision machining companies in Southern Taiwan as well as recent technology breakthroughs and interface integration that are required throughout the entire process ranging from product concept, actual production, to market entrance. Resources come from different public and private sectors and no single agency from business, academia, or governments is able to integrate all players within existing administrative boundaries. As a result, the STSPB developed the concept of an interface organization by establishing the **"Innovation Services Platform"** as the core for resource search, resource integration, and one stop services.

The Innovation Services Platform is a commonly addressed theme in relevant literature, but there is a lack of effective discussions on how to implement and combine the planning of science parks mainly because of the cross-boundary requirement of industrial planning, administrative organization integration, and public policy support. It has been more than four years since the establishment of the STSP Innovation Services Platform with a successful attraction of investment at the amount of approximately 6 billion by 36 enterprises in the biomedical industry (both at TSP and KSP). The park enterprise, Hung Chung Bio-S. Co., Ltd., successfully developed Taiwan's first dental implant and became the first certified and registered manufacturer of dental implants in Taiwan on July 27, 2010. At present, it has launched relevant advanced products into the market.

From an academic perspective, more time is needed to monitor the successful operation of this platform but the mechanism to link with academic research to promote the transformation of traditional businesses and the influence of the administration organization to facilitate cooperation between enterprises and academia to promote the development of the biomedical device industry has proven to be effective. This is especially true in regard to the challenges and solutions for the above problems involved in the steel making, precision machining, medical, and medical devices industries, which can be used as the important data for future science park planning and industrial consultation. As a result, according to literature review, this study attempts to examine and understand what the Innovation Services Platform did to promote cooperation among academia, industry, and the medical field and lead a successful market entrance from the development perspective of the dental implant as well as challenges and solutions provided by the Innovation Services Platform during the operation process. In addition to the Introduction and literature review, in Section 3, we address the market state of the dental implant, technology required for market entrance, as well as market barriers in Taiwan. Section 4 explores the process, challenges, and services provided by the Innovation Services Platform for Taiwanese producers to develop a dental implant on their own. In Section 5, based on the above research results, this study concludes the important mechanism as well as points of planning for science parks in Taiwan to operate the Innovation Services Platform; Section 6 includes the conclusion and suggestions proposed by this study.

2. Literature Review

2.1 The concept of the platform

What managers and researchers refer to as "platforms" exist in a variety of industries, especially in high-tech businesses driven by information technology such as Google or Intel. It builds hardware and software products as well as applications, and provides a variety of services, from computers, cell phones, to consumer electronics devices that in one form or another serve as industry platforms. All these firms and their partners participate in what we can call platform-based "ecosystem"

innovation[1,2] (Moore, 1996; Lansiti and Levien, 2004). Platforms are also often associated with "network effects": that is, the more users who adopt the platform, the more valuable the platform becomes to the owner and to the users because of growing access to the network of users and often a set of complementary innovations. As we will discuss later, there are increasing incentives for more firms and users to adopt the platform and join the ecosystem as more users and complementors join.

Gawer and Cusumano (2013)[3] compared existing platforms and categorized them into internal and external ones. Internal (company or product) platforms are a set of assets organized in a common structure from which a company can efficiently develop and produce a stream of derivative products while external (industry) platforms such as products, services or technologies are similar to the former but provide the foundation upon which outside firms (organized as a 'business ecosystem') can develop their own complementary products, technologies, or services[4,5] (Gawer and Cusumano, 2002; Gawer, 2009).

2.2 The concept of a business ecosystem

According to Moore[1] (1996) the business ecosystem is made up of customers, market intermediaries, companies selling complementary products, suppliers, and the company itself, which can be thought of as the primary species of the ecosystem. Therefore, the business ecosystem is a field of economic actors whose individual business activities are anchored around a platform.

Within a business ecosystem, the activity of a firm relies on a mesh of relationships characterized by varying degrees of intensity with other partner firms that take a more or less significant part in the innovation process. However, a company may be in a central position because of the business potential it creates for other companies. Business relationships give access to knowledge, technologies, and innovation potential, which make it an attractive partner. Within this framework, the networks represent the foundation on which relationships between firms are organized. Lansiti and Levien[2] (2004) distinguish three types of actors within a business ecosystem:

- **The Dominators:**
  One can distinguish between the "**physical dominator**", whose role consists in dominating all of its ecosystem's niches via integration strategies that enable it to control the maximum number of nodes within its network, and thereby capture the value created for its own benefit. On the other hand, there is a "value dominator" or "hub landlord" whose role is to extract the maximum value

[1] Moore, J.F. (1996). The Death of Competition: Leadership and Strategy in the Age of Business Ecosystems. John Wiley & Sons.

