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Received 13 March 2014
Revised 4 May 2014
Accepted 6 May 2014

# Incubator policy to support entrepreneurial development, technology transfer and commercialization

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## Abstract

**Purpose** – The purpose of this paper is to study the incubator policy to support entrepreneurial development. In particular, the study reviews the incubation programs and strategies of technology transfer and commercialization as well as the innovation policies to support innovation commercialization in Thailand, based on the Triple Helix model.

**Design/methodology/approach** – This study employs the use of case study methodology to understand in-depth the operations of major university business incubators (UBIs) and technology business incubators in enhancing the process of technology commercialization. The study examines case studies of leading UBIs (Mahidol University, Chulalongkorn University and King Mongkut's University of Technology Thonburi) and science and technology incubators of the National Science and Technology Agency (NSTDA) and the National Innovation Agency (NIA). The operations and incubating policies are analyzed through the lens of Triple Helix model. The interviews were carried out using the semi-structured questionnaire to understand the views of trilateral parties (the government, university and industry) related to the concept of Triple Helix model. The interviews were carried out with major stakeholders including policy makers, policy analysts, government officials, managers running incubators, incubates, university professors, research managers. Interview data were supported by an examination of secondary data so as to provide a cross check on internal validity.

**Findings** – The results have shown that the incubation program is one of the major policy mechanisms to support innovation and suggested that UBIs should act as an intermediary between the spheres of university and industry to provide interactive linkages and promote effective utilization of university research. The empirical study provides insightful implications on the move toward the entrepreneurial university and the dynamics of the Triple Helix system in stimulating innovation development and diffusion.

**Originality/value** – By focussing on the major UBIs and technology business incubators in one of the Asian Tigers – Thailand, the study offers the model of university technology commercialization which could be applied to other developing economies. The study provides useful lessons and insights on the process of technology transfer and commercialization through the university incubation mechanism (university technology commercialization).

**Keywords** Technology transfer, Triple Helix, Business incubator, Entrepreneurial development, Technology commercialization

**Paper type** Case study

## 1. Introduction

Strategically, Thailand is one of the emerging tigers in Asia attempting to become a knowledge-based economy through deepening national technological capabilities. The economic growth of Thailand is one of the world's fastest growing with an average growth rate of 5 percent per year. The Thai government has introduced the university incubation program as a means to promote job creation, entrepreneurial development, innovation and economic growth. Thailand attempts to use business and technology

World Journal of Entrepreneurship, Management and Sustainable Development
Vol. 10 No. 4, 2014
pp. 334-351

2042-5961
DOI 10.1108/WJEMSD-03-2014-0008

incubators in transition from lower middle-income economy toward upper middle-income economy after its recovery from the Asian financial crisis. This paper discusses the capacity for innovation with a focus on technological infrastructure of incubators to support innovative activities in Thailand. The study focusses on the process of technology transfer and entrepreneurial development through university business incubator (UBI).

The overview of economic and innovation performance of Thailand is shown in Table I. In 2012, Thailand was ranked 30th (out of 59 countries) according to the International Institute for Management Development world competitiveness ranking and 38th (out of 144 countries) according to the World Economic Forum Global Competitiveness Report.

The paper is organized as follows. Section 2 reviews the theoretical framework on technology incubator and the Triple Helix model. Section 3 provides the background of research universities and policies to support university technology commercialization. Section 4 discusses the research methodology. Section 5 presents the findings with regard to the role of the government policies and business incubation program in

| Indicator | Year | Thailand |
|---|---|---|
| Population (million) | 2012 | 69.5 |
| GDP | 2012 | USD366 billion |
| GDP growth (%) | 2011 | 0.1 |
| | 2012 | 6.4 |
| IMD world competitiveness ranking | 2010 | 26 |
| | 2011 | 27 |
| | 2012 | 30 |
| *IMD world competitiveness ranking* | 2012 | 30 |
| Ranking in economic performance | 2012 | 15 |
| Ranking in government efficiency | 2012 | 26 |
| Ranking in business efficiency | 2012 | 23 |
| Ranking in infrastructure | 2012 | 49 |
| Ranking in scientific infrastructure | 2012 | 40 |
| Ranking in technological infrastructure | 2012 | 50 |
| WEF competitiveness ranking | 2010 | 38 |
| | 2011 | 39 |
| | 2012 | 38 |
| *WEF competitiveness ranking* | 2012 | 38 |
| Ranking in basic requirements | 2012 | 45 |
| Ranking in efficiency enhancers | 2012 | 47 |
| Ranking in technological readiness | 2012 | 84 |
| Ranking in innovation and sophistication factors | 2012 | 55 |
| Ranking in innovation | 2012 | 68 |
| *Knowledge Economy Index (KEI) ranking* | 2012 | 66 |
| KEI Index | 2012 | 5.21 |
| Research and development (R&D) expenditure | 2012 | USD740 million |
| % of R&D expenditure to GDP (approximate) | 2012 | 0.24% |
| Proportion of R&D spending (public and private) | 2012 | 60:40 |

