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MANAGING ABSORPTIVE CAPACITY:
THE EFFECT OF SPILLOVER CHANNEL MECHANISM
AND THE IMPACT ON INNOVATION

Miss Surasvadee Rajkulchai

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By   Surasvadee Rajkulchai

Department   Commerce

Thesis Advisor   Assistant Professor Dr.Pakpachong Vadhanasindhu

Thesis Co-advisor   Professor Dr.Achara Chandrachai

Accepted by the Faculty of Commerce and Accountancy, Chulalongkorn
University in Partial Fulfillment of the Requirements for the Doctor's Degree

.... Dean of Faculty of

Commerce and Accountancy

(Associate Professor Dr. Danuja Kunpanitchakit)

THESIS COMMITTEE

.... Chairman

(Professor Dr. Uthai Tanlamai)

.... Thesis Advisor

(Assistant Professor Dr. Pakpachong Vadhanasindhu)

.... Thesis Co-advisor

(Professor Dr.Achara Chandrachai)

.... Member

(Associate Professor Dr. Pradit Wanarat)

.... Member

(Associate Professor Dr. Ekachidd Chungcharoen)

สุรัสวดี ราชกุลชัย : การจัดการความสามารถในการดูดซับความรู้: ปัจจัยกำหนดจากกลไกการรั่วซึม ความรู้และผลกระทบต่อนวัตกรรม (MANAGING ABSORPTIVE CAPACITY: THE EFFECT OF SPILLOVER CHANNEL MECHANISM AND THE IMPACT ON INNOVATION) อ.ที่ปรึกษา : ผศ. ดร.พักตร์ผจง วัฒนสินธุ์ อ.ที่ปรึกษาร่วม : ศ. ดร.อัจฉรา จันทร์ฉาย 297 หน้า

ความสามารถในการดูดซับความรู้ มีความสำคัญต่อบริษัทและยังมีบทบาทสำคัญในการสะสม แสวงหา การเรียนรู้เข้าใจ การปรับแปรสภาพ และการประยุกต์ความรู้จากภายนอก เพื่อนำมาสู่ความได้เปรียบใน เชิงแข่งขัน ทั้งที่มีความสำคัญดังกล่าว แต่กลับไม่ใคร่มีการศึกษาเจาะจงหรือบางครั้งอาจถูกมองข้าม จนกระทั่งมี การปรับปรุงแนวคิดและรูปแบบใหม่ของแบบจำลองความสามารถในการดูดซับความรู้ อย่างไรก็ตาม แบบจำลอง ดังกล่าวยังคงมีช่องว่างอยู่บางประเด็น อาทิ ความชัดเจนเกี่ยวกับมิติของความสามารถในการดูดซับความรู้ ความสำคัญในบทบาทการเป็นตัวแปรสื่อกลาง การศึกษาเชิงประจักษ์ทดสอบความสมบูรณ์ของแบบจำลอง แนวคิดใหม่นี้ในองค์รวม โดยเฉพาะยังขาดปัจจัยกำหนดตัวใหม่คือการรั่วซึมความรู้จากภายนอก

การศึกษานี้ นำเสนอปัจจัยกำหนดตัวใหม่ ที่พัฒนามาจากกรอบแนวคิดทฤษฎีการรั่วซึมความรู้ ซึ่ง ให้ชื่อว่า "กลไกการรั่วซึมความรู้" โดยเป็นปัจจัยที่มีอิทธิพลต่อความสามารถในการดูดซับความรู้ ปัจจัยนี้ ประกอบด้วย การร่วมมือ และ ความสัมพันธ์ ซึ่งถือเป็นปัจจัยกำหนดที่มีความพิเศษเพราะถือเป็นตัวแทนทั้งด้าน เหตุผลและด้านสังคมในเวลาเดียวกัน การศึกษานี้คาดว่ากลไกการรั่วซึมความรู้ มีบทบาทเชิงกลยุทธ์โดยตรงต่อ การสร้างเสริมความสามารถในการดูดซับความรู้ และโดยอ้อมต่อความสำเร็จของนวัตกรรม ในขณะเดียวกัน การศึกษานี้ยังได้ตรวจสอบอิทธิพลของความสามารถในการดูดซับความรู้ ในบทบาทของตัวแปรสื่อกลางอีกด้วย การศึกษาแบบจำลองในเชิงประจักษ์ครั้งนี้เก็บข้อมูลโดยการใช้แบบสอบถามธุรกิจอิเลคทรอนิคส์ และ เครื่องใช้ ไฟฟ้าในประเทศไทย จำนวนรวม 2.158 บริษัท ผลจากการรวบรวมแบบสอบถาม 305 ชุดได้ทำการทดสอบ สมมติฐานโดยการวิเคราะห์ทางสถิติด้วยโมเดลโครงสร้างสมการเชิงเส้น

ผลลัพธ์จากการศึกษา พบว่า แบบจำลองความสามารถในการดูดซับความรู้ที่ตั้งสมมติฐานไว้ให้ผล สอดคล้องกับข้อมูลที่ทำการสำรวจเป็นอย่างดี และได้พบสามประเด็นสำคัญ ประการที่หนึ่ง ความร่วมมือ (โดยเฉพาะการร่วมมือในการวางแผน) และความสัมพันธ์(โดยเฉพาะการสร้างระดับความผูกพัน) เป็นปัจจัย กำหนดสำคัญ ที่มีผลกระทบโดยตรงต่อความสามารถในการดูดซับความรู้และยังมีผลกระทบโดยอ้อมต่อ นวัตกรรม ประการที่สอง ความสามารถในการดูดซับความรู้มีบทบาทหลักในการเป็นตัวแปรสื่อกลาง แสดงถึงการ เป็นปัจจัยสำคัญต่อการสร้างนวัตกรรมทั้งด้านการตลาดและด้านการบริหาร ประการที่สาม แหล่งการรั่วซึม ความรู้ที่แตกต่างกันมีผลกระทบต่อความสามารถในการดูดซับความรู้ การศึกษานี้ได้สร้างประโยชน์ต่อธุรกิจ อิเลคทรอนิคส์และเครื่องใช้ไฟฟ้าในประเทศไทย โดยผลของการศึกษามีประโยชน์ต่อบริษัทที่เป็นฝ่ายได้รับการ รั่วซึมความรู้ ที่นำไปพัฒนากลยุทธ์เพื่อเพิ่มความสามารถในการดูดซับความรู้อย่างมีประสิทธิภาพ และมี ประโยชน์ต่อบริษัทที่เป็นฝ่ายสูญเสียจากการรั่วซึมความรู้ ที่จะสามารถนำไปใช้ปรับเปลี่ยนกลยุทธ์เพื่อการบริหาร การรั่วซึมความรู้อย่างมีประสิทธิผลอีกด้วย

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KEY WORD : ABSORPTIVE CAPACITY/ KNOWLEDGE SPILLOVER/ INNOVATION/ COOPERATION/ CONNECTEDNESS

SURASVADEE RAJKULCHAI: MANAGING ABSORPTIVE CAPACITY: THE EFFECT OF SPILLOVER CHANNEL MECHANISM AND THE IMPACT ON INNOVATION. THESIS ADVISOR: ASST.PROF.PAKPACHONG VADHANASINDHU, D.B.A., THESIS CO-ADVISOR: PROF. ACHARA CHANDRACHAI, PH.D. 297 pp.

Absorptive capacity is important to a firm and plays a crucial role in the acquisition, assimilation, transformation and exploitation of knowledge from outside firm boundaries and thereby enhances competitiveness. Despite its importance, it is seldom a focus and sometimes even overlooked until there was a reconceptualization of the concept and formation of a proposed absorptive capacity model. The model itself, however, contains some gaps such as the clarity of its dimensions, its importance as mediator, an empirical test for completion of the absorptive capacity reconceptual model, and is particularly lacking a new factor, external knowledge spillovers-.

Drawing on a knowledge spillover framework, this study proposes a 'spillover channel mechanism' as a new factor influencing absorptive capacity. This mechanism consists of cooperation and connectedness and is a specific factor simultaneously representing both cognitive and social aspects. This study posits that the spillover channel mechanism plays a strategic role in directly strengthening a firm's absorptive capacity and indirectly achieving innovation. As such, the study can also concurrently examine the mediation effect power of absorptive capacity. To empirically test the proposed model, data was collected by questionnaires surveying 2,158 electrical and electronics (E&E) firms in Thailand. Structural Equation Modeling statistical analysis is employed on the usable 305 questionnaires to assess construct validity and test the stated hypotheses.

The results indicate that the proposed model of absorptive capacity fits well with the data and three important findings are revealed. Firstly, cooperation, particularly in terms of joint planning and connectedness, especially its strength, are crucial factors directly influencing potential absorptive capacity and indirectly affecting innovation. Secondly, absorptive capacity plays the pivotal role of main mediator, indicating that it is a critical factor for enhancing both marketing and management innovation. Thirdly, the different spiller/source of knowledge spillover has a moderating affect on absorptive capacity. This study contributes to local E&E firms in Thailand, with the results of benefit not only to the recipient firms to allow them to develop strategies for efficient absorption ability from incoming knowledge spillovers, but benefits also the spiller firms and enables them to transform strategies for effective management of outgoing knowledge spillovers.

Department..........Commerce..................   Student's signature........................

Field of Study.........International Business...   Advisor's signature.....P. Yadl........

Academic year......2006.........................   Co-advisor's signature...................

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CHAPTER I

INTRODUCTION

The first chapter introduces the study and is divided into six sections. The first section starts with the rationale of the study, sections two to four detail the purposes of the study, research questions, and research objectives. Section five briefly describes the expected outcome of the study and the organization of the study is shown in the final section.

1.1 The Rationale of The Study

Our world has become a knowledge-based economy, forcing many firms to create their own individual knowledge in order to overcome specific obstacles. Developing knowledge-based resources and undertaking innovative activities provides an continuing source of competitive advantages. Conscious of this, companies strive to innovate by generating the technological knowledge necessary to develop new products and production processes. The intensity of this effort to innovate, however, varies from one company to the next, depending on individual ability and drive. To survive and achieve, firms need to recognize new external knowledge, assimilate it, and apply it to commercial benefit. This ability is referred to as absorptive capacity (Cohen and Levinthal, 1990) and has emerged as an underlying theme as an affective conduit in strategy and management research.

Absorptive capacity (ACAP) is important construct, particularly in a knowledge-based economy. It plays a crucial role in the acquisition, assimilation, transformation and exploitation of knowledge from outside the firm's boundaries to enhance competitiveness and innovative ability (Cohen and Levinthal,1990; Lane and Lubatkin,1998; Zahra and George, 2002; Matusik and Heeley,2005). In previous studies, however, there were gaps in the discussion of absorptive capacity, including the clarity of dimension, a lack of direct measures, the mediator role was overlooked and they lacked empirical testing of the absorptive capacity re-conceptual model. Since one purpose of this study is to fill some of the research gaps, the four primary gaps are here pinpointed.

The first gap is clarity of dimension. Cohen and Levinthal's (1990) seminal study introduces three dimensions/capabilities of absorptive capacity as: (1) recognizing value, (2) assimilating, and (3) applying new external knowledge to commercial ends. Although some scholars propose their own specific dimension of absorptive capacity (e.g. Mowery and Oxley, 1995; Grant, 1996a; Van den Bosch et al., 1999), the three dimensions suggested by Cohen and Levinthal (1990) remain influential and popular.

This was true until Zahra and George (2002) recently reconceptualized absorptive capacity and proposed a new paradigm. This is divided into two main components, with each component consisting of two dimensions/capabilities. The first component, potential absorptive capacity (PACAP), consists of acquisition capability/dimension and assimilation capability/dimension. The second component,

realized absorptive capacity (RACAP), is a function of the transformation capability/dimension and exploitative capability/dimension. Implicitly, these two components deal with absorptive capacity by focusing on knowledge creation and subsequent commercially deployment of the knowledge (Matusik and Heeley, 2005). Unlike earlier other scholars, Zahra and George (2002) capture the three earlier capabilities and add a new one, 'transformation capability', in order to pinpoint the importance of the role of conversion and internalization. The re-conceptualization model of absorptive capacity recommended by Zahra and George(2002) is presented in Figure 1.1.

Figure 1.1: The re-conceptualization model of absorptive capacity

Source : Adapted from Zahra and George,2002, Figure 1
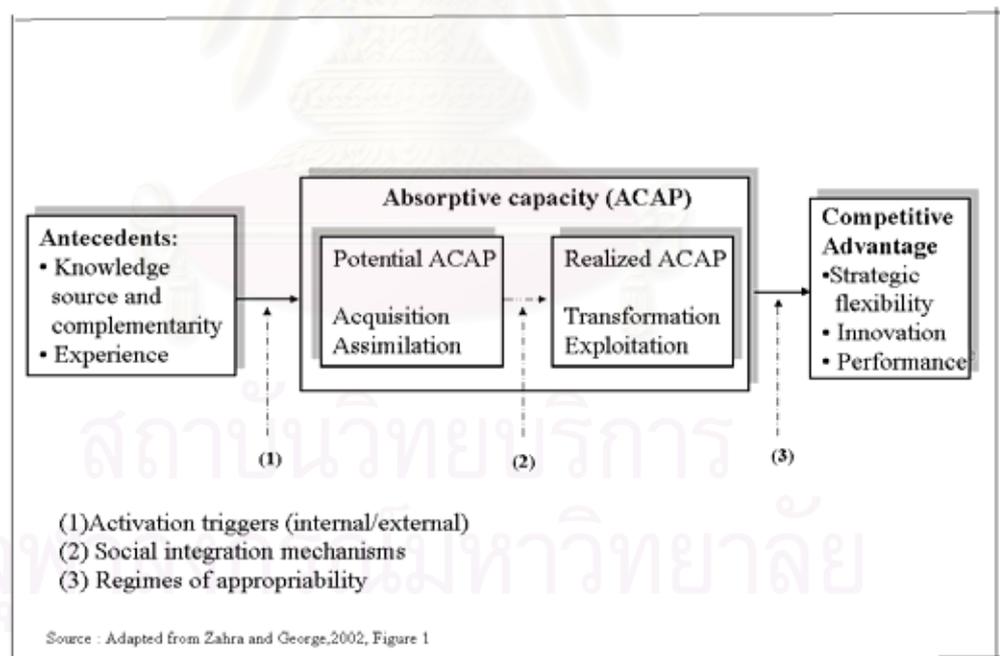
Most previous studies on absorptive capacity undertook research based on dimensions and the initial definition of Cohen and Levinthal (1990), e.g Szulanski, 1996; Lane and Lubatkin, 1998; Balkin and Montemayor, 2000; Harrington and

Guimaraes, 2005). Many of the new generation researchers are interested in following Zahra and George's (2002) proposals, instead (e.g. Liao et al., 2003; Minbaeva et al., 2003; Tu et al., 2005). However, there are few empirical studies capturing all dimensions of absorptive capacity simultaneously.

The second gap is the lack of direct measurement, which leads to measuring absorptive capacity largely by proxies such as research and development (R&D) expenditure (e.g. Cassiman and Veugelers, 2002; Oltra and Flor, 2003; Belderbos et al., 2004), prior experience in R&D (e.g. Cockburn and Henderson, 1998; Den Bosch et al., 1999, 2003). One reason there is a lack of a direct measure of absorptive capacity is the guideline recommended by Cohen and Levinthal (1990), who propose that R&D has two faces. One face is general R&D and the other is absorptive capacity. This view makes absorptive capacity equivalent to R&D capability. Thus, studies of absorptive capacity following Cohen and Levinthal's (1990)conceptual framework all measure via R&D as a proxy. Although their theme is useful, it should be used as traditional framework for the era surrounding the industrial revolution rather than as a competitive concept for the ongoing knowledge-based revolution, particularly in the international business arena. According to Lane et al. (2002), the lack of a direct empirical measure of absorptive capacity has not only caused some problems with the comparability of research results, it has also led to little research on the process by which absorptive capacity is developed.

The re-conceptualization model of absorptive capacity recommended by Zahra and George (2002) is developed to emphasize the distinctive characteristics of absorptive capacity. This view considers absorptive capacity as a dynamic capability

not just R&D capability. This lead to development of a system of direct measurement and subsequent to this, the studies began to be based more on the absorptive capacity re-conceptual model recommended by Zahra and George (2002). For example, Jansen et al. (2005) and Schimdt (2005) study and initiate a multi-item scale for direct measurement. However, their attempts to fill this gap are incomplete and results are inconsistent as there was little empirical testing.

The third gap is the overlooking mediating role. Most earlier studies consider absorptive capacity as a supporting antecedent and/or moderator of other constructs. They neglect the other important role of absorptive capacity and apparently absorptive capacity is not considered as a mediator until the re-conceptual model is proposed. According to Zahra and George's (2002) re-conceptual model, absorptive capacity plays a vital role as a strategic tool to absorb external knowledge through the capabilities of creation and deployment of new knowledge in order to achieve competitive advantage. Malholta et al. (2005) state that Zahra and George's (2002) conceptual framework is useful and beneficial to further study in many issues, especially the importance of the mediating role. Since the view towards absorptive capacity is modified, empirical studies are required and the strong power of the mediating affect of absorptive capacity should be recognized by empirical testing.

The last gap is the lack of empirical studies leading to the completion of the model. While the absorptive capacity re-conceptual model highlights its important role as mediator, it implies that the antecedents and consequences of absorptive capacity should be provided and completely tested simultaneously. Currently, there are few empirical studies on not only the importance of the mediating role but also

the completion of the absorptive capacity re-conceptual model. Since absorptive capacity should be studied empirically with regards to both the mediator role and as a goal to complete the model, this study proposes an empirical study concurrently on new antecedents and consequences by focusing on the mediating role of absorptive capacity. Thus, this study aims to be not research that not only fills the gaps but goes beyond into more advanced research. Based on the knowledge spillover channel framework and innovation literature, new antecedents and consequences of absorptive capacity are proposed.

For new antecedents, most factors determining absorptive capacity come from theoretical and empirical studies on knowledge management, particularly in R&D and innovation processes. There are both internal factors (i.e. R&D activities, organizational structure, human resource management practices) and external factors (i.e. knowledge sources and complementarity) affecting absorptive capacity (Daghfous, 2004; Leahy and Neary, 2004; Gradwell, 2003; Nonaka and Takeuchi, 1995). Between internal and external factors, external factors have more power to create absorptive capacity, but this is little studied. Since external knowledge sources are difficult to both measure and acquire, most studies concentrate on knowledge transfer through formal channels or via contractual agreements. For example, Minbaeva et al. (2004) study why and how firms have success when undertaking joint ventures and transferring knowledge for mutual benefit. They suggest important mechanisms such as trust and commitment.

However, another important source of knowledge is knowledge spillover or externalities that are more important but neglected or else overlooked, especially in

the international business arena (Meyer, 2004). Although there are many studies on the spillover affect, these utilize a macro-economic view using comparable econometric measures and do not dwell on the direct relationship between spillover channels and absorptive capacity. It wasn't until Lin et al. (2002) did their study that this was dealt with and they discovered that technology diffusion channels can facilitate absorptive capacity. Although their diffusion channels are both formal and informal, their channels normally mean modes of entry such as licensing and contract research, and these are not true spillover channels.

Taking a different path from previous studies, this study initiated a new construct, the 'spillover channel mechanism' and proposes it as a direct factor affecting absorptive capacity. Adapted from Dhanaraj et al. (2004), this study defines 'spillover channel mechanism' as 'the degree to which commercial ties are related in both cognitive (or task-oriented) and social (or people-oriented) attachments'. In other words, it is the specific factor that a recipient firm uses to get incoming knowledge spillovers from spiller. Drawing on the spillover channel framework, the spillover channel mechanism consists of cooperation and connectedness. Since these are derived from spillover channel characteristics, they are representative of true spillover. This study assumes that this mechanism is generally overlooked as factor affecting absorptive capacity despite its importance and positive affect and believes should be of concern and empirically tested.

For consequences, innovation is an imperative issue and represents the core renewal process in any organization. Since innovation is not an automatic attribute of organizations, the process has to be enabled through sophisticated and active

management. There are no guaranteed formulae for success in what is inevitably a risk-based activity, but extensive research dating back over a century suggests a series of convergent themes from which guidelines for affective innovation management can be extracted (Tidd et al., 1997). In addition, Meyer (2004) suggests that there is upward trend in studying the spillover affect and innovation through an integrated framework. Based on different perspectives, several factors are relevant to innovation, particularly product and process innovation.

Unlike previous studies, this study proposes and examines two new dimensions of innovation – marketing innovation and management innovation - simultaneously and observes the direct outcome from the impact of absorptive capacity and indirect outcome from the affect of the spillover channel mechanism as mediated by absorptive capacity. According to the Oslo Manual Revision, these are new versions of innovation developed for a competitive conceptual framework (Bloch, 2005). Since they are quite new, this study also develops a multi-item scale index to use as a direct measure instead of a proxy or single index used in traditional views.

1.2 Purpose of The Study

The main purposes of this study are twofold. Firstly, this study aims to be a gap-filling research. Secondly, it aims at being integrated or advanced research by use of an integrated framework such as spillover channel from the economic view, absorptive capacity from the management view, and innovation from the knowledge-based view.

As a gap-filling research, the study proposes complete empirical testing on the absorptive capacity re-conceptual model suggested by Zahra and George (2002). The proposed absorptive capacity model investigates the clarity of each dimension (i.e. if and how it plays a different role), a new multi-item scale for direct measurement (i.e. whether it is usable and applicable), the importance of the mediating role (i.e. whether and how absorptive capacity has a mediatative affect), completion of empirical testing (i.e. what dimension of the spillover channel mechanism affects absorptive capacity and how it is different, and what component of absorptive capacity influences innovation and how it is different). In addition, while the model fills the gaps, the study also provides something new from previous studies such as new antecedent (spillover channel mechanism), and new dimension of consequences (marketing and management innovation).

For advanced research with an integrated framework, a new factor, 'spillover channel mechanism', is introduced based on the spillover channel framework, with the new dimension of outcomes drawing on the innovation and management framework. The spillover channel mechanism comprises cooperation and connectedness, considered as cognitive and social factors. Although there has been speculation on how cognitive and social factors influence learning (Grant and Baden-Fuller, 1995; Dhanaraj et al., 2004), very little is known about how such factors differentially influence the absorptive capacity and its different components (i.e. potential absorptive capacity and realized absorptive capacity). Interestingly, the importance of cooperation and connectedness may vary over each component of absorptive capacity. In addition, the absorptive capacity is essentially a path-

dependent phenomenon and few studies consider how it changes with simultaneous occurrences of cooperation and connectedness. As such, either cooperation or connectedness or both of the relationship between spiller/source of knowledge and recipient firm may become more important factors and considered as a strategic tool to create a firm's own distinctive identity and processes such as marketing innovation and management innovation. This study is thus proposed to complete the model of an integrated framework and examine expected results.

1.3 Research Question

The research questions of this study are posed in such a way that will lead to development of the research model and state the hypotheses. There are four research questions:

1. What is the comprehensive theoretical and practical perspective of absorptive capacity?

2. Does the spillover channel mechanism have an influence on absorptive capacity? If so, how?

3. How does absorptive capacity impact innovation? Is there any difference between potential absorptive capacity and realized absorptive capacity in the impact on innovation and to what extent does the impact increase?

4. What is the relationship among spillover channel mechanism, absorptive capacity, and innovation?

1.4 Research Objective

The research questions elicited five research objectives for this study as given below:

1. To provide a comprehensive theoretical and practical perspective of absorptive capacity.

2. To examine if and how the spillover channel mechanism influences absorptive capacity.

3. To investigate how absorptive capacity affects innovation and whether the impact of potential absorptive capacity and realized absorptive capacity are different and if so, how.

4. To explore the relationships among the spillover channel mechanism, absorptive capacity, and innovation.

5. To empirically test the fit of the absorptive capacity re-conceptual model in the context of the Thai setting.

1.5 Organization of The Study

The study is structured into six chapters as follows:

Chapter 1: This chapter introduces the study, beginning with the rationale behind the study, followed by the purposes of the study, research questions and research objectives. As a last step, the organization of the study is illustrated.

Chapter 2: This chapter provides the theoretical framework and literature review, specifically the two primary frameworks (i.e. the absorptive capacity framework and the spillover channel framework). At the same time, innovation literature is reviewed.

Chapter 3: Based on the literature review, this chapter presents the development of the model and testing of the hypotheses. The study hypothesizes: (1) the relationship between the spillover channel mechanism and absorptive capacity, and (2) the relationship between absorptive capacity and innovation.

Chapter 4: This chapter discusses the research methodology, which consists of research design, research scope, research method, scale and measurement development, questionnaire development, sampling, data collection, and data analysis.

Chapter 5: This chapter contains the illustration and discussion of data analysis and results. Details include data preparation, which explains the process of data coding, data entry, treatment of missing data, and non-response bias testing. Further, the result of descriptive data analysis is presented by respondents' profile, followed by item analysis using reliability and validity measurement. The next section in this chapter deals with the structural equation modeling (SEM) analysis, utilizing most of the relevant processes in SEM, such as confirmatory factor analysis and structural model. The final section of the chapter shows the model assessment fit and hypotheses testing results.

Chapter 6: This chapter presents the conclusion, contribution, implication, limitations and suggestions for further study. The greatest emphasis is placed on the research summary and findings of interest. Contribution covers both methodological and measurement contribution and implication includes both managerial implication and policy implication. This chapter provides a management guideline or checklist to help manage a firm's absorptive capacity and innovation efficiency, effectiveness, and competitiveness.

CHAPTER II
THEORETICAL FRAMEWORK AND
LITERATURE REVIEW

This chapter provides the theoretical perspectives on which this study is founded. It is divided into three main sections. The first section deals with the absorptive capacity framework, providing details such as definition and characteristics, including a review of previous studies of absorptive capacity. The second section explains the knowledge spillover framework, including definition, characteristics, and the spillover channel, as well as a review of previous studies of knowledge spillover that relate to absorptive capacity. In the final and third section, the study proposes innovation literature reviews.