[2] Lansiti, M. and Levien, R. (2004) The Keystone Advantage: What the New Dynamics of Business Ecosystems Mean for Strategy, Innovation, and Sustainability, Harvard Business School Press.

[3] Gawer A, Cusumano MA, 2013, Industry Platforms and Ecosystem Innovation, Journal of Product Innovation Management, forthcoming.

[4] Gawer, A. and M.A. Cusumano. 2002. Platform Leadership: How Intel, Microsoft, and Cisco Drive Industry Innovation, Boston, MA, US: Harvard Business School Press.

[5] Greenstein, S. 2009. 'Open platform development and the commercial Internet', in Gawer, A. (ed.), Platforms, Markets and Innovation, Cheltenham, UK and Northampton, MA, US: Edward Elgar, pp. 219-248.

from the network without trying to dominate it. In both instances, the objective pursued is to extract the maximum value without redistributing it to other actors. The resulting effect is usually a weakening of the business ecosystem.

- **Keystones:**

This type of actor plays a significant role in both the creation and the redistribution of value created within the network. Contrary to a "dominator", it does not try to control the whole network and its actors, but tries to position itself on a few nodes and assume leadership. The keystones often resort to platform strategies which give them the opportunity to take advantage of the other network actors' contributions by facilitating access to some resources. They usually adopt a "win-win" attitude vis-à-vis the other members of their ecosystem.

- **Niche players:**

There are many such actors, small in size and pursuing a specialization strategy in order to differentiate themselves from the others. They account for a large part of the value created within the ecosystem. The resources they access via the platform made available to them by the keystone give them an opportunity to develop new products or services. Indeed, they maintain very close relationships with the keystone, by actively contributing to the platform's evolution and the dynamics of the ecosystem.

2.3 Innovation ecosystems

As shown in business literature, existing platforms consist of a dominator (in addition to the internal platforms of large scale enterprises) and their business ecosystems are based on the cores of products, services, and technologies. Each member plays both the roles of keystones and niche players. It is worth noting that these business ecosystems do not focus on their geographical locations and there is no role for public or semi-public sectors. In fact, unlike countries in the US and Europe, Asian countries, especially Taiwan, rely on production systems based on small and medium enterprises rather than those of big ones. As a result, industrial and technology upgrading require cooperation between public and private sectors.

If a business ecosystem would like to expand similarly to one in the science parks, the relationship between innovation and the business ecosystem needs to be discussed. Innovative models for enhanced linkages and collaborations can enrich a business ecosystem so that more ideas can surface, more job-creating enterprises can be developed, more companies can find skills and innovation, and more enterprises can increase their capabilities to grow and compete in global markets. Therefore, the term "Innovation ecosystems" can be explained with successful examples of agglomeration whether in geographic, economic, industrial or entrepreneurial terms. In Schumpeter's words, innovation ecosystems are primarily about successful innovative regions (Silicon Valley), or new industries (cloud computing) and entrepreneurs and investors from all over the world jump on the bandwagon of these successes. In short, the STSP and its Innovation Services Platforms are integrated into an "innovation ecosystem" with an Innovation Services Platforms that focuses on the integration of innovation and technology as well as the operation of business model. Innovation ecosystems are based on a business ecosystem and the operation of the business ecosystem is driven by the operation. This study, thus, examines the composite elements of innovation ecosystems as well as the composition structure of Innovation Services Platforms in order to explore the cooperative mechanism between enterprises and academic institutions.

3. An Overview of STSP and the Medical Device Industry

The STSP as shown in Figure 1 includes the TSP and the KSP. The TSP is situated between the Xinshi, Shanhua and Anding Districts of Tainan City with a total area of 1,043 hectares. The KSP is situated between the Luzhu, Gangshan and Yongan District of Kaohsiung City with a total area of 570 hectares. The TSP was established in 1997 and the KSP is established in 2003 as the second site managed by STSPB. The distance between the KSP and TSP is about twenty kilometers. There have

been ideas of utilizing KSP as a spill-over site for the fast expanding TFT-LCD industry in the TSP several years ago; however, stronger calls from both local communities and the STSPB motivated the KSP to construct core industries of its own, preferably, new industries that may have closer relationships with existing industries and may act as a catalyst to transform the local economy. The Medical Device (MD) industry was chosen due to the trend for upgrading for three main reasons.