**Sources:** The author's design, based on the World Competitiveness Scoreboard (various years) by International Institute for Management Development (IMD), World Economic Forum (WEF) Global Competitiveness Report, World Bank, United Nations Conference on Trade and Development (UNCTAD)

**Table I.**
Overview of economic and innovation performance of Thailand

supporting innovation commercialization as well as the model of university technology commercialization in Thailand. The analyses of findings cover case studies of UBIs and technology business incubators. The case studies of UBIs include three major universities in Thailand: Mahidol University, Chulalongkorn University and King Mongkut's University of Technology Thonburi (KMUTT) whereas the science and technology incubator cases include national incubation centers of National Science and Technology Agency (NSTDA) and National Innovation Agency (NIA). The analyses in this section also include the multi-faceted discussions of policy issues concerning the capacity of university technology transfer and commercialization. The analyses and discussions are based on the Triple Helix model emphasizing the integration of three institutional spheres (university-industry-government relations). Section 6 concludes the paper by drawing lessons and insights that can be used as policy guidelines for other developing economies in the process of technology transfer and commercialization through the university incubation mechanism (university technology commercialization). It also presents the research implications, managerial implications and recommends avenues for future research.

## 2. Theoretical framework

### *2.1 Technology incubator*

Technology incubators provide a mechanism for technology transfer and commercialization. The incubation program helps improve small- and medium-sized enterprises' (SMEs) competitiveness by providing supportive environments for start-up ventures to help them survive and grow. Business incubator and technology incubator are a kind of infrastructure geared to support and nurture the development of SMEs (Barrow, 2001; Bøllingtof and Ulhøi, 2005; Tsai *et al.*, 2009; Barbero *et al.*, 2012; Somsuk *et al.*, 2012). Business incubator provides business assistance to firms in the early stages of development to increase firm survival rates (Bøllingtof and Ulhøi, 2005; Bøllingtof, 2012). Business incubators typically provide office space, administrative support and mentoring services (Peters *et al.*, 2004). Technology incubators are business incubators focussing on new companies with advanced technologies and often have the characteristics shown in Table II. Generally, technology incubators are known under various names such as innovation centers, science parks and technology centers (OECD, 1997). The incubator resources could help young entrepreneurial firms access new knowledge, expertise and industrial networks. The business incubation program also helps support the commercialization of new technologies, job creation leading to the wealth of nation (Barrow, 2001; Rothschild and Darr, 2005; Al-Mubaraki and Busler, 2010, 2014).

| Host institution | University | Research facilities | Production facilities | Technology transfer office | Park facilities | Incubator | Venture capital |
|---|---|---|---|---|---|---|---|
| Science and research parks | x | x | o | x | x | x | o |
| Innovation centre | o | o | x | x | o | x | o |
| Technology park | x | x | x | x | x | x | x |

**Notes:** x, Essential or integrated feature; o, desirable feature; accessible through science and technology (S&T) infrastructure and industry

**Source:** The Working Group on Innovation and Technology Policy (TIP) of the OECD Committee for Scientific and Technological Policy (CSTP)

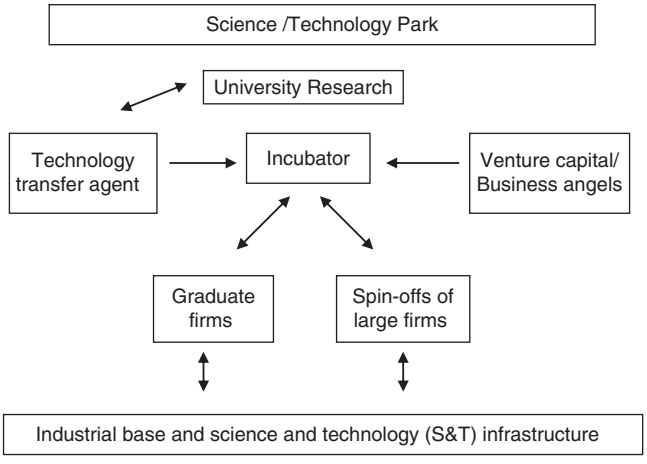
**Table II.**
Characteristics of technology incubators

From the innovation policy perspective, the incubation program is intended to help promote SME entrepreneurship activities, technological development and transfer. The governments of many developing countries now use the incubator policy to develop new enterprises, which in turn can harness innovative capacity. However, the success of the business incubation process is often determined by how well technology is transferred from the labs to the industries (Markman *et al.*, 2005; Al-Mubaraki and Busler, 2010, 2014). Given that the business incubators provide a mechanism for commercializing research and development (R&D), it is not surprising that many researchers have tried to study the impacts of business incubators and technology transfer. Interestingly, the performance of business incubators can be assessed in various dimensions. From the literature review, the indicators of incubator performance are, for example, the occupancy rate, the number or proportion of firms graduated, the number of business spin-offs, the number of jobs created, the number of patent applications per firm, etc. (Colombo and Delmastro, 2002; Chan and Lau, 2005; Hackett and Dilts, 2008; Schwartz and Hornych, 2010). In the recent study by Özdemir and Şehitoğlu (2013), they have developed the indicators for assessing the performance of business incubators in the case of Turkey by using various measures including economic performance, innovative output, interaction with similar businesses and universities, information networks and financial supports and entrepreneurs.