2.1 Absorptive Capacity Framework

In this section, the study elaborates on absorptive capacity with details such as characteristics, antecedents and so on. Included are reviews of relevant literature on absorptive capacity. First the study takes a close look at the definitions of absorptive capacity, focusing in particular on two main components of absorptive capacity: potential absorptive capacity (consisting of acquisition and assimilation capability), and realized absorptive capacity (consisting of transformation and exploitation capability). Following this, the study focuses on the antecedents of absorptive capacity found in previous literature. And lastly, it discusses direct measurement and the mediating role of absorptive capacity. The entire review is restricted to the application of the absorptive capacity concept at firm level.

2.1.1 Definition and dimension

Cohen and Levinthal (1990) define absorptive capacity as "the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends." Essentially, it is a company's ability to deal with external knowledge. Implicitly, absorptive capacity is treated as 'distinctive competency' from its ability to utilize imported technology. Mowery and Oxley (1995) define absorptive capacity as a broad set of skills needed to deal with the tacit component of transferred knowledge and the need to modify this imported knowledge. Kim (1998) defines absorptive capacity as the capability to learn and solve problems. Lane and Lubatkin (1998) use the three components proposed by Cohen and Levinthal (1990) for their study on the prerequisites of a firm's ability to learn from another. Van Den Bosch et al. (2003) also suggest defining absorptive capacity as having three components: the ability to recognize the value of external knowledge, assimilate it, and apply it to commercial ends. Following Cohen and Levinthal's (1990) work, these scholars agree that the three main dimensions of absorptive capacity are recognition, assimilation, and utilization.

At the same time, several authors point out that absorptive capacity is a multidimensional construct. Thus, they attempt to establish different dimensions from the three initial dimensions. For example, based on Grant's (1996) focus on three dimensions as knowledge integration, Van den Bosch et al. (1999) suggest distinguishing similar dimensions of knowledge absorption, respectively the efficiency, scope and flexibility dimension. Van Wijk et al. (2001) highlight the depth

and breadth dimension of absorptive capacity. The depth dimension of absorptive capacity facilitates the absorption of new, additional knowledge in a domain in which knowledge is already present. Deep knowledge gains from specialization. Specialization enhances rationalization and routinization. The depth of absorptive capacity is, therefore, associated with the efficiency dimension of knowledge absorption. The breadth dimension of absorptive capacity enables the absorption of new knowledge in domains other than but related to what is currently known. This dimension is associated with the scope dimension of knowledge absorption and with exploration. However, there has been some discussion about whether there are more than the three components of absorptive capacity proposed by Cohen and Levinthal (1990).

Zahra and George (2002) reviewed the concept and operations of absorptive capacity. They build upon past research and define absorptive capacity as "a set of organizational routines and processes by which firms acquire, assimilate, transform and exploit knowledge to produce a dynamic organizational capability". In brief, absorptive capacity consists of two main components as functions of four dimensions/capabilities. The first component, potential absorptive capacity (PACAP) makes the company receptive to acquiring and assimilating external knowledge. Thus, it comprises acquisition and assimilation dimensions/capabilities. The second component, realized absorptive capacity (RACAP), consists of transformation and exploitation dimensions/capabilities (Zahra and George, 2002). According to Matusik and Heeley (2005), Zahra and George's (2002) definition reflects the first component, focusing on knowledge creation, and the second component, commercially deploying

the knowledge. Both components play different but complementary roles in explaining how absorptive capacity can influence organizational outcomes or results. The summary of various definitions and dimensions is shown on Table 2.1

Table 2.1 Summary of definition and dimensions of absorptive capacity(ACAP)

Reference Author(s)	Definition	Dimensions
Cohen and Levinthal(1990) Boynton et al.,(1994); Szulanski (1996); Cockburn and Henderson (1998); Lane and Lubatkin (1998); Balkin and Montemayor (2000); Pak and Park (2004)	The ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends.(Cohen and Levinthal,1990)	-Ability to value knowledge through past experience and investment -Ability to assimilate • based on knowledge characteristics • based on organizational or alliance dyad characteristics • based on technological overlap -Ability to apply/commercialize new external knowledge • based on technological opportunity (amount of external relevant knowledge) • based on appropriability (ability to protect innovation)
Kim and Dahlman (1992); Mowery and Oxley (1995); Keller (1996); Liu and White (1997); Veugelers (1997); Luo (1997); Glass and Saggi (1998); Minbaeva et al., (2003)	A broad array of skills, reflecting the need to deal with the tacit components of transferred techno-logy, as well as the frequent need to modify a foreign-sourced tech-nology for domestic applications (Mowery and Oxley, 1995)	Focusing on human capital: • skill level of personnel • trained R&D personnel as percent of population • trained engineering graduates • employees' motivation (e.g.internal communication, merit based promotion) • employees'ability (e.g.competence/ performance appraisal)
Grant(1996a); Van den Bosch et al., (1999); Van Wijk et al., (2001)	ACAP is explored in terms of knowledge absorption (Van den Bosch et al.,1999) which is adapted dimensions from Grant's (1996a) knowledge integration	Dimensions of knowledge absorption adapted from knowledge integration • efficiency, scope and flexibility dimension • depth and breadth dimension
Kim (1995, 1997); Matusik and Heeley (2001)	ACAP requires learning capabili-ty(assimilate knowledge for imitation) and develops problem-solving skills(create new know-ledge for innovation) (Kim, 1998)	Focusing on prior knowledge base and the intensity of effort
Zahra and George(2002); Liao et al.,(2003); Tu et al.,(2005);Jansen et al., (2005); Malhotra et al.,(2005)	A set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability. (Zahra and George, 2002)	Two components(with four dimensions/ capabilities): • Potential absorptive capacity • acquisition capability • assimilation capability • Realized absorptive capacity • transformation capability • exploitation capability

Source: Adapted from Zahra and George(2002)

Zahra and George (2002) retain the other three dimensions and agree to the notion that absorptive capacity is not a one-dimensional concept, consisting rather of various skills and dimensions. However, Zahra and George (2002) expand the concept by introducing an additional dimension – transformation of knowledge – defined as a company's ability to develop and refine the routines that facilitate combining existing knowledge and the newly acquired and assimilated knowledge. This additional dimension is definitely worth considering for analysis, as it explains an aspect of the process of knowledge usage that has been implicitly assumed by other authors. Malhotra et al., (2005) and Jansen et al (2005) explicitly support Zahra and George's (2002) four dimensions (acquisition, assimilation, transformation, and exploitation) as the aspects required to examine the knowledge creation within the absorptive capacity framework. In contrast, Schmidt (2005) argues that affective exploitation requires transformation of external knowledge in order to be used by various actors within the enterprise. Thus, the transformation dimension need not be made explicit, as it is an integral part of the "exploitation" component.

In summary, since there is a lack of clarity on the dimensions of absorptive capacity, earlier studies are divided into two groups. Following the absorptive capacity dimensions suggested by Cohen and Levinthal (1990), the first group focuses on and tests three dimensions (e.g Szulanski, 1996; Lane and Lubatkin, 1998; Balkin and Montemayor, 2000; Harrington and Guimaraes, 2005). The second group follows Zahra and George's (2002) re-conceptual model and examines four dimensions of absorptive capacity (e.g. Liao et al., 2003; Jansen et al., 2005; Tu et al., 2005). Since this study aims to complete a re-conceptual model of absorptive capacity

and to fill this gap, it examines four dimensions through the second order of potential and realized absorptive capacity.

In sum, absorptive capacity is beneficial and a specific construct. This study also aims to investigate if the mechanism of knowledge spillover affects absorptive capacity and innovation and if so, what the different impact on each component of absorptive capacity is. This means that the absorptive capacity re-conceptual model recommended by Zahra and George (2002) should be used in this study. There are still few empirical studies on the dimension or component level and it would seem beneficial to fill this gap by examining both components of absorptive capacity (potential and realized), simultaneously.

2.1.2 Measurement

For measurement, most previous studies continue to follow up on the arguments presented by Cohen and Levinthal (1990). This means measurement is indirect and uses a proxy to capture company absorptive capacity. In the innovation and cooperation behavior of firms, the popular proxies continue to be R&D budgets, R&D stocks, and R&D intensities (e.g. Stock et al., 2001; Cassiman and Veugelers, 2002; Oltra and Flor, 2003; Belderbos et al., 2004). Other proxies and measures (primarily used by researchers from the field of business administration) include organizational structure and practices, like incentive systems and human resource and knowledge management (Van Den Bosch et al., 1999; Vinding, 2000; Lenox and King, 2004;) and production line performance in terms of labor productivity and conformance quality (Mukherjee et al., 2000).

The absorptive capacity concept following up on Zahra and George's (2002) proposal, which is distinctive and more focused on external knowledge sources as the main antecedent, is quite new and there have been few empirical studies to test direct measurement (as opposed to using proxies) of absorptive capacity. According to Lane et al.(2002), the lack of a direct empirical measure of absorptive capacity has not only caused some problems with the comparability of research results, it has also led to little research on the process by which absorptive capacity is developed. There is an emerging trend to study and follow up on Zahra and George's (2002) conceptual framework, particularly with regards to direct measurement, such as is found in the works of Jansen et al., (2005).

Jansen et al. (2005) study the details of both components (potential and realized) of absorptive capacity following Zahra and George's (2002) proposal. They discuss simultaneous testing on four dimensions at the intra-firm level with the aim of exploring organizational antecedents influencing absorptive capacity. They adapt and develop scales for direct measurement of potential and realized absorptive capacity. Although the results are mixed, the findings show why units in organizations may have difficulty managing levels of potential and realized absorptive capacity and vary in their ability to create value from their absorptive capacity.

In sum, there are still gaps in direct measurement of absorptive capacity. In furtherance of this study's aims to fill this gap, a multi-item scale index is provided and modified based on literature reviews and expert interviews and all scales are empirically tested.

2.1.3 Model of absorptive capacity as mediator

As a useful and specific construct, absorptive capacity has been investigated with exploration of its many roles, such as predictor or independent variable (e.g. Saulanski,1996; Lu and White, 1997; Cockburn and Henderson, 1998; Lane and Lubatkin, 1998; Tsai, 2001; Liao et al., 2003; Pak and Park, 2004; Matusik and Heeley, 2005; Tu et al., 2005, etc.), dependent variable (e.g. Lado and Vozikis, 1996; Jones and Craven, 2001; Harrington and Guimaraes, 2005, etc.), moderator (e.g. Cohen and Levinthal, 1989, 1990; Mowery and Oxley, 1995; Veugelers, 1997; Sinani and Meyer, 2004; Nielsen, 2005; Nieto and Quevedo, 2005; Rhee, 2005, etc.) and mediator (e.g. Lin et al., 2002; Minbaeva et al., 2003; Molholta et al., 2005, etc.). Table 2.2 shows some examples of the role of absorptive capacity derived from the review of literature.

The most popularly tested roles are predictor and moderator and the least studied role is mediator. Until Zahra and George's (2002) influential work was launched, recent literature dealt more with the mediating role of absorptive capacity. Figure 2.1 shows the re-conceptual model of absorptive capacity proposed by Zahra and George (2002).

Table 2.2
Summary the conceptualization and operationalization issues of absorptive capacity (ACAP)

Authors	Unit of Analysis	Sample/Data	Theoretical Approaches	Modeling/ Treatment	Measurement	The results/effects
Mowery and Oxley (1995)	Country	Conceptual illustrated with statistical data	Compare inward technology transfer channels and national innovation system.	National ACAP as moderator of inward technology transfer and national innovation system	Investment in scientific and technical training and economic policy that enforce competition	•National innovation and productivity are greater for countries that invest in building their ACAP
Keller (1996)	Country	Conceptual/economic modeling	Transitional dynamics and sustainable long-run growth dependent upon rate of human capital development	ACAP allows exploitation of technology	(1) Engineering students as percentage of total post-secondary educated population; (2) scientists and engineers per million of population;(3) scientists and engineers in R&D per million of population	•Switch in government policy toward an outward orientation(policy liberalism) gives a country only the information part of technology; implementation, however, requires ACAP for skilled human capital
Lu and White (1997)	Country	145 firms from 29 manufacturing industries in China	Innovation in developing economies	ACAP as predictor of innovative output	Investments in R&D personnel	•Innovation is driven by synergy between investments in ACAP and investment in sources of new knowledge (foreign technology imports)
Lane and Lubatkin (1998)	Inter-organiza-tion	69 R&D nonequity alliances between 48 pharmaceutical and 22 biotechnology firms	Organizational learning theory: resource based theory	ACAP as predictor of organizational learning in an alliance dyad	8 total measures based on valuing new knowledge (2),assimilating new know-ledge(5),and commercializing new knowledge(1)	•ACAP best measured at the dyadic unit of analysis; relative similarities between two firms' knowledge and knowledge-processing systems are more important than one firm's knowledge base
Cohen and Levinthal (1990)	Firm	1,719 business units from 318 firms in 151 lines of business in US. manufacturing sector	Organizational learning; economic theory	ACAP is used as precidtor of innovative activity	R&D intensity; responsiveness of R&D to learning incentives (relevance, ease, and the appropriability)	•R&D creates a capacity to assimilate and exploit new knowledge

Source : Adapted from Zahra and George(2002)

Table 2.2
Summary the conceptualization and operationalization issue of absorptive capacity (ACAP)
(continued)

Authors	Unit of Analysis	Sample/Data	Theoretical Approaches	Modeling/ Treatment	Measurement	The results/effects
Boynton, et al., (1994)	Firm	132 nits with similar information technology(IT) mainframe systems	Organizational learning	ACAP as a predictor of the extent of managerial IT use	(1)Managerial IT knowledge of business processes & the value of information technology; (2) managerial IT process effect-tiveness	•Managerial IT knowledge was found to influence an organization's extent of IT use;IT management process effectiveness did not influence extent of use; also,higher levels of IT management climate positively influenced both dimensions of ACAP
Szulanski (1996)	Firm	271 respondents comment on 122 transfers of 38 practices technologies	Organizational learning and strategic management	ACAP as predictor of effective transfer of best practices within firm	9 measures that capture the ability to value, assimilate and apply new technology	•Lack of ACAP of the recipient is a major source of 'stickiness," defined as difficulties in imitating best practices within a firm
Veugelers (1997)	Firm	290 Flemish firms with active R&D units	Organizational learning/ innovation	ACAP is a moderator of level of innovative activity	ACAP as (1)R&D department fully staffed; (2)R&D depart-ments with doctorates;(3)R&D department engaged in funda-mental research	•When ACAP is present, external sources of R&D (e.g., from alliance partner) stimulate internal R&D spending; there is no similar effect when capacity is not present
Cockburn and Hender son (1998)	Firm	68,186 publications in scientific journals	Industrial/ organization economics	ACAP as predictor of research productivity	Not a direct operationalization of ACAP but is reflected by number of scientific publications	•Developing ACAP is not adequate, *connectedness* to scientific community is a key factor in driving a firm's ability to recognize and use upstream research and findings
Kim (1998)	Firm	Case study of a manufacturing firms (Hyundai Motor Co.)	Organizational learning (OL); organizations as learning systems	OL is a function of ACAP;it is the capacity of assimilate know-ledge(for imitation) and create new knowledge for innovation	Changes in firm orientation toward use of assimilated tech-nology; transition from techno-logy assimilation to imitate to development of internal R&D functions to innovate	•ACAP is integral part of a learning system; creation of crises keeps firm on forefront of knowledge development through investment in learning and increased intensity of efforts to learn.
Lin et al. (2002)	Firm	548 firms in Taiwan with 368 electronics sector and 165 chemical manufacturing sector	Technology transfer research and management practice	ACAP as mediator of critical factors (organi-.zational culture,techno-logy diffusion channel, interaction mechanism, R&D resource) to transfer performance	Technology ACAP as (1) adaptation capability; (2) application capability; and (3) production capability)	•Technology diffusion channel, interaction mecha-nism, and R&D resource are related to ACAP. • Organizational cultures impact on interaction mechanism, R&D resource, ACAP, and transfer performance. • Different organizations will experience different technology transfer performance.

Source : Adapted from Zahra and George(2002)

Table 2.2
Summary the conceptualization and operationalization issues of absorptive capacity (ACAP)
(continued)

Authors	Unit of Analysis	Sample/Data	Theoretical Approaches	Modeling/ Treatment	Measurement	The results/effects
Zahra and George (2002)	Firm	Re-conceptualization previous ACAP illustrated with description	Dynamic capability	ACAP as mediator covering both many antecedents and consequences in terms of compe-titive advantage	4 dimensions of ACAP (acquisition, assimilation, transformation, exploitation) form 2 distinct components (potential and realized)	• Four dimensions play different but complementary roles to show the influence on organizational outcome; • ACAP is multidirectional and non-patterned developmental path; • ACAP depends on many factors, focusing on knowledge source and complementarity, and experience
Matusik and Heeley (2005)	Firm	901 firms in pre-packaged software industry	ACAP framework from Cohen and Levinthal's (1990) influential definition	Establish multidi-mensions of ACAP to determine level of private know-ledge outcomes	ACAP as : (1)collective dimension(component) as relevant public industry know-ledge; (2) collective dimension (architectural) as structures/ routines for knowledge transfer; and (3)individual absorptive ability	•ACAP composes of multiple dimensions: (1) the firm's relationship to its external environment; (2) the structure, routines, and knowledge base of the main value creation group; and (3) individual's absorptive abilities. • The results show that each of these dimensions contributes to increased knowledge or knowledge creation activities.
Minbaeva et al., (2003)	Intra-firm	169 subsidiaries of MNEs in 3 host countries (USA, Russia,Finland)	Human resource management (HRM)	Establish new dimensions from HRM view(as HR- ability and motivation) for ACAP and link to transfer of knowledge	ACAP as : employee's ability dimension(2), and employee's motivation dimension (3)	•Two aspects of subsidiary's ACAP (ability and motivation) are needed to optimally facilitate the absorption of knowledge from other parts of multinational company
Jansen et al.,(2005)	Intra-firm	769 organizational units in 220 branches in one country of large, European, multi-unit financial services firm	Combinative capabilities	ACAP as dependent variable of three organizational mechanisms (coordination, system, and socialization)	4 dimensions of ACAP (follow up Zahra and George's(2002) argument) with qualitative approach	•Organizational mechanisms associated with combinative capability drive a unit's potential and realized ACAP in different ways •The mechanisms associated with coordination capabilities (cross-functional interfaces, participation in decision making, and job rotation) primarily enhance a unit's potential ACAP. •The mechanisms associated with socialization capabilities (connectedness and socialization tactics) primarily increase a unit's realized ACAP.

Source : Adapted from Zahra and George(2002)

Figure 2.1 A model of firm's absorptive capacity: antecedents and outcomes

Source : Adapted from Zahra and George,2002, Figure 1
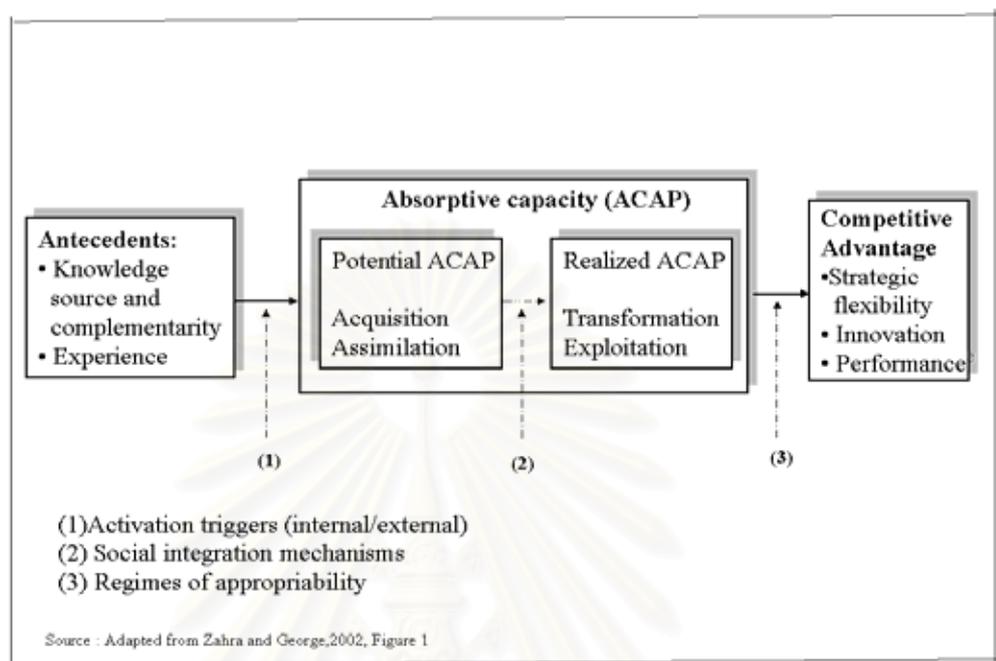
Zahra and George's (2002) seminal framework portrays an absorptive capacity model at firm level in which the distinction between a firm's potential absorptive capacity and realized absorptive capacity to absorb knowledge is introduced. In the model, potential absorptive capacity comprises knowledge acquisition and assimilation while realized absorptive capacity is determined by transformation and exploitation. In this connection Zahra and George (2002) point out that outcomes reflect a firm's realized absorptive capacity and that the potential absorptive capacity component has received disproportionally less empirical scrutiny when compared to realized absorptive capacity. They suggest that both types of capabilities have separate, but complementary roles. Firms with a high degree of potential and realized absorptive capacity are likely to increase their performance and competitive advantage.

In addition, Zahra and George (2002) distinguish as key antecedents external sources of knowledge, including inter-organizational relationships such as alliances, knowledge complementarity and experience. External sources of knowledge should be complementary to the knowledge a firm already possesses. Internal (for example an organizational crisis) and external (for example regulatory change) triggers are introduced as moderating the antecedents, potential and realized absorptive capacity and outcomes. In the model, so-called internal social integration mechanisms (such as structure of communication between units) may be supposed to reduce the gap between potential and realized absorptive capacity and thereby increase the efficiency and effectiveness. The model explicitly takes into account the external context to explain the relationship between absorptive capacity and outcomes. Additionally, the model introduces the regime of appropriability as a moderating factor. Under a strong regime of appropriability it is expected that there will be a significant and positive relationship between realized absorptive capacity and sustainable competitive advantage as an outcome because of higher costs of imitation by rivals.

Though Zahra and George (2002) suggested the conceptual model sketched above, they did not test the model. Present studies are increasingly following this particular model (e.g. Malholta et al.,2005) because of the more robust and numerous issues to further develop and on which real empirical tests can be done.

In sum, absorptive capacity is studied in various roles but only few deals with the mediating role. This study follows Zahra and George's (2002) model, seeing

it as an influential framework that underscores the importance of the mediating role of absorptive capacity. Before providing a new antecedent and consequence of absorptive capacity, earlier studies of factors influencing absorptive capacity should be reviewed and discussed.

2.1.4 Internal and External factors

The application of the absorptive capacity concept in various fields has led to the identification of a whole array of factors that are assumed to influence absorptive capacity (Schmidt, 2005). Most of these factors/determinants come from theoretical considerations and empirical studies of knowledge management or innovation processes, particularly internal factors. Broadly categorized, factors affecting a firm's absorptive capacity can be either an internal or an external factor. Daghfous (2004) sums up the internal factors from previous studies into three main groups: R&D activities, related prior knowledge and individuals' skills, and organizational structure and human resource management practices.

The first group is R&D activities. Cohen and Levinthal (1990) focus mainly on the role of R&D expenditure in building absorptive capacity and point to the dual role R&D plays in the innovation process of firms: building absorptive capacity and generating new knowledge and innovations. Many other scholars have thus used R&D-related measures and approaches to model absorptive capacity at the company level. Among them are (1) R&D expenditure: R&D intensity (R&D total sales/ expenditure) (e.g. Cantner and Pyka, 1998; Rocha, 1999; Stock et al., 2001), and level

of R&D investment (e.g. Grünfeld, 2003; Leahy and Neary, 2004); (2) continuous R&D activities (e.g. Becker and Peters, 2000; Oltra and Flor, 2003); and (3) existence of an R&D lab (e.g. Veugelers, 1997; Becker and Peters, 2000).

The second group is related prior knowledge and individuals' skills. In Cohen and Levinthal's (1990) paper, they expand and argue the concept that absorptive capacity is path-dependent because experience and prior knowledge facilitate the use of new knowledge. Thus, absorptive capacity is cumulative. The cumulative nature of knowledge may also be related to another determinant of absorptive capacity, employees' level of education. The more education and training employees receive, the higher their individual ability to assimilate and use new knowledge will be. As company absorptive capacity depends on the capacity of their employees, the general level of education, experience and training of their employees have a positive influence on that company's level of absorptive capacity. For example, Rothwell and Dodgson (1991) find that (small) firms need well-educated technicians, engineers and technological specialists to access knowledge from outside their boundaries. Frenz et al. (2004) take this into account in their analysis by including the share of scientists and engineers to total employees as well as training expenditures in their model.

The third group is organizational structure and human resource management practices. A firm's absorptive capacity is not the simple sum of its employees' abilities as Cohen and Levinthal (1990) argue. According to them, it depends on the ability of an organization as a whole to stimulate and organize the transfer of

knowledge across departments, functions, and individuals. This aspect of absorptive capacity has been incorporated into many studies: It has been shown that the absorptive capacity of a firm is determined by its expertise in stimulating and organizing knowledge sharing (Van Den Bosch et al., 1999) and the similarity of any two cooperating firms' systems for doing so (Lane and Lubatkin, 1998). Daghfous (2004) review suggests that the organizational structure of a firm and crosstraining leads to improved knowledge sharing among departments and individuals within a firm (e.g. Lane and Lubatkin, 1998; Van Den Bosch et al., 1999, 2003; Welsch et al., 2001). Daghfous (2004) states that organizational culture has a positive influence on the level of absorptive capacity if it provides incentives for knowledge diffusion through the empowerment of employees and managers. Gradwell (2003) points to the strong influence of close networks and relationships within firms in stimulating the transfer of tacit knowledge.

Closely related to organizational structure and knowledge sharing is human resource and knowledge management. To name a few examples, forming workgroups made up of actors from different departments, stimulating job rotation, managing proposals submitted by employees, and encouraging employees to read and monitor relevant literature and developments can certainly help facilitate the flow of knowledge (e.g. Jones and Craven, 2001; Mahnke et al., 2005). Human resource management can also help to stimulate learning through reward systems and training (e.g. Minbaeva et al., 2003; Daghfous, 2004; Mahnke et al., 2005) These actions lead to higher individual absorptive capacity and, consequently, to a higher capacity of the organization as a whole. Williamson (1967) argues that information gets lost or at

least distorted if it is transferred through different layers of hierarchy. Thus, direct contact among employees from different departments, units and the like should lead to a more efficient transfer of knowledge and a subsequently higher absorptive capacity.

