Technology Transfer Model to Enhance Sustainable Competitiveness of SMEs

Orapan Khongmalai and Anyanitha Distanont
College of Innovation, Thammasat University, Bangkok, Thailand
okhongmalai@yahoo.com
anyanitha@yahoo.com

Abstract: Thailand is implementing the Thailand 4.0 policy that aims to bring technology and innovation to build sustainable competitiveness for the private sector. However, in the context of SMEs, the ability to transfer technology from universities is still a limitation. The objective of this research is to identify the technology assistance needs of SMEs, as well as, to study the key factors that make the technology transfer successful in the context of collaboration between universities, government agencies and SMEs. The sample group of this research is 226 SME entrepreneurs participating in the Boost up New Entrepreneurs with Technology and Innovation Program carried out by The Office of SMEs Promotion and Thammasat University between 2019-2020. The research results indicated that to create sustainable competitiveness, SMEs need technology assistance in 4 areas: (1) enhancing digital marketing capabilities, (2) developing product innovations, (3) raising product standards, and (4) improving production efficiency. In addition, this research also indicated that the technology transfer success factors for SMEs has 3 key elements: (1) a technology transferor who stands out for collaboration between researchers and business consultants, (2)atechnology transferee who has key characteristics of entrepreneur orientation and absorptive capacity of SMEs, and (3)the technology characteristics which can be connected to the original business processes of the organization which is a technology that gives SMEs' products uniqueness that is difficult for competitors in the market to copy.

Keyword: Technology assistance needs, Technology transfer, SMEs, Sustainable competitiveness

1. Introduction

Developing innovations in a developing country has a much lower success rate than in a developed country. Therefore, policymakers emphasize the role of universities in transferring technology to the private sector to drive innovation in businesses (Secundo, De Beer and Passiante, 2016). Universities are not only expected to be a source of educated professionals, but also are expected to be the main engine in the transition of scientific and business administration knowledge to the country's economic and social development (Secundo, Del Vecchio and Passiante, 2015; Chais, Ganzer and Olea, 2018). Technology transfer is an important tool for innovation development (Ismail, Hamzah and Bebenroth, 2018) linked to performance improvement and sustainable competitiveness of business (Shahzad, Xiu and Shahbaz, 2017; Omar, et al., 2017). The concept of university – industry technology transfer arises from the fact that the production sector needs new technology, as well as the fact that universities develop scientific knowledge or advanced technology and require commercialization (Chais, Ganzer and Olea, 2018). Technology transfer needs integration among a number of stakeholders, namely the academic researcher, the technology transfer office, and the entrepreneur. The success rate of technology transfer has not been very high, even in the USA, which is a developed country and a leading country of advanced technology, only 50% of technology transfer offices can make a profit (Oliveira, Teixeira and Martins, 2010). Several factors have created gaps in collaboration among universities as technology transferors and the private sector as technology transferees. This research has identified several weaknesses of universities, such as the lack of entrepreneurial attitude (Chais, Ganzer and Olea, 2018; Ismail, Hamzah and Bebenroth, 2018) and the lack of skills in the understanding of the firms' needs (Anderson, Daim and Lavoie, 2007), etc.

Innovation has become essential in the business world. It helps increase the competitiveness of the business organization. In particular, Small and Medium Enterprises (SMEs) are under high pressure from the rapid changes in technology and marketing (Chung and Tan, 2017). However, most SMEs are limited in technology and resources. Therefore, SMEs need to take advantage of the open innovation ecosystem to develop innovation. In other words, SME - university collaboration helps SMEs to plan to invest in only the necessary core competencies and receive technology transfers from universities instead of large-budget in-house R&D (Radziwon and Bogers, 2019). Building sustainable competitiveness for SMEs is not only in applying technology to develop product innovation, but also in other areas of business process development, like marketing

capability (Madhoushi and Mehdivand, 2011) and an organization database (Buenechea-Elberdin, Saenz and Kianto, 2018).

For Thailand, the Office of SMEs Promotion (OSMEP) is a government agency that sets out policies to promote SMEs and is the centre for connecting public and private networks to drive the development of SMEs towards strength and sustainability. The OSMEP Annual report 2020 states that the GDP value of Thailand was 15.7 trillion baht, of this, SMEs account for 5.38 trillion baht or 34.27% (OSMEP, 2020). It can be seen that SMEs play a very important role in Thailand's economic expansion. Therefore, the Thai government has a policy to support the creation of technology transfer from universities to enhance the competitiveness of SMEs, which have many limitations with both the basic technology of the organization and the limited resources. However, SMEs in Thailand have a variety of development levels. Therefore, the need for technological assistance to create sustainability for the organization also varies. The readiness for technology transfer is also different.

Research question 1: SMEs in the context of developing countries like Thailand, for what purposes do SMEs need technology assistance?

Research question 2: What are the key factors that make the technology transfer successful?

2. Literature Review

Technology transfer is the process of transferring technology from one source to another group of people or agencies (Distanont, Khongmalai and Kritpipat, 2018). It may be in the form of scientific knowledge, processes, or newly developed tools, with the aim of enabling technology to be delivered to a broader audience (Davenport, 2013). Technology recipient organizations have access to technical information from their own organizations and can learn and absorb to develop new manufacturing processes or new products (Ismail, Hamzah and Bebenroth, 2018). In the past, technology transfer was the process of transferring cutting-edge technologies from developed countries to local economic development to achieve product innovation and process innovation. This improved the quality of life of people in society (Shane, 2004). Nowadays, technology transfer can take place in many contexts, both the technology transfer from the parent company to the subsidiary and changes in corporate work processes caused by mergers and acquisitions or in joint venture firms (Ismail, Hamzah and Bebenroth, 2018). Technology transfers among universities and technology transfer from university to business is also known as University - Industry Technology Transfer (Osabutey and Jin, 2016). The goal of university - industry technology transfer is not only an aim to maximize profits from commercialization, but also the contribution of universities to developing communities and societies by transferring applied research (Velasquez, 2010) or medium-low-technology. There are many factors affecting the efficiency of university – industry technology transfer such as qualified faculty and researcher involvement (Chais, Ganzer and Olea, 2018).

Based on technology transfer theory, a technology transfer model consists of three main components: technology characteristics, technology transferor, and technology transferee (Distanont, Khongmalai and Kritpipat, 2018). Technology characteristics affect the success of technology transfer. Technology characteristics include: transferability is the degree of complexity or simplicity of the technology that affects the difficulty of the transfer; aggregate capacity is the difficulty with which the technology transferee can implement the existing technology; and appropriability is the suitability of technology for its application and benefit (Ismail, Hamzah and Bebenroth, 2018) such as the development of new products and new process development.

A technology transferor is a technology owner or a person representing an organization (Young and Lan, 1997). A technology transferor is an individual or group with knowledge and skills covering the value chain of technology commercialization, including technology specialist and scientist, patent agent, and patent analyst consultant (Ismail, Hamzah and Bebenroth, 2018). Transferor characteristics affect technology transfer efficiency, management skills, technical skills, and communication skills (Wang, et al., 2003). The technology transferor's ability to develop relationships affects technology transfer efficiency. If the technology transferor can build a good relationship with the technology transferee, the more successful the transfer will be (Distanont, Khongmalai and Kritpipat, 2018; Choi and Johanson, 2012). The technology transferor's intention is a factor in supporting efforts to collect and transform knowledge to be more easily communicated (Minbaeva, et. al., 2018). The technology transferor transfers knowledge and technology through both formal and informal processes such as training, workshops, on the job training, or on-the-job interactions (Ismail, Hamzah and Bebenroth, 2018).

Technology transfer is mainly related to scientific knowledge, method, and physical tools. A place for technology transfer must be a particular facility with equipment such as university laboratories or public or private research agencies (Ismail, Hamzah and Bebenroth, 2018).

The technology transferee plays a role in supporting successful technology transfer (Ismail, Hamzah and Bebenroth, 2018). It can be measured by the technology transferee's ability to learn and understand technology until it can be distributed to the people involved, as well as being able to create commercial benefits. The technology transferee has several important elements. The first one is the absorptive capacity which is a company's ability to identify, assimilate, and exploit knowledge from the external sources (Cohen and Levinthal, 1990). The absorptive capacity enables technology transferees to recognize the value of external data, able to screen suitable knowledge and technology to apply, and create commercial benefits for the organization. Organizations will be able to apply knowledge from outside to benefit business greatly if they have a strong knowledge base and a mechanism to implement and continually expand. Absorptive capacity is a strategic resource necessary to build the ability to create added value and enhance the competitiveness of the organization (Xiea, Zoub and Qic, 2018), especially in the age of rapid technological change. An organization's ability to keep up with these changes depends on its ability to absorb and use knowledge effectively (Alexiou, Khanagha and Schippers, 2018). The technology transferee's intention is also a factor to make technology transfer more efficient (Distanont, Khongmalai and Kritpipat, 2018). Intention is based on motivational factors, for example, the motivation to advance in the job will drive the employees in the technology transfer organization to be willing and open to new technologies, as well as to seek additional knowledge to be able to use technology for maximum benefits for the organization. Even though the organization is full of highly skilled employees if there is no motivation to use the skills of employees, it will be limited (Minbaeva, et al., 2003; Xu and Ma, 2008). In the context of SMEs participating in technology transfer projects from the government, intention is equally important - both the intention to receive new technologies that are difficult to imitate and the intention of bringing the technology to commercialization. The qualifications of the technology transferee are generally based on existing knowledge from past experience (Winkelbach and Walter, 2015), as well as technology-related skills to be transferred (Minbaeva, et al., 2003). In the context of SMEs, key qualifications include existing production resources and investments for new technologies. The university – industry technology transfer process requires commitment from each party by providing priorities and investment plans (Chais, Ganzer and Olea, 2018).

3. Research Methodology

The research process had three phases:
Phase I: In this phase, the literature review was executed in order to understand the overall technology transfer and technology assistance to create sustainable competitiveness in the context of SMEs.

Phase II: This phase was the empirical study. The data were collected through in-depth interview to understand the context studied in depth, by observation and company visit to analyze the pain point of the business in depth, and by focus group discussion to capture lessons learned and to study the success factors of technology transfer. The sample group for this research consisted of 226 SMEs participating in the Boost up New Entrepreneurs project with technology and innovation operated by the Office of SMEs Promotion and Thammasat University from 2019-2020. The SMEs were in the food, health, and beauty business sectors. The largest number of SMEs in the project came from food and beverages with 94 enterprises or 41.59%, followed by cosmetic products with 84 enterprises accounting for 37.17%, and dietary supplement products with 48 enterprises accounting for 21.24%, respectively. The sample group was selected carefully on three criteria: 1) the early-stage enterprises (business age not more than 3 years), 2) adopting technology and innovation to enhance the business, and 3) doing business in the food, health and beauty industry sector.

Phase III: The final phase was to combine the intensive theoretical reviews and findings from the empirical analyses to illustrate the innovative methods in the study and to provide insight into how it enhanced the effectiveness of the case study. Data collected in this research was systematically coded and analyzed using the NVivo program. NVivo is a qualitative data analysis computer software package which helps with classifying, sorting, and arranging data. In this research, this analysis was useful to extract meanings and insights based on the data collected from the interviews and focus groups.

In order to ensure the reliability and validity of the research, the data were collected by using: 1) in-depth interview, a method that can really explain the context of the study, 2) observation and company visit, and 3) focus group discussions. In order to increase reliability, this research used the same set of interviews throughout the research, as well as the same method to record the interview, transcribe the words from sound, and store data in a systematic way. In addition, the informants were also asked to review and comment on research papers while the data were being analyzed. Moreover, the researcher checked the validity of the findings by using appropriate methods. In this research, triangulation was used to find information from a variety of sources (Khongmalai and Distanont, 2018). The informants were chosen from various positions in order to be able to obtain information and opinions from various perspectives. Moreover, the research report was sent to the informants for further review and comments.

4. Results and Discussion

4.1 Pain Point Analysis

Amid the rapid changes in technology, whether bio-technology and digital technology, Thai SMEs still face challenges in adopting modern technology to enhance their business competitiveness. OSMEP Annual Report 2020 points out that Thai SMEs still have limitations in many areas such as lack of product differentiation, lack of modern knowledge, lack of accessibility to innovative technologies, lack of partners and networks, etc. (OSMEP, 2020). OSMEP therefore operates the SME Boost up project, which integrates cooperation with Thammasat University from 2019-2020, in the development of SME entrepreneurs registered for juristic persons of not more than 5 years to be able to connect research, technology, and innovation from both government and private agencies to enhance their potential by focusing on adding value from agricultural and herbal products to become food, health, and beauty products (OSMEP, 2020).

SMEs participating in the project were consulted by the researcher and business consultant team in order to analyze the pain point of the business and receive appropriate technology transfer to solve problems and enhance their competitiveness in various fields of food, health, and beauty products. The researcher and business consultant team interviewed and visited the business of 226 SMEs. It was found that most of the SMEs in the business process had 4 processes: designing the business model, new product development, production, and sales and marketing. According to the results of the analysis, it was found that SMEs have a pain point in 2 main dimensions, namely product and production. In the product dimension, there are 3 problems: (1) SMEs with existing products with good quality and standards but with insufficient sales due to their inability to adapt to e-commerce and lack of digital marketing skills. (2) SMEs with herbal raw materials or local wisdom but who do not know how to use technology to add value to raw materials or how to create innovative products; and (3) SMEs who already have products but do not know the nutritional value and various properties or do not have product standards making it impossible to set a high selling price or expand the market. For production dimension, it was found that the problem (4) is that SMEs want to increase production capacity and expand factories but are still lacking the knowledge of factory standards as shown in detail in Figure 1.

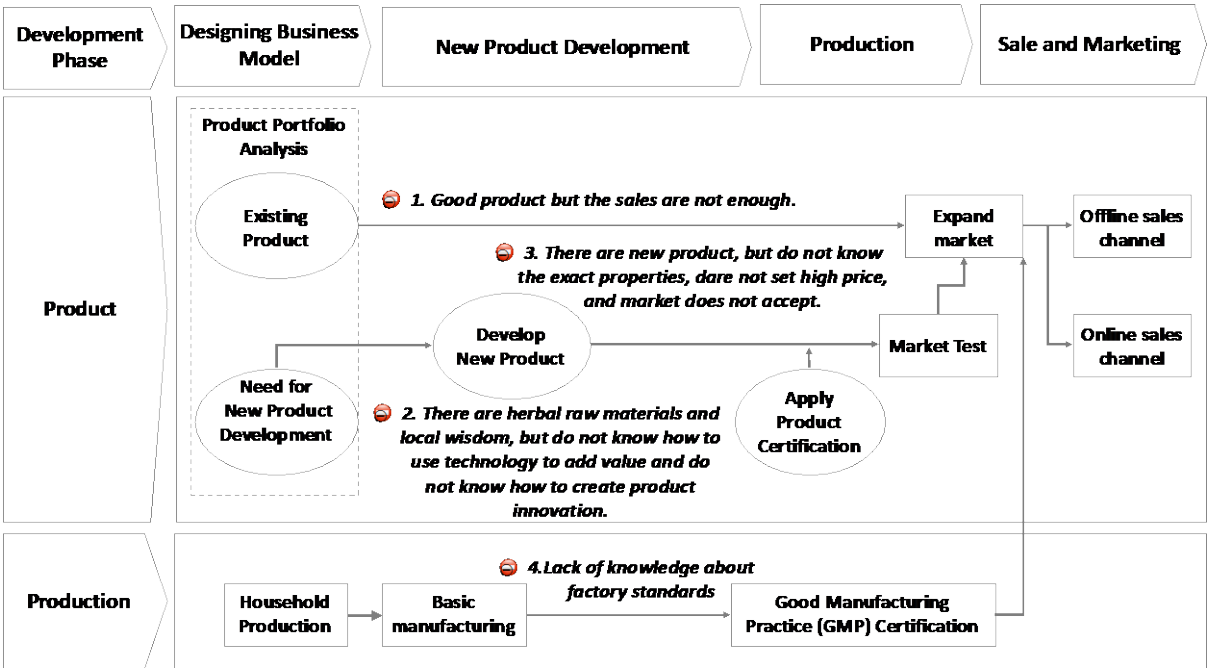

Figure 1: Business Process and Pain Point of SMEs

According to the pain point of SMEs above, the researcher and business consultant team from Thammasat University analyzed and selected suitable technology to solve problems for SMEs. The use of technology can be classified into 4 aspects: the first one was New Product Development with 82 entrepreneurs (36.28%), followed by Standards for Food and Health Product Applications with 80 entrepreneurs (35.40%), Digital Marketing with 47 entrepreneurs (20.80%), and Improving Production Efficiency with 17 entrepreneurs (7.52%).

Table 1: Objectives in applying technology to solve problems and upgrade SMEs

Aspect	No. of entrepreneurs	%
- New Product Development	82	36.28%
- Standards for Food and Health Product Applications	80	35.40%
- Digital Marketing	47	20.80%
- Improving Production Efficiency	17	7.52%
Total	226	100.00%

4.2 Technology Transfer Success Factors

The technology transferor team transferred technology to entrepreneurs which took approximately 6-8 months per case. Business owners and key personnel were involved in the technology transfer process throughout the project period. After the project ended, it was found that the entrepreneurs who received the technology transfer were able to adapt to the competition that led to various economic activities including investment in improving the factory to meet the standards, capacity increase, and an increase in sales totaling 376.58 million baht, which is 12 times the project target value. It is considered one of the most successful technology transfer projects in the government sector.

In this research, the lessons learned from the focus group, exchange of stakeholders' views, and content validation through the triangulation approach from 50 stakeholders were classified into 2 groups: 1) 27 technology transferees consisting of 9 entrepreneurs from the group of food and beverages, 9 entrepreneurs from the group of cosmetic, and 9 entrepreneurs from the group of food supplement product; and 2) 9 technology transferors consisting of 9 researchers, 9 business consultants, and 5 OSMEP personnel as policy units and funders. The results of the research can be concluded that there are 3 factors for success of University – SME technology transfer:

1. **Technology transferor:** This technology transfer project employed a diverse skilled technology transferor team, both researchers who own or specialize in the technology, and business consultants from both universities and the private sector with perspectives on product planning and marketing. In the business model and pain point analysis of entrepreneurs, the business consultants played a significant role in providing advice to select technologies that are in line with the organization's product

strategy, can increase marketing potential, and optimize production processes. The researchers have the skills to listen to the technical requirements of the entrepreneurs in detail, explain complex technologies in a way that is easy to understand, and follow up on technology implementations continuously.

2. **Technology transferee:** There were 226 entrepreneurs who were selected to join the project out of 450 applicants. They are entrepreneurs in the system of the Office of SMEs Promotion (OSMEP), registered for not more than 3 years and want to use technology to enhance competitiveness. Therefore, entrepreneurs have entrepreneur orientation and are ready to expand their investments based on their existing production resources and accept the risks that may arise from investing in new products or processes. They also have a good absorptive capacity with an attitude of accepting new technologies and are able to apply new technology to business.
3. **Technology characteristics:** Most of the entrepreneurs consider the transferred technology was appropriate, can be connected to the original business processes of the organization (transferability), is a technology that allows SMEs' products to have a uniqueness that is difficult for competitors in the market to copy and helps new products from entrepreneurs to compete in the market.

5. Conclusion and Recommendation

In this research, most of the SMEs were micro-enterprise entrepreneurs (with earnings not more than 1.8 million baht per year) and small enterprises (with earnings not more than 100 million baht in the manufacturing sector and income not more than 50 million baht in the service and trading sector), which has limitations in terms of resources and technology. Therefore, technology transfer requires a technology transferor team consisting of researchers and business consultants with close and step-by-step coaching skills. This is consistent with the study of Ismail, Hamzah and Bebenroth (2018) which stated that the efficiency of technology transfer depends not only on a technology specialist and scientist, a patent agent, a patent analyst consultant, but on business perspectives such as business case development, business plan development and marketing plan development

In the Thai context, there are many SMEs promotion projects. However, for projects that aim to use technology to enhance competitiveness, it is essential to select entrepreneurs who are really ready to accept technology transfers, both with absorptive capacity and readiness to invest in new product developments to the market and to raise production standards.

This study is qualitative research that highlights the need for technology assistance in various dimensions of SMEs and the key elements of university – SME technology transfer. In the future, there should be quantitative research to study empirical research on the impact of factors affecting the efficiency of university – SME technology transfer.

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