



## Journal of Modern Management Science

Faculty of Management Science, Lampang Rajabhat University

<https://www.tci-thaijo.org/index.php/JMMS>



2020 - 2024

### The Effect of Strategic Technology Transfer Capability on Firm Outcomes: An Empirical Study from Information and Communication Technology Businesses in Thailand

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#### Article Information

Received: Jun 28, 2019

Revised: May 27, 2020

Accepted: May 28, 2020

Available Online: Jun 30, 2020

#### Abstract

Technology transfer has been viewed as a high quality approach for gaining competitive advantages and firm performance under the dynamic and continuous changes of business world. The purposes of this study were to examine the effect of each dimension of strategic technology transfer capability (STTC) consisting of technology learning capability, technology innovation focus, technology exchange competency, technology changes; and to investigate the awareness of new product development, valuable operational improvement, outstanding business effectiveness as well as firm performance. The conceptual model was empirically tested via the quantitative methods. The data were gathered from the survey of 286 information and communication technology firms in Thailand which was 20.38 percent of the response rate. The hypotheses were examined and proved by multiple regression analysis. The results indicated that technology innovation focus and technology exchange competency had significant positive effects on all firm outcomes. Furthermore, it was found that the firm performance was strongly and positively affected by new product development, valuable operational improvement, and outstanding business effectiveness. Thus, the summary of this study provided theoretical and managerial contributions, including the proposed directions for future research.

**Keywords:** Strategic Technology Transfer Capability, Firm Outcomes, Information, Communication Technology Businesses

#### Introduction

Nowadays, Business firms under the foreseen or unpredicted circumstances are faced with the competition characterized by product and market uncertainties, globalization and rising research and development costs. Technology management is important to the business and becomes the main determinant of competitiveness and the firm's strategy. It can enhance the

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management of technology transfer activities that plays a key role in enhancing the competitiveness of the firm (Kohut, 2016). Therefore, technology transfer is regarded as a high quality approach to gain competitive advantages over other organizations in developing countries (Kumar et al., 2015). In managing technology transfer capability, there is a strategy enabling the firm to increase its competitiveness and performance. According to the previous studies on technology transfer, most of them focused on two major aspects. Many studies put a great emphasis on international technology transfer to examine the impact of technology diffusion (Cohen & Levinthen, 1990; Kneller et al., 2010; Reddy & Zhao, 1990). Meanwhile, some studies were fascinated in the transfer of technology between universities and industry (Arvanitis & Woerter, 2009; Ho et al., 2014; Santoro & Bierly, 2006). However, there are a few studies of technology transfer focusing on the firm's strategic capability. Therefore, the present study can fill in the gap between aspects of research on the relevant field and fulfill the technology transfer literature to investigate strategy among Thai businesses as firm performance.

In this study, the information and communication technology (ICT) businesses in Thailand were selected as a sample group in relation to the flagship policy known as Thailand 4.0 promoted by Thai Government. This has changed the belief that the country will be driven industrially instead of those by technology, creativity and innovation. According to the report of World Economic Forum, it showed the data of level assessment of technology absorption of businesses in Thailand was with the higher score rather than average. This meant that Thai businesses could apply more new technology which was good technology transfer in organization. Consequently, ICT businesses have become a key success factor for the country development which was also related to the technology transfer, yet it was selected as a sample of this study. It was revealed that absorptive capacity was the stimulation of technology transfer to be effective which the dimension of this research was adapted from Zahra and George (2002). This included acquisition, assimilation, transformation, and exploration. Thus, the contribution of this study was to develop the concepts and provide clearer understanding of strategic technology transfer capability (STTC) and firm outcomes.

### **Research Objective**

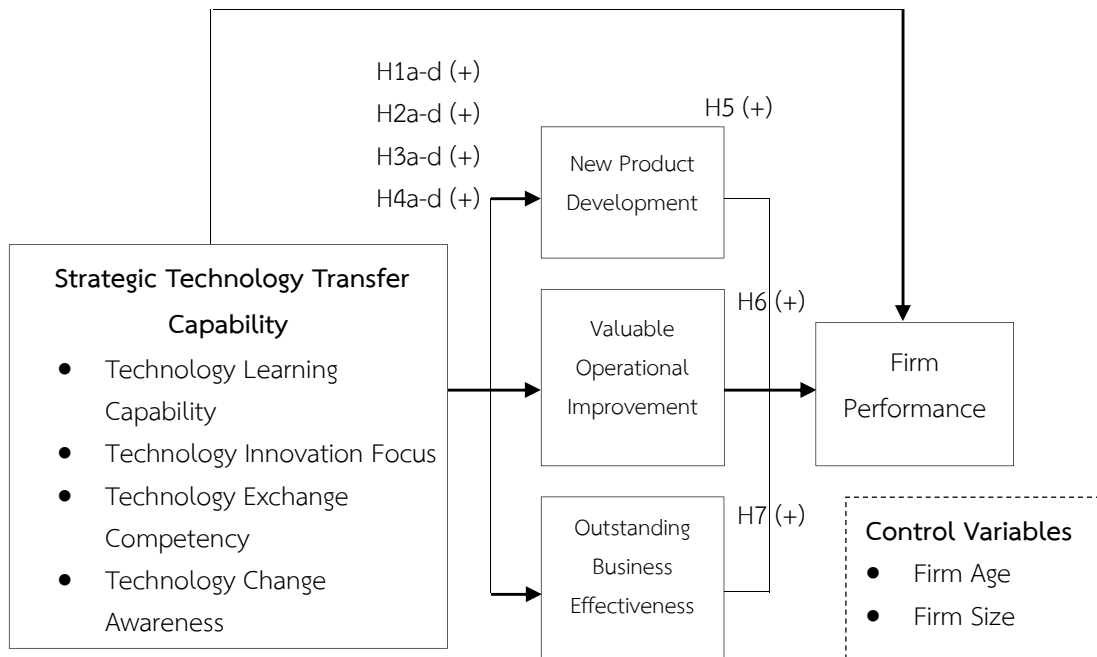
The research objectives are as follows:

1. To examine the relationships among four dimensions of strategic technology transfer capability on various aspects of firm outcomes of information and communication technology businesses in Thailand.
2. To investigate the influences of new product development, valuable operational improvement, and outstanding business effectiveness on firm performance.

## Literature Review

This study employed the absorptive capacity theory to explain the relationships among the dimensions of strategic technology transfer capability and firm outcomes. Therefore, the conceptual framework was illustrated in Figure 1 below:

**Figure 1:** Conceptual framework of relationship between STTC and firm outcomes



### Strategic Technology Transfer Capability

There have been many studies on technology transfer for a decade. A code of conduct for transfer of technology was developed by The United Nations Conference on Trade and Development (UNCTAD) in 2001. According to Economic and Social Council, technology transfer refers to the process of deliberate and systematic acquisition, provision or sharing of equipment and technology, including skills knowledge, intellectual property rights, business and organizational processes, designs and facilities for the manufacture of a product, for the application of a process, or for the rendering of a service (ECOSOC, 2014). Meanwhile, strategic capability is the ability to change an organization and create a business environment, and the capacity is strategic if it results in change or potential (Johannesson & Palona, 2010).

In this study, strategic technology transfer capability (STTC) was defined as an ability of the firm to manage the process of acquisition e.g., adaptation, utilization of skill, knowledge, technology, information from the origination which lead to competitive advantages and business success (ECOSOC, 2014; Janssen, 2010; Johannesson & Palona, 2010). Moreover, there were four dimensions of strategic technology transfer capability adapted from the key dimension of absorptive capacity including acquisition, assimilation, transformation, and exploitation (Zahra et al., 2010).

### **Technology Learning Capability (TLC)**

Technology learning capability refers to a firm's ability to systematically develop the knowledge and skills of personnel in the organization. It enables the firm's operation and administration effectively (Hsu & Fang, 2009). The results of the empirical research showed that a firm's learning capability as a competency, and its impact on the product innovativeness, improved performance, the execution new technology of organization function which was said to operational improvement, and it had a significant impact on organizational effectiveness (Akgün et al., 2007; Sutanto, 2017; Ussahawanitchakit, 2008). Consequently, technology learning capability would affect different aspects of firm outcomes as stated in the first hypothesis:

*Hypothesis 1: Technology learning capability is positively related to (a) new product development, (b) valuable operational improvement, (c) outstanding business effectiveness, and (d) firm performance.*

### **Technology Innovation Focus (TIF)**

Technology innovation focus refers to many things, including product, process, radical, and incremental innovation. It occurs when innovation is based on the use of technology for change. In this study, technology innovation focus was defined as the firm's process of classifying and integrating the knowledge to generate the new technological functionality that enabled the management of the organization success (Li et al., 2006; Akiike, 2014). According to Yam, Lo, Tang, and Lau (2011), technological innovation capabilities would enable the firm to achieve its performance and effectiveness. Therefore, the second hypothesis is as follows:

*Hypothesis 2: Technology innovation focus is positively related to (a) new product development, (b) valuable operational improvement, (c) outstanding business effectiveness, and (d) firm performance.*

### **Technology Exchange Competency (TEC)**

The technology-oriented relationships distinguishes technology-related exchange activity including transfer of technological information, needs and requirements (Ritter & Gemünden, 2003). In this study, technology exchange competency was defined as the firm's ability to manage the knowledge and skills in technological information, requisition, and requirement for two-way sharing which was mutually beneficial into the organization (Kumaraswamy & Shrestha, 2002). There were a positive relationship between knowledge exchange and new product development which both were effective and efficient and enhancing the operational process (Paulraj et al., 2008; Thomas, 2013). Thus, the third hypothesis is as follows:

*Hypothesis 3: Technology exchange competency is positively related to (a) new product development, (b) valuable operational improvement, (c) outstanding business effectiveness, and (d) firm performance.*

### **Technology Change Awareness (TCA)**

The firms have technology alignment that will be taken into consideration on the technological change in the organization (Chan & Reich, 2007). Technological change is based on both better and more technology. Technology change awareness is then defined as the firm's perception explicitly, enabling it to technological advance and movement in order to provide the highest usefulness of the organization (Burkhardt & Brass, 1990). It is evident that technology changes in every activity in the organization, and it could significantly affect the efficiency of new product development and competitive advantage (Kak, 2002; Tatikonda & Stock, 2003). Thus, the fourth hypothesis is as follows:

*Hypothesis 4: Technology change awareness is positively related to (a) new product development, (b) valuable operational improvement, (c) outstanding business effectiveness, and (d) firm performance.*

### **Firm Outcomes**

This study also examined the effect of strategic technology transfer capability (STTC) on each aspect of firm outcomes as follows:

### **New Product Development (NPD)**

New product development is a process that transforms a concept into a commercial product (Hertenstein & Platt, 2000). In this study, new product development was defined as a process of thinking and generating a new product and service which the outcome of a specific process is to achieve the business goals and objectives (Atuahene-Gima & Murray, 2007; Nakata & Sivakumar, 1996). NPD could change the firm's ability to learn about the new rich environment, to create new capabilities, and to develop strategic choices, market advantage, and firm performance (Howell et al., 2005; Ledwith & O'Dwyer, 2009; Vorhies & Harker, 2000). Thus, the fifth hypothesis is as follows:

*Hypothesis 5: The higher new product development is, the more likely that firms will gain greater firm performance.*

### **Valuable Operational Improvement (VOI)**

Adding value to operations is the firm's ability to enhance the business, focusing on creating more opportunities to achieve its goals, and in identifying improvements operations (Corbett & Klassen, 2006; Coulter, 2002). In this study, valuable operational improvement was defined as the use of structured processes and procedures keeping continuous development of the activities that bring benefits to the firm (Yang et al., 2015). The operational performance is similar to improvements in manufacturing or sales sides (Demeter, 2014). Therefore, the sixth hypothesis is as follows:

*Hypothesis 6: The higher valuable operational improvement is, the more likely that firms will gain greater firm performance.*

#### **Outstanding Business Effectiveness (OBE)**

Outstanding operational excellence refers to the firm's management ability to focus on a superior target of its competitors. According to Mouzas (2006) the effectiveness is the firm's ability to generate the sustained revenue growth in its surrounding network related to the organization's own strategy. In this study, outstanding business effectiveness was defined as a firm's capability to achieve its goals and generate business growth which is favorable impressive than its competitors (Mouzas, 2006). There is the examining of the effectiveness of business processes as the method to assess the relationship between firm-specific resources and firm performance (Ray et al., 2004). Thus, the seventh hypothesis is as follows:

*Hypothesis 7: The higher outstanding business effectiveness is, the more likely that firms will gain greater performance.*

#### **Firm Performance**

Output measurement was considered from the firm's major objective and highlight profitability including both financial and non-financial assessment, whereas input measurement was focused on the useful duty and activities in reaching the end outcomes (Li et al., 2009). Therefore, in this study, firm performance was defined as the perception of the firm to overall outcome and goal achievement in both the financial and non-financial assessment over the long term operation.

#### **Research Methods**

In this study, ICT businesses in Thailand were selected as a sample group for the investigation. There were 18,466 firms were from the database list of the Department of Business Development, Ministry of Commerce in Thailand. There were 376 firms out of 18,466 firms were selected from the calculation based on the formula of Krejcie & Morgan (1970). According to Aaker, Kumar, & Day (2001) pointed out that the 20% of response rate is acceptable. Finally, questionnaires were distributed to 1,880 firms.

The stratified random sampling method was used to divide the population before mailing the questionnaires to the firms. The key respondents were managing directors, managing partners, or managers. The original mails were sent to 1,880 firms, the valid mailing was 1,403 surveys. The effective response rate was approximately 20.38 percent. The surveys were completed and returned, but only 286 surveys were valid for the present study after ignoring the missing data.

For testing of non-response bias the researcher used chi-square statistic (Armstrong & Overton, 1977) to make a comparison of the demographics such as the period of time in operating business (firm age) and number of full-time employees (firm size). The result indicated no statistically significant difference between the early and late respondents. Thus, this study was free

from response bias problem. Moreover, for the validity and reliability testing, the researcher used the first 30 returned questionnaires. The content validity was checked by relieving the related literatures and evaluating by two experts.

The factor loading was between 0.627 and 0.959 (>0.4) and statistically significant, while Cronbach's alpha is a range between 0.710 and 0.939 (>0.7) of each item of all variables. It indicated construct validity, and reliability was acceptable (Hair et al., 2010; Nunnally & Bernstein, 1994). This study employed the Enter technique of regression analysis for processed to test all postulated hypotheses and the research model is represented as the following equations:

$$\text{Equation 1: NP}D = \alpha_1 + \beta_1\text{TLC} + \beta_2\text{TIF} + \beta_3\text{TEC} + \beta_4\text{TCA} + \beta_5\text{FA} + \beta_6\text{FS} + \epsilon_1$$

$$\text{Equation 2: VOI} = \alpha_2 + \beta_7\text{TLC} + \beta_8\text{TIF} + \beta_9\text{TEC} + \beta_{10}\text{TCA} + \beta_{11}\text{FA} + \beta_{12}\text{FS} + \epsilon_2$$

$$\text{Equation 3: OBE} = \alpha_3 + \beta_{13}\text{TLC} + \beta_{14}\text{TIF} + \beta_{15}\text{TEC} + \beta_{16}\text{TCA} + \beta_{17}\text{FA} + \beta_{18}\text{FS} + \epsilon_3$$

$$\text{Equation 4: FPM} = \alpha_4 + \beta_{19}\text{TLC} + \beta_{20}\text{TIF} + \beta_{21}\text{TEC} + \beta_{22}\text{TCA} + \beta_{23}\text{FA} + \beta_{24}\text{FS} + \epsilon_4$$

$$\text{Equation 5: FPM} = \alpha_5 + \beta_{25}\text{NP}D + \beta_{26}\text{VOI} + \beta_{27}\text{OBE} + \beta_{28}\text{FA} + \beta_{29}\text{FS} + \epsilon_5$$

## Results and Discussion

The correlation matrix of all variables was not over 0.8. Besides, while there was no multicollinearity problem found in verifying the correlation of any independent variables. The results of VIFs indicated the maximum value of 1.987 which was below the cut-off value of 10. This indicated that the independent variables were not correlated with each other (Hair et al., 2010). Table 1 shows the results of multiple regression analysis which can be described as the details below:

**Table 1:** Results of Regression Analysis

Independent Variables	NP	VOI	OBE	FPM	FPM
	Model 1	Model 2	Model 3	Model 4	Model 5
Technology Learning Capability (TLC: H1a-d)	0.107* (0.057)	0.186*** (0.058)	0.134** (0.063)	0.047 (0.061)	
Technology Innovation Focus (TIF: H2a-d)	0.295*** (0.067)	0.265*** (0.067)	0.273*** (0.073)	0.248*** (0.071)	
Technology Exchange Competency (TEC: H3a-d)	0.147** (0.065)	0.148** (0.065)	0.158** (0.071)	0.149** (0.069)	
Technology Change Awareness (TCA: H4a-d)	0.140** (0.069)	0.101 (0.069)	-0.015 (0.075)	0.131* (0.073)	
New Product Development (NP					0.323*** (0.054)
Valuable Operational Improvement (VOI: H6)					0.169*** (0.062)

Outstanding Business Effectiveness					<b>0.337<sup>***</sup></b>
(OBE: H7)					<b>(0.057)</b>
Firm Age (FA)	0.026	-0.172	-0.121	-0.050	0.003
	(0.123)	(0.123)	(0.134)	(0.131)	(0.104)
Firm Size (FS)	0.132	0.147	0.020	<b>0.188<sup>*</sup></b>	0.127
	(0.102)	(0.102)	(0.112)	<b>(0.108)</b>	(0.087)
<b>Adjusted R<sup>2</sup></b>	<b>0.324</b>	<b>0.319</b>	<b>0.190</b>	<b>0.236</b>	<b>0.512</b>
<b>Maximum VIF</b>	<b>1.987</b>	<b>1.987</b>	<b>1.987</b>	<b>1.987</b>	<b>2.278</b>

<sup>\*\*\*</sup> p < 0.01, <sup>\*\*</sup> p < 0.05, <sup>\*</sup> p < 0.10, Beta coefficients with standard in parenthesis

Firstly, the results indicated that the coefficients of technology learning capability were positive. They also showed significant impacts on NPDP ( $\beta_1 = 0.107$ ,  $p < 0.10$ ), VOI ( $\beta_7 = 0.186$ ,  $p < 0.01$ ), and OBE ( $\beta_{13} = 0.134$ ,  $p < 0.05$ ) respectively. These were consistent with the previous studies by Akgün et al., (2007) and Sutanto (2017) indicating that a firm's learning capability had an impact on the innovativeness and improved performance, and affected the execution of new technology of organization function. As indicated in the study by Ussahawanitchakit (2008), organizational learning capability to which only managerial commitment had a direct impact on organizational effectiveness in Thai accounting firms. Thus, the findings of the previous studies supported the Hypotheses 1a, 1b, and 1c of the present study. However, the results in the present study did not show the significant effect of technology learning capability on firm performance ( $\beta_{19} = 0.047$ ,  $p > 0.10$ ). It is possible to explain that the firms investigated had over emphasized the technology learning capability for training and development to develop their employees' ability and skill. This was consistent with the study of Sapienza, Autio, George, and Zahra (2006) suggesting that the younger firms which focused on learning were able to decrease the probability of growth and did not assess the potential threats to survival. For this reason, technology learning capability did not affect the firm performance in ICT business to establish new business easier. Thus, Hypothesis 1d was not supported by this empirical fact discovered, and that firm performance does not relate to technology learning capability.

Secondly, technology innovation focus has a positive influence on all four outcomes: NPDP ( $\beta_2 = 0.295$ ,  $p < 0.01$ ), VOI ( $\beta_8 = 0.265$ ,  $p < 0.01$ ), OBE ( $\beta_{14} = 0.273$ ,  $p < 0.01$ ), and firm performance ( $\beta_{20} = 0.248$ ,  $p < 0.01$ ), respectively. According to Akiike (2014), it could provide the results indicating that technology innovation enhanced new product to appearance and user friendliness, as well as added new functionality to operational improvement, whereas the study by Yam et al., (2011) convinced that the firms with greater technology innovation capabilities were able to achieve higher levels of organizational effectiveness in Hong Kong manufacturing industries. Moreover, as indicated in the studies by Mumford, (2000); Rubera & Droge, (2013) and, Yam et al., (2011) the firms could gain higher firm performance via technology innovation focus. Thus, Hypotheses 2a, 2b, 2c, and 2d were strongly supported by the previous studies as such.

Thirdly, technology exchange competency is positively related to NPD ( $\beta_3 = 0.147$ ,  $p < 0.05$ ), VOI ( $\beta_9 = 0.148$ ,  $p < 0.05$ ), and OBE ( $\beta_{15} = 0.158$ ,  $p < 0.05$ ), and firm performance ( $\beta_{21} = 0.149$ ,  $p < 0.05$ ), respectively. These results were consistent with the study by Thomas (2013) who investigated manufacturing firm in U.S. and it was found that there was a significant and positive relationship between knowledge exchange address computer-mediated communication channels and NPD which both were effective and efficient. According to Paulraj, Lado, and Chen (2008), the exchange of knowledge in information technology effects enhance the operational process of supply chain partner. Likewise, the study by McCarter et al., (2005) indicated that the firm ultimately had the supply chain to remain competitive, and there was information gathering and sharing of new knowledge for the exchange competency. Moreover, the study by Collins & Smith (2006) suggested that the facilitated knowledge exchange and combination had predicted the firm performance from new products and services' revenue and sales growth. **Thus, the previous studies had strongly supported Hypotheses 3a, 3b, 3c, and 3d of the present study. It was evident that** technology exchange competency had a positive relation to new product development, valuable operational improvement, outstanding business effectiveness, and firm performance.

Fourthly, it was found that technology change awareness has significance on NPD ( $\beta_4 = 0.140$ ,  $p < 0.05$ ) and firm performance ( $\beta_{22} = 0.131$ ,  $p < 0.10$ ). This was supported by the results of similar study by Tatikonda and Stock (2003) indicating that the fit in technology change with interactions between organizations had a positive effect on the efficient development of new products. Likewise, the study by Sutanto, (2017) showed that the change needed by the organization in technology had an effect on more innovation to develop its new products or services. The firm was able to make technological advances which would result in better performance. The prior study by Al-Ansari et al., (2013) convinced that the awareness of technological changes to innovation in firms could enable them to gain better firm performance. **Thus, the results of previous studies had supported Hypotheses 4a and 4d of the present study.** However, the present study indicated that there was no significant effect of technology change awareness on VOI ( $\beta_{10} = 0.101$ ,  $p > 0.10$ ) and OBE ( $\beta_{16} = -0.015$ ,  $p > 0.10$ ). It was possible to explain that some employees might not believe in technological change that could improve the business functionality (Ghobakhloo et al., 2012).

Finally, NPD has a significance on firm performance ( $\beta_{25} = 0.323$ ,  $p < 0.01$ ). It was found that NPD could change the firm's ability to learn about the new rich environment, create new capabilities, and develop the firm performance (Howell et al., 2005; Ledwith & O'Dwyer, 2009; Vorhies & Harker, 2000). **Thus, it was hypothesized that** "the higher new product development is, the more likely that firms will gain greater firm performance." in **Hypothesis 5 was not evident in the present study.** However, valuable operational improvement has a positive effect on firm performance ( $\beta_{26} = 0.169$ ,  $p < 0.01$ ) which is consistent to **Hypothesis 6**. The study by Lee (2015) supported the hypothesis that firm could improve operational processes which ultimately led to

the enhancement of firm performance. Moreover, outstanding business effectiveness is positively affected by firm performance ( $\beta_{27} = 0.337$ ,  $p < 0.01$ ). It was hypothesized that “The higher outstanding business effectiveness is, the more likely that firms will gain greater performance”, yet it was evident in the present study. Similarly, Ray, Barney, and Muhanna (2004) indicated that the effectiveness of business concerned with the relationship with competition of organization in long-term firm performance. **Thus, Hypothesis 7 was supported.**

### Contributions

This research attempts to explore the causal relationship among the dimension of strategic technology transfer capability (STTC), firm outcomes, its antecedents, and moderator as shown in Figure 1. The main theoretical contribution was related to conceptualizing the comprehensive view of strategic technology transfer capability as a multidimensional construct, presented as a newly developed construct and dimension. The research framework was described based on the absorptive capacity and dynamic capability theory.

The findings were practically suggested to help practitioners, including managing directors, managing partners, or managers, who are responsible for strategic planning in capability development of the organization. In particular, for information and communication technology businesses, the practitioners should understand how their firms can achieve operational effectiveness, enhance firm performance, and improve sustainable competitiveness over their competitors in the industry through strategic technology transfer capability development.

### Conclusion

This study investigated the effect of strategic technology transfer capability that included four dimensions on its firm outcomes. The multiple regression analysis was employed to analyze the data gathered from 286 ICT firms in Thailand. The results showed that technology innovation focus and technology exchange competency were essential components that helped enhance all firm outcomes. Furthermore, new product development, valuable operational improvement, and outstanding business effectiveness had the influence on firm performance.

The results of this research should be interesting which can contribute to the technology transfer literature. Moreover, it was also convinced that the importance of managerial practices can enhance the firm's ability to gain its goal achievement. Managing directors, managing partners, and managers should, consequently, pay more attention to increase the determinants of strategic technology transfer capability, especially for both technology innovation focus and technology exchange competency.

### Limitations and Future Research Directions

This study had some limitations when using the cross-sectional study in the quantitative approach and survey by questionnaire. For instance, Thai information and communication technology firms are registered in the Department of Business Development. To this limitation, the

firms which are not registered were not included the sampling framework of the study. Therefore, this has an impact on the generalization of the findings. Another, there is a limitation of the data collection as they were obtained from only a single group of industries in Thailand context. As a result, almost all firms as respondents are the Thai ownership and trading businesses, which technology transfer is not as widely used as modern and international firms. This may affect the analytical power of the statistical tests so that the results are possibly weakened. Thus, the finding cannot generalize to other sectors or countries.

For future research, it was suggested that there should be an investigation of strategic technology transfer capability application in a wide range of businesses in order to ensure the reliability and validity of the conceptual framework. Furthermore, there should be a study carried on different types of industries which are concerned with STTC such as production industry or services industry with the Foreign Direct Investment (FDI).

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