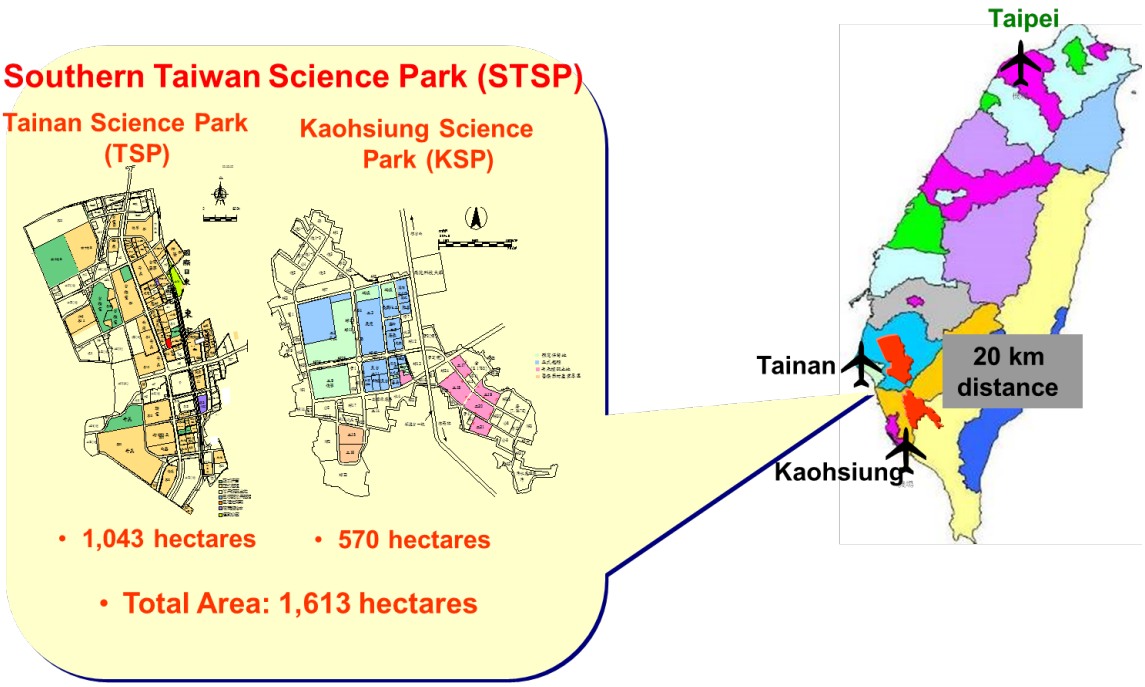

Figure 1: The Location of the TSP and KSP in Taiwan

- First, the MD industry is widely recognized as having a great potential in the future, because of the increase in the global ageing population as well as the rising awareness of the value of health. Different research studies have estimated that the global market for medical devices was approximately 300 billion US dollar per year between 2013 and 2018, with an annual growth rate between 6-9%.
- Second, before the establishment of the KSP, the southern region of Taiwan was famous for its comprehensive steel and chemical clusters. Kaohsiung was a major steel and precision machining industrial center in Taiwan. With a variety of materials and the convenience of the biggest harbor of Taiwan, metal works and precision machinery SMEs have clustered in Kaohsiung and southern Taiwan, and are still a significant industrial sector in the early 21st century (Yen and Kung, 2008)[6]. Yet, with rising industrial competition from China and ASEAN countries, many of these SMEs have to find new methods of production or providing higher value-added and more sophisticated products if they want to compete instead of moving to lower cost countries. Therefore, the MD industry has the opportunity to combine the latest in technology from different fields such as metal, precise machining, chemical, and plastic industries that have high reputations in the manufacturing sector.
- Third, the STSP is in an excellent geographical location surrounded by abundant research resources including four teaching hospitals and a medical center, namely Chung-Ho Memorial Hospital, E-DA Hospital, National Cheng Kung University Hospital and Chi Mei Hospital, ten public and private universities or colleges, such as National Cheng Kung University, Kaohsiung Medical

[6] 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).