Figure 1 demonstrates a schematic presentation of technology incubator. The UBI provides services such as laboratories and equipment, management and technical support, legal advice and networking which add value to incubating companies (OECD, 1997, 2010). Given the high risks associated with the formation of new enterprises, many governments attempt to use technology incubator as a vehicle for linking technology, entrepreneurs, small and large firms and sources of capital for technology development and commercialization (OECD, 1997; Lofsten and Lindelof, 2005; McAdam and McAdam, 2008; Wonglimpiyarat, 2010).

### *2.2 Triple Helix model*

Given that innovation is increasingly regarded as an important factor in driving economic growth, the nation needs policy coordination among various agents




**Source:** OECD (1997)

**Figure 1.**
Schematic presentation of technology incubator

participating in the innovation system to promote sustainable economic growth and long-term competitiveness (Lundvall, 1998; Freeman, 1987). The governments in developing countries are considered the national agents playing a crucial role in strengthening technological capability to support the national system of innovation. Promoting S&T specialization would influence a nation's future economic performance since countries with technological strengths in rising areas are likely to benefit from increasing returns, which in turn allow them to expand technological and production capabilities (Archibugi and Michie, 1997).

Figure 2 illustrates the Triple Helix model emphasizing the integration of three institutional spheres (university-industry-government relations). The Triple Helix model has been regarded as a valuable framework for analyzing the linkages and the process of building an effective innovation system (Etzkowitz, 2002, 2004, 2011; Etzkowitz and Leydesdorff, 1998, 2000; Nishizawa, 2011; Khan and Park, 2013). This model is similar to the concept of the national innovation system (Lundvall, 1992, 1998, 1999, 2003) emphasizing the importance of linkages and interactions among the institutions, private and public firms, universities and government agencies as well as policies to promote economic development. The networks connecting the productive sector and the government aim to enhance economic development and competitiveness. The Triple Helix model postulates an interaction among the institutional spheres to foster the conditions for innovation in both advanced industrial and developing economies. (Etzkowitz, 2002, 2004, 2011; Etzkowitz and Leydesdorff, 1998, 2000; McEvily *et al.*, 2004). The interactions help facilitate the move of technologies from universities/research organizations to the private sector. It is argued that the government policies should support these interactions for knowledge generation and industrial development (Etzkowitz and Leydesdorff, 1998, 2000; Gay and Dousset, 2005).

## 3. Background of research universities and policies to support university technology commercialization

The Thai government has enacted various sets of policies and programs as a means to revive the economy after the 1997 financial crisis. The National Economic and Social

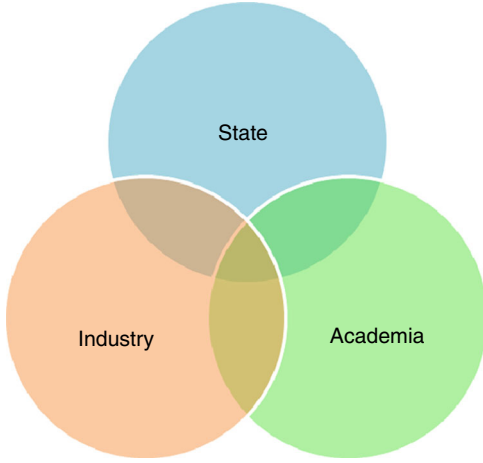



**Figure 2.**
Triple Helix model

**Sources:** Etzkowitz (2002), Etzkowitz and Leydesdorff (1998, 2000)

Development Plan and SME Promotion Master Plan are major SME policies to support entrepreneurship. Realizing the importance of SMEs in terms of job creation and economic growth, the government has paid special attention toward supporting new start-ups and entrepreneurial ventures. The 11th National Economic and Social Development Plan (Years 2012-2016) is a continuation of the tenth plan (Years 2007-2011) placing emphasis on SME development in order to meet the challenges of the twenty-first century.