There are fewer studies of how external factors affect absorptive capacity than of internal factors. Based on a review of literature during 1990-2005, external factors are divided into three main groups: external knowledge environment, network and alliance with external partner, and knowledge source and complementarity.

First is the external knowledge environment. According to Nonaka and Takeuchi (1995), this factor is crucial to absorptive capacity because the firm does not exist alone. A knowledge-creating company operates in an "open system" in which it constantly interacts with its outside environment by exchanging knowledge. This knowledge may be in the form of new capabilities, which improve the firm's absorptive capacity. This external factor that previous literature has presented as determining a firm's absorptive capacity includes 'industry dynamism' and 'position in external knowledge network and relationship with players in the network'.

For industry dynamism, according to De Boer et al. (1999) and Grant (1996b), firms that face changing knowledge environments also face the challenge of recategorizing or recontextualizing their "existing knowledge components," which requires an ability to absorb new knowledge.

With regards to the position in external knowledge network and relationship with players in the network, Nonaka and Takeuchi (1995) state that one of the five primary phases of creating knowledge in an organization is "cross-leveling" which is the movement of knowledge between a firm and external entities (e.g. customer, partner, and university). Firms in industry communities (defined as the concentration of interdependent firms and professions) enjoy the benefits of being able to respond to changes in demand for skills because of abundant know-how. They are better able to absorb innovative practices due to the information-sharing facilitated by the overlapping networks (Arthur and Defillippi, 1994). This implies that an important external determinant of a firm's absorptive capacity is the strength of its relationships with other members of the knowledge networks, which may include knowledge institutions as primary participants. These may include technical support, academic institutions, and consultants.

Second is knowledge source and complementarity. Zahra and George's (2002) work proposes the most obvious model to pinpoint the importance of this group as external factor influencing absorptive capacity. Although they did not empirically test this group, it is more elaborately investigated by other scholars.

The third and final group is network and alliance with external partner. Recently, Schimdt (2005) uses the dimensions of absorptive capacity model recommended by Zahra and George (2002) to explore innovative firms and test them with their networks. He determines that network and alliance with external partner is an external factor influencing absorptive capacity.

In sum, the internal factors from all three groups have largely been treated as independent of each other. Nonetheless, it is feasible to assume that they are, at least to some degree, interrelated. In addition, most of the internal factors are complements rather than substitutes. Similarly, the external factors in the three groups seem to have some correlation and complementarity but with a different perspective.

This study attempts to pinpoint external factors affecting companies' absorptive capacity, where subject there are few empirical studies despite its importance. This study is different from preview studies in two ways: first, it provides a new mechanism to assess incoming knowledge spillovers and second, it proposes that they have separate roles that affect strengthening absorptive capacity differently. Table 2.3 summarizes the factors affecting absorptive capacity.

2.1.4 Summary of current gaps and research directions

Since it is a useful and specific construct, absorptive capacity is important not only as a multilevel construct but also as a trans-disciplinary construct (e.g. economics, sociology, strategic management) (Van den Bosch et al., 2003). Much of the literature provides evidence of the vital nature of absorptive capacity in various fields. Absorptive capacity is examined and brought to bridge and to enrich various literatures such as organizational learning, knowledge management, and innovation. Table 2.4 shows some examples of absorptive capacity studies for bridging and enriching in various literatures.

Table 2.3 Summary of factors affecting absorptive capacity (ACAP)

Factor	Explanation	Dimensions of ACAP being affected	Authors
Internal Factor	R&D activities • investment in R&D	•Acquisition, assimilation, exploitation	•Cohen and Levinthal ,1990;Jones and Craven,2001; Veuglers,1997; Ahanotu,1998; Vinding, 2000
	Related prior knowledge and individual's skills • level of education and academic degree	•Acquisition, assimilation, Transformation	•Rothwell and Dodgson,1991; Vinding,2000;Frenz et al., 2004
	• diversity of backgrounds	•Assimilation, transformation	•Cohen and Levinthal,1990
	• the presence of gatekeepers	•Assimilation, transformation	•Vinding,2000;Gradwell,2003
	• experience	•All four dimensions	•Zahra and George,2002
	Organizational structure and HRM practice • organizational structure	•Assimilation, Transformation, exploitation	• Terziovski and Morgan,2006 ; Welsch et al., 2001;Nonaka and Takeuchi, 1995
	• level of internal communication	•Assimilation, Transformation	• Cohen and Levinthal,1990; Bosch et al.,1999
	• organizational culture-empowerment of employees	•Exploitation	• Lloyd,1998
	• level of organizational bureaucracy, organization inertia	•Exploitation	•Nonaka and Takeuchi,1995; Davenport and Prusak,1998; Welsch et al.,2001
	• size	•Acquisition; exploitation	•Welsch et al.,2001
	• human resource management (HRM) (e.g.recruitment, job rotation, incentive etc.)	• All four dimensions	• Simons,1994;Veuglers,1997; Davenport and Prusak,1998; Dhanaraj et al.,2003
External Factor	External knowledge environment • industry dynamism	• Acquisition; assimilation	• Boer et al.,1999;Grant,1996b
	• position in external know-ledge networks, relationships with players in the network	• Acquisition; assimilation	• Arthur and Defillippi,1994; Nonaka and Takeuchi ,1995
	Network and alliance with external partner	•Acquisition; assimilation; exploitation	• Schimdt,2005
	Knowledge source and complementarity	• All four dimensions	• Zahra and George,2002

Source: Adapted from Doughous(2004)

Table 2.4 Examples of absorptive capacity bridging and enriching in various literatures

Authors	Related literature	Explanations
Cohen and Levinthal (1990);Cockburn and Henderson (1998)	• Organizational learning	•When firms invest in form of in-house basic research, they are able to access and learn from upstream basic research.
Volberda(1998); Dijksterhuis et al. (1999)	•Managerial cognition	•A change in shared managerial schemas, which is shared among a firm's key decision makers, influences firm's absorptive capacity • Firms associated with a classical manage-ment logic do not consider environment as a source of valuable knowledge to be absorbed and, thus, lack absorptive capacity
Cohen and Levinthal , 1990; Carlsson and Jacobsson ,1994; Wegloop,1995; Meyer-Krahmer and Reger ,1999; Stock et al., 2001 ;Tsai, 2001; Narula,2004	•Innovation and national systems of innovation (NSI)	• Increasing ACAP of the economy becomes an important aspect of public policy • ACAP is important for raising the ability of national systems of innovations in a European context • Institutions and actions that allow firms within NSI to recognize value of new external information, assimilate it, and apply it to commercial ends-that is national ACAP-
Dyer and Singh,1998; Deeds,2001	•Organizational change, Strategic renewal and Entrepreneurship	•Strategic renewal can take place by external actions like strategic alliances aimed at creating an organizational competitive advantage in which the ACAP involved are important • Positive relationship between ACAP and entrepreneurial wealth creation in pharmaceutical biotechnology firms
Volberda et al.(2001)	•Dynamic capability theory	•Internal actions, like starting up new business and launching new products and services, require substantial exploration activities and ACAP to facilitate the activities
Lewin et al.(1999)	•Co-evolutionary research	•ACAP is considered as one of the main mediating factors between micro and macro evolution
Nonaka and Takeuchi, 1995; Dyer and Singh, 1998; Lin et al.,2002; Van Wijk et al.,2002; Caloghi-rou et al,2004; Lim, 2004	•Inter-organizational relations and network	• The movement of knowledge between a firm and external entities (called cross-levelling) affects ACAP. •The strength of relationships with other members of the knowledge networks is important external determinant of ACAP
Lyles and Salk (1996); Mowery et al. (1996) Kim (1998); Koza and Lewin (1998); Lane and Lubatkin (1998); Ahuja (2000); Van Wijk et al. (2001)	•Knowledge transfer and strategic alliances	•Vertical knowledge transfer relates to increases in the depth dimension of ACAP but have no significant relation with the degree of exploration over exploitation. •Horizontal knowledge transfer has a positive relationship with the breadth dimension of ACAP. The breadth of ACAP positively related to the level of exploration over exploitation.

Source: Adapted from Van den Bosch et al.(2003)

Literature dealing with absorptive capacity continues to have gaps and requires research to enable completion of the model. For example, Van den Bosch et al. (2003) indicate the progress and some problem topics for absorptive capacity as (1) an awareness of multilevel and trans-disciplinary characteristics of absorptive capacity; and (2) measurement. There is no general agreement as to how to measure absorptive capacity. There is also a barrier in the form of lack of attention to the question of what can be learned from absorptive capacity model building efforts.

In addition, a summary of many reviews of absorptive capacity construct reveals that emphasis on construct and measurement development and model building is needed to enable further research (e.g. Calori et al., 1994; Klein et al., 1994; Lewin and Volberda, 1999; Sanchez, 2001; Van den Bosch and Van Wijk, 2001; Schmidt, 2003; Van den Bosch, 2003; Lim, 2004; Tu et al., 2005). Regarding measurement, utilizing and comparing complementary methods are clearly needed. Reflecting on different measurement methods of absorptive capacity and clearly distinguishing the measurement of the construct and the measurement of its antecedents and consequences will enable further progress (e.g. Van den Bosch, 2003; Schmidt, 2005). Construct development will also be triggered by a strong emphasis on model building efforts.

Another research direction for absorptive capacity relates to the completion of a model. According to Van den Bosch et al. (2003), the perspective of a model as mediator between theories and empirical phenomena may be useful to both highlight different aspects of the absorptive capacity construct and stimulate the search for

corresponding aspects of the empirical phenomena explored. This research direction is compatible with this study. Table 2.5 shows a summary of current gaps and the focus of this study.

Table 2.5 Summary of current gaps and focus of this study

The issue	Previous studies	Gap(s)	The focus of this study
Dimension	Most focus on 3 dimensions (suggested by Cohen and Levinthal ,1990), or some focus on only 2-3 dimensions (suggested by Zahra and George, 2002)	Few studies four dimensions, simultaneously	Examining two main components (potential and realized absorptive capacity: ACAP), which include all 4 dimensions, simultaneously
Measurement	Most use proxy of ACAP and focus on input of ACAP rather than result of ACAP	Few studies of direct measurement of ACAP	Using direct multi-item scale measure 4 dimensions of ACAP, and focus on result of ACAP, instead.
Mediating role and model building	Most test ACAP as predictor or moderator	Few studies of mediator	Investigating importance of mediating role and develop the completion of ACAP re-conceptual model
Antecedent	Most concerns on internal factors	Few studies of external factor	Exploring special external source (knowledge spillover) through spillover channel mechanism

Source: The author

Using the absorptive capacity framework as well as literature reviews, the present study considers absorptive capacity as a strategic tool that is both crucial and useful in achieving competitive advantage. Strategic management to create and strengthen a company's absorptive capacity is necessary, helpful and should be of more concern, especially in this competitive knowledge-based era. As such, this study focuses on managing absorptive capacity by using an effective and efficient new tool such as the spillover channel mechanism, which is expected to more directly facilitate both components of absorptive capacity. At the same time, it is expected to indirectly enhance outcomes such as innovation. Therefore, the findings of this study are

expected to not only fill in gaps but also expand the body of knowledge. The main antecedent in this study is derived from specific external knowledge source (e.g. knowledge spillovers). The next section provides more details of both the framework and literature reviews of knowledge spillover.

2.2 Knowledge Spillover Framework

External knowledge source for a firm, a region or a country is obtained as a combination of R&D performed by other firms/regions/countries somehow weighted to account for the intensity of knowledge flows between the source and the destination. The fact that knowledge can spill over from one country, industry or firm to another is due to the public good nature of knowledge, as first recognized by Arrow (1962) and later extensively discussed by many scholars (e.g. Blomström and Kokko, 1998;Keller, 2001; Mancusi, 2004). The lack of rivalry and exclusivity for knowledge invoke free-riding behavior, allowing parties other than the innovator the ability to be benefit from innovation at no cost, so that the actual innovator may not be able to fully appropriate all the rents originating from his innovation (Smeets and Vaal, 2005).

Spillovers and R&D externalities have been one of the most active areas of research over the past thirty years (Meyer, 2004). The reason for the continued lively interest in the topic lies in its importance for the explanation of productivity growth, particularly in economics literature. Moreover, the reach of spillovers has important implications for cross-country convergence in living standards of the host country (Mancusi, 2004) and innovation (Ferrero, 2004). In recent years interest has gradually

shifted to this last issue and significant research has been devoted to trying to assess the relevance of international knowledge spillovers and how they can be enhanced. In this study, knowledge spillover is considered as an external special source of knowledge. It is the first root to further develop related mechanisms, representative of factors affecting absorptive capacity (as mediating role) and impact innovation as the final consequence.

2.2.1 Main characteristics

2.2.1.1 Definition and level

MacDougall (1960) was the first to include spillovers when trying to measure the full effects of foreign direct investment (FDI). Fundamentally though, spillovers seem to suffer from a definition problem. The term 'spillovers' has been used in much of the literature as a cover-all term, to pick up the perceived residual benefits from FDI, which accrue to indigenous firms and for which foreign firms are uncompensated, raising the overall level of productivity. Kokko (1994) points out that the term 'spillover' has a broader meaning than 'imitation' or 'technology diffusion'. It is primarily associated with 'productivity' hence the interchangeable use of the terms 'productivity' and 'technology' spillover in much of the literature. Meanwhile, Lim (2000) defines spillover as contagion or knowledge diffusion, which often referred to as externalities or efficiency 'spillovers'. According to Meyer (2004), spillovers arise from non-market transactions when resources, notably knowledge, are spread without a contractual relationship, so-called externalities. Whether foreign investors allow positive externalities depends on their opportunity costs of sharing the knowledge, and the transaction costs of establishing barriers to knowledge flows.

Several spillovers are differently called by using the reference base from these definitions, such as productivity spillover, knowledge spillover, and technology spillover. For example, productivity spillovers from FDI take place when the entry or presence of multinational corporations increases productivity of domestic firms in a host country and the multinationals do not fully internalize the value of these benefits (e.g. Blomstrom et al., 2000; Buckley et al., 2002).While policy makers have long believed that FDI can be an important source of technology for developing economies (Blalock and Gertler, 2005), they argue that the technology employed by firms in emerging markets is inferior to that of their multinational counterparts based in developed economies. When multinationals enter an emerging market they therefore bring more advanced technology or knowledge. Thus, there is knowledge spillover, defined here as the managerial practices, production methods, and other tacit and codified know-how by which a firm transforms inputs into a product. This technology may then diffuse throughout the host economy.

The spillover affect may impact indigenous firms in three levels. The first is defined as intra-industry, which may occur through demonstration effects, competition effects or the labor market (Aitken and Harrison, 1999; Girma et al., 2001). The second occurs at the inter-industry level, through backward and forward (i.e. intermediate buyer-seller) linkages (Markusen and Venables, 1999; Kugler, 2001). The last is the agglomeration spillover effect, most likely to be felt through the labor market and local infrastructure arrangements, and occur as a result of geographic proximity to foreign firms (Taylor and Wren, 1997; Driffield, 1999).

2.2.1.2 Type and measurement

Spillovers are categorized differently depending on viewpoint. For example, in a pioneering paper, Grilliches (1979) identifies two main sources of potential innovation externalities generated by R&D activities: rent spillovers and pure knowledge spillovers. Rent spillovers arise when the prices of intermediate inputs purchased from other firms or countries are not fully adjusted for quality improvements resulting from R&D investment. As such, they originate from economic transactions and are the consequence of measurement 'errors' (Mancusi, 2004). In contrast, pure knowledge spillovers arise because of the imperfect appropriability of ideas: the benefits of new knowledge accrue not only to the innovator, but 'spill over' to other firms or countries, thus enriching the pool of ideas upon which subsequent innovations can be based (Smeets and Vaal, 2005). Hence, knowledge spillovers may occur without any economic transaction and are not the manifestation of any measurement problem (Mancusi, 2004).

Meanwhile, Keller (2001) adheres to a somewhat similar taxonomy of active versus passive knowledge spillovers, although he bases this classification mainly on spillover transfer mechanisms: (international) trade, FDI, personal communication patterns, articles in journals and patents (Keller, 2004). Accordingly, spillovers are termed active when they provide the receiver with a kind of 'blueprint' of the knowledge (e.g. patents) and are termed passive when they allow the receiver only to apply certain pre-designed elements of the knowledge or technology (e.g. trade in intermediate goods).

Some scholars try to classify spillovers by the characteristics of knowledge. For example, Grunfeld(2002) differentiates between embodied and disembodied knowledge spillovers as relating to tangibles (e.g. goods) and to intangibles (e.g. services). Generally, the literature distinguishes between codified knowledge and tacit knowledge (Powell and Grodal, 2005). The former is preserved in a more tangible form such as books and data files, the latter is preserved in intangibles such as experience, routines, and norms.

On the other hand, Smarzynska (2002) proposes another viewpoint of the two types of spillovers. First is horizontal spillover, occurring when local firms benefit from the presence of foreign companies in their sector. It can take place through observation, worker movements across companies, and/or information dissemination. To the extent that local firms compete with multinationals, the latter have an incentive to prevent technology leakage and spillovers from taking place. This can be achieved through formal protection of their intellectual property, trade secrecy, paying higher wages or locating in countries or industries where domestic firms have limited imitative capacities to begin with (Smarzynska, 2002). The second type is vertical spillover, which refers to spillover taking place due to linkages between foreign firms and their local suppliers, customers, or distributors. Such spillovers can operate through various methods such as direct knowledge transfer from foreign customers to local suppliers, and indirect knowledge transfer through movement of labor (Financiar, 2001). It seems, then, that the type of spillover depends on the purpose.

Table 2.6 Main characteristics of spillovers

Issue	Author(s)	Description
Definition	•MacDougall(1960) •Lim (2000) •Meyer (2004)	• The residual benefits from FDI, which accrue to indigenous firms and for which foreign firms are uncompensated, raising the overall level of productivity. • The contagion or knowledge diffusion, which often referred to as externalities or efficiency "spillovers". • Non-market transactions when resources, notably knowledge, are spread without a contractual relationship
Level of spillover effects	Taylor and Wren(1997); Driffield(1999); Markusen and Venables (1999);Aitken and Harrison(1999) ; Girma et al.(2001) ; Kugler (2001)	• Intra- industry spillover effect • Inter-industry spillover effect • Agglomeration spillover effect
Types	• Grilliches(1979) • Keller(2001) • Grunfeld(2002) • Smarzynska(2002)	• Rent spillover and pure knowledge spillover • Active and passive knowledge spillover • Embodied and disembodied knowledge spillover • Horizontal spillovers (local firms benefit from the presence of MNEs in their sector) and vertical spillovers (the linkages between MNEs and their local firms both upstream and downstream in supply chains)
Measurement	•Harris and Robinson ,2004 ; Ferrero and Maffioli,2004 • Jaffe et.al.,1993; Mancusi, 2004	• Foreign presence in the sector (the proportion of capital in the industry owned by foreign firms) • Foreign presence in region and in upstream and downstream industries (measurement of intra industry spillovers) • Patent citations
Channel for knowledge dissemination	• Saggi, 2002; Smeets and Vaal, 2005 • Eden et al.,1997; Blomstrom and Kokko, 1998; Aitken and Harrison, 1999; Blomstrom et al., 2000; Feinberg and Majumdar, 2001; Smarzynska, 2002 ; Ferrero and Maffioli , 2004	• 3 channels: demonstration, labor turnover (training of local employees), linkages effect (cooperation) • 4 channels: demonstration effect (e.g.reverse engineering and imitation); competition effect (e.g. local firms benefit as low-cost assess to leading-edge technology is the productivity-enhancing); acquisition of human capital (workforce turnouts/ mobility/ experts); and linkages effect (backward and forward between MNEs and local supplier/ buyer in supply chain)

Source: The author

In terms of measurement of general spillovers, most previous studies use the proxy of foreign presence. For example, Harris and Robinson (2004) examine the evidence of spillovers by using several measurements such as foreign presence in the sector (the proportion of capital in the industry owned by foreign firms), foreign presence in the region and in upstream and downstream industries (measurement of intra-industry spillovers). However, the measurement issue is in fact mostly related to the way such knowledge flows are inferred. Different solutions have been adopted, but since the work by Jaffe et. al. (1993) patent citations have come to be considered as the most informative tool for the purpose of tracing knowledge flows (Mancusi, 2004). This has resulted in measurement of spillover by foreign presence and patent citations. Table 2.6 briefly reviews overall main characteristics of spillover as discussed.

2.2.2 Spillover channel

Most previous studies concern the indirect effect between spillovers and absorptive capacity through the proxy of foreign presence and citation. A few studies focus on direct affect and/or use through other direct mechanism. For example, based on Sher (1997), Lin et al.,(2002) study the importance and direct affect of the technology diffusion channel as a key factor in absorptive capacity. They test their hypotheses in different industries in Taiwan (electronics and chemical manufacturing). The technology diffusion channel is divided into a formal channel and an informal channel. The results show that there is significant association between technology diffusion channels and absorptive capacity in both diffusion

channels. However, they define channel in the same was as mode of entry such as joint venture, licensing, contract research and equipment purchases. This study differs in that it focuses on spillover channels using specific externalities, i.e. without contractual agreement characteristics. This is discussed in more detail in the next section.

2.2.2.1 Taxonomies and conditions

According to Eden et al. (1997), multinational enterprise (MNE) technology can spill over to host country firms in the following ways (1) demonstration effects; (2) backward and forward linkages between MNEs and their local suppliers and buyers; (3) training of local employees by the MNE; (4) competitive effects between foreign and local firms (Blomstrom, et al.,2000; Ferrero and Maffioli, 2004). The existence of such spillovers should benefit local firms, as low-cost access to leading-edge technologies should be productivity-enhancing (Feinberg and Majumdar, 2001).

However, Smeets and Vaal (2005) identify more specific transfer channels that can in turn be related to the transfer mechanisms. Based on Saggi's (2002) classification, Smeets and Vaal (2005) present three transfer channels that are specifically related to FDI: (1) linkages effect, which means that the MNE may transfer knowledge or technology to its suppliers of intermediate goods (upstream linkages) or its customers (downstream linkages), (2) labor turnover, which means that workers employed by the multinational enterprise (MNE) undertaking the FDI may switch jobs and take with them firm-specific knowledge, and (3) demonstration effect, which may lead to reverse engineering and imitation. Compared with other

channel classifications, these three channels identified by Saggi(2002) are generally considered to be the most important channel and mechanism in FDI, particularly. Although demonstration effects are not solely related to FDI because they are bound up with other mechanisms as well, for instance with trade, it is still considered as one channel of the FDI mechanism. Grossman and Helpman (1991) argue that communication is an important transfer channel for trade as well. Generally, communication should be a channel for all mechanisms because of its importance in any interaction and activity.

Table 2.7 presents a clear picture of what was discussed above. It can be seen, for example, that there is apparently no straightforward relationship between (dis)embodied and active/passive spillovers. This also goes for the relationship between classifications of spillovers and the types of knowledge involved. Importantly, the table hints that FDI comprises an interesting mix of various channels. Consequently, it is useful to have specific spillover channels for the FDI mechanism as the guideline applied in this study.

Table 2.7 Knowledge spillover taxonomies

Spillover mechanism	Spillover channel(s)	Classification of spillover	types of knowledge
Trade	•Demonstration effects • Communication	• Embodied/ passive • Disembodied/ active	• Codified • Tacit
Foreign Direct Investment (FDI)	•Demonstration effects • Labor turnover • Linkage effects	•(Dis)embodied/ passive • Disembodied/ active •(Dis)embodied/ passive	• Codified/ tacit • Tacit • Codified/ tacit
Communication patterns	• Communication	• Disembodied/ active	• Tacit
Articles in journals	•Demonstration effects	• Embodied/ active	• Codified
Patents	•Demonstration effects	• Embodied/ active	• Codified

Source: Adapted from Smeets and De Vaal,2005

2.2.2.2 Spillover channel mechanism

Adapted from Dhanaraj et al., (2004), this study defines 'spillover channel mechanism' as 'the degree to which commercial ties are related in both cognitive and social attachments' which relates to spillover-generating firms and recipient firms. The mechanism is derived from the characteristics and the method of spillover channel in order to represent factors affecting absorptive capacity. Therefore, the study adapts and develops the setting mechanism from three spillover channels in terms of cognitive and social aspects arising from the property of special relationships. These are classified as cooperation (cognitive aspect) and connectedness (social aspect) as following:

The first spillover channel is the linkage effect, sometimes called cooperation. The method of knowledge spillover might be between an MNE and its supplier – that is, through upward linkages (Matoushek, 1999); and it might be between an MNE and its customers – that is, through downward linkages. Wucherer (2006) claims that cooperation is the main mechanism used and created between companies and helps them complement each other on a work and synergy basis and work together fairly and competently. Furthermore, this channel is said to be the most influential channel to create spillover because of the several leakages from various cooperative or joint action/activities in the channel between spillover-generating and recipient firm (Smeets and Vaal, 2005). In other words, cooperation can stand for this channel this channel is represented by the mechanism of cooperation.

The second channel is labor turnover or human mobility. Since MNE (as spillover-generating firms) tend to demand relatively skilled labor in the host country, and to invest in training, the movement of labor from MNEs to existing firms or new start-up firms can generate outflows of specific knowledge, and the localization of MNEs in a particular area generates new training opportunities for local workers and can be spread through two mechanisms: a direct spillover to complementary workers, and the move of workers carrying with them knowledge of new technology or new management (Blomstrom and Kokko, 1998; Motta et al, 1999). According to Holden and O'Tool (2004), communication is implicitly reflected in the direction or flow of activities, particularly among human interactions. This second spillover channel is more related to general social ties/relationships. Communication reflects connectedness in terms of intensity of relationship (e.g. frequency and modes of contact). This channel is then represented by the mechanism of connectedness.