University, and a non-profit research institute, Metal Industries Research & Development Centre (MIRDC). Besides, there are two industrial parks nearby to formulate a complete supply chain supporting Southern Taiwan Science Park. Therefore, it is considered to be a quite suitable base to help companies in the medical device industry.

In fact, the MD industry is a branch of the biotechnology industry by definition. Since the Taiwanese government has identified the biotechnology industry as a star industry for the 21st century, a great deal of resources has been allocated to strengthen the competitiveness of Taiwan's biotechnology industry as well as medical device industry. The MD industry in Taiwan has been developing for over forty years and the annual quantity of many products have entered the top three of the world ranking, such as the electric scooter, ear thermometer, electronic sphygmomanometer, etc. Currently there are 705 medical device manufacturers in Taiwan (Biotechnology Industry in Taiwan, 2013)[7]. The advantages of the medical industry in Taiwan include comprehensive laws and regulations addressing medical devices, superior medical techniques and hospital quality, excellent management professionals and logistics capabilities, and a high technology base in fields such as ICT, advanced materials, precision processing, mold and die casting. These facts indicate that the medical device industry in Taiwan has quite a sound industrial basis and is globally competitive. Taiwan is, therefore, very suitable to develop the medical devices industry (Chen et al., 2010)[8].

After making an assessment according to the geographical strengths, regional industry system characteristics and national technology policy, the STSPB came to a consensus that the medical device industry is an appropriate industry to develop in the Southern Taiwan Science Park. An idea of a "Medical Device Industrial Cluster" thus emerged. In another feasibility study, the STSPB decided to initiate the Southern Taiwan Bio-Medical Biomedical Devices Cluster Project.

4. The Structure and Service Platform of the "Southern Taiwan Biomedical Devices Industrial Cluster Establishment Project"

From 2009, the "Southern Taiwan Biomedical Devices Industrial Cluster Establishment Project" was promoted by the STSPB and executed by the MIRDC. The structure of the project is shown in Figure 2. The proposed areas of this project include dental instrument systems, orthopedics instruments, cosmetic surgery equipment or instruments, medical alloys, and other sub-areas such as developing technology, training talents, and building a platform for research and development cooperation among potential bio-medical instrument producers. It aims to stimulate the development of a national bio-medical instrument industry cluster, inspire firms in the industry to be proactive in their research and develop in order to obtain necessary technology, and integrate relevant academic power and establish a platform for training professionals and relaying expertise among members of the bio-medical instrument industry; furthermore, to promote national competency, to construct an ideal and superior environment for academic research, and to integrate the national research and development force toward the required technology for training hi-tech professionals and promoting expertise in order to develop a thriving industry cluster.

[7] Industrial Development Bureau, Ministry of Economic Affairs, 2013, 'Biotechnology Industry in Taiwan'. (in Chinese).

[8] C.-W. Chen, S.-F. Kung, Y.-C. Yen, and B.-W. Huang, 2010, 'The Policy Making Process of the Kaohsiung Medical Device Special Zone in Southern Taiwan Science Park', IASP-ASPA Joint Conference.