The Thai government has played a significant role in establishing the national research universities so as to increase research outputs in the fields of study that are important to national competitiveness. To enhance national competitiveness, the government has set the policies to develop the National Research University program in 2009. The Office of the Higher Education Commission has selected nine universities as flagship national research universities to improve research capacity and promote university research for production which would further support social and economic development. The national research universities are Chulalongkorn University, Thammasat University, Mahidol University, Kasetsart University, KMUTT, Chiang Mai University, Khon Kaen University, Suranaree University of Technology and Prince of Songkla University. The purpose of establishing national research universities is to encourage entrepreneurship and research commercialization.

Thailand can be seen as a late adopter of SME policy to support entrepreneurial development (Thailand adopted policies later than other Asian countries like Taiwan and Singapore whose SME innovation policies were adopted since the 1980s). A set of entrepreneurship policies (termed "Thaksinomics policies") was implemented in the late 1990s to upgrade the capacities of SMEs after the Asian financial crisis. The first SME Promotion Master Plan (Years 2002-2006) and the second SME Promotion Master Plan (Years 2007-2011) were initiated to mainly solve the problems on financial crisis and support the revival of SMEs. The Bank of Thailand Financial Sector Master Plan II (Years 2010-2014) was introduced as a national entrepreneurship policy to support and develop entrepreneurs through policy-based institutions (commercial banks and financial institutions).

The Thai government, through the Office of the Higher Education Commission, Ministry of Education, also launched the innovation policy of setting up UBIs with an aim to support new ventures which would thereby create jobs and strengthen the country's economic competitiveness. The UBIs supported by the Office of the Higher Education Commission are shown in Table III. The purpose of establishing UBIs is to encourage wide use of university research as well as of intellectual properties (IPs). Currently, there are 35 UBIs established with 327 cases incubated and 60 new enterprises established (OECD, 2011). The UBI has been implemented to foster linkages between university and industry so as to improve the process of technology commercialization.

## 4. Research methodology

This study is a qualitative research using the case study methodology (Eisenhardt, 1989; Yin, 2003, 2013). The research aims to study the incubator policy to support entrepreneurial development and in particular the role of business incubation program to support technology transfer and innovation commercialization. Therefore, it seems reasonable to employ the case study research in order to understand in-depth the logical or causal drivers of phenomena (rather than statistical generalization). The sample size in this study covers the case studies of UBIs and technology business incubators. The case studies of UBIs include three major universities in

| | Name of university with business incubators |
|---|---|
| 1. | Chulalongkorn University |
| 2. | Dhonburi Rajabhat University |
| 3. | Kasetsart University |
| 4. | King Mongkut's Institute of Technology Ladkrabang |
| 5. | King Mongkut's Institute of Technology North Bangkok |
| 6. | King Mongkut's University of Technology Thonburi |
| 7. | Mahidol University |
| 8. | Nakhon Sawan Rajabhat University |
| 9. | Nakhon Pathom Rajabhat University |
| 10. | Naresuan University |
| 11. | Rajamangala University of Technology Thanyaburi |
| 12. | Silpakorn University |
| 13. | Srinakharinwirot University |
| 14. | Suan Dusit Rajabhat University |
| 15. | Suan Sunandha Rajabhat University |
| 16. | Thammasat University |
| 17. | Burapha University |
| 18. | Buriram Rajabhat University |
| 19. | Khon Kaen University |
| 20. | Loei Rajabhat University |
| 21. | Mahasarakham University |
| 22. | Nakhon Ratchasima Rajabhat University |
| 23. | Rajamangala University of Technology Isaan |
| 24. | Suranaree University of Technology |
| 25. | Surindra Rajabhat University |
| 26. | Ubon Ratchathani University |
| 27. | Chiangmai University |
| 28. | Chiangrai Rajabhat University |
| 29. | Mae Fah Luang University |
| 30. | Maejo University |
| 31. | Phuket Rajabhat University |
| 32. | Prince of Songkla University |
| 33. | Suratthani Rajabhat University |
| 34. | Walailak University |
| 35. | Yala Rajabhat University |

**Source:** The office of the Higher Education Commission (2014)

**Table III.**
List of university business incubators (UBIs) in Thailand

Thailand: Mahidol University, Chulalongkorn University and KMUTT whereas the science and technology incubator cases include national incubation centers of NSTDA and NIA.

The analyses focus on the operations of major UBIs and technology business incubators in enhancing the process of technology commercialization. The operations and incubating policies are analyzed through the lens of Triple Helix model. The interviews were carried out using the semi-structured questionnaire to understand the views of trilateral parties (the government, university and industry) related to the concept of Triple Helix model. The empirical analysis is based on 39 interviews with a range of stakeholders including policy makers, policy analysts, government officials, managers running incubators, incubatees, university professors, research managers. To understand the process of technology transfer and entrepreneurial development

through the business incubation process, the research attempts to answer the questions as follows:

(1) How the government policies and business incubation program could support innovation commercialization in Thailand?

(2) What is the model of university technology commercialization in Thailand?

The analyses and discussions are based on the Triple Helix model and the results are based on the study of UBIs and technology business incubators. For the purpose of triangulation, the research derives evidence from multiple sources including the use of documentary data and a collection of interviews. Taking into account the research design of this study, the research begins by undertaking the search for secondary data to gain a broad understanding on the points/themes of research. The concepts on policies and the role of institutions according to the Triple Helix model then guide the formulation of variables used in the semi-structured questionnaire. The data gathered from interviews are then analyzed and supported by an examination of secondary data so as to provide a cross check on internal validity. The use of triangulation thereby increases the robustness of results as the findings can be strengthened through cross-validation of multiple data sources (Benbasat *et al.*, 1987; Jonsen and Jehn, 2006). The use of triangulation also helps reduce subjectivity in this qualitative research study.

## 5. Analyses of findings

The analyses of findings in this section attempt to answer the research questions set out in Section 4:

(1) How the government policies and business incubation program could support innovation commercialization in Thailand?

(2) What is the model of university technology commercialization in Thailand?

### *5.1 How the government policies and business incubation program could support innovation commercialization in Thailand?*

Enhancing the innovative capacity has assumed increasing importance in the national competitiveness agenda of Thailand. The Thai government has introduced a number of policy measures to promote technology transfer and entrepreneurial development. Importantly, the incubation program is one of the policy mechanisms to support innovation in SMEs in Thailand. The UBIs program was coordinated by the Office of Commission on Higher Education (CHE) and universities to provide entrepreneurial mentoring and advisory services. Table IV presents the analysis of the operations of major UBIs and technology business incubators to enhance technology commercialization in Thailand.

The case study focusses on leading UBIs (cases of Mahidol University, Chulalongkorn University and KMUTT) and national technology business incubators (cases of the National Science and Technology Development Agency and National Innovation Agency). The UBIs of Mahidol University, Chulalongkorn University and KMUTT are selected because they represent major authorized UBIs and also are recognized as major national research universities in Thailand. The NSTDA and the NIA under the management of the Ministry of Science and Technology are major technology business incubators providing incubation services to support the entrepreneurial process.

The Thai government has introduced a range of policies to revive its economic crisis after the Asian financial crisis embracing the incubator policy to support entrepreneurial

**Table IV.**
The operations of major university business incubators and technology business incubators in Thailand

| | University business incubators | | | Technology business incubators | |
|---|---|---|---|---|---|
| Year of establishment | Mahidol University 2004 | Chulalongkorn University 2004 | King Mongkut's University of Technology Thonburi (KMUTT) 2005 | National Science and Technology Development Agency (NSTDA) 2001 | National Innovation Agency (NIA) 2011 |
| Incubating policies | Policies focused on supporting start-up companies and projects having commercial potential<br>The incubator has clear policies and mechanisms to form spin-off companies | Policies focused on providing true incubation services with intellectual property (IP) management and VC support programs | Policies focused on using the networks within and outside the university in making use of KMUTT research laboratories, university personnel/ faculties and providing marketing services | Policies focused on funding early-stage firms to provide incubation support via Science Park and Software Park<br>Provide incubation services according to the venture life cycle stages of pre-incubation, incubation and post-incubation | Policies focused on risk reduction investments<br>Provide late stage investments to finance firms already generating sales with private sector financial holding |
| Area of support | Healthcare, medicine, life sciences, medical equipment, biological and biochemical materials | Agricultural technology, health and medical technology, educational technology | Material science, biochemistry, composites materials, nanotechnology, agricultural technology | Major technologies of genetic engineering, biotechnology, metal, materials, electronics, computer, nanotechnology | Major technologies of bio-business, eco-industry, design and solutions |
| Operational functions | Provide technology communalization programs, inventor forum, entrepreneurial know-how and training services<br>Establish Good Manufacturing Practice (GMP) plant | Implement the cluster support program in line with the national clusters and competitiveness agenda<br>The incubator is managed under the University Intellectual Property | Provide matched funding, training and advisory services in marketing new product development<br>Establish collaborative links with NSTDA's Industrial Technology Assistance Program (ITAP) program to support entrepreneurial start-ups | Project-based operation supporting research projects in the stages of pre-incubation, incubation and post-incubation<br>Cooperation and coordination with financial institutions to provide financial assistance and with the | Facilitate access to finance via collaboration with 9 financial institutions and make appropriate referrals to network of specialists<br>Innovation Park supports innovation- |

(*continued*)

| | University business incubators | | | Technology business incubators | |
|---|---|---|---|---|---|
| Year of establishment | Mahidol University 2004 | Chulalongkorn University 2004 | King Mongkut's University of Technology Thonburi (KMUTT) 2005 | National Science and Technology Development Agency (NSTDA) 2001 | National Innovation Agency (NIA) 2011 |
| | for drug production Support the university spin-offs through Stang Holding Company Limited | Institute to incubate firms that use technology developed by the university Provide entrepreneurial support to students and alumni interested in developing early-stage ventures | Set up Student Entrepreneur Club to encourage new start-up businesses | Revenue Department to provide 200% R&D tax relief | based projects with grants, zero-interest rate loans and VC financing |
| No. of patents granted to university from 1995-2004 | 15 | 19 | 36 | n/a | n/a |

**Source:** The author's design, based on the annual reports of the university business incubators and technology business incubators and interview data

**Table IV.**

development. Most UBIs were set up in 2004-2005 (as can be seen in Table IV) to support high-potential projects which could be further developed to become university spin-off companies. In particular, the UBIs support university faculties, researchers and students to start new ventures from research outputs/projects. Currently, UBIs of Mahidol University, Chulalongkorn University and KMUTT received USD 3.09-15.43 annually to develop their R&D capacities. In 2013, the Office of CHE, Ministry of Education, has set up a USD172 million venture capital (VC) fund to support entrepreneurial start-ups with an aim to create 5,000-10,000 new enterprises annually. Taking into account the operation of technology business incubator, the operation of NSTDA's Science Park and NIA's Innovation Park is structured in clusters to provide necessary infrastructure for facilitating technology transfers of UBIs. The linkages between NSTDA's Science Park and NIA's Innovation Park with UBIs help utilize the university research-based knowledge and increase the survival rate of university spin-offs.

At present, the process of technology transfer from university to industry is not effective in terms of bringing academic research toward commercialization. Most of the university research is in the embryonic stage and could not reach the marketplace. Although the government has introduced various entrepreneurship policies/programs to support SMEs, the public innovation schemes for SMEs are seen as inefficient and bureaucratic, obstructing the process of commercializing university research. The main problem is a lack of policy coherence among the government agencies dealing with SMEs as many programs are overlapping among those launched by the Ministry of Science and Technology and the Ministry of Industry. Further, there is a limitation in terms of providing finance to SMEs due to scarcity of VC funds and private equity investments. There are no networks of venture capitalists for firms seeking venture funding. Also, the university researchers suffer from a lack of government funding support and discontinuities of operations due to frequent changes of the government and policies.

Taking into account the operation of technology business incubators of NSTDA and NIA, the development of technology clusters, the linkages and interactions among the institutions are relatively weak. As the technology business incubators under the Ministry of Science and Technology, it is argued that the government should realign its policies to focus on increasing the R&D capacity of research universities and other research institutions through public and private sector partnerships. To promote commercialization of university and public R&D, it needs more linkages and interactions with the national research universities to enhance the process of research collaboration and brining potential technology to innovation commercialization. Furthermore, the government policies should focus on facilitating the transfer of knowledge from R&D programs to industry (enhancing the mechanisms of bringing the public research to the marketplace). Although the Thai government has currently tried to identify important clusters that are necessary for accelerating its technological innovation, the linkages and interactions between the Innovation Park and Science Park themselves (linkages between science, technology, and innovation of NSTDA and NIA) are not effective and need to be improved so as to promote technology transfer and commercialization.

*5.2 What is the model of university technology commercialization in Thailand?*

The analyses in Section 5.1 reveal the operation of business incubation program in Thailand whereby the government policies have influence on the activities of business

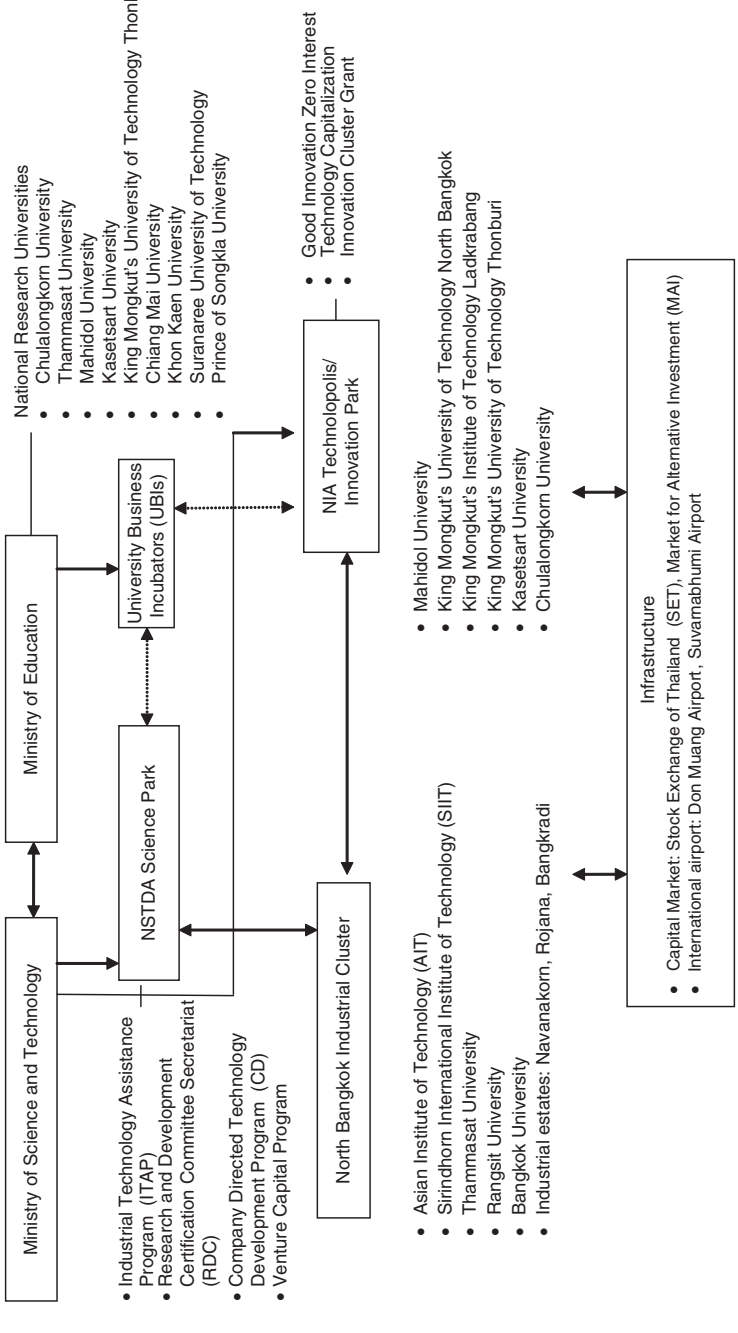
incubators. Indeed, the incubator policy to assist SMEs can be seen as an important link between academia and industry under the Triple Helix model. Figure 3 attempts to portray the model of university technology commercialization in Thailand. It can be seen that the UBIs operate under management of the Ministry of Education. Based on the Triple Helix model of tri-lateral networks among the government, university and industry (Figure 2), the national research universities assume an important role in the facilitation of development projects associated with the universities' R&D.

It is interesting to note that the technology clusters of Science Park in the northern Bangkok and Technolopolis or Innovation Park in a metropolitan area were established to emulate the success of US Silicon Valley. The Science Park is situated in the area surrounded by universities and industries. In the northern Bangkok Industrial Cluster, Asian Institute of Technology, Sirindhorn International Institute of Technology, Thammasat University, Rangsit University, Bangkok University were formed near the areas of Navanakorn, Rojana, Bangkradi industrial estates to enhance R&D collaboration and commercialization. Taking into account the Triple Helix characteristics, it can be seen that the Technolopolis or Innovation Park of the NIA is located at the nexus of universities in central business district of Bangkok. It is surrounded by many universities: Mahidol University, KMUTT north Bangkok, KMUTT Ladkrabang, KMUTT, Kasetsart University, Chulalongkorn University. These universities are in the Bangkok metropolitan area and in close proximity to industrial estate and export zones.

Although the national clusters are established to improve the capacity to innovate, the linkages and interactions among the institutions are relatively weak. That is to say, while the Triple Helix settings are represented by the clusters shown in Figure 3, there is a lack of active interactions among the state/government, industry and academia. Major problems/rationales to support the argument that the government should play more active role in fostering linkages between the industry and academia are shown in Table V. These problems/rationales are drawn from the interviews. Although the UBI mechanism has been implemented to promote linkages between university and industry, the process of commercializing university IPs through licensing/technology transfer office is not very successful in Thailand. During the years 1995-2004, there were 140 patents awarded to the universities but only six of them were transferred to industry, showing the low level of university research commercialization (Krisnachinda, 2009).

Under the Triple Helix model, the successful commercialization of university technologies needs strong interactions among academia, industry, policies and stimuli supported by the government. To encourage the process of university research commercialization, the operation of UBIs should have close coordination with the commercialized unit of university technology transfer office/technology licensing office. Further, the process of commercialization needs financial and tax incentives to improve IP exploitation and promote IP commercialization apart from the government incentive of 200 percent tax deduction for R&D expenses.

It is argued that the UBIs should work collaboratively with the government agencies such as NSTDA Science Park and NIA Technolopolis/Innovation Park to promote the utilization of university research. In particular, the networks of angel and VC investors should be established and maintained closely with the university incubators. Given the difficulties faced by firms in accessing financial resources during their early stages of business development, the UBIs should act as an intermediary to give advice and guidance in helping start-up firms get access to alternative sources of finance. In the future, the move toward the entrepreneurial university may need the




**Source:** The author's design, based on the analyses of secondary data and interview results

**Figure 3.**
Model of university technology commercialization in Thailand

| Problems/Rationales |
| --- |
| *Weak linkages between the industry and academia*<br>Although the universities are regarded as the source of creating basic research, their linkages with the private sector are relatively weak. Such weak linkages thus hamper the ability to bring their research towards the commercialization stage |
| *Lack of policies to support spin-offs*<br>Currently, there are virtually no selective government policies to support business spin-offs. Most of the incubated firms have financial constraints which limit the chance to grow or expand their business operations. The interviewees suggest that the government should establish a specific agency responsible for providing hands-on support to the firms graduating from the university business incubator and technology business incubator (the post graduation period) |
| *Difficulties in knowledge sharing and knowledge transfer*<br>At present, Thailand faces major problems concerning lack of human capital with skills in managing incubators. To alleviate these problems, the interviewees suggest that the policy makers should lower the costs of innovation by facilitating the collective learning processes around business incubation management as well as creating adequate institutional framework to facilitate knowledge sharing and knowledge transfer from abroad |
| *Embryonic innovation system*<br>The Thai innovation system is still embryonic and lack continuing policies to support public-private investments in science, technology and innovation due to frequent changes of government and cabinet reshuffle which make the policies inconsistent (inefficient policy implementation) |

**Source:** The author's design (summarized from the research report and interviews)

**Table V.**
Major problems/rationales behind the need for an active role of the government

university-owned VC fund to facilitate technology transfer and commercialization. To catalyze cluster development, the key performance indicator should include the number of university spin-offs as measurement of incubator performance. In line with the knowledge-based strategy for economic growth of Thailand, the government policies on university financing should be developed to increase efficiency in business incubation and technology commercialization.

## 6. Conclusions, research implications and recommendations

*Conclusions*

This paper explores the incubator policy and incubation programs to support entrepreneurial development in Thailand. The study also reviews the strategies of technology transfer and commercialization as well as the government policies to support innovation commercialization, based on the Triple Helix model. The case analyses in this research include the major UBIs and technology business incubators. The UBIs comprise the incubators operating under the major national research universities of Mahidol University, Chulalongkorn University and KMUTT. The cases of technology business incubators comprise the incubators operating under the national agencies of NSTDA and NIA, Ministry of Science and Technology.

The study has shown that the Thai government has introduced various policies and programs to encourage the creation of new entrepreneurs as well as to support the development of technological and innovative capabilities of firms, for example, the SME Promotion Master Plan, the Bank of Thailand Financial Sector Master Plan, the National Economic and Social Development Plan. In the process of entrepreneurial development, technology clusters of Science Park in the northern Bangkok and Technolopolis/Innovation Park provide necessary infrastructure that could help reduce the risks in new venture formation. However, the findings have shown that the process

of technology transfer from university to industry is not effective in terms of bringing academic research toward commercialization. Although the Thai government attempts to use the incubation program as a means of reviving its economies after the Asian financial crisis, the results have shown weak network linkages (inactive interactions among the industries, universities and government agencies) to drive the process of technology commercialization. It is argued that the government should play an active role in setting up VC funds to support SMEs and remedy the problems of under-investments in the entrepreneurial start-ups.

*Research implications and managerial implications*

The analyses of findings in this study have shown that the aspect of fostering linkages (government- university-industry linkages) among institutional settings within the Triple Helix system is an important factor to stimulate innovation development and diffusion. This study provides insights and implications in building national innovative capacity. That is to say, the government should function as a catalyst in the process of techno-economic development (the government needs to play a catalytic role to induce the environment that supports new business creation and innovation diffusion to enhance technology capacity and promote national economic development). Arguably, it is crucial that the government should consider upgrading the present national research universities to become entrepreneurial universities as well as providing spin-off supports. In moving toward the entrepreneurial university, Thailand would require improvements of entrepreneurship policy to facilitate university-industry collaboration which would increase the commercial potential of university research.

The study also provides managerial implications with regard to the application of using the business model to create new ventures. The proposed model of university technology commercialization in Thailand (Figure 3 shown in Section 5.2) provides some useful guidelines on how to forge Triple Helix linkages in order to enhance R&D collaboration and commercialization as well as achieve technology-based innovations. The model offers a range of programs and policy initiatives to support knowledge creation and the creation of industrial clusters. The results of this study could partly fill the gap in the innovation policy studies and provide some useful lessons to other developing countries in the process of technological catch-ups.

*Recommendations on future research*

This study provides useful lessons for other countries to learn from the Thai experience in the process of technology transfer and entrepreneurial development through business incubation program. Through the lens of the Triple Helix model, this research study has shown that the interactive system of industries, universities and government agencies is important to support the production, diffusion and exploitation of R&D results. The research findings suggest that if future research could further explore the role of various intermediary organizations other than the Triple Helix parties within the innovation system, it would provide better understanding of the functions and mechanisms of the Triple Helix linkages in enhancing the national economic performance.

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