The third channel is imitation which is the classic transmission mechanism for new products and processes. One common way to imitate is so-called reverse engineering, which differs from replication in that it might completely destroy MNE rents. The channel may be the so-called demonstration effect if there are arm's-length relationships between the MNEs (as spillover-generating firm) and the local firms (as recipient firm) who learn superior production technologies from MNEs (Wang and Blomström, 1992; Ferrero and Maffioli, 2004). According to Uzzi (1997) and Dhanaraj et al. (2004), this type of arm's length market relationships is always facilitated through strong social ties that promote learning between buyers and suppliers. This spillover channel is thus characterized in terms of the spillover from

the strength of social ties and can also be represented by the mechanism of connectedness.

In conclusion, drawing on the spillover channel framework, the spillover channel mechanism is proposed in terms of cooperation and connectedness to examine factors affecting absorptive capacity. Importantly, they are represented as different aspects (cognitive and social) to determine if and how the difference affects different components of absorptive capacity.

2.3 Literature on innovation

Innovation is an imperative issue and represents the core renewal process in any organization. Unless it changes what it offers the world and the ways in which it creates and delivers those offerings, it risks its survival and growth prospects (Bessant et al., 2005). Innovation is not, however, an automatic attribute of organizations; the process has to be enabled through sophisticated and active management. There are no guaranteed formulae for success in what is inevitably a risk-based activity, but extensive research dating back over a century suggests a series of convergent themes from which guidelines for effective innovation management can be extracted (Tidd et al., 1997).

Over the years, several theories have been developed in an attempt to communicate to managers how innovation occurs in a company and which factors affect the outcome of this process. These theories come from different perspectives

that either focus on management, economic or social sciences. The factors that are relevant to innovation, as they are presented in the literature, however, create a complex net. This complexity often makes managers make a decision, the outcome of which contradicts their original aims, because changes on one side of this net are often difficult to correlate with affects in another area (Galanakis, 2006).

However, this study is concerned more about the internal sources of innovation with the firm's absorptive capacity as a factor affecting the level of its innovation. A firm's absorptive capacity is influenced by the specific mechanism called the 'spillover channel mechanism'. Implicitly, this mechanism is also extrapolated from the knowledge spillover framework. Since absorptive capacity in this study takes a mediating role in the proposed model, the source of innovation may come from a direct channel from internal sources (absorptive capacity) and an indirect channel through the mechanism (spillover channel mechanism) of external sources (knowledge spillover), simultaneously. In next section, the main characteristics of innovation from previous studies are elaborated upon.

2.3.1 Main characteristics

2.3.1.1 Definition and type

Gopalakrishnan and Damanpour (1994) define innovation as 'a new idea, method or device' or 'the process of introducing something new'. Tidd et al. (1997) state that innovation is a process of turning opportunities into practical use. The effective deployment of innovation has been widely recognized in recent years as a means of building sustainable competitive advantage and thereby enhancing

organizational performance. Smith-Doerr et al. (2004) state that innovation is a process by which individuals working in a particular organizational context generate and implement new ideas. Traditionally, the definition of innovation concentrates on product and process innovation. However, the new trend for innovation is in marketing, such as innovation in marketing position and organizational or managerial innovation such as innovation in paradigm (Francis and Bessant, 2005). This makes the other types of innovation – marketing and managerial - more interesting and beneficial to study.

The recent revision of the Oslo Manual was in many ways a joint product of policy needs and developments in the innovation concept and changes in the economy. It is accepted and popularly used as the main source of innovation literature. In the new revision, the innovation framework is expanded from earlier frameworks. The most central change to the Manual is the use of a broader definition of innovation in addition to product and process innovations, to now include marketing innovation and organizational innovation. In line with the Oslo Manual Revision (Bloch, 2005), the definition of innovation used in this study is summarized in Table 2.8, using the overall definitions found in Bloch's (2005) work. Neely et al. (2001) and Lee and Tsai (2005) propose defining management innovation in the same way as administrative innovation, and this is shown in Table 2.8 as well.

An important challenge in defining the types of innovations is addressing how best to distinguish between innovation types for borderline cases. Efforts have been made to minimize borderline cases, though it is not considered feasible or desirable to make clear-cut distinctions among types. Distinctions will often depend

on the nature of the firm's business and on the specific characteristics of a firm's innovations. In many cases, innovations may actually span more than one type. Examples are a firm that introduces a new product that requires the development of a new process or that introduces a new marketing method to market a new product. These 'integrated innovations' may often involve coordination of innovation activities across a firm's functions or departments, and thus are of great interest (Bloch,2005).

Table 2.8 Summary of definition of related innovation in this study

Type	Definition
Innovation	The implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations. (Bloch,2005)
Marketing innovation	The implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing. (Bloch,2005)
Management innovation	The implementation of a new management method in firm's practices involving significant changes or introduce of new approaches to managing, planning, organizing, or controlling the firm. (Neely et al.,2001; Lee and Tsai,2005)

Source: The author

However, the review of earlier literature shows the most distinctive and popular types of innovation used are incremental, radical, technological, process, product, organizational, operational, managerial, social, and institutional innovation. For example, incremental innovations are close to existing practices, and may therefore be realized more easily than radical innovations, which need adaptation of systems of production and consumption or the development of new technologies (Nooteboom, 2000) and therefore meet resistance from inside as well as outside the organization (Chakravorti, 2004). Radical innovations are occasionally needed to

renew the core business and to deal with discontinuities caused by pressures from outside the industry or by technological change (Utterback, 1994).

Innovative organizations often generate radical product and process innovations that challenge dominant designs. Product and technological innovations can increase efficiency more than process innovations as seen by the positive correlation between the production of R&D-intensive goods and high productivity (high-growth) (Tushman and Nadler, 1996). Organizational and social innovations can also promote growth in productivity and competitiveness, as they can improve the application of new technology (Edquist, 1997; Lundvall, 1990). Research indicates that significant economic impact can only be created through a combination of technological, product, process, organizational and managerial innovations (Freeman and Perez, 1990), because customers, firms, products and production processes operate in highly interdependent, dynamic systems (Utterback, 1994). Consequently, radical innovations invariably require change or concerted effort by a range of loosely connected actors (Van Kleef and Roome, 2005).

2.3.1.2 Source of innovation and measurement

According to Ferrero and Maffioli (2004), the sources of innovation are classified by sector (as resource-based, low-technology, medium-technology, and high-technology industries) or industry (e.g. food, textile and garments, automotive, and electronics). Across different sectors and industries, innovation is generated or enhanced by different main sources. Table 2.9 presents a simplified classification based on sector heterogeneity with a simplified characterization of the prevalent sources of innovation in each one.

Table 2.9 Main sources of innovation assigned by sectors and technology

Sector	Industries	Main sources of innovation
•Resource-based industries.	•Processed food, wood and leather, refined petroleum and rubber products.	•Generally generated from upstream suppliers (chemicals, machinery, etc.) and regulations/ quality standards
•Low-technology industries	•Textiles, garments, footwear, furniture, glassware, toys.	•Opportunities for innovation are concentrated production methods and inputs, as well as product design.
•Medium-technology industries.	•Automotive industry, chemicals, metal products, machinery.	•Design, construction and operation of complex production systems/products. Value chains Corporate R&D.
•High-technology industries	•Electronics, pharmaceuticals, biotechnology, precision instruments, aerospace.	•High-intensity of corporate R&D interacting with research agencies and universities.

Source: Adapted from Malerba and Orsenigo (2000) and Richard (2003).

Classified by broad view, innovation is created from internal and external sources. For example, Afuah (1998) posits that younger entrepreneurial firms are generally more affective at developing and exploiting innovation, particularly radical innovation. In other words, it is believed that the start-up business has more ability to exploit knowledge and create radical innovation than older businesses. Thus, internal sources such as a firm's exploitation capability can be sources of innovation. Chesbrough (2003) proposes that the 'Open Innovation' model has increased the attention paid to the role of external sources (including users) in the innovation process, in business as well as in academic circles.

Macpherson (1997) and Millar et al. (1997) state that the chances of attaining commercial success for innovations could be higher when firms use both internal and external sources for their innovation efforts, rather than just using one or the other. Syakhroza and Achjari (2002) highlight the role of internal and external networks as a source of organizational innovation processes. In the past,

organizations might produce innovation internally due to simplicity of products. However, fundamental changes in the business environment such as information technology and global competition have forced organizations to shift the innovation process. Current products and processes tend to be more complicated, hence more capabilities are required. To cope with these innovation problems, networked innovation is seen as a necessity since the innovating organizations can share the information as well as the risk with their counterparts.

There are different measures of innovation depending on type of innovation and the specific objective of the study. Typically, most research on innovation has been based on a single (or a few) innovation indicator(s) with R&D expenditures and patent counts being the most popular proxies for firm innovativeness. However, given that the innovation process is a complex phenomenon characterized by several stages ranging from basic research to the penetration of the market with a new product (Hollenstein, 1996), it is important to consider a broad range of innovation indicators in order to more accurately capture the level of innovativeness in a firm. For example, Wan et al. (2005) measure firm innovation by using an eight multiple-items. These items are developed from Hollenstein (1996), Morris and Jones (1993) and Rogers (1998).

Rogers (1998) states that one method of assessing innovation is to distinguish between the outputs of innovative activity and the inputs to innovative activity. Output measures include the number of new products or processes that are developed by the firm in a year. Innovative firms are assumed to develop more new products and processes than non-innovative firms. Another output measure used is the

percentage of sales attributed to new products or processes. Innovative firms would also be expected to have a greater proportion of revenue derived from new products or processes. Input measures include the percentage of annual revenue or sales used to fund R&D development projects.

Measurement may be in terms of innovation success. However, this is not only difficult to ascertain, but also "multifaceted and difficult to measure" (Griffin and Page, 1996). For example, it has been defined as success in the market (Ulrich and Eppinger, 1995; Griffin and Page, 1996), the creation of new opportunities, technical advantage (Freeman and Beale, 1992; Lipovetsky et al., 1997) and customer satisfaction (Lipovetsky et al., 1997; Paolini and Glaser, 1997). Kumar et al. (1996) propose other categories of project success such as external, internal, marketing and product/process. While Smith-Doerr et al. (2004) cite from the previous study that three fundamental measures of project success are successful implementation, perceived value of the project, and customer satisfaction. The inconsistent findings may be due in part to the lack of consensus on what success means.

Another difficulty is that the definition of R&D project success is contextual (Olson et al., 1995), depends on the type of innovation (Green et al., 1995), and can be evaluated best by a combination of objective and subjective measures (Balachandra and Friar, 1997). A project's success could depend on who measures it, by what criteria, when the measure is taken, and whether it is introduced to a new or existing market (Smith-Doerr et al., 2004). This lack of clarity on how to define, and

consequently measure, project success presents a concern to academics and practitioners as it creates space for different subjective interpretations.

In sum, this study aims to examine the outcome in terms of two new dimensions of innovation: marketing innovation as defined in the Oslo Manual Revision (Bloch, 2005) and management innovation as identified by Neely et al. (2001) and Lee and Tsai (2005). By focusing on these new dimensions of innovation, the study also develops a multiple-item scale indicator instead of the single indicator in traditional measurement. In the next section, previous studies of innovation are reviewed with respect to the issues of knowledge spillover and absorptive capacity.

2.3.2 The distinctiveness and focus on innovation

There are various studies of many related issues in the literature on innovation, especially product and process innovation. For example, Hausman (2005) states that network affects reflect the ability of other firms to provide valuable information necessary to fuel innovation and adoption. Thus, channel partnerships appear to have heavily influenced innovation, especially small businesses. Also, Dodgson (1994) posits that another form of external network which is important to innovation is university and research institutions. Innovating organizations can establish the innovation arrangement with these parties to reduce risks and uncertainties.

Table 2.10 Summary of previous studies of innovation

Related issue	Authors	The explanations
Network	Dodgson,1994	•Another form of external network is university and research institution •Innovating organization can establish the innovation arrangement with these parties to reduce risks and uncertainties.
	Goes and Park,1997	•Innovative processes in organization can be enhanced by the presence of inter-organizational links
	Hausman and Fontenot,1999	•Small firms may suffer from the small size of their network and the relative paucity of innovative information available in this small network
	Frambach and Schillewaert, 2002	•Cooperative adoption takes advantage of network externalities or critical mass formed when customers, suppliers, and others all use the innovation
	Syakhroza and Achjari,2002	•Role of internal and external network in organizational innovation process. •In past, firms produce innovation internally due to simplicity of products. Then, environment changes force organizations to shift the innovation process. •The current products and processes tend to be more complicated, hence more capabilities are required. Thus, networked innovation is as a necessity since organizations can share information and risk with their counterparts.
Product innovation	Cooper,2001; Keizer et al., 2002	•Essence of *product innovation* is to create or establish something new. This process necessarily involves risk, thus, innovating firms require a strategy not of risk avoidance, but of early diagnosis and management
Product/ process	Franke and Shah, 2003	•End users frequently develop important *product and process innovations*.
Spillover	Harhoff,1996	•Defying conventional wisdom on the negative effects of uncompensated *spillovers*, innovative users also often openly reveal their innovations to competing users and to manufacturer

Source: The author

Meanwhile, Cooper (2001) and Keizer et al. (2002) propose that the essence of product innovation is to create or establish something new. This process necessarily involves risk, thus, innovating firms require a strategy not of risk avoidance, but of early diagnosis and management. In addition, Franke and Shah (2003) state that end users frequently develop important product and process innovations. Harhoff (1996) proposes that defying conventional wisdom on the negative affects of uncompensated spillovers, innovative users also often openly reveal their innovations to competing users and to manufacturers. Table 2.10

summarizes the examples of studies on innovation literature, regarding product/process innovation, knowledge spillover and absorptive capacity.

However, this study's focus is different from previous research. For example, the mediating role of absorptive capacity is less studied, with more emphasis placed on direct affect, instead. This role of absorptive capacity affecting innovation is rarely studied. Most studies of knowledge spillover and innovation are in economics literature in terms of econometric measurement through macro point of view such as country level of analysis and national innovation system. These are suitable in terms of government policy, which may lack directly specific managerial and policy implication. There are few studies of spillover and innovation in international business at firm level. Meyer (2004) points out the importance of spillover affect and absorptive capacity to innovation and encourages IB scholars to advance the body of knowledge in this specific area. The distinctiveness of innovation in this study is the direct measurement with a multi-item scale instead of a single indicator index as in the earlier framework. Importantly, this study aims to obtain the best possible practical results and so uses the newer concepts of innovation, marketing innovation and managerial innovation.

To summarize, this chapter provides a look at the theoretical framework and literature of absorptive capacity and knowledge spillover, and literature on innovation. This chapter also tells of this study's attempts to fill gaps as well as to extend the body of knowledge of the absorptive capacity construct in terms of model development. The proposed model concerns the relationship between two main

components of absorptive capacity (potential and realized absorptive capacity) and its antecedent (spillover channel mechanism) and its consequence (marketing and managerial innovation). Drawing on absorptive capacity and spillover channel theoretical framework, the model development with three main hypotheses and six sub-hypotheses is discussed and proposed in the next chapter.

CHAPTER III

MODEL DEVELOPMENT AND HYPOTHESES

Using the theoretical framework and literature review in the second chapter as a foundation, this chapter shows the development of a model and hypotheses on: (1) the relationship between the spillover channel mechanism (cooperation and connectedness) and absorptive capacity (potential absorptive capacity and realized absorptive capacity); and (2) the relationship between absorptive capacity (potential absorptive capacity and realized absorptive capacity) and innovation (marketing and managerial innovation). Once this is achieved, the proposed research model with three main hypotheses and six sub-hypotheses is given.

3.1 Model Development

The spillover channel framework and literature is reviewed in Chapter II. For easier understanding of the development of the model, this section briefly describes the method in which the spillover channel mechanism is derived from a spillover channel.

Drawing on spillover channel framework, this study establishes a new variable called the "spillover channel mechanism" consisting of cooperation and connectedness, to examine its affect on a firm's absorptive capacity and innovation. Spillover channel mechanism here is defined as 'the degree to which commercial ties are related in both cognitive (task-oriented) and social (people-oriented) attachments'.

According to Saggi (2003), the spillover channel consists of a linkage effect, labor turnover, and demonstration effect. The first spillover channel, linkage effect, is the method of knowledge spillover through upward-downward linkages (Matoushek, 1999) such as between a firm and its customers. This channel is recognized as the most likely channel to spill over because of the several leakages from various cooperative or joint action/activities in the channel between spiller and recipient firm (Smeets and Vaal, 2005). This channel is represented by cooperation.

The second spillover channel is labor turnover or human mobility. Since the spiller tends to demand relatively skilled labor and to invest in training, the subsequent movement of labor from this company to other firms or to be involved in the start-up of new firms can generate outflows of specific knowledge. Closely communication is reflected in the direction or flow of activities among human interactions and reflects connectedness in the sense of intensity of a relationship. This channel is represented by the mechanism of connectedness (intensity and formality).

The third channel is imitation, which is the classic transmission mechanism for new products and processes. Sometimes it is called the demonstration affect if there are arm's-length relationships between the spiller and recipient firm who learn superior production technologies from the spiller (Wang and Blomström, 1992; Ferrero and Maffioli, 2004). According to Uzzi (1997) and Dhanaraj et al. (2004), this type of arm's length market relationships is always facilitated through strong social ties that promote learning between partners. Thus, this channel is also

represented by the mechanism of connectedness (ties strength). The summary of this development is given in Table 3.1.

Table 3.1 Summary of model development derive from spillover channel framework

Authors	Contributions to model development	Spillover channel mechanism
Wang and Blomström,1992; Uzzi, 1997; Blomstrom and Kokko, 1998; Matoushek,1999; Motta et al, 1999; Dhanaraj et al., 2004 Ferrero and Maffioli,2004 ; Holden and O'Toole, 2004; Smeets and De Vaal,2005	• First channel is *linkage effect*. Knowledge spillover relates to tasks in vertical linkages(upward and downward) between spillor and recipients.	Cooperation
	• Second channel is *labor turnover*. Knowledge spillover relates to human interaction in terms of communication or contacts. For example, spillor firms demand skilled labor and invest in training. Or movement of labor from spillor to existing firms or the start-up of new firms can generate outflows of specific knowledge	Connectedness (intensity and formality)
	• Third channel called *demonstration effect* if there are arm's-length relationships between spillor and recipient. The latter learn superior production technologies from the former. This relationship is facilitated through social ties that promote learning between spillor and recipient.	Connectedness (ties strength)

Source: The author

In conclusion, drawing on the spillover channel framework, a spillover channel mechanism consisting of cooperation and connectedness is proposed as a factor affecting absorptive capacity. They are implicitly considered as representatives of different aspects (i.e. cognitive or task-oriented and social or people-oriented aspect). The result will better identify both the magnitude and difference in their affect on absorptive capacity.

3.1.1 Proposed research model

The proposed research model is illustrated in Figure 3.1 as following:

Figure 3.1 Research model
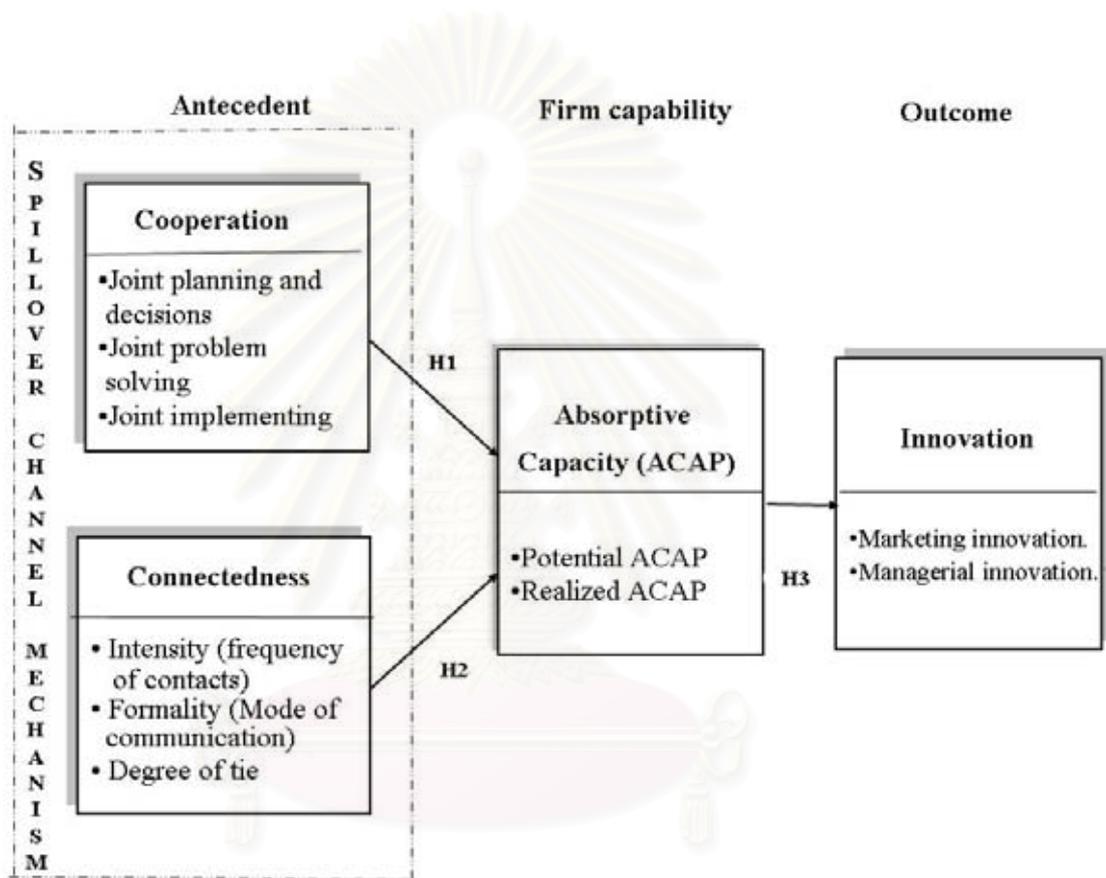
Since this study aims to complete the absorptive capacity conceptual model and also show the importance of mediating role at the same time, it also investigates the antecedents and consequences of absorptive capacity. Following Zahra and George's (2002) absorptive capacity re-conceptual model, the antecedent here is derived from external knowledge source (i.e. 'knowledge spillovers'). After model development, the study proposes two main independent variables; cooperation and

connectedness. Absorptive capacity is considered and examined as mediator and its two main components (potential absorptive capacity and realized absorptive capacity) are also explored. Absorptive capacity is tested by using direct measurements instead of the traditional proxy. Finally, the consequence of model, innovation, is tested as a dependent variable by using the multi-item index measurement instead of the traditional single indicator as well as absorptive capacity measurement. Importantly, these relationships are simultaneously tested in order to complete the proposed model.

In the next section, the details of each variable: independent variable (spillover channel mechanism), mediator (absorptive capacity), and dependent variable (innovation) are discussed.

3.1.2 Variables

3.1.2.1 Independent variable (Spillover channel mechanism)

In this study, the new antecedent of absorptive capacity is the factor derived from the spillover channel framework, called "spillover channel mechanism" and it is proposed that this mechanism influences the firm's absorptive capacity. Drawing on the spillover channel framework, the spillover channel mechanism consists of two main elements: (1) cooperation and (2) connectedness.

1. Cooperation

In general, cooperation refers to cooperative activities between firms and is primarily task oriented, such as joint programs and/or projects. The cooperation can

be viewed as a value chain (Malhotra et al., 2005), innovation network (e.g.Brass et al., 2004), a social network (Gulati, 1998; Gulati et al., 2000) and so on. For example, Wucherer (2006) examines a joint (formal) cooperation between Siemens and its supplier network since Siemens' interfaces have been established to form a rational alliance, offering benefits to all involved, and can be used regardless of the size of the company. Therefore, these offerings generate the results of win–win situations in which are constantly created and exploited knowledge/information through cooperation. Therefore, he claims cooperation is the main mechanism used and created between companies, complementing each other on a synergy basis and enabling them to work together fairly and competently.

Cooperation is perceived through various names (i.e. collaboration, coordination) depending upon the forms or reasons for an inter-organizational relationship, such as necessity and reciprocation. For reasons of necessity, cooperation is known as collaboration. For example, Gulzar and Henry (2005) study the nature and results of collaboration between organizations in health service management. Because health organizations function in complex environments, it is difficult for any single organization to manage affectively in isolation (Vangen and Huxham, 2003). Collaboration is thus used to increase the availability of human, material, and informational resources, enhance organizational coping with turbulent environment, and strengthen organizational stability and sustainability (Gulzar and Henry,2005). It also can reduce costs (Himmelman, 1996; Dunevitz, 1997) and improve the access to and continuity of care as well. In other words, cooperation is beneficial, especially the availability of and access to knowledge or information. For

reasons of reciprocity, cooperation is called coordination. For example, Nieson (2005) agrees that the setting up an explicit organizing mechanism for coordinating alliance-related activities might develop significant tacit knowledge about alliance management, thereby providing a focal point for knowledge sharing and learning. Thus, he points out that coordination is associated with knowledge embeddedness. In other words, cooperation relates to knowledge sharing and learning regarding to joint in tasks/activities.

Johnson et al. (2004) suggest cooperation as a cognitive aspect of an interactional knowledge store, which consists of knowledge about issues related to interactions in partner relationships. Interactional knowledge stores are instrumental in the identification and facilitation of the development of behaviors and properties that are desirable in close, partner-style inter-relationships (Morgan and Hunt 1994; Ford and McDowell 1999). Interactional knowledge can be key in building trust and commitment in a relationship (Morgan and Hunt, 1994), and building strong bonds with a partner, thereby providing stability to a relationship (Anderson and Weitz, 1992).

According to Ferrero and Maffioli (2004), the benefits of cooperation accrue both directly (through market and contracts) and indirectly (through public good – external -spillovers) to individual firms. Cooperation from a spillover point of view is certainly beneficial to firms. Cooperation can be regarded as a joint knowledge generating process between partners. The knowledge can be spilled out through cooperative actions/activities between partners and it may in the end be absorbed.

Tsai (2002) also investigates the effectiveness of coordination mechanisms on knowledge sharing in intra-organizational networks in various part of the organization. It is argued that social interaction allows individual units to accumulate social capital that can help them gain access to new knowledge or new information and that the flows of information or knowledge through inter-unit networks require social interaction to promote trust. The findings thus indicate that formal hierarchical structure, in the form of centralization, has a significant negative affect on knowledge sharing. In contrast, informal lateral relations, in the form of social interaction, have a significant positive affect on knowledge sharing (Foss et al., 2005).