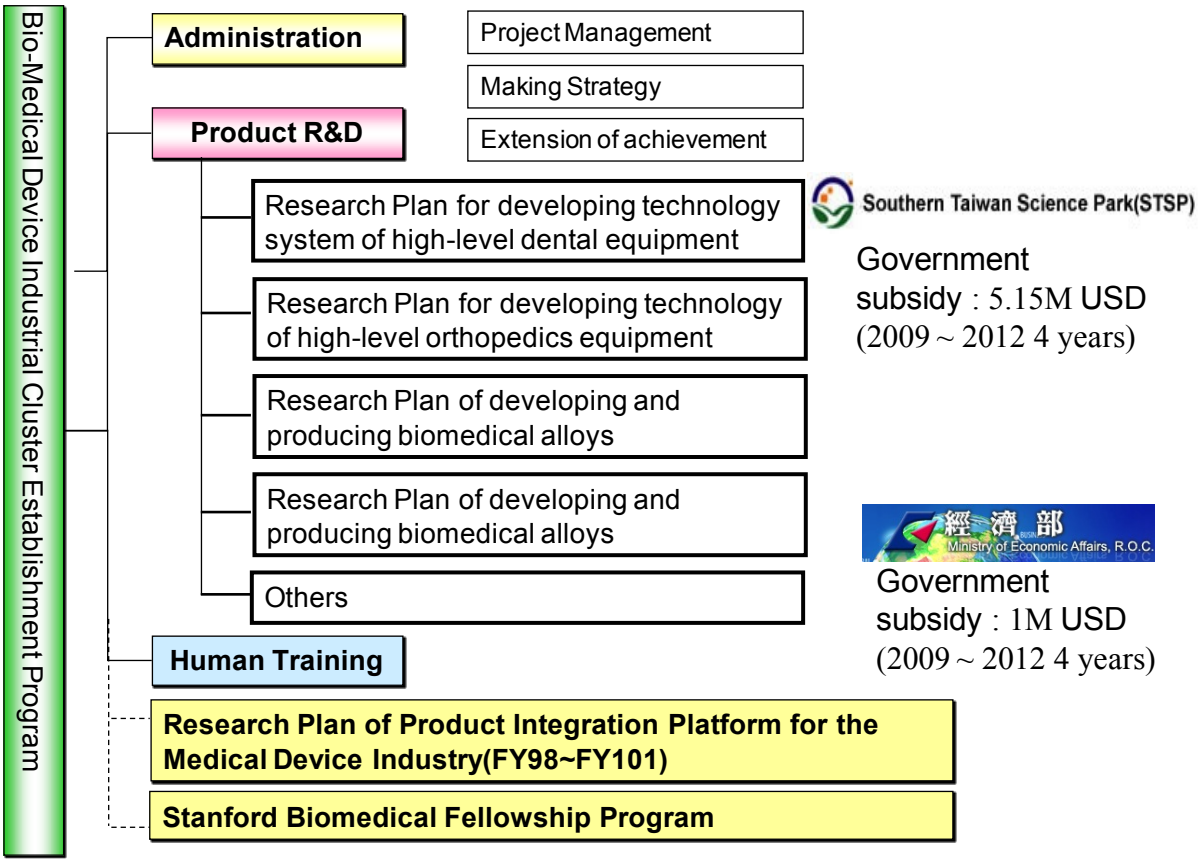

Figure 2: The structure of "Southern Taiwan Biomedical Devices Industrial Cluster Establishment Project"

One of the goals of this project includes upgrading and transforming the industry in Taiwan. This project is a method for members of the industry to tenant in the STSP more easily as the industry may be able to obtain financial support from the STSPB and technical and professional services from the MIRDC. The STSPB provides a subsidy for the industry to do research and development on medical device products. It could help the industry to upgrade products or transform traditional industrial company into a medical device industrial company quickly by obtaining financial support from the STSPB. Moreover, the STSPB is not only the sponsor but also a consultant. Both the STSPB and MIRDC help park enterprises with international marketing services such as providing a national pavilion at famous exhibitions as well as medical device regulation consulting services.

5. Case Study

5.1 About the case

Hung Chung, in the past, specialized in screw tooling devices. Due to the policy encouragement to actively promote the development of the medical device industry and subsidies granted by the Southern Taiwan Biomedical Devices Industrial Cluster Establishment Project, Hung Chung has successfully transformed itself into Taiwan's first Class three implantable medical device manufacturers. At its current stage, it is focused on the design, R&D, and manufacturing of dental implants and relevant medical devices with advanced precision machinery and coating treatment technology. In terms of hardware, Hung Chung is equipped with a Class 1000 Clean Room, an integrated cleaning and packing devices equivalent to the medical standards, and high quality laboratory equipment such as a fatigue testing machine, cupping machine, field emission scanning electron microscope, nano lithographic machine, and atomic force microscope. Hung Chung has also been present at the Incubation Center of Taipei Medical University and with the consultation and assistance

from the Research Center for Biomedical Implants and Microsurgery Devices, Hung Chung has been widely recognized for its high quality. It cooperates with National Kaohsiung University of Applied Science on material mechanics and engineering design. From screw tooling molds to dental implants, the products are not only a result of cooperating with the STSPB, firm, universities, hospitals, and public research institutes but also the process to understand and implement innovative concepts to product launch and marketing, the key to duplicating and applying these lessons to future university-industry cooperation. The main elements are described and analyzed below:

5.2 Milestone

Hung Chun Toolings Co., Ltd. was founded in May 1991, the initial staff of about 10 people, on turnover of NT only 500,000 and began the transition to the biomedical field in 2006. HC Bio-S has devoted into developing dental implant system ever since its establishment. With the full support from STSPB in developing biotechnology medical device cluster of the KSP, the application for moving into the KSP in May, 2008 was approved. The aids from Science Park and the various subsidies allowed HC Bio-S to expand the production on this particular high end medical device. In order to enhance the production level, HC Bio-S implemented GMP and ISO 13485 into quality management for medical device system to build professional factory mainly in developing, designing, and manufacturing dental implant in the early establishment.

2006

June	Team was assembled for evaluating marketing and technology development
August	Market and equipment in America expedition
October	Market and equipment in Europe expedition
December	With devotion in developing application nano material technique on biomedical implants and related products, office and lab were established at Taipei Medical University Innovation Incubation Center(Technology matching service platform, Clinical information platform)

2007

October	Application for residing in the Southern Taiwan Science Park and implementing GMP and ISO 13485 for dental implant manufacturer (Product accreditation platform)

Figure 3: The interior and exterior of Hung Chun's standard factory in KSP.

2008

October	Factory was completed with class 1000 clean room and was incorporated as part of the manufacturing
October	Obtained subsidy provided by Southern Taiwan Science Park for Innovation Research and Development with Collaboration between Industry and School

2009

July	Qualified by GMP for medical device manufacture factory
September	Obtained Biotechnology medical devise zone development subsidies for three years provided by Southern Taiwan Science Park
December	Successfully developed innovated hydrophilic dental implant with patent surface treatment technique named SLAffinity®

2010

March	Dental implant system with massive production which is named Ti-One 101 dental implant system
August	The first company to obtain Class three manufacturers certification for dental implant system in Taiwan
December	Signed Contracts with distributor Cosm-Lion Co., Ltd. for Taiwan (Product promotion platform)

2011

January	Ti-One®101 dental implant system launched
May	Obtained Silver award in Moscow International Salon of inventions and innovation technologies «Archimedes» for Ti-One®101 dental implant system
June	Obtained Gold award in Inventeco International Invention Show in Italy for Ti-One®101 dental implant system
June	Obtained 8th Taiwan National Innovation Award

October	HC Bio-S was considered as Innovative Biotechnology Medicine Company by Ministry of Economic Affairs
November	Obtained CE 0123 and ISO 13485 Certifications

2012

July	Obtained U.S.A. FDA certification
August	Signed distributor contract with A-Plus shine Bio-Med Co., Ltd. for Taiwan (Product promotion platform)

2013

February	Coland invested in Hung Chun to access to China dental market
March	Obtained Annual Taiwan Golden Root Awards for Ti-One®101 dental implant system

2014

Built the new factory

Figure4: The blueprint of the new factory of Hung Chun Bio-S Co., Ltd.

Figure 5: Milestone of Hung Chun Bio-S Co., Ltd.

5.3 STSPB played an important role as the "dominator" in the construction of the innovation ecosystem

Open innovation has been a prevalent innovation model in Europe and the US. It effectively connects concepts and products via open platforms. The key element of the platform operation is the dominator. As shown in international cases, most successful models are those platforms dominated by big enterprises such as Apple and Intel since they control technology as well as market scales and channels. Manufacturing is not a core skill, and therefore, manufacturing has been outsourced oversea. Unlike Europe and the US, innovation models are mostly initiated by small and medium enterprises (SMEs). For example, in Taiwan, 97% of its enterprises are SMEs and the platforms are hardly dominated by business owners. Even the most well-known A-team of Giant was led by the public sector at its initial stage and was later transferred to a company that would operate within the business ecosystem.

The medical device industry requires very complicated industrial technology and product screening and barriers of market entry are relatively tough. It was not easy for Taiwanese enterprises to enter the market as a late entrant. But along with improvements in the economic environment as well as the expectation of medical quality and treatment effectiveness, various types of advanced technologies have been applied to the development of medical devices. Generally, the existing market of medical devices can be easily replaced with equivalent products with better quality. Therefore, the medical device industry needs to increase expenditures on R&D more than traditional manufacturers to speed up product launches in order to survive. It is a technology intensive and labor less intensive industry and the key to success is continuous innovative R&D and meeting clinical demands.

Since medical devices are essential for human life, stricter standards are imposed on safety and effectiveness. Hence, each country government has regulated relevant management rules and regulations. Before coming to their markets, strict accreditations are required. In Europe and the US, rules and regulations require immediate recalls if accidents occur and statistical reports have to be provided. But the stricter standards in safety, reliability, and effectiveness often result in high costs

for the initial operation of small firms and again, small firms are likely to find it difficult to survive as well as enter the market.

In the end, the medical device industry involves professional medical behaviors and thus, the hospital system plays an influential role. The hospital system has been known as a professional and closed market and sales made to hospitals are done different from channels in other industries. Promotion methods need also be applied differently. Overall, industrial pulls tie to research, rules and regulations, and marketing.

Due to the above factors, even though Hung Chung had the mold making technology, it could not build a platform on its own that could integrate different organizations and resources. Relatively, the drive to transform was limited. The STSPB, as a governmental agency, again, unlike those managed by the private sector in Europe and the US, needed to take charge of the administration of the science parks and shoulder the responsibility of promoting industrial upgrading and local development. From the future prospect of investment invitation to the science parks, the SPSPB through the integration of central and local governmental resources is able to act as the platform dominator for construction. It was also because of the participation of this governmental agency that relevant enterprises felt more assured and were more willing to invest in resources for product transformation and technology upgrades. The importance of governmental participation in the innovation models can be observed in Taiwan and other Asian countries by reviewing the differences in intervention models and involvement levels.

5.4 The MIRDC played an important role in linking knowledge creation to enterprise creation

The ideas-to-markets chain starts with centers of knowledge creation. R&D increasingly depends on the collaboration between firms and universities. But the interests of the parties are not always well-aligned. University technology transfer offices, which have been growing in number over the past 20 years, are often more interested in maximizing their own revenue rather than maximizing venture formation. Unlike Europe and the US, Taiwan's public research institutes play an important role in closing the gap of knowledge creation among enterprises.

Although the government is willing to create the platform there are still some difficulties encountered by the government or academic institutions as they try to integrate resources alone. Unique national research institutions in Asia play a key role. From the ITRI in the past to the current MIRDC, national public research institutions do not only work with universities for technology cooperation and R&D but also to establish complete industrial chains via spin-offs. They now play a more active role in closing the gap between industry and academia and to help industries break through technology barriers. They themselves do not need to possess or research and develop complete technology and instead, through screening market information, they work with universities on R&D. They are also proactive third-party advisors of enterprises that help the firms to look for universities to solve issues related to production technology and marketing.

Hung Chung, for example, experienced a technology gap between the manufacturing of screws and artificial tooth roots and it needed the assistance of those in the medical field and in research institutions. The medical professionals analyzed and compared clinical data, surgery device designs, and advised on the pros and cons of existing implants. It also provided sufficient clinical information during product launches to allow the industry to give immediate feedback for the improvement of implants and machines. Academia drove the rapid growth of industrial technology in terms of processing and surface treatment, building the solid foundation of the KSP as the home of the dental

industrial cluster. In Stage II, academia, research institutions, and the medical field provided tests, accreditations, and planning services during product launches. Products, then, can be launched faster. In Stage III, marketing was assisted through the coordination of cluster products and integration of industry exhibition mechanisms. It was based on the B to C concept on the interactive platform to cooperate with the medical circle. By participating in professional dental annual galas and exhibitions, the B to B product marketing concept became the focus.

5.5 Introduction of technology and resources via innovative service platforms: the MIRDC as the gatekeeper for defining problems from product conceptualization to marketing and to re-distribute technology and resource investment.

In Taiwan, the majority of enterprises in the medical device industry are SMEs that are limited by manpower, technology, equipment, and capital. Hence, they can only concentrate their R&D strength on products, and they even have difficulties with completing simulations, tests, and test production at the R&D stage. There is a need to rely on professional knowledge provided by the R&D service platform to speed up innovation and transformation as well as to achieve the goal of maximizing industrial value. For this purpose, in the sub-projects of industrial technology R&D platforms, the following platforms have been developed:

1. Technology matching service platform

The purpose of this platform is to integrate the energy of relevant domestic and international research institutions and schools on medical device studies to form a complete service network and to establish a single window for the provision of quick access to R&D resources by tenant enterprises in order to provide quick product development.

2. Clinical information platform

The purpose of this project is to satisfy clinical information needs during the medical device product development process. Items addressed include (1) to improve clinic information exchange during the R&D process; (2) formation of professional teams and R&D discussions; and (3) pilot consultation and evaluation of clinical experiments. Through the operation of these three project items, the goal to provide the industry with clinical information can be achieved.

3. Product launch service platform：

The medical device industry has high market barriers, but after products are launched into the market, due to the requirements for accreditation and limits on promotion channels, they have a relatively long product life cycle and impressive profits compared to other industries. It is planned that with this sub-project, resources can be integrated before product launches to reduce costs and improve efficiency and service levels. According to this sub-project, two platforms are constructed for product accreditation and promotion:

(1) Product accreditation platform:

Ethylene Oxide (EtO) sterilization system, high-temperature sterilization equipment, and relevant sterilization test equipment are required to build a GLP sterilization laboratory (including sterilization system and a packing material aging and fatigue test lab). By working with existing vendors to provide sterilization services and training for practical operators, we help enterprises to improve sterilization effectiveness and manufacturing processes. Additionally, an investigation on the gaps in the domestic sterilization industry has been conducted to develop a new sterilization method to replace the

traditional one, to assist with technology updating for the sterilization industry, and to improve domestic medical quality.

The product accreditation service platform will be built and the MIRDC will take charge of the operation. After the MIRDC becomes the accreditation center for medical device products, the professional skills for accreditation services will be cultivated. Meanwhile, the resources of Taiwan's relevant private accreditation organizations can be integrated for more effective accreditation compliance. Cooperation with international and EU notified bodies can also be facilitated for the mutual acceptance of test reports to save the costs and time of enterprises that are spent on identical tests and reduce the time needed for product launches.

(2) Product promotion platform

The purpose of this project is to construct a promotion platform that helps to boost the overall image of Taiwan's medical device industry. Through the establishment of the National Image Pavilion of High-End Products, oversea technology matching seminars, and oversea expansion, the visibility of Taiwan's medical device products has been enhanced. Furthermore, a brand mechanism shall be jointly created to achieve strategic alliances and joint Internet promotions among domestic brand leaders and medical device makers. At the same time, the cluster exhibition is designated in the medical device area to boost product visibility and increase matching opportunities for agents.

In the case of Hung Chun, through the technology matching mechanism of STSPB project and cooperation with academia and research institution, such as surface treatment technology from Metal Industries Research & Development Centre and clinicians from Taipei Medical University, the research is more likely to success. In fact, the STSPB project includes medical regulation consultation, and it combines the consultation from Food and Drug Administration to assist the company, Hung Chun, in obtaining GMP and ISO13485 certification. Further, the subsidies of STSPB project reduce the cost of manpower. Finally, after the company obtains the above-mentioned certifications, the operation of the product promotion platform starts, which aims at facilitating the launch of a new product, construction of the product show room, matching mechanism of distributors, and assistance of medical exhibitions, and enabling the company to receive more orders.

6. Conclusion

With the development experience of the medical device industry, Taiwan is successfully creating a series of innovative service platforms that will not be easy to duplicate in other countries. However, there are several important mechanisms in this study that can serve as a reference for other countries.

First, countries in the initial stages of industrial development can give enterprises more confidence by constructing platforms and operating mechanisms. Then after entering the development stage, platforms should be given to the private sector for free operation. As a result, this innovative platform in Taiwan is considered a task oriented model and only when its operation is transferred to the private sector will sustainability will be achieved.

Second, several studies around the world have focused on the innovations of Taiwan's public research institutions. In the past, the dominator used to be enterprises derived from public research institutions and there had been fewer barriers to communications between the industry, academia, and research institutions. The system in operation at the time was not as complicated as it is now. Hence, facing the current complicated business ecosystem, public research institutions need to play a role in linking knowledge creation and business creation. There is, thus, a need for Taiwan to establish public research institutions with different industrial attributes. If a country wants to develop its newly emerging industries based on SMEs, it can consider the feasibility to reduce losses in transaction costs.

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