As such, cooperation can be broadly divided into formal and informal cooperation. Most previous studies show examples of formal cooperation that include joint ventures, strategic alliances, joint programming, business groups, consortia, relational contracts, and some forms of franchising and outsourcing (e.g. Podolny and Page, 1998; Claro et al., 2003). These are examples of formal cooperation. The main point of formal cooperation is the transfer of knowledge in line with the contractual agreement. In contrast, this study concerns on knowledge spillover or externalities, where knowledge is spilled over without contractual agreement by means of spillovers through cooperation of joint action/activities in routine work.

Thus, the cooperation mechanism in this study stands for only cooperation without contractual agreement and consists of three elements: (1) joint planning; (2) joint problem solving; and (3) joint implementation:

(1) **Joint planning**: Joint planning is meant to measure the extent to which future contingencies and consequential duties and responsibilities in a relationship have been made explicit ex ante. It also refers to mechanisms providing an avenue for the sharing of richer information through socialization and articulation of working together. This develops a deeper understanding of the needs of their partners, which results in richer communication between them.

According to Te'eni (2001), a message of communication may serve more than one purpose. For example, many messages contain information that is both task and socially oriented. It is perceived that the closer the relationship, the more relational (human) and innovative (involving joint planning and sharing of proprietary information) the message becomes. In other words, joint planning is beneficial for human interaction or communication. Importantly, joint planning is helpful to deepen the understanding between partners. Thus, the more joint planning, the more the firms acquire and understand the partner's knowledge/information.

(2) **Joint problem solving**: Joint problem solving refers to refers to the behavior in the relationships that captures the degree of joint solutions to problems such as a joint solution to a problem of delayed delivery. The negotiating rules and determination roles and responsibilities are also actions/activities in this joint problem solving.

Uzzi (1996) posits that joint problem solving is a cooperation-based mechanism since the joint problem solving arrangements enable actors to coordinate functions and work out problems. Thus, it provides more rapid explicit feedback than do market-based mechanisms. These coordinating arrangements enable firms to work through problems and to accelerate learning and problem correction. In addition, Brass et al.(2004) claim that the problems in partnerships are typically resolved through discussion, and rules and norms of reciprocity ensure cooperation. In other words, joint problem solving is helpful to resolve a problem through the learning process. Thus, the more joint problem solving is undertaken, the more the firms learn, acquire, and converse to the solution guidelines from the partner's knowledge/information.

(3) **Joint implementing**: Joint implementing refers to the setting up of action/activities mechanisms or methods such as a control procedure from best-practices manual in order to set the standard for the tasks-manual or join work procedures. It may include establishing long-term production/marketing management together. The success of joint implementing depends on the well-defined and well-communicated links between actors to implement the activities together.

Hardy et al(2005) state that process conversation can create a collective identity and translate into effective inter-organizational collaboration. They intended to show that a part of communication (i.e. conversation) is an important factor through collaboration. In other words, the more joint

implementing, the more the firms effectively understand through communication and transform the partner's knowledge or information.

Since this study attempts to examine a new factor based on the spillover channel framework, measuring the strength of cooperation is mainly based on breadth rather than depth. It is because the study assumes that the greater the degree the recipient firms cooperate with spiller-generating firms, the more complementary knowledge/management skills the recipient firms get because of the greater opportunity to acquire and assimilate the new knowledge in order to transform and exploit the new practices/processes to the market and firms in future. The strength of cooperation is considered in terms of the degree of joint planning (Claro et al., 2003). Joint problem solving and joint implementing in routines work are considered in the same manner. Table 3.2 summarizes these three properties of cooperation and their effect on absorptive capacity.

Table 3.2 Summary of three properties of cooperation and the effect on absorptive capacity

Property	Meaning/Definition	Effect on absorptive capacity
Joint planning	The extent to which future contingencies and consequential duties/responsibilities in a relationship have been made explicitly ex ante such as market trend analysis plans, pricing strategic planning	The more the firm joint planning with spiller, the more likely to facilitate firm's absorptive capacity.
Joint problem solving	The behavior to the relationships that captures the degree of joint solutions to problems such as a problem-solving in production, delay delivery problem	The more the firm joint problem solving with spiller, the more likely to facilitate firm's absorptive capacity.
Joint implementing	The setting up action/activities with the important mechanism/ methods such as control procedure from best-practices manual in order to set the standard of tasks-manual or work procedures together	The more the firm joint implementing with spiller, the more likely to facilitate firm's absorptive capacity.

Source: the author

2. Connectedness

Connectedness means the extent to which individuals perceive that they are central to, visible in and involved with the organizational community (Raghiuram et. al., 2001). Organizational connectedness is likely to be especially important as a predictor of a stronger and more enduring relationship between workers and their interaction partners and of adjustment. In addition, connectedness to the social context thus provides employees with a feeling that there is a community that they can rely upon for support and information (Baumeister and Leary, 1995). Connectedness is useful for accomplishing immediate work requirements and for defining a longer-term relationship with the organization. Connectedness with the organizational community yields opportunities for exposure and visibility through which individuals can demonstrate their capabilities and thus feel more confident in their job security and career development (Chao et al., 1992).

Lindberg-Repo and Gro¨nroos (2004) propose that connectedness provides for the enhancement of the relationship between the parties and a closer connection. Also, it can be seen as a consequence of planned communications and contact creation. However, it is not the sum of them. Connectedness has more distinctive structural features. The process of connectedness is the most effective way of creating value between the parties, the firm, and the customer (Raghuram et al.,2001). Through connectedness, participants in a relationship can reach increased understanding and shared meaning, and thereby be jointly involved in value creation. Connectedness is most effectively reached through a dialogue that entails the flow

and improvement of tacit and explicit knowledge between the parties (Harrington and Guimaraes, 2005). In other words, it is said that connectedness is associated with intensity and formality of contacts/ relationship.

In addition, ties strength are important in assessing the overall connectedness of actors in an environment and the likelihood that knowledge/information will flow from one actor to another (Haythornthwaite, 1996). Thus, social capital is composed of individual and collective social networks, ties and structures that help the individual get access to information and know-how (Bøllingtoft and Ulhøi, 2005). Social ties can either be strong or weak. In the literature, weak ties have often been associated with idea generation, whereas strong ties tend to be related to problem solving (Henderson and Cockburn, 1994; Eisenhardt and Tabrizi, 1995; Hansen, 1999; Hoang and Antoneic,2003).Table 3.3 shows the comparison between strong and weak ties.

Table 3.3 Comparison between strong and weak ties

Issue	Strong ties	Weak ties
Meaning	•Strong ties tend to be related to problem solving	•Weak ties have often been associated with idea generation
Results from Previous studies	•Strong for the exchange of information •Persons are more intimate and motivated to provide information to others •More critical in explaining firm success (survival and financial performance) than weak ties	•More effective means for knowledge sharing than strong ties •Persons are more likely to gain access to novel information than strong ties •Benefit for transmission of new, innovative notation.
Measurement (Proxies)	•Self-reports of receiving support from friends and family	•Support from business partners and acquaintances
Reference author(s)	Starr and Macmillan (1990); Henderson and Cockburn (1994); Eisenhardt and Tabrizi (1995); Zhao and Aram (1995); Uzzi (1997); Bruderl and Preisendorfer (1998); Hansen (1999);Kate et al. (2000); Uzzi and Lancaster (2003)	Granovetter(1973)Henderson and Cockburn (1994); Eisenhardt and Tabrizi(1995); Bruderl and Preisendorfer (1998); Hansen(1999); Uzzi and Lancaster (2003).

Source: The author

Connectedness plays pivotal role in social relationships. Acting as a social aspect, connectedness is also element of the spillover channel mechanism based on the spillover channel framework. In this study, connectedness consists of (1) intensity, (2) formality, and (3) ties strength:

(1) **Intensity**: Intensity refers to the intensity of relationships and is measured by the frequency of contacts. Russell and Puto (1999) state that the construct of connectedness is introduced as a richer indicator of the nature and intensity of the relationship between actors. Russell (2002) and Russell et al. (2004) formally define connectedness as the level of intensity of the relationship that a one actor develops with the characters and contextual settings of a program in the social environment of other actors.

Brown and Eisenhardt (1995) argue that when team members are communicating frequently, they are more likely to develop an absorptive capacity such that they become more efficient in gaining and using information. Also, this absorptive capacity can improve productivity and speed of new product development. Thus, the more contact, the more the firms develop absorptive capacity.

(2) **Formality:** Formality stands for the formations or modes of contacts or communication modes between actors. It is broadly categorized as formal (e.g. formal business letters/correspondence) and informal mode (e.g. face-to-face contact, word of mouth). Drawing on the spillover channel

framework, the form/pattern suitably dealing with a partner for spillovers is an informal pattern of contact/communication.

Jaffe et al.,(1996) underline the significance of maintaining face-to-face contacts in the process of technological learning. Audretsch and Feldman (1996) further argue that the cost of transmitting knowledge rises with spatial distance. In other words, effective use of the informal mode of communication influences acquisition and assimilation dimensions. The informal mode seems to be more important in order to acquire and learn from new knowledge. In brief, the more the informal mode is used to contact, the more the firms develop absorptive capacity.

(3) **Tie strength:** Tie strength refers to the extent of the degree of closeness and/or the level of connection. In general, social ties can either be strong or weak (Bøllingtoft and Ulhøi, 2005).

According to Granovetter (1973), some researchers suggest that weak social ties are more effective means for knowledge sharing. Persons in social networks characterized by weak ties are more likely to gain access to novel information than those in networks characterized exclusively by strong ties. Although the resolution of the debate regarding the benefit of strong versus weak ties may ultimately require a contingency approach (Rowley et al., 2000), the importance of both strong and weak ties in information exchange is now well accepted (Bøllingtoft and Ulhøi, 2005). Importantly, it is not just the strength or weakness of a tie that contributes

to the role of each of these types of ties in information exchange. Each type of tie indicates the nature of an individual's connectedness within one or more networks, which in turn affects exposure to specific kinds of information (Uzzi and Lancaster, 2003). In other words, the higher the degree the companies have ties, the more they strengthen their absorptive capacity.

Table 3.4 summarizes three properties of connectedness and the effect on absorptive capacity.

Table 3.4 Summary of three properties of connectedness and the effect on absorptive capacity.

Property	Meaning/definition	The effect on absorptive capacity
Intensity (frequency of contacts)	The intensity of relationship and measure by the frequency of contacts	The more the firm contact with spiller, the more likely to facilitate firm's absorptive capacity.
Formality (Informal contact/ communication	The formations or modes of contacts between actors (formal and informal mode)	The more the firm use informal pattern/mode of contact with spiller, the more likely to facilitate firm's absorptive capacity.
Tie strength	The extent to which the degree of closeness and/or the level of connection.	The higher the firm has tie strength with spiller, the more likely to facilitate firm's absorptive capacity.

Source: The author

3.1.2.2 Mediating variable (Absorptive capacity: ACAP)

According to Harrington and Guimardes (2005), absorptive capacity has been developed theoretically through an examination of the organization's cognitive structures and prior related knowledge that underlie learning (Cohen and Levinthal, 1990). A review of the literature (Zahra and George, 2002) reveals two clarifying definitions beyond that provided originally by Cohen and Levinthal (1990): (1) a

broad set of skills needed to deal with the tacit component of transferred knowledge and the need to modify this transferred knowledge and (2) the capacity to learn and solve problems. While implied by the original definition, these additional definitions have been used to argue for separating the absorptive capacity construct into two main components: potential absorptive capacity (refers to the capability to acquire and assimilate knowledge) and realized absorptive capacity (refers to the transformation and exploitation or use of the knowledge that has been absorbed). Potential absorptive capacity is believed to consist of building the organization's ability to access and share external knowledge, which requires a knowledge-sharing culture (Daghjfous, 2004). These dimensions reveal the dynamic aspect of absorptive capacity pertaining to knowledge transfer and creation.

Mowery and Oxley (1995) and Kim (1998) also stress the importance of importing new knowledge, which forms the acquisition dimension. Cohen and Levinthal's (1990) definition highlights the assimilation and exploitation dimensions. Kim (1998) suggests that the ability to solve problems comes from modified knowledge, which is the basis for the transformation dimension. Table 3.5 summarizes the four dimensions/capabilities that compose absorptive capacity to its respective elements, roles, and importance.

Table 3.5 highlights four distinct but complementary capabilities that compose firm's absorptive capacity: acquisition, assimilation, transformation, and exploitation. According to Eisenhardt and Martin (2000), although these capabilities have some commonalities across different firms, they are idiosyncratic in the specific

ways firms pursue, develop, and employ them. This variability gives firms a basis to develop different types of competitive advantage such as strategic flexibility, innovation and so on. Zahra and George (2002) see the four dimensions as having two main components: potential absorptive capacity and realized absorptive capacity. This study delves deeper into these two main components: (1) potential absorptive capacity and (2) realized absorptive capacity.

Table 3.5 Dimensions of absorptive capacity (ACAP) elements and corresponding roles

Components and dimensions	Elements	Role and Importance	Authors
Acquisition	• Prior investment • Prior knowledge • Intensity • Speed • Direction	• Scope of search • Perceptual schema • New connections • Speed of learning • Quality of learning	Cohen and Levinthal (1990); Lyles and Schwenk (1992); Boynton et al.,(1994) ; Keller (1996); Mowery et al.,(1996); Rocha, (1997); Veugelers (1997) Kim (1998); Van Wijk et al.,(2001); Zahra and George(2002)
Assimilation	• Understanding	• Interpretation • Comprehension • Learning	Cohen and Levinthal(1990); Dodgson (1993); Leonard-Barton(1995); Szulanski (1996);Kim, 1997; Lane and Lubatkin (1998); Fichman and Kemerer (1999); Rosenkopf and Nerkar(2001); Zahra and George(2002)
Transformation	• Internalization • Conversion	• Synergy • Recodification • Bisociation	Kim (1997); Christensen et al.(1998); Fichman and Kemerer (1999); McGrath and MacMillan(2000); Zahra and George(2002); Smith and De-Gregorio(2002).
Exploitation	• Use • Implementation	• Core competencies • Harvesting resources	Cohen and Levinthal (1990); Lyles and Schwenk(1992); Dodgson(1993); Szulanski, (1996); Kim ,1998; Tiemessen et al.(1997); Lane and Lubat-kin (1998);Van den Bosch et al (1999);Van Wijk et.al.(2001); Zahra and George (2002)

Source: adapted from Zahra and George(2002)

1. Potential absorptive capacity

     Lane and Lubatkin (1998) state that potential absorptive capacity (PACAP) makes a firm receptive to acquiring and assimilating external knowledge. It also captures Cohen and Levinthal's (1990) description of a firm's capability to value and acquire external knowledge but does not guarantee the exploitation of this knowledge. Within this scope, potential absorptive capacity consists of two dimensions/ capabilities: (1) acquisition and (2) assimilation.

(1) **Acquisition**: Acquisition refers to a firm's capability to identify and acquire externally generated knowledge that is critical to its operations. According to Zahra and George (2002), effort expended in knowledge acquisition has three attributes that can influence absorptive capacity: intensity, speed, and direction. The intensity and speed of a firm's efforts to identify and gather knowledge can determine the quality of its acquisition capabilities. The greater the effort, the more quickly the firm will build requisite capabilities (Kim, 1997). The direction of accumulating knowledge can also influence the paths that the firm follows in obtaining external knowledge. These activities vary in their richness and complexity, highlighting a need to have different areas of expertise within a firm to successfully import external technologies (Rocha, 1997).

Karim and Mitchell(2004) discuss how firms innovate within and across firm boundaries by reconfiguring their resources and business units over time. Their study highlights the dual importance of acquisitions and

internal development as sources of value and innovation for a firm, along with the complementary role of business unit reconfiguration. Thus, the more acquisition capability it has, the more a firm can enhance its innovation.

(2) **Assimilation:** Assimilation denotes the firm's routines and processes that allow it to analyze, process, interpret, and understand the information obtained from external knowledge sources (Szulanski, 1996; Kim, 1997). Ideas and discoveries that fall beyond a firm's search zone are overlooked because the firm cannot easily comprehend them (Rosenkopf and Nerkar, 2001). Externally acquired knowledge may embody heuristics that differ significantly from those used by the firm, delaying comprehension of the knowledge (Leonard-Barton, 1995). External knowledge is also context specific, which often prevents outsiders from understanding or replicating this knowledge (Szulanski, 1996). Comprehension is especially difficult when the value of knowledge depends on the existence of complementary assets that may not be available to the recipient firm (Zahra and George, 2002).

Jacob and Los (2005) propose an assimilation theory to challenge the absorptive capacity view. In this view, technology is seen as something that does not automatically and immediately flows across firms or countries. Instead, only firms or countries that have invested sufficiently in their 'absorptive capacities' will be able to turn innovations developed elsewhere into productivity gains for themselves (Jacob and Los, 2005). In

the view of assimilation, policies to stimulate entrepreneurship and eagerness to learn are more important. In other words, the assimilation view emphasizes absorptive capacity as a necessary capability to achieve innovation through ability to learn. Thus, the more assimilation capability firms have, the more they can enhance their innovation.

Table 3.6 summarizes two dimensions of potential absorptive capacity and the impact on innovation.

Table 3.6 Summary of two dimensions of potential absorptive capacity and the impact on innovation

Dimensions/ capabilities	Meaning/definition	The impact on innovation
Acquisition	The firm's capability to identify and acquire externally generated knowledge that is critical to its operations	The more the firm has acquisition dimension/capability, the more the firm enhances innovation
Assimilation	The firm's capability to analyze, process, interpret, and understand the information obtained from external knowledge sources	The more the firm has assimilation dimension/ capability, the more the firm enhances innovation.

Source: The author

2. Realized absorptive capacity

According to Zahra and George (2002), realized absorptive capacity (RACAP) is a function of the transformation and exploitation capabilities discussed earlier. It in principle reflects the firm's capacity to leverage the knowledge that has been absorbed (Malhotha et al., 005). The remaining dimension of absorptive capacity is set in this component. Within this scope, thus, realized absorptive capacity consists of two dimensions/capabilities: (1) transformation and (2) exploitation.

(1) **Transformation**: Transformation refers to a firm's capability to develop and refine the routines that facilitate combining existing knowledge and the newly acquired and assimilated knowledge (Zahra and George, 2002). This is accomplished by adding or deleting knowledge or simply by interpreting the same knowledge in a different manner. Hence, the ability of firms to recognize two apparently incongruous sets of information and then combine them to arrive at a new schema represents a transformation capability. This capability shapes the entrepreneurial mindset (McGrath and MacMillan, 2000) and fosters entrepreneurial action (Smith and De-Gregorio, 2002). Furthermore, it yields new insights, facilitates the recognition of opportunities, and alters the way the firm sees itself and its competitive landscape.

According to Tang (1998), a company requires the capability to process and convert various pieces of information into knowledge that in turn, enables that firm to design, make and sell new products and processes. Thus, the more transformation capability a firm has, the more it can innovate.

(2) **Exploitation:** Exploitation is defined by Cohen and Levinthal (1990) as the application of knowledge. This incorporation of exploitation is treated as a dimension of absorptive capacity. Exploitation as an organizational capability is based on the routines that allow firms to refine, extend, and leverage existing competencies or to create new ones by incorporating acquired and transformed knowledge into its operations. The primary

emphasis is on the routines that allow firms to exploit knowledge. Firms may be able to exploit knowledge serendipitously, without systematic routines. However, the presence of such routines provides structural, systemic, and procedural mechanisms that allow firms to sustain the exploitation of knowledge over extended periods of time. Exploitation reflects a firm's ability to harvest and incorporate knowledge into its operations (Tiemessen et al., 1997; Van den Bosch et al., 1999). It requires retrieving knowledge that has already been created and internalized for use (Lyles and Schwenk, 1992).

According to Spender(1996), the outcomes of systematic exploitation routines are the persistent creation of new goods, systems, processes, knowledge, or new organizational forms. Similarly, successful established companies are likely to establish routines that target and deploy their knowledge to enhance existing initiatives or encourage new initiatives within a firm. Afuah (1998) proposes that younger entrepreneurial firms are generally more effective at developing and exploiting innovation, particularly radical innovation. In other words, thus, the more exploitation capability a firm has, the more innovative it can be.

Table 3.7 summarizes two dimensions of realized absorptive capacity and the impact on innovation.

Table 3.7 Summary of two dimensions of realized absorptive capacity and the impact on innovation

Dimensions/ capabilities	Meaning/definition	The impact on innovation
Transformation	The firm's capability to develop and refine the routines to facilitate combining existing knowledge and the newly acquired and assimilated knowledge	The more the firm has transformation dimension/capability, the more the firm achieve innovation
Exploitation	The firm's capability to refine, extend, and leverage existing competencies or to create new ones by incorporating acquired and transformed knowledge into its operations.	The more the firm has exploitation dimension/capability, the more the firm achieve innovation.

Source: The author

In sum, the above discussion classifies the two main components of absorptive capacity as potential and realized absorptive capacity. According to Zahra and George (2002), potential absorptive capacity consists of acquisition and assimilation capabilities whereas realized absorptive capacity consists of transformation and exploitation capabilities. These two main components of absorptive capacity are take complementary roles. Importantly, they are explored as factors influencing innovation in this study.

3.1.2.3 Dependent variable (Innovation)

In the Oslo Manual Revision (Bloch, 2005) innovation is defined as the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations. In other words, it expands the areas of interest from marketing and organization to take in the concept of innovation.

Innovation is always explored as a dependent variable or outcome (e.g. Hausman and Fontenot, 1999; Frambach and Schillewaert, 2002; Syakhroza and Achjari, 2002; Franke and Shah, 2003; Hausman and Stock, 2003; Mazzanti et al., 2006), as does this study. However, this study focuses on a newer trend of marketing innovation and management innovation rather than product and process innovation as in the traditional framework.

There are earlier studies concerning absorptive capacity and innovation but these take a different view than this study. For example, some researchers (e.g. Ogawa, 1998; Morrison et al., 2000; Lim, 2000; Lakhani and Hippel, 2000; Lüthje, 2000; Shah, 2000; Lilien et al., 2002) propose that the analysis of customer innovation processes has also often shown a puzzling phenomenon. Innovating users often do not sell or license their innovations to manufacturers. Instead, they freely reveal details of their innovations to other users and to manufacturers. Implicitly, it means that users can be both spiller-generator (as source of innovation knowledge) and recipient (as receiver from other users). In other words, the users may have absorptive capacity so they can create customer innovation to deal with this situation.

Jones and Tang (1996) propose that the links within networks provide the opportunity to share learning, exchange resources, acquire new technology and broaden markets. The results show that networks play a significant role in the effective transfer of technology. In other words, the firms in a network can generate innovation from the opportunity to acquire and exploit new technology that is

transferred within the network. In this study, innovation is examined in terms of (1) marketing innovation, and (2) management innovation:

(1) **Marketing innovation**: Marketing innovation is defined as the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing (Bloch,2005). It covers new marketing methods aimed at better addressing customer needs, opening up new markets, or newly positioning a firm's product on the market, with the objective of increasing the firm's sales. In order to ease firms' understanding of this concept, the definition is based on the well-known 4 P's model for marketing strategies: Product, Price, Place and Promotion.

Product design changes refer to changes in product form and appearance that do not alter the product's functional or user characteristics. They also include changes in the packaging of products such as foods, beverages and detergents, where packaging is the main determinant of the product's appearance. Product placement involves methods used to sell goods and services to customers. Promotion includes concepts for promoting a firm's goods and services, such as new advertising methods or new brand symbols. Pricing involves the use of pricing strategies to market the firm's goods or services. Some examples of marketing innovation are provided below:

Francis and Bessant (2005) propose that innovation in product positioning means in the eyes of the potential customer and/or a new market segments as targets. There are many examples of successful positioning and re-positioning such as when the Daily Mail repositioned itself as the leading newspaper in the UK in the 1980s. Also, the example of Haagen-Daz to become a global brand was developed from marketing innovation (Joachimsthaler and Taugbol, 1995).

(2) **Management innovation**: Management innovation involves a new method or paradigm in the management arena. For example, business practices which refer to routines or procedures for the conduct of work can range from practices for sharing knowledge to the sets of procedures involved in management systems. Also, the workplace organization which involves organizational structures and the distribution of responsibilities and decision making can be considered as managerial innovation as well.

According to Francis and Bessant (2005), innovation in paradigm is a way to 'switch' and/or 'breakthrough' organizational management. Thus, managerial innovation in paradigm relates to a business model that is a system of coherent, comprehensive construct used by managers to understand their firm and shape its development (Senge, 1992). Managerial innovation can be considered in terms of new processes relating to the principle of management such as planning, organizing, directing, and controlling.

3.1.2.4 Control variable

A set of control variables consists of firm size, ownership structure effect, and the firm's experience. In detail, these control variables are:

1. Firm size

Firm size is considered as one of the most frequently studied contextual variables. Firm size is defined as a control variable in this study due to the possibility that firm size may affect the level of cooperation, connectedness, absorptive capacity, and innovation. Most previous studies placed considerable emphasis on the size of a company, particularly because of the resource advantage that large firms possess and use to compete. Small firms may not have the same means and opportunities to exploit external knowledge, simply because they cannot risk betting on the wrong horse. Larger firms, on the other hand, often have multiple innovation projects running at the same time and can thus potentially exploit external knowledge better. Hausman and Fontenot (1999) state that small firms may suffer from the small size of their network and the relative paucity of innovative information available in this small networks.

Firm size in this study is defined by registered capital. The Ministry of Industry recommends a threshold level of 50 and 200 million baht. Small firms are defined as having registered capital of less than 50 million baht, medium firms as those with registered capital between 50 and 200 million baht, and large firms as those with registered capital of 200 million baht and above.

2. Ownership structure effect

The study includes the effect of ownership structure as a control variable in order to remove the effect of foreigners on the degree of cooperation and connectedness. Many experts suggest that the level of cooperation and connectedness may be different between a Thai-owned firm and a foreign-owned firm since those firms may have different business operations, working style, and social networking. For instance, a member of a Japanese keiretsu group normally cooperates within its own group members, whereas a Thai-owned firm is generally flexible in terms of cooperation and connections both within and without its own group. Ownership structure in this study is divided into four subgroups: Thai-owned firm, foreign-owned firm, Thai majority joint venture, and foreign majority joint venture.

3. Firm's experience

This study includes business experience as a control variable to remove the bias of the experienced firm. According to Zahra and George (2002), past experience influences the development of future acquisition capabilities. Experience is the product of interactions with customers (Nonaka and Takeuchi, 1995), alliances with other firms (Lane and Lubatkin, 1998), and learning-by-doing, which enables the firm to develop new routines that influence the locus of a firm's future search for knowledge. In addition, firms with long business experience may use more techniques to acquire knowledge spillover apart from just its own absorptive capacity. Also, they have more advantages than those with shorter business experience.

Business experience in this study is referred to as the period the company has been in its industry and is divided into six subgroups: less than 1 year, 1-5 years, 6-10 years, 11-15 years, 16-20 years, and more than 20 years.

3.2 Hypotheses Development

3.2.1 Relationship between spillover channel mechanism and absorptive capacity

Comparing to 'relational embeddedness' (which refers to trust, the strength of social ties, and shared value) (Dhanaraj et al., 2004), 'spillover channel mechanism' here is not totally similar or different. Because the spillover channel mechanism in this study is adapted and preliminarily extended to establish new links from a specific relationship (spiller-recipient), the only core concept closely related to relational embeddedness. However, both sources and outcome of the linkage are different. The spillover channel mechanism is easily explained as a mechanism linking in special relationship from the externalities/spillovers concept. In other words, it means that this relationship is perceived as 'regardless or without contractual agreement' or 'leakage'. In addition, this mechanism simultaneously shows the direct affect on firm's absorptive capacity and indirect affect on innovation.

Drawing on spillover channel framework, the spillover channel mechanism consists of two main elements: cooperation and connectedness. Implicitly, they mean

a mechanism from a task-oriented or cognitive aspect (cooperation), and a people-oriented or social aspect (connectedness). As previously discussed, cooperation consists of joint planning, joint problem solving, and joint implementing while connectedness is categorized as intensity, formality, and tie strength. These factors are proposed and hypothesized as follows:

3.2.1.1 Cooperation

According to Gulzar and Henry (2005), collaboration is largely an outcome of effective boundary spanners who provide pertinent information from the environment to the decision-making within an organization, increasing an organization's ability to absorb and respond to environmental complexity. Bonte and Keilbach (2005) state that informal cooperation is more prevalent and more important than formal cooperation. Thus, informal cooperation, particularly vertical cooperation, through routine work such as continuous R&D, reflects the improvement in firms' absorptive capacity. As noted above, a hypothesis is proposed as follows:

Hypothesis 1: There is a significant and positive relationship between cooperation and absorptive capacity.

Hardy et al.(2003) state that cooperation influences the sharing of critical resources and facilitates knowledge transfer. It also facilitates the creation of new knowledge and produces synergistic solutions. It means that cooperation is used to support prior knowledge through learning and comprehension capability. In other

words, it refers to acquisition and assimilation capability. Jansen et al. (2005) propose that the organizational mechanisms associated with coordination capabilities (i.e. cross-functional interfaces, participation in decision making, and job rotation) primarily enhance a unit's potential absorptive capacity. Thus, the first sub-hypothesis is proposed below:

Hypothesis 1a: There is a significant and positive relationship between cooperation and potential absorptive capacity.

Teece and Pisano(1994) state that the importance of external cooperation is related to the 'dynamic capability' perspective and 'innovation and network' research. Not all companies possess a full range of capabilities that are necessary for commercializing their innovations. Thus, cooperation with other firms is a way to access the requisite capabilities in a timely manner (Tidd et al., 1997). For example, from the dynamic capability perspective, cooperation is regarded not only as exploitation of partners' complementary assets/knowledge but also as an exploration of learning and knowledge creation processes. Furthermore, cooperation provides a channel for learning via access to new cognitive frameworks, routines, institutional arrangements and cultures (Mody, 1993).

The study by Faulkner and Senker (1995) showed that the most effective way to transfer technology from knowledge-generating organizations (i.e., universities and R&D institutions) to firms is to establish cooperative links between them. These links give companies the opportunity to internalize and use their core

competencies to implement new related processes or routines. In other words, cooperation that is achieved through formal organizational arrangements or informal personal contacts influences a firm's ability to transform and exploit the external knowledge.

Rothaermel and Thursby (2005) examine the cooperation between universities and companies. Their results show that cooperation creates technology incubators that facilitate knowledge flows from university to incubator firms. In this respect, the incubator firm's absorptive capacity is an important factor when transforming knowledge from the university into a firm-level competitive advantage. This leads to the next sub-hypothesis relating to realized absorptive capacity, as follows:

Hypothesis 1b: There is a significant and positive relationship between cooperation and realized absorptive capacity**.**

In sum, this study overall hypothesizes that cooperation is positively related to a firm's absorptive capacity. The more cooperation actions/activities (including joint planning, joint problem solving, and joint implementing) undertaken with the spiller, the stronger the company's absorptive capacity will become, since it will better acquire, collect and learn and understand the new knowledge. Then, the firm can better internalize, converse, and implement the new knowledge acquired and assimilated.

3.2.1.2 Connectedness

Sheremata (2000) observes that certain organizational structures increase employee interaction, promoting problem solving and creative action. These are related to connectedness as social integration within firms. Firms that use social integration mechanisms that build such connectedness are therefore positioned to make their employees aware of the types of data that constitute their absorptive capacity. In other words, absorptive capacity tends to be affected by social mechanism.

According to Wiethaus (2006), competing firms' decisions to choose identical or idiosyncratic R&D approaches depends on connectedness. Implicitly, he suggests the importance of the relationship between connectedness and absorptive capacity (which is considered as the second face of R&D) through the proxy of R&D investment. As such, firms have both strong and weak ties. Since competing firms choose identical R&D in order to maximize knowledge flows from external sources through the connectedness between firms, they will associate more with knowledge sharing (weak ties) and information exchange (strong ties) companies. In other words, ties strength tends to strengthen a firm's absorptive capacity in terms of R&D investment.

Thus, this study hypothesizes that connectedness is positively related to firm's absorptive capacity to learn and understand. The greater the connectedness with a spiller firm, the greater will a company's absorptive capacity be facilitated. For the reasons above, the second hypothesis is:

Hypothesis 2: There is a significant and positive relationship between connectedness and absorptive capacity.

Potts (2000) states that connectedness among relationships suggests an interdependency between direct and indirect capabilities. He discovers that despite an incomplete system, an interconnected relationship can develop and draw on particular mutual 'absorptive capability'. His results show that the evolution of boundaries involves gradual changes in particular configurations of specific connections, which affect the development and distribution of capabilities. Connectedness is thus perceived as tool to create understanding and support the quality of learning or absorptive capacity between actors. Implicitly, it means increasing acquisition and assimilation capability occurred from connectedness.

Jansen et al.,(2005) find a strong and positive effect of connectedness on potential absorptive capacity within units of organization, particularly the assimilation capability to understand and comprehend the new external knowledge. For the reasons above, a sub-hypothesis is proposed:

Hypothesis 2a: There is a significant and positive relationship between connectedness and potential absorptive capacity.

Bøllingtoft and Ulhøi (2005) propose that social capital is composed of individual and collective social networks, ties and structures that help the individual get access to information and know-how. Aldrich and Wiedenmayer (1993) found

that social ties connecting entrepreneurial actors to resource providers facilitate the acquisition of resources and the exploitation of opportunities. Sheremata (2000) and Chaudhuri and Tabrizi (1999) agree and emphasize that these mechanisms can facilitate the free flow of information, allowing the firm to transform and exploit this information as well. Applied to connectedness, therefore, the next sub-hypothesis is proposed as follows:

Hypothesis 2b: There is a significant and positive relationship between connectedness and realized absorptive capacity.

In conclusion, this study hypothesizes that connectedness is positively related to a company's absorptive capacity. The stronger the connectedness with a spiller, the stronger the firm's absorptive capacity will be, since it will be able to build on the opportunities to learn, acquire, transform, and utilize the new knowledge which is spilled over from the spillers.

3.2.2 Relationship between absorptive capacity and innovation

Firms differ in their ability to assimilate and replicate new knowledge gained from external sources. Cohen and Levinthal (1990) propose 'absorptive capacity' to contribute to innovation. Thus, absorptive capacity tends to develop cumulatively and builds on prior related knowledge. According to Cohen and Levinthal (1990), firms that possess relevant prior knowledge are likely to have a

better understanding of new technology that can generate new ideas and develop new products.

According to Levinson and Asahi (1995), absorptive capacity refers to the ability of an organization to pick up new ideas and to adapt to them. Zahra and George (2002) propose that absorptive capacity is thus the foundation for technical learning within an organization. Implicitly, absorptive capacity tends to be an effective tool to enhance innovation through the absorption process.

Tsai (2001) posits that firms with a high level of absorptive capacity are likely to harness new knowledge from other units to help their innovative activities. In addition, absorptive capacity results from a prolonged process of investment and knowledge accumulation. A firm's absorptive capacity for learning depends on its endowment of relevant technology-based capabilities. Thus, organizations with a high level of absorptive capacity invest more in their own R&D and have the ability to produce more innovations.

Most of the previous studies indicate that absorptive capacity can create innovation through learning and conversion capability. However, Nieto and Quevedo (2005) claim that there are only a few empirical studies of the relationship between absorptive capacity and innovative effort despite positively correlated evidence (e.g. Veugelers,1997; Becker and Peters, 2000). Based on this, the third main hypothesis is:

Hypothesis 3: There is a significant and positive relationship between absorptive capacity and innovation.

Stock et al. (2001) find that potential absorptive capacity is necessary for new and better and more efficient modem products in the computer modem industry. Since absorptive capacity is traditionally operationalized by R&D intensity, Poldahl (2005) also states that absorptive capacity is important for new product development. The reason is that absorptive capacity tends to gain benefit from the acquisition and use of external information. In other words, potential absorptive capacity tends to have an effect on new product development.

Zahra and George (2002) posit that the development of a firm's potential absorptive capacity is path dependent. This path dependence in developing capabilities can determine a firm's success or failure. Therefore, firms with well-developed potential absorptive capacity are likely to be more adept at continually revamping their knowledge stock by spotting trends in their external environment and internalizing this knowledge. Also, potential absorptive capacity plays a pivotal role in renewing a firm's knowledge base and the skills necessary to compete in changing markets. In other words, potential absorptive capacity facilitates innovation. In addition, since today's information age is intensely competitive, having the latest information about best-practices, for example, and being able to integrate this information with internal know-how may spell the difference between competitive success and failure. Therefore, a firm's absorptive capacity - ability to acquire,

assimilate, transform, and exploit knowledge – is important to determining its level of managerial innovation and adaptability.

Based on these findings, potential absorptive capacity tends to generate marketing innovation and management innovation. Therefore, a sub-hypothesis proposes:

Hypothesis 3a: There is a significant and positive relationship between potential absorptive capacity and innovation.

Zahra and George (2002) state that the transformation and exploitation capabilities that comprise realized absorptive capacity are likely to influence firm performance through innovation. For example, firms require knowledge leveraging and recombining skills to pursue the extension of new managerial methods to overcome and compete with other competitors. Transformation capabilities in realized absorptive capacity help firms to develop new perceptual schema or changes to existing new processes. Exploitation capabilities take this a step further and convert knowledge into new products (Kogut and Zander, 1996). Given that realized absorptive capacity is based on knowledge exploitation (March, 1991), it thus enhances innovation (Liebeskind, 1996). Therefore, the last sub-hypothesis is stated as follows:

Hypothesis 3b: There is a significant and positive relationship between realized absorptive capacity and innovation

In sum, this study hypothesizes that a firm's absorptive capacity is positively related to the firm's innovation. The higher the absorptive capacity - both potential and realized - the higher the level of innovation firms can achieve since it will be able to increase its absorption capability in all dimensions, particularly in the transformation and exploitation dimensions

3.3 Summary of Hypotheses

The summary of all hypotheses in this study is illustrated in Table 3.8.

Table 3.8 Summary of research hypotheses

Hypotheses	The statement
H1	There is a significant and positive relationship between cooperation and absorptive capacity
H1a	There is a significant and positive relationship between cooperation and potential absorptive capacity
H1b	There is a significant and positive relationship between cooperation and realized absorptive capacity
H2	There is a significant and positive relationship between connectedness and absorptive capacity
H2a	There is a significant and positive relationship between connectedness and potential absorptive capacity
H2b	There is a significant and positive relationship between connectedness and realized absorptive capacity
H3	There is a significant and positive relationship between absorptive capacity and innovation
H3a	There is a significant and positive relationship between potential absorptive capacity and innovation
H3b	There is a significant and positive relationship between realized absorptive capacity and innovation

In conclusion, this chapter shows the development of the model and proposes the three primary hypotheses and six sub-hypotheses to examine the relationships in the proposed research model. The research methodology, including scope, design, scale/measurement development and sampling frame are provided and discussed in the next chapter.

CHAPTER IV

RESEARCH METHODOLOGY

This chapter describes the procedure used to conduct the research and provides the details of research methodology, including research design, sample selection criteria, scale/measurement development, population and sampling plan, data collection, and data analysis for hypotheses testing. The details are arranged into the steps shown in Table 4.1.

Table 4.1 Stages of research methodology

4.1 Research design	• Descriptive research
4.2 Research scope	• Industry selection: The Electrical and Electronics (E&E) industry • Classification of E&E industry
4.3 Research method	• Qualitative and quantitative research methods
4.4 Scale and measurement development	• Spillover channel mechanism (Cooperation and Connectedness) • Absorptive capacity • Innovation
4.5 Questionnaire development	• Five sections of questionnaire
4.6 Sampling	• Population (Target sample) • Sampling technique • Sample size
4.7 Data collection	• Preliminary interview • Pretest • Field survey
4.8 Data analysis	• Frequency test • ANOVA • Principle component factor analysis • Structural Equation Modeling analysis (SEM) • Measurement model (Confirmatory Factor Analysis: CFA) • The assessment of model fit

Source: The author

4.1 Research design

To explore the relationship among the main indicator (spillover channel mechanism), the mediator (absorptive capacity), and the outcome (innovation), this study employs descriptive research to describe the characteristics of population or phenomena. This type of research design is appropriate to specify the type of problems such as the relationship between variables and is guided by an initial hypothesis (Churchill and Iacobucci, 2002). This research is also designed as a cross-sectional survey that relies on a sample from the population of interest measured at a single point in time. This study also focuses on the relationship between a company and its customers. The firm here is the recipient firm while his main customer is the spiller/source of knowledge spillovers. In other words, this study researched only the customer side of the supply chain.

4.2 Research scope

Since the study aims at investigating the importance and strategy of managing absorptive capacity, it is related to a knowledge-based industry. The scope of the study is thus the Electronics and Electrical (E&E) industry, as it is the major knowledge-based industry providing a significant contribution to Thailand's economic development. The study singles out the electrical and electronics industry because it is a high growth-oriented and high technology-based industry. It is an important sector in emerging countries, especially Thailand. This industry is discussed in brief below.

4.2.1 Industry selection: The Electrical and Electronics industry

The electrical and electronics (E&E) industry is selected for this study for the following reasons. First, this industry is important to the Thai economy, both in terms of foreign investment and export value. From the foreign investment viewpoint, the electrical and electronics industry is the most popular industry with the highest growth in foreign investment. Thanks to confidence in its infrastructure, Foreign Direct Investment (FDI) has helped Thailand evolve from a largely agrarian society to one of vibrant economic diversity. Today, 38% of GDP comes from manufacturing, 52% from services and wholesale and retail trade, and only 10% of GDP from agriculture. The growth of all manufacturing and services sectors has been supplied largely by FDI, both direct and indirect. Most of the FDI and multinationals in Thailand are from Japan. Japan is the country's largest trading partner and number one source of foreign direct investment, particularly in the electrical and electronics industry. The Board of Investment (BOI) estimates that 43% of all foreign investors in the electrical and electronics industry are Japanese. Implicitly, the electrical and electronics industry thus is crucial to stimulating foreign investment in Thailand.

Over the period 2000-2006, most foreign investment (FI) projects (foreign capital of at least 10%) and FI export projects (foreign investment for export more than or equal to 80% with capital at least 10%) that applied to the BOI for promotion and were approved were in the Electrical and Electronics (E&E) sector. Table 4.2 shows the number of projects and investment value (million baht) of FI projects and FI export project applications and approvals by the BOI in the E&E sector.

Table 4.2 Foreign investment (FI) projects and FI export projects applications and approved for BOI promotion over 2000-2006

Year	FI projects				FI export projects			
	Net applications		Applications approved		Net applications		Applications approved	
	No.	Value (M.Baht)	No.	Value (M.Baht)	No.	Value (M.Baht)	No.	Value (M.Baht)
2000	211	88,856.9	185	71,613.2	130	79,823.2	156	66,905.4
2001	163	35,362.8	173	51,855.0	91	26,891.4	127	49,221.4
2002	142	35,090.4	135	28,551.6	97	26,842.2	108	27,144.6
2003	152	63,161.3	123	43,190.3	117	55,634.8	95	38,157.6
2004	152	79.411.1	146	89,466.3	102	70,229.9	122	88,304.2
2005	173	82,659.5	162	85,820.4	87	66,158.8	106	82,557.9
2006	180	71,777.8	166	57,938.2	95	58,817.1	117	55,933.0

Source: Board of Investment (available from http://www.boi.go.th , retrieved on February 21, 2007)
Note: Foreign investment (FI) projects refer to investment projects with foreign capital of at least 10%
         FI export is the investment for export ($\geq$ 80%) with foreign capital of at least 10%

In terms of export value, the electrical and electronics (E&E) industry had the highest export value during 2000-2006 and was in the top five based on export value. This is the industry of future with high growth potential and positive trend of success for Thailand. In Thailand, the growth rate of production in the E&E industry averaged 25-38 percent annually from 1990 to 2006 (www.bot.go.th, February 2007). In addition, it is recognized as the most significant industry to boost Thailand's economy (www.thaieei.com, February 2007).

The E&E sector employs over 600,000 workers. Its products comprise 30% of Thailand's export revenue. In 2005, particularly, electrical and electronics exports totaled one trillion baht, a 7.8 % increase from 2004. The number one E&E export is hard disk drives (HDD), accounting for 14.2% of Thailand's exports. HDD production in Thailand more than doubled to 140 million units, representing 42% of the world market share. Thailand now claims to be overtaking Singapore to become the world's number one HDD exporter. Thailand is recognized as already dominating

this key industry niche. Tables 4.3 and Table 4.4 show E&E export and import value from 2000 to 2006.

Table 4.3 Export value in the electrical and electronics industry 2000-2006

Year	Export value (Million baht)		
	Electrical	Electronics	Total
2000	357,720	686,438	1,044,158
2001	379,087	645,937	1,025,024,
2002	417,408	640,420	1,057,829
2003	447,567	708,111	1,155,677
2004	542,067	765,941	1,308,007
2005	543,587	869,970	1,413,557
2006	561,000	998,808	1,559,808

Source: Electrical and Electronics Institute (available from http://www.thaieei.com;
retrieved on February 21,2007*)*

Table 4.4 Import value in the electrical and electronics industry 2000-2006

Year	Import value (Million baht)		
	Electrical	Electronics	Total
2000	264,124	544,965	809,089
2001	268,548	577,920	846,468
2002	279,311	564,067	843,379
2003	305,216	582,095	887,310
2004	325,215	660,999	986,214
2005	406,450	740,151	1,146,600
2006	426,000	767,238	1,193,238

Source: Electrical and Electronics Institute (available from http://www.thaieei.com;
retrieved on February 21,2007)

The second reason for choosing this industry is that it is one of five industries promoted by the government of Thailand. It earns benefits from government support campaigns, including tax privileges, unrestricted local content, improved infrastructure, advanced technology, and labor skills development. The Thai government has said it is embarking on its next industrial revolution with a major campaign that will affect all electrical and electronics firms in Thailand. Within three years, government also plans to transform Thailand into "Southeast Asia's

largest electrical and electronics hub". Thus, the electrical and electronics sector is the spearhead of Thailand future, fortifying many of the most important industries and modernizing the country. The ultimate goal is the creation of "Future Thailand" which means a nation with the ability to compete far into the future.

Since the government plans to boost the E&E industry to become Southeast Asia's electrical and electronics hub, broadening and deepening individual company capabilities is very important. It means further development of both upstream and downstream industries, including filling in missing links in value chains, and building a high performance industrial portfolio. Due to the high competition, the strategic response is also to 'ramp up' competitiveness and to create effective partnerships. The industrial network, investment climate and operational conditions should continue to improve. Currently there are 36 industrial estates in Thailand with four dedicated to electrical and electronics firms.

Thailand is receiving interest from industrial estates to develop 'electronic cities' to provide even more sites. As these clusters develop in the midst of a growth trend, the necessity and importance of studying FDI, the spillover channel mechanism between partners, and absorptive capacity are underscored and confirmed as crucial at both the firm and country level.

4.2.2 Classification of the electrical and electronics industry

According to Das (1998), the electrical and electronics (E&E) industry comprises of three main segments: industrial electronics (e.g. communication and computer, factory automation, aviation and navigation, system integration), electronics components and parts (e.g. semiconductor industry; integrated circuits), and consumer electronics (e.g. communication and personnel computer, office automation, multimedia). The Department of Export Promotion (DEP) in Thailand classifies this industry into two groups: electrical, and electronics products and parts. The Board of Investment (BOI) categorizes E&E industry into three groups, covering entire businesses both direct and indirect relating to E&E as follows:

A) Electrical business. The electrical category consists of four subgroups: industrial equipment, consumer electrical products, parts and components, integrated production of electrical appliances or parts. B) The second group is electronics, with six main subgroups: industrial equipment, consumer electrical products, parts and components, integrated production of electrical appliances or parts, material for micro-electronics, and electronic design. C) The last group is the electrical and electronic business, comprising other firms related to electrical and/or electronics businesses such as software and e-commerce.

Since this study concerns the absorptive capacity of firms and knowledge spillovers, the view of partnerships are considered. The industry should be divided neither too narrow nor too broadly in order to best understand the relationship of partners. This study thus classifies the E&E industry into three groups in line with the BOI.

4.3 Research Method

The study uses both qualitative and quantitative research methods. The qualitative method is provided by in-depth interviews with experts in the electrical and electronics industry after literature reviews. Data from E&E newsletters, textbooks, Internet websites (i.e. www.thaieei.com, www.oie.go.th), and related journal/publications of knowledge transfer/diffusion and innovation in E&E industry, particularly in Thailand, are included as secondary sources of information.

For the quantitative research method, the study uses self-administered mail questionnaires for its survey. According to Hair et al. (2000), this method has both advantages and disadvantages. The advantage is that it can cover a broader respondent base and does not require any field staff and is free from interviewer bias. The cost of mailing questionnaires is also low when compared to personal or telephone interviews. Importantly, this method can be used effectively for industrial surveys where the respondents are highly knowledgeable and the topic of the survey is very specific (Kumar, 2000). The primary disadvantage of a mail survey is a very high non-response rate. This may cause other related problems, such as a higher cost per survey or a significant bias occurring from the low response rate. Taking these factors into consider, this study did employ a mail survey.

In order to overcome some of the disadvantage, the mailing list used comprised electronics and electrical manufacturers listed in the Electrical and Electronics Institute (EEI) 2006 directory. There are 2,158 firms listed in that

directory. Previous studies report a response rate of 9-10% and with this in mind, it was hoped to receive a response from not less than 200 firms, sufficient on which to base statistical methodology. To ensure this, a strong follow-up process was set up to deal with a non-response rate. For example, after some early responses, others were called to check on the status of the survey and provide convenience for returning questionnaires. The details of follow-up procedure are elaborated in the section on data collection.

4.4 Scale and Measurement Development

Ever since Churchill (1979) published his seminal paper on scale development, the use of multi-item measures and the investigation of the psychometric properties of the latter has become the rule rather than the exception in many disciplines (Bruner and Hensel, 1993; Diamantopoulos, 1999). Based on literature reviews, different scales and measurement are developed to measure all the proposed constructs in this study: 1) spillover channel mechanism, (2) absorptive capacity, and (3) innovation.

4.4.1 Spillover channel mechanism

As previously discussed, spillover channel mechanism is represented by two main variables: cooperation and connectedness. The measure of the spillover channel mechanism is thus a summated measure of cooperation and connectedness. Since the study intends to explore the effect of each factor on absorptive capacity, the detail of scale and measurement development should be focused on these two variables, separately as: (1) cooperation, and (2) connectedness.

4.4.1.1 Cooperation

Cooperation is often discussed but seldom measured; this study defines cooperation as the extent to which activities, people, routines, and assignments work together to accomplish overall objectives. Drawing on the spillover channel framework, cooperation in this study implies spillover from task-oriented actions/activities. It thus focuses on cooperation between partners in non-contractual agreements. In other words, it is cooperation in general/routine work. It assumes that the higher the degree the E&E firm (acting as recipient) cooperates with his customer (acting as spiller/source of knowledge spillover), the better the recipient firm facilitates its absorption capability. Since this study attempts to examine the cooperation deriving from knowledge spillovers, the measurement of the degree of cooperation is mainly based on breadth rather than depth. Thus, cooperation consists of regular task-basis activities such as joint planning, joint problem solving, and joint implementing.

Joint planning is defined to actions/activities providing an avenue for the sharing of richer information through socialization and articulation to deal work together. This joint planning develops a deeper understanding of the needs of the partners. The six items used to measure the level of joint planning are derived and modified from relevant literature (e.g. Malhotra et al. 2005; Claro et al., 2003; Subramani and Venkatraman, 2003; Zaheer and Venkatraman, 1995; Hiede and John, 1992). The details are illustrated in Table 4.5.

Table 4.5 Measurement items for Joint planning

Dimension	Measurement items	Modified and derived from
Joint planning	You and your customer joint to plan for market demands in each quarter.	Subramani and Venkatraman (2003)
	You and your customer joint to plan and determine marketing strategy in long-term.	Malhotra et al.(2005); Claro et al.,(2003); Subramani and Venkatraman (2003)
	You and your customer joint to plan and determine pricing strategy.	Zaheer and Venkatraman(1995); Hiede and John (1992)
	You and your customer joint to analyze market trends and create new distribution channels	Zaheer and Venkatraman(1995); Hiede and John (1992)
	You and your customer joint to analyze the responses from marketing promotion.	Zaheer and Venkatraman(1995); Hiede and John (1992)
	You and your customer joint to plan for purchasing, ordering, setting the special equipment usage's policy	Zaheer and Venkatraman(1995); Hiede and John(1992)

Source: The author

Joint problem solving is considered as the actions/activities reflecting behavior of the relationship that captures the degree of problem solutions between partners. It is measured by four items that are derived from literature and modified (e.g. Claro et al., 2003; Lusch and Brown, 1996; Heide and Miner, 1992). Table 4.6 shows the measurement items in detail.

Table 4.6 Measurement items for Joint problem solving

Dimension	Measurement items	Modified and derived from
Joint problem solving	You and your customer joint to determine the solutions for any task problems (e.g. production problem, delivery problem)	Claro et al.(2003); Lusch and Brown (1996)
	You and your customer always joint to negotiate and determine roles and responsibilities to solve problems	Claro et al.(2003); Lusch and Brown (1996);Heide and Miner (1992)
	You and your customer joint to set the conflict solution for operations problems.	Claro et al.(2003); Lusch and Brown (1996)
	You and your customer always joint to exchange knowledge/technology of market/product for problem solving	Brass et al.(2004); Lusch and Brown (1996);Heide and Miner (1992)

Source: The author

Joint implementing is defined as the setting of action/activities between partners for control systems, best-practices manuals, and standard procedures. It may include activities establishing long term production or marketing management together. The measurement items of joint implementing are based on Hardy et al (2005), and the results of in-depth interviews and/or expert recommendations. The details of all items are illustrated in Table 4.7.

Table 4.7 Measurement items for Joint implementing

Dimension	Measurement items	Modified and derived from
Joint implementing	You and your customer joint to set up the tasks control system.	New item based on interviews
	You and your customer joint to set up the standard operation manual	New item based on interviews
	You and your customer joint to initiate long term marketing management for your target group	Hardy et al(2005)
	You and your customer joint to initiate operation/work procedures	New item based on interviews
	You and your customer joint to create performance evaluation system.	New item based on expert recommendations

Source: The author

4.4.1.2 Connectedness

Connectedness was also adapted in the same manner as other variables. Generally, connectedness is measured in terms of frequency of communication, pattern of communication, and commitment. This study defines connectedness as the extent to which individuals perceive that they are central to, visible in and involved with the organizational community (Raghiuram et. al., 2001) Drawing on the spillover channel framework, connectedness in this study implies spillover from people-oriented (or social aspect) actions/activities. It thus focuses on connectedness between partners regardless of a contractual agreement. In other words, it uses connectedness from social contacts or networking.

It is assumed that the higher the degree of connectedness the E&E firm (or recipient firm) has with his customer (or spiller/source of knowledge spillover), the more the recipient firm strengthens his absorptive capacity. Since this study attempts to examine connectedness drawing on the spillover channel of human mobility and demonstration affect/imitation, the measurement of the degree of connectedness is mainly based on social or relationship interactions and/or people-oriented actions/activities. Thus, connectedness consists of social-based or relationship-based actions/activities such as intensity, formality, and ties strength.

Intensity refers to the intensity of a relationship and is measured by the frequency of contacts between partners. Some studies measure by using formative/composite scale. In order to match the other dimensions of connectedness

in this study and to make it appropriate for data analysis in the structural model, however, intensity is measured by one item, which is derived from literature of communication (e.g. Brown and Eisenhardt, 1995; Russell and Puto, 1999; Russell, 2002; Russell et al., 2004). Table 4.8 shows the measurement item in detail.

Table 4.8 Measurement items for Intensity

Dimension	Measurement items	Modified and derived from
Intensity	How frequency of the contact or communication	Brown and Eisenhardt (1995); Russell and Puto (1999); Russell et al., (2004)

Source: The author

Informal (pattern) contact/communication refers to the formation or mode of contact/communication that is informal, such as fact-to-face contact. Informal is measured by five items which are derived from literature and modified (e.g. Mohr and Spekman, 1994; Mohr et al., 1996). Table 4.9 shows the measurement items in detail.

Table 4.9 Measurement items for Informal

Dimension	Measurement items	Modified and derived from
Informal	Most of communication used is casual, informal, word-of-mouth channel	Mohr et al.(1996); Mohr and Spekman (1994)
	Contacts between you and your customer are personal contact	Mohr et al.(1996); Mohr and Spekman (1994)
	The patterns of relationship between you and your customer have recognized without writing down in detail.	Mohr et al.(1996); Mohr and Spekman (1994)
	Customer's knowledge flows are provided to you in detail	Mohr et al.(1996); Mohr and Spekman (1994)
	Informal mode is always used to deal whenever you need knowledge sharing and exchange with your customer	Mohr et al.(1996); Mohr and Spekman (1994)

Source: The author

Tie strength refers to the extent of the degree of closeness and/or the level of connection. Normally, ties strength can either be strong or weak (Bøllingtoft and Ulhøi,2005). Social ties mean friendship, social support, attitudes, behaviors that are not prescribed by the requirements of work and indicate the presence of a social rather than work basis for relationship. Ties strength is measured by four items that are derived from literature (e.g. Smith-Doerr et al., 2004; Mehra et al., 2001; Ibarra, 1993). Table 4.10 shows the measurement items in detail.

Table 4.10 Measurement items for Ties strength

Dimension	Measurement items	Modified and derived from
Ties strength	You and your customer deal with problem solving together regardless the supervisor's command	Smith-Doerr et al.(2004); Mehra et al.(2001); Ibarra (1993)
	Your feeling is comfortable whenever having contact together	Mehra et al.(2001); Ibarra (1993)
	It is ease of acquiring or access the knowledge from each other	Mehra et al.(2001); Ibarra (1993)
	You and your customer spend time together outside the workplace (e.g. joint lunch, joint in clubs and voluntary associations etc.)	Mehra et al.(2001); Ibarra 1993)

Source: The author

4.4.2 Absorptive capacity

Instead of using a proxy, this study modifies a measure for absorptive capacity on the basis of identification of the principal factors having an influence, whether positive or negative, over accumulation of this capacity. All items are five-point Likert scale, derived from literature and modified (e.g. Jaworski and Kohli, 1993; Jansen et al., 2005; Nieto and Quevedo, 2005), measuring both potential absorptive capacity and realized absorptive capacity. Table 4.11 and Table 4.12 show the measurement items of potential absorptive capacity and realized absorptive capacity, respectively.

Table 4.11 Measurement items for Potential absorptive capacity

Dimension	Measurement items	Modified and derived from
Potential-absorptive capacity	Your firm acquires new knowledge by having frequent interaction with your main customer	Jansen et al.(2005)
	Your firm collects industry information through informal means (e.g. lunch with industry friends, talks with trade partners)	Jansen et al.(2005)
	Your firm acquires new knowledge by periodically organizing special meetings with your main customer.	Jansen et al.(2005)
	Your firm is fast to recognize shifts in your market (e.g. competition, regulation)	Jansen et al.(2005); Nieto and Quevedo(2005)
	Your firm quickly analyzes and interprets for changing market demands.	Jansen et al.(2005)
	Your firm quickly understands the new opportunities to serve the customers.	Jansen et al.(2005); Nieto and Quevedo(2005)

Source: The author

Table 4.12 Measurement items for Realized absorptive capacity

Dimension	Measurement items	Modified and derived from
Realized absorptive capacity	Your firm regularly considers the consequences of changing market demands in terms of new products and services.	Jansen et al.(2005); Nieto and Quevedo(2005), Jaworski and Kohli(1993)
	Your firm quickly recognizes the usefulness of new external knowledge to existing knowledge.	Jansen et al.(2005)
	Your firm periodically meets with your customer to discuss consequences of market trends and new product development.	Jansen et al.(2005); Nieto and Quevedo(2005)
	Your firm easily implements new products and services.	Jansen et al.(2005)
	Your firm constantly considers how to better exploit knowledge.	Jansen et al.(2005)
	Your firm clearly knows how activities between firms should be performed.	Jansen et al.(2005)

Source: The author

4.4.3 Innovation

For the measurement items of innovation, since marketing and management innovation examined here includes imitated and adapted innovation rather than creation of a new or other type of innovation in the market, they are first derived and modified from the Oslo Manual Revision (2005). Then, based on previous studies of

Francis and Bessant (2005) and Chang (2003) as well as expert interviews, this study

adapts and sets up a new eight and six item five-point Likert scale for measuring

marketing innovation and management innovation, respectively. Table 4.13 and Table

4.14 show the measurement items for marketing innovation and management

innovation, respectively.

Table 4.13 Measurement items for Marketing innovation

Dimension	Measurement items	Modified and derived from
Marketing innovation	Your firm establishes the new market segments you serve	Francis and Bessant (2005)
	Your firm sets the new positioning for your new market	Francis and Bessant (2005)
	Your firm expands the new or emerging markets	Francis and Bessant (2005)
	Your firm sets new pricing strategy to overcome the competitors	Francis and Bessant (2005)
	Your firm creates new channels to distribute/ sell the products	Francis and Bessant (2005)
	Your firm improves services for customers and/or creates new after-sales services	Francis and Bessant (2005)
	Your firm establishes new promotion and/or new advertising strategy	Francis and Bessant (2005)
	Your firm creates and develops strategies to compete in the market that would not have been possible otherwise.	Francis and Bessant (2005); New item based on interviews

Source: The author

Table 4.14 Measurement items for Management innovation

Dimension	Measurement items	Modified and derived from
Management innovation	Your firm initiates new paradigm and sets up new management policy	Francis and Bessant (2005); Chang(2003)
	Your firm rearranges day-to-day technical routines and informal procedures	Francis and Bessant (2005); Chang(2003)
	Your firm changes and/or sets up new management practices (e.g. new patterns to communicate across different department/ functions within firm)	Francis and Bessant (2005); Chang(2003)
	Your firm creates new methods to set up strategic plans	Chang(2003); New item based on interviews
	Your firm sets up new control-system	Chang(2003)
	Your firm initiates the new culture/sub-culture (e.g. setting own technical manual/ procedure to create the learning-culture etc.)	Francis and Bessant (2005); Chang(2003)

`Source: The author

In sum, the overview of scale and measurement development is shown in Table 4.15. All scales are five-point Likert scales, unless otherwise noted.

Table 4.15 Summary of scale/measurement development

Constructs	Modified/Adapted from
Spillover channel mechanism	
• Cooperation	
•Joint planning	• 6 items (Malhotra et al., 2005;Claro et al., 2003; Subramani and Venkatraman, 2003; Zaheer and Venkatraman, 1995; Hiede and John, 1992)
•Joint problem-solving	• 4 items (Brass et al.,2004; Claro et al.,2003; Lusch and Brown, 1996; Heide and Miner, 1992)
•Joint implementing	• 4 items (Hardy et al.,2005; new items based on interviews and experts recommendations)
• Connectedness	
• Intensity	• 1 item (Russell et al., 2004; Russell and Puto, 1999; Brown and Eisenhardt,1995)
• Informal contact	• 5 items (Mohr et al., 1996; Mohr and Spekman,1994)
• Ties strength	• 4 items (Smith-Doerr et al., 2004;Mehra et al.,2001; Ibarra, 1993)
Absorptive Capacity(ACAP)	
• Potential-ACAP	• 6 items (Jansen et al.,2005;Nieto and Quevedo, 2005)
• Realized-ACAP	• 6 items (Jansen et al.,2005; Nieto and Quevedo, 2005; Jaworski and Kohli,1993)
Innovation	
• Marketing innovation	• 8 items (Francis and Bessant, 2005; new items based on interviews)
• Managerial innovation	• 6 items (Francis and Bessant,2005; Chang ,2003; new items based on interviews)

Source: The author

4.5 Questionnaire development

An important component of survey research is the development of the survey instrument-questionnaire which is a set of questions designed to evoke useful answers (Kumar, 2000). Designing a good questionnaire is considered an art and not merely a bunch of questions thrown in with the intention of eliciting some information from the respondent. Following the steps of questionnaire design, the

study starts with planning what to measure. This involves going back to the research problem and the research questions. Also, the study has to check back on the data collected during the course of secondary research and the hypotheses formulated when descriptive research is conducted. Then, formatting of each question is necessary to work out the wording and layout. As previously mentioned, this study designed and developed the questionnaire using suggestions from experts throughout the process and during a pretest. The sequence of questions is checked for logical continuity. The pretest of the questionnaire can be helpful to rectify any problems that may show up.

In addition, this study needed to be sure the language, context and topics being investigated were familiar to the respondents. Then, a willingness to participate in the survey without external pressure was another focus, to ensure unbiased responses that reflected the true feeling of the respondents (Kumar, 2000). The questionnaire used in this study can be divided into five sections. Table 4.16 illustrates the structure of the questionnaire used in this study.

Table 4.16 Questionnaire structure

Section	Content	Questions number
1	Respondents' profile	1-15

2	Spillover channel mechanism
	  A. Cooperation
	  B. Connectedness
		
		17-19
		20-24

3	Firm's absorptive capacity	25
4	Innovation (marketing and management innovation)	26-27
5	Problems and Suggestions	28

Source : The author

The first section contains questions about the respondents, such as company profile, general characteristics, performance, and specific characteristics relating to spillers/sources of knowledge spillover. The questions in this section also cover both the nominal and interval scale by using closed-end and open-ended questions.

In the second to the fourth section the questions centered on the spillover channel mechanism (including subsections of cooperation and connectedness), absorptive capacity, and innovation, respectively. Most of questions asked whether the respondents agreed with the statement relating to each variable. This study developed all questions in terms of attitude measurement, which was measured according to the five-point Likert scale ranging from strongly disagree (1) to strongly agree (5).

The last section asked for any problems and suggestions from respondents with open-ended questions. Although this type of question is seldom answered, they were included in order to get more opinions in a Thai setting.

The total length of this questionnaire was eight pages, which was within the acceptable range that does not appear too daunting to the respondents (Churchill, 1999). The questionnaire was in both English and Thai, since most respondents are Thais. The questionnaire was originally developed in English and translated to Thai by a bilingual speaker. Then, it was back translated to English to ensure that the translation matched the original version. This is back-to-back translation or translation verification being widely used with a good outcome (Zikmund, 1996).

4.6 Sampling

Based on the 2006 Electrical and Electronics Institute (EEI)directory, a list of 2,158 local E&E firms are collected. Indeed, it is the same meaning as the sampling frame of the study. The information studied for effective data collection included mailing addresses, telephone numbers, contact persons, and brief product type, product standard and management standard of all firms. Then, this study determined the population (target sample), sampling technique, and sample size to capture a research sampling approach as follows:

4.6.1 Population (Target sample)

The group of interest is defined as a target population consisting of the complete group of elements (people or objects) typically identified for investigation according to the objectives of the research study (Churchill and Iacobucci, 2002). The precise definition of the target population is vital. In this study, the target population is local firms in the electrical and electronics industry. According to the information from EEI, the 2006 directory consists of various types of E&E firms such as OEM, OBM, ODB, firms providing services for E&E, E&E trading firms, firms relating to software in electronics, firms supporting E&E, and so on (www.thaieei.com;March, 2006). These firms are recognized as E&E firms, not taking ownership into consideration. Interviews with industry experts revealed that wholly Thai E&E firms are few, with most local E&E firms in Thailand being in the form of joint ventures. Since the study aims to investigate the mechanism of spillovers between a firm and its

customers as well as a firm's absorptive capacity and innovation, thus, a group of local firms whether or not wholly Thai, is acceptable and reasonable to use for this study.

4.6.2 Sampling technique

This study employs the probability technique by simple random sampling. This technique has several advantages. It permits demonstrating the representatives of the sample, helps to state the variation introduced by using a sample instead of a census, and helps to identify possible biases introduced due to sampling (Kumar, 2000). In addition, the study obtains a sampling frame that works best with the probability method.

4.6.3 Sample size

This study employed three methods to calculate an appropriate sample size. The first method is based on the recommendation of Hair et al., (1998). It is suggested that multivariate analysis requires a sample size between 5 to 20 observations for each attribute of independent variable in the proposed model. In this study, there are a total of 8 attributes under 3 variables including mediator. For example, the cooperation and connectedness variable has three attributes for each variable while absorptive capacity has two attributes. Based on this method, thus, the required sample size for multivariate analysis of this study is in the range of 40 to 160 samples.

In the second method, the sample size in this study can be simply determined by statistical formulation developed by Yamane (1967). The formulation is illustrated as follows:

$$n = \frac{N}{1+N\ e^2}$$

where;

      n =   The required sample size
      N =   The size of the target population
      e =   Significant level

Given N (the size of the target population)= 2,158 firms; e (significant level) in social science = 0.05-0.10, thus, n (the required sample size) is in between the range of 96 (for level of 0.10) observations and 337 (for level of 0.05) observations.

The last method is based on the requirement of Structural Equation Modeling (SEM) which is the statistical tool used for quantitative data analysis and hypotheses testing in this study. Since SEM relies on tests that are sensitive to sample size as well as to the magnitude of differences in covariance matrices, according to Kline (1998), sample size under 100 is considered as 'untenable' in SEM. Meanwhile, Loehlin (1992) recommends at least 100 cases but preferably at 200 cases. The rule of thumb proposed by Steven (1996) states that the sample size should have at least 15 cases per measured variable or indicator. Following this rule of thumb, the required sample size for this method should be 135 cases.

In sum, the sample size of 100 observations required by SEM should be referred as the least desirable but acceptable size since it does not violate the underlying assumptions of all three methods. Although the previous studies show the

highest response rate at only 9-10 percent (approximately 215 cases for this study), this study tried to collect more data or close to 337 observations, which is a more conservative number to lower the significance level to 0.05 and to gain more statistical inference power.

4.7 Data collection

The study set three steps in the data collection procedure: preliminary interview, pretest, and field survey. The details of each step are discussed as follows:

4.7.1 Preliminary interview

In this first step, expert interviews with those in academic institutions, the Electrical and Electronics Institute (EEI), and E&E firms are conducted. The purpose of the interview is to refine the basic rationale of the conceptual framework corresponding to management perspective in absorptive capacity and the spillover channel mechanism (cooperation and connectedness), and to examine these variables based on the literature review to determine whether they or not they form a relevant mechanism in practice and should be included in the proposed research model.

The interviewees provided information regarding the spillover channel mechanism in terms of cooperation and connectedness in Thailand's electrical and electronics (E&E) industry that is consistent with the extensive review of related literature. The comments on relationships among the spillover channel mechanism,

absorptive capacity, and innovation also supported the thesis. These five interviews as well as a comprehensive literature review are used to check the content and construct validity and to develop a sound research instrument

4.7.2 Pretest

The pretest is conducted with the objective of ensuring the interpretability of the questionnaire items and to finalize the questionnaire (McDaniel and Rogers, 1999). According to Sudman (1976), the required sample size of the pretest is between 20 and 50 cases. In this study, the questionnaires are pre-tested with 17 top executives (randomly selected from the list of population in the 2006 E&E directory) and ten academic researchers or experts. The pretest participants are asked to comment on the wording, presentation, and validity of items in the instrument. Measurements are tested for reliability and validity. The results show that all measures have reliability and validity as expected. Table 4.17 shows the summary of scale reliability from the pretest.

Table 4.17 Summary of reliability from pretest

Construct	Cronbach's alpha
Spillover channel mechanism	
• Cooperation	0.945
• Connectedness	0.859
Absorptive capacity	0.919
Innovation	0.928

Source: The author

4.7.3 Field survey

The final step, field survey is conducted by mailing questionnaires to the target samples selected by probability sampling technique. Firms are randomly contacted by telephone to solicit their participation in a mail survey. A cover letter and final questionnaires are mailed. Each mailing packet includes a pre-addressed postage paid envelope to encourage response as well as a cover letter describing the purpose of the study. Respondents were promised that all information provided would be kept confidential and the results of the study would be provided upon request by attaching their name card. Two weeks after the first mailing, a follow up call is carried out. The second letters attached to questionnaires are mailed to those who have failed to respond. Fax, registered mail and express mail services (EMS) are used if necessary

One of best ways to protect against non-response is to increase the response rate. The study thus uses a combination of methods that have been shown to be the most consistently effective way to achieve a high response rate: 1) make a phone call for preliminary notification; 2) follow-up or remind respondents by calling them a few days after to encourage them to complete and return the received questionnaires as soon as possible (James and Bolstein, 1990); 3) provide a return envelope including postage; and 4) attach a persuasive cover letter.

This study took five months to collect primary data (July to November 2006). Secondary data was also collected from academic journals, textbooks, and relevant materials from specific sources, such as the Electrical and Electronics

Institute (EEI) and the Board of Investment (BOI). In addition, related information from Internet websites is provided.

4.8 Data analysis

After data collection, data analysis followed to analyze and examine hypotheses testing. Important techniques and criteria are provided for data analysis, such as frequency testing, analysis of variance/multivariate analysis of variance (ANOVA/MANOVA), principle component factor analysis and reliability test, structural equation modeling with AMOS 4.0, confirmatory factor analysis, and assessment model fit. They are briefly explained as follows:

4.8.1 Frequency test

This is used for data screening/editing with the idea of exploring: 1) respondents' profile; 2) typing errors by examining whether data fall within minimum and maximum range of a five-point Likert scale; and 3) incomplete information by investigating if there is any missing data.

4.8.2 Test of significant differences (*t*-test and Multivariate Analysis of Variance:MANOVA)

Independent test (*t*-test) is used to test the significance differences between paired groups of early and late respondents. In order to assess possible non-response bias, the study compares the responses of the questionnaires from the first wave to

those from the second wave on the constructs used in the study (Armstrong and Overton, 1977). If the *t*-test result shows no significant differences between the two groups, the late response bias does not cause any problem for the study. Similarly, MANOVA is used to test the difference among groups. MANOVA provides information on the nature and predictive power of the independent measures, as well as the relationships and differences seen in the several dependent measures. Thus, the three control variables are tested by using MANOVA to find whether the differences affect more than two constructs used in the study. If the results show no significant differences occurring from any control variables, it means those variables are not used for further analysis.

4.8.3 Principle component factor analysis

Principle component factor analysis is used to test not only scale construction but also validity of the measures as well as extracting the number of model dimensions. All items used to measure cooperation, connectedness, absorptive capacity, and innovation are subjected to these analysis.

4.8.4 Structural Equation Modeling (SEM)

SEM is used for hypotheses testing in this study. It is a multivariate technique combining aspects of multiple regression and factor analysis to estimate a series of interrelated dependence relationships simultaneously (Hair et.al., 1995). Following Byrne (2001) and Arbuckle and Wothke (1999), this study uses a two-step approach in which a measurement model is developed and evaluated separately from the full structural equation model, which is simultaneously composed of measurement

and structural relations. The measurement model in conjunction with the structural model makes possible a comprehensive confirmatory assessment of construct validity (Bentler, 1978).

4.8.4 Test of Measurement Model (Confirmatory Factor Analysis: CFA)

Based on the measurement model, the exploratory factor analysis is first used to provide a preliminary scale. Then CFA is conducted to assess unidimensionality of each scale since CFA affords a stricter interpretation of unidimensionality than the traditional methods such as coefficient alpha, item-total correlation, and exploratory factor analysis. Thus, CFA provides strong confirmation of an acceptable scale. After unidimensionlity has been established, the reliability of the composite scores is also assessed.

4.8.5 Test of Structural Model

After a measurement model has been used, the structural model is conducted to find out which sets of one or more dependences relate to the model constructs. A series of dependent relationships are examined simultaneously. It is particularly suitable for the model that one dependent variable becomes an independent variable in subsequent dependent relationships (Hair et al., 1995). In other words, the structural model is a suitable statistical technique to examine and test for absorptive capacity as mediator

4.8.6 Assessment of Model fit

A chi-square test and goodness-of-fit indices are used to investigate the model fitting. In brief, the model will fit if these conditions are met: 1) Absolute fit index (χ^2/df) or ratio of chi-square to the degree of freedom should be between 3 and 5 as recommended by Byrne (2001); 2) the incremental fit index (IFI) and Tucker-Lewis coefficient (TLI) are above 0.90 (Hair et.al., 1998); 3) comparative fit index (CFI) should be more than 0.90 (Bentler, 1992); and 4) Root Mean Square Error of Approximation (RMSEA) is recommended the value less than 0.1 (MacCallum et al., 1996) but preferable if less than 0.08 and 0.05 (Browne and Cudeck, 1993).

4.9 Summary

This chapter explained the research methodology in detail. All steps are provided and discussed such as research design, research scope, research method, scale and measurement development, questionnaire development, sampling, data collection, and data analysis. The Electrical and Electronics (E&E) industry is selected as the context of the study. The measurement items derived and modified from previous literature and interviews are all tested to examine the reliability and validity of the questionnaire. The overall results of reliability analysis are satisfactory. However, the revised questionnaire from the pretest is used for the field survey. The results and hypotheses testing are performed and discussed in the next chapter of data analysis.

CHAPTER V

DATA ANALYSIS AND RESULTS

This chapter describes the procedure and the results of data analysis. As discussed in Chapter 4, this chapter is divided into four main sections. The first section explains the data preparation, including data screening, coding, treatment of missing data, and non-response bias testing. The second section contains the descriptive analysis of respondent profiles. Assessment of scale reliability and validity (Cronbach's alpha and exploratory factor analysis) are given in the third section. In the final section, structural equation modeling analysis including model assessment/fitting and goodness-of-fit statistics is presented to explore the structural relationship of the model and hypotheses testing.

Table 5.1 Steps of data analysis and results

5.1 Data preparation	• Data screening and editing • Data coding and entry • Data missing treatment • Non-response bias testing
5.2 Respondents' profile	• The general characteristics • The specific characteristics
5.3 Item analysis	• Means and standard deviation of constructs • Reliability analysis (Cronbach's Alpha) • Exploratory Factor Analysis (EFA)
5.4 Structural Equation Modeling analysis (SEM)	• Structural Equation Modeling assumption checks • Confirmatory Factor Analysis (CFA) • Model assessment (specification/fitting) • Hypotheses testing
5.5 Findings	• Discussion

Source: The author

5.1 Data Preparation

The process of data preparation covers the all-important arrangement of data. It includes data screening and editing, data coding and entry, the treatment of missing data, and the late response bias test to confirm the non-response bias. The details are discussed below:

5.1.1 Data screening and editing

Of the 2,158 questionnaires sent to electronics and electrical (E&E) firms, 451 were returned, out of which 132 were omitted due to a change in address and/or closure of the company. 319 questionnaires were edited, with the result that 14 were excluded because of incomplete information or unusable responses, for example, having too many incomplete responses to the key variables. In the end, 305 responses were usable, giving a yield response rate of 14.13 percent. This rate is close to the norm compared to previous studies at a firm level, especially for the E&E industry

5.1.2 Data coding and entry

Data is coded by frequency tests of all variables. To make understanding and interpretation easier, variables are named using relevant abbreviations for that portion of the data analysis, and the code details of the main variables are shown in Table 5.2. After completion of this step, data was keyed into SPSS version 14.0. The items were coded and the response to each item assigned a number. This illustrated

that the maximum and minimum scores were in the normal range, eliminating typographical errors as a problem.

Table 5.2 Summary of the coding variables

Variables	Abbreviation	Type of variable
1.Cooperation	COOP	Independent variable
1.1 Joint planning	JPL	
1.2 Joint problem solving	JPB	
1.3 Joint implementing	JMP	
2.Connectedness	CONN	Independent variable
2.1 Tie	TIE	
2.2 Informal	INF	
3.Absorptive capacity	ACAP	Mediator
3.1 Potential-absorptive capacity	PACAP	
3.2 Realized-absorptive capacity	RACAP	
4.Innovation	INNO	Dependent variable
4.1 Marketing innovation	MKN	
4.2 Management innovation	MTN	

Source: The author

5.1.3 Treatment of missing data

The usable questionnaires with some minor data missing were completed by using the means to complete the missing value. Cases with major data missing were considered as incomplete and excluded.

5.1.4 Non-response bias testing

The non-response bias was checked by comparing the early and late respondents (Armstrong and Overton, 1977). Early respondents complete the questionnaires during the first two months of the data collection period and the late respondents complete the questionnaires in the last two months after the follow-up procedures. The first and second waves of returned questionnaires are tested by

independent sample test (*t*-test) to explore the mean differences of all constructs reported by early and late respondents. Table 5.3 shows the results of the *t*-test. The results show that respondents from the first wave and the second wave do not have significantly different means in all variables, leading to the conclusion that non-response bias is not a problem in this study.

Table 5.3 Mean Comparison between Early and Late respondents

Variables	Early respondents[a]	Late respondents[a]	Mean Difference[b]
Cooperation	3.14 (0.84)	3.23 (0.82)	-0.08 *(-0.79)*
Connectedness	3.47 (0.65)	3.55 (0.62)	-0.07 *(-0.93)*
Absorptive capacity	3.37 (0.67)	3.43 (0.68)	-0.05 *(-0.68)*
Innovation	3.35 (0.71)	3.37 (0.73)	-0.01 *(-0.17)*

Note: [a] Each item is measured based on 5-point Likert scale (1= Strongly disagree, 5= Strongly agree), Standard deviations are shown in parentheses.
[b] Mean Difference is tested by independent *t*-test, *t*-value is shown in italic parentheses.
* *p-value* < 0.05 ,** *p-value* < 0.01, *** *p-value* < 0.001

5.2 Respondent Profiles

In this section, descriptive statistics are used to show the characteristics of respondents in terms of both general and specific information. General information consists of the main characteristics of respondents (i.e. business group, years of experience, sales income, company size, number of employees, employee turnover rate, etc.). Specific information focuses on characteristics relating to knowledge spillovers or spillers such as the importance of multinational enterprise (MNE) customers and Thai customers.

5.2.1 The general characteristics

Business group is based on the Board of Investment (BOI) classification and 2006 IIE directory, which divides the electrical and electronics (E&E) industry into three main groups: electronics, electrical, and related electrical and electronics group. This study used 90 electronics firms (accounting for 29.5 percent), 112 electrical firms (36.7 percent), and 55 (18 percent) related electrical and electronics firms. The business activities of the remaining 48 respondents (15.77 percent) fall into more than one E&E business group.

Since the target sample focuses on company executives, all respondents are in top management positions. Of the respondents, 71 respondents (23.3%) are in the highest level such as Chief Executive Officer (CEO), Vice President, or else the owner. The majority of the respondents (90 or 29.5%) hold the position of Managing Director (MD) or General Manager (GM). Of the remaining respondents, 43 are Chief Executive Operations Officer (14.1%), 57 Assistant Vice President (18.7%), and 44 Managers (14.1%).

The length of experience revealed that 71 respondent firms (23.3%) have been in the E&E business for six to ten years, with 67 firms (22%) between eleven to fifteen years. A total of 56 firms (18.4%) have sixteen to twenty years of business experience. Interestingly, 51 respondent firms (16.7%) have been in the E&E business for over twenty years. On the other end of the scale, 47 respondent firms

(15.4%) have been in the industry for five to one years, with only 4 respondent firms (1.3%) with less than one year experience in the E&E business.

Firm size ranged from small enterprises, with 155 respondents (50.8%) functioning in this category (registered capital less than 50 million baht) and 101 respondents (33.1%) being medium sized firms (registered capital 50-200 million baht). The remaining 49 (16.1%) were large companies (registered capital more than 200 million baht). Company size is reflected in number of employees, with 119 respondent firms (39%) having fewer than fifty on the payroll, with 50 companies (16.4%) having between fifty to ninety-nine employees. 31 firms (10.2%) have more than one thousand employees and 21 (6.9%) have 500-1,000 employees. 40 of the respondent firms (13.1%) have 100-199 employees and 40 (13.1%) have 200-499 employees.

Sales income in 2005 revealed the majority of respondents (144 firms or 47.2%) had sales income of less than 100 million baht. Total sales income for 84 firms (27.5%) was between 100-500 million baht and 27 firms (8.9%) had income of 501 to 1,000 million baht. The minority of respondent firms had sales income of higher than 1 billion baht, with only 17 (5.6%) at 1 to 2.5 billion baht, 16 (5.2%) with 2.5-5.0 billion baht and only 11 (3.6%) with more than 5.0 billion baht.

A study of the ownership structure revealed a total of 113 respondent firms (37%) are Thai-owned while only 50 (16.4%) are foreign-owned. However, a majority of respondent firms are joint venture (JV) companies, with 66 (21.6%) of them being Thai-majority JVs and 63 (20.7%) are foreign-majority JVs.

Questions about R&D showed that the the majority of respondents (179 firms, 58.7%) do not have R&D staff, with 119 firms (39%) having from between two to 50 R&D staff. It is this information that was traditionally used as a proxy to measure absorptive capacity. These studies claimed that the more that was spent on R&D, the more absorptive capacity a company would have. Although this study proposes a new view using a multi-item scale index to measure absorptive capacity, this general information may be useful as a support in the data analysis section.

Employee turnover rate was reported at 1-5 percent for 126 respondent firms (41.3%). 65 companies (21.3%) have a 6-10 percent turnover rate and 43 (14.1%) have a small employee turnover rate of less than 1 percent. The remaining respondent firms have rather high employee turnover rate: 21 firms (6.9%) with 11-15 percent, 22 firms (7.2%) with 16-20 percent, and 22 firms (7.2%) with more than 20 percent. Implicitly, employee turnover reflects human mobility and is one channel of knowledge spillover. As with the R&D data, this item will be used to support the results of the study in the data analysis section.

In sum, the respondents come from both the electrical and electronics business groups and numbers closely correspond. Most have long experience in the E&E industry. Classified by assets and/or number of employees, the majority of respondents are small and medium firms. Half had sales income of less than 100 million baht in 2005. The respondents are mostly joint venture companies and most have a low employee turnover rate (less than 5%) but little focus on R&D staff. Table 5.4 summarizes of respondents' characteristics.

Table 5.4 Characteristics of respondents

Characteristics	Frequency	%	Graph
Business group			
• Electronics	90	29.5	
• Electrical	112	36.7	
• Related E&E	55	18.0	
• More than 1 group	48	15.7	
Experience			
• Less than 1 year	4	1.3	
• 1-5 yrs	47	15.4	
• 6-10 yrs	71	23.3	
• 11-15 yrs	67	22.0	
• 16-20 yrs	56	18.4	
• More than 20 yrs	51	16.7	
Firm Size			
• Small	155	50.8	
• Medium	101	33.1	
• Large	49	16.1	
Number of employee			
• Less than 50	119	39.0	
• 50-99	50	16.4	
• 100-199	40	13.1	
• 200-499	40	13.1	
• 500-1,000	21	6.9	
• More than 1,000	31	10.2	
Sales income (M.baht)			
• Less than 100	144	47.2	
• 100-500	84	27.5	
• 501-1,000	27	8.9	
• 1,000-2,500	17	5.6	
• 2,501-5,000	16	5.2	
• More than 5,000	11	3.6	
Ownership structure			
• Thai-owned	113	37.0	
• Foreign-owned	50	16.4	
• Thai majority JV	66	21.6	
• Foreign majority JV	63	20.7	
R&D Staff			
• Have	119	39.0	
• No have	179	58.7	
Employee Turnover rate			
• Less than 1 %	43	14.1	
• 1-5 %	126	41.3	
• 6-10%	65	21.3	
• 11-15%	21	6.9	
• 16-20%	22	7.2	
• More than 20%	22	7.2	

Source: The author

5.2.1 Specific information on spillovers

Since this study aims to examine the effects of the spillover channel mechanism between a company and its customers, the customer here is called the spiller or the source of knowledge spillover. This section shows the specific information relating to spiller for the respondent firm, identifying the main spiller in each company's opinion, and identifies the method by which the respondent firm receives the knowledge spillover. First, though, this study presents the business type and category of respondent firms in order to allow better understanding of the status of receiver/recipient firms. Table 5.5 summarizes the business type of the respondents.

Table 5.5 Business types of respondents

Business type		Frequency	
		Type level	Category-level
Manufacturer		110 (36.07%)	
	OEM		47 (42.73%)
	ODM		47 (42.73%)
	OBM		4 (3.64%)
	More than one category		12 (10.90%)
Supplier		42 (13.77%)	
	Tier 1		24 (57.14%)
	Tier 2 or 3		18 (42.86%)
Both manufacturer and supplier		108 (35.41%)	
Others		45 (14.75%)	
Total		305 (100.00%)	

Source: The author

For business type and category, the majority of respondents are manufacturers (110 firms, 36.07%) consisting of OEM (47 firms), OBM (47 firms), ODM (4 firms), and more than one category (12 firms), accounting for 42.73, 42.73, 3.64, and 10.9 percent, respectively. The other 42 respondent firms (13.77%) are

suppliers categorized as tier 1 (24 firms, 57.14%), and tier 2 or 3 (18 firms, 42.86%). 108 respondent firms (35.41%) that are both manufacturer and supplier and 45 (14.75%) are other types of E&E firms based on the IIE directory, such as distributor.

Information on the customers (spiller/source of knowledge spillovers) of respondent companies included type of customer, main spiller and method used for spillover, are provided in the descriptive statistics in Table 5.6 and Table 5.7, respectively.

Table 5.6 Type of customer/spiller of respondent firms

Customer	Frequency (no.)	Percent (%)
Multinational Enterprise (MNE)	30	9.84
Thai firm	43	14.10
Both MNE and Thai firm	232	76.07
Total	305	100.00

Source: The author

For type of customer, the study reveals that customers of 30 respondent firms (9.84%) are only multinational enterprises (MNEs) and 43 firms (14.10%) have only Thai customers. The majority of respondents (232 firms) have both MNE and Thai customers, accounting for 76.07 percent.

Table 5.7: The main spillers and method used for spillovers

Spiller/source of spillovers	Frequency (no.)	The method used for spillovers		
		Cooperation	Connectedness	Both
MNE-customer	161	89 (55.28%)	29 (18.01%)	43 (26.71%)
Thai-customer	144	61 (42.36%)	36 (25.00%)	47 (32.64%)
Total	305	150 (49.18%)	65 (21.31%)	90 (29.51%)

Source: The author

For the question regarding the main spiller and method used to receive knowledge spillovers, a total of 161 out of 305 respondent firms (52.79%) identify their MNE customers as their main spillers. For 161 respondents, 89 companies (55.28%) use the method of cooperation/task-based activity to receive knowledge spillovers. The other 29 firms (18.01%) use the method of connection/social-based activity while 43 firms (26.71%) use both cooperation and connection activities. 144 out of 305 respondent firms (47.21%) indicate that their main spillers are Thai customers. 61 of these companies (42.36%) use the cooperation method, 36 firms (25%) use connectedness, and 47 firms (32.64%) use both cooperation and connectedness.

5.3 Item Analysis

This section provides the details of item analysis means and standard deviation, analysis of control variables, and reliability and validity measurement analysis as follows:

5.3.1 Means and Standard Deviations of Constructs

To understand the overview of the responses reported for each construct, the means and standard deviations of all constructs are presented. Since the questionnaire in this study is designed to use multiple measurement items for each of the constructs, the mean and standard deviation of the unweighted summated score for each major construct are shown instead of the mean and standard deviation for each measurement

item. Table 5.8 illustrates the summary of mean and standard deviation of all proposed constructs.

Table 5.8: Mean and standard deviation of constructs

Construct[a]	Minimum	Maximum	Mean	Standard deviation
Cooperation	1.00	5.00	3.16	0.84
Connectedness	1.00	5.00	3.50	0.64
Absorptive capacity	1.08	5.00	3.39	0.67
Innovation	1.07	5.00	3.36	0.71

Note: [a] Each item is measured based on five-point Likert scale (1=Strongly disagree;5=Strongly agree)
* *p-value* < 0.05;** *p-value* < 0.01; *** *p-value* < 0.001

Since each construct may be affected by some characteristics of a company, such as firm size, ownership structure and experience, these characteristics are determined as control variables. To double-check whether these variables should be defined as control factors during the data analysis, this study tests and evaluates whether the responses of all main constructs based on each of these control characteristics is significantly different. The next section provides more discussion and analysis of control variables.

5.3.2 Control variables

As previously mentioned, this study has three control variables: firm size, ownership structure, and experience. All are investigated against the proposed constructs of the study (i.e. cooperation, connectedness, absorptive capacity, and innovation). To test the effects of control variables on the constructs, the study uses the statistical tool of multivariate analysis of variance (MANOVA), which is suitable for the purpose of mean comparison testing.

5.3.2.1 Firm size

In order to find whether the means of the proposed constructs are different across firm size, the study initially divides respondents into three groups based on their registered capital (registered at the Ministry of Industry). Small firms are those with registered capital under 50 million baht, medium firms defined as those with registered capital between 50 to 200 million baht, and large firms with registered capital of 200 million baht and above. As previously shown, the sample size of each group in N = 155 (50.8%) for small firms, N=101 (33.1%) for medium firms, and N=49 (16.1%) for large firms.

Due to the few large firms but limited time for data collection, medium and large firms are combined to test the differences. The results reveal that medium versus large firms are not significantly different in important variables such as R&D investment/staff, whereas small versus medium firms are significantly different in those variables. This indicates that R&D investment by small and medium firms are significantly different at *p-value* <0.05 (*F-value* = 4.259; *p-value* = 0.04), while the R&D investment of medium and large firms are not significantly different at *p-value* < 0.05 (*F-value* =1.465; *p-value* = 0.228). Therefore, the groups of medium and large firms are combined in order to balance the large group of small firms. This result in a total of 155 small firms and 150 large firms used to examine whether means differences of the proposed constructs exist across firm size in this study. Table 5.9 shows the result of the test.

Table 5.9: Mean comparison of constructs based on firm size

Construct[a]	Small firm	Large firm	Mean Differences[b]
Cooperation	3.01	3.34	6.614*
Connectedness	3.52	3.49	0.613
Absorptive capacity	3.38	3.41	0.201
Innovation	3.31	3.41	1.174

Note: [a] Each item is measured based on five-point Likert scale (1=Strongly disagree;5=Strongly agree)
[b] Mean differences are tested by MANOVA; *F*-value is shown.
* *p-value* < 0.05;** *p-value* < 0.01; *** *p-value* < 0.001

The result of the study reveals that there is no significant difference in the means of connectedness, absorptive capacity, and innovation between the group of small and large firms in this study. Only cooperation shows a significant means difference at *p-value* < 0.05 across firm size. In order to confirm this effect, then, the study tests the effect of firm size on cooperation in the initial structural equation model for control purposes. The result reveals that the effect of firm size on each dimension of cooperation is not significant at *p-value* < 0.05. For example, the effect of firm size on joint planning is 0.115 with *p-value* = 0.342, that on joint problem solving is 0.053 with *p-value* = 0.623, and that on joint implementing is 0.021 with *p-value* = 0.864. Based on the data of the study, thus, these two subgroups categorized by the firm size are not different and the pool of 305 usable samples in this study can be used for further analysis. Therefore, the path of firm size as a control variable in this study can be disregarded from further data analysis.

5.3.2.2 Ownership structure

For ownership structure, the study uses the multivariate analysis of variance (MANOVA) to examine whether the mean differences of the proposed constructs across different types of stakeholder structures are significant. There are four

categories of the ownership structure in this study: 113 Thai-owned firms, 50 foreign-owned firms, 66 Thai majority joint venture (JV) firms, and 63 foreign majority joint venture (JV) firms. Table 5.10 presents the results of MANOVA.

Table 5.10: Mean comparison of constructs based on ownership structure

Construct[a]	Thai-owned	Foreign-owned	Thai majority JV	Foreign majority JV	Differences[b]
Cooperation	2.96	3.30	3.31	3.38	3.621*
Connectedness	3.43	3.54	3.55	3.59	1.301
Absorptive capacity	3.31	3.42	3.42	3.47	1.207
Innovation	3.25	3.39	3.41	3.43	0.898

Note: [a] Each item is measured based on five-point Likert scale (1= Strongly disagree; 5= Strongly agree)
[b] Mean differences are tested by one-way MANOVA; F-value is illustrated.
* *p-value* < 0.05;** *p-value* < 0.01; *** *p-value* < 0.001

This shows that there are no significant differences in the means of connectedness, absorptive capacity, and innovation across the four subgroups of firms based on different ownership structure. Similar to the result based on firm size, only means of cooperation are significantly different at *p-value* < 0.05. In order to confirm this effect, the study tests the effect of ownership structure on each dimension of cooperation in the initial structural equation model for control purposes. The result reveals that ownership structure has no material effect on cooperation at *p-value* < 0.05. For example, the effect of ownership structure on joint planning is 0.033 with *p-value* = 0.661, that on joint problem solving is 0.084 with *p-value* = 0.214, and that on joint implementation is 0.087 with *p-value* = 0.254. Based on this data, the four subgroups categorized by ownership structure are not different and the pool of 305 usable samples in this study can be used for further analysis and the path of ownership structure as a control variable can be omitted from further data analysis.

5.3.2.3 Firm's experience

Another control variable in this study is the years of experience of firm. The multivariate analysis of variance (MANOVA) is again used to explore whether the means differences of any constructs across varying years of experience exist. The study implies experience from the length of years in the E&E industry, i.e. less than 1 year, 1-5 years, 6-10 years, 11-15 years, 16-20 years, and more than 20 years. Table 5.11 illustrates the result of the MANOVA test.

Table 5.11: Mean comparison of constructs based on years of experience

Construct[a]	< 1 year	1-5 years	6-10 years	11-15 years	16-20 years	> 20 years	Differences[b]
Cooperation	2.79	3.10	3.12	3.15	3.22	3.28	0.937
Connectedness	3.19	3.43	3.46	3.52	3.56	3.58	0.563
Absorptive capacity	3.25	3.26	3.32	3.39	3.40	3.55	0.673
Innovation	3.05	3.17	3.31	3.38	3.43	3.48	0.846

Note: [a] Each item is measured based on five-point Likert scale (1= Strongly disagree; 5= Strongly agree)
[b] Mean differences are tested by MANOVA and shown by F-value.
* $p\text{-value} < 0.05$;** $p\text{-value} < 0.01$; *** $p\text{-value} < 0.001$

The results suggest that there are no significant differences in the means of cooperation, connectedness, absorptive capacity, and innovation between years of experience in this study. Based on the data, these six subgroups categorized by the years of experience are not different and the pool of 305 usable samples in this study can be used for further analysis. In other words, company years of experience for control purposes in this study can be disregarded from further data analysis.

5.3.3 Reliability and Validity

In this section, exploratory factor analysis and Cronbach's alpha coefficient analyses are used to assess unidimensionality and internal consistency. The items are analyzed to investigate the validity and reliability of the measurement items pertaining to key research variables. All scale items are defined and accepted on the basis of the conventional guidelines by Nunnally (1978) and Churchill(1979).

5.3.3.1 Reliability analysis

For internal consistency, reliability tests are conducted with Cronbach's alpha coefficient analyses (α). This coefficient also provides a summary measure of the inter-correlation existing among a set of items. A high and low value of Cronbach's alpha directly indicates high and low internal consistency. Reliability for all variables scales exceed 0.70, the threshold or cut off point as recommended by Nunnally (1978). In addition, item-to-total correlations are explored for each set of items measuring a key construct/variable. Items with this subscale correlation below 0.50 are deleted (Churchill, 1999). The scale reliability values (coefficient α) and item-to-total correlations are reported in Table 5.12.

The result in Table 5.12 shows that the Cronbach's alpha coefficients for all constructs are higher than the minimum threshold value of 0.70 as recommended by Nunnally (1978). In addition, the result of the reliability assessment at a dimension level is also satisfactory, as they ranged from 0.728 to 0.919. Marketing innovation

has the highest value while potential absorptive capacity has the lowest value of reliability. The item-to-total analysis for all set of items measuring the constructs are generally normal, with corrected item-to-total subscale correlations higher than 0.5 as recommended by Churchill (1999).

Table 5.12 Reliability analysis results

Construct	Dimension	Cronbach's alpha	
		Construct level	**Dimension level**
Cooperation		.931	
	Joint planning		.863
	Joint problem solving		.843
	Joint implementing		.880
Connectedness		.793	
	Tie		.843
	Informal		.728
Absorptive capacity		.921	
	Potential-absorptive capacity		.778
	Realized-absorptive capacity		.913
Innovation		.934	
	Marketing innovation		.919
	Managerial innovation		.911

Source: The author

The intensity dimension of connectedness is disregarded since it has only one item (frequency), which is insufficient to explain the power of the dimension as well as the very low-negative correlation (-.003) with other items in the same construct. If this item/dimension is deleted from the results of item-to-total analysis for the entire set of items, the Cronbach's alpha of connectedness construct is increased from 0.726 to 0.793. To purify the scale measurement, therefore, the intensity dimension including the item of frequency is disregarded and was not used for further data analysis.

5.3.3.2 Exploratory Factor analysis

For measurement validity, unidimensionality is explored by principle factor analysis. The exploratory factor analysis with varimax rotation is performed to determine the number of dimensions underlying the construct and also to confirm whether the number of conceptualized dimensions can be verified empirically (Churchill, 1979). Varimax rotation is recommended since it would imply uncorrelated factors (Rossiter, 2002). Measurements with low loading (<0.50), low communities (< 0.30), and/or high cross-loadings (> 0.40) are eliminated to purify the scale (Hair et al., 1998). To ensure the validity of the overall construct, the factors with eigenvalue exceeding one are considered as significant and accepted as powerful measurement items since the eigenvalue criterion indicates that the individual factor accounts for the variance of at least a single variable whether it is retained for interpretation (Hair et al., 1998). Factors with eigenvalue less than one are disregarded.

The Kaiser-Meyer-Olkin (KMO) measure, which is used to determine whether the data is adequate for a factor analysis, is performed. Hair et al. (1998) recommend that a KMO of 0.80 or higher is considered meritorious while a KMO of less than 0.50 is unacceptable. The Bartlett's test of Sphericity is also applied to test the significance of the corresponding correlation matrix together with the KMO test. A *p-value* of less than 0.05 illustrates a significant correlation among all items, indicating that the factor analysis is suitable for the analysis of that particular dataset (Hair et al., 1998).

Exploratory factor analysis is performed on the constructs that have more than one dimension: cooperation, connectedness, absorptive capacity, and innovation. The results of validity the measurement are illustrated in Tables 5.13 to 5.16. The factor analysis results show the most desirable outcome, since it produces dimensions that agree with those conceptualized, thus strongly indicating unidimensionality.

Table 5.13 Factor of Cooperation

Dimension	Question items	Components		
		1	2	3
Joint planning	JPL1	.763		
	JPL2	.677		
	JPL3	.845		
	JPL4	.601		
Joint problem solving	JPB1		.788	
	JPB2		.802	
	JPB3		.750	
	JPB4		.559	
Joint implementing	JMP1			.700
	JMP2			.853
	JMP3			.825

Note: Extraction method: Principle Component Analysis
Rotation method: Varimax with Keiser Normalization
Total variance explained 3 components = 71.78%
KMO measure = 0.908; Bartlett's test: *p-value* = 0.000

The results of exploratory factor analysis of cooperation show that the cooperation construct consists of three dimensions: are joint planning, joint problem solving, and joint implementation. These three factors accounted for 71.78 percent of the total variance. Most items except JPL5-6 and JMP4-5 are loaded in these three factors, as all factor loadings exceeded the cutoff point of 0.50 (Hair et al., 1998). Those items may not be well explained in each factor. For example, the question item of JMP4 focuses on exchanging technology and/or marketing information to solve the relevant problem. In reality, cooperation relating to technology transfer is mostly based on contractual agreements with the joint venture partner. This is closely linked

to formal cooperation tasks/activities and may not relate to the cooperation construct, which here concentrates on the leakages/spillovers. Therefore, the low loading items are disregarded for further analysis. The KMO measure of sampling adequacy indicates a satisfactory result (0.908) whereas the Bartlett's test of Sphericity is significant at *p-value* < 0.000.

For the connectedness construct, the 9 question items are included into the analysis. As previously discussed, only one item measured the intensity dimension and it had a low value of reliability and thus was disregarded in further analysis. The results of factor analysis on connectedness are reported in Table 5.14.

Table 5.14 Factor of Connectedness

Dimension	Question items	Components	
		1	2
Ties	TIE1	.823	
	TIE2	.881	
	TIE3	.861	
Informal patterns of contact	INF1		.674
	INF2		.745
	INF3		.795
	INF4		.683

Note: Extraction method: Principle Component Analysis
Rotation method: Varimax with Keiser Normalization
Total variance explained 2 components = 64.67%
KMO measure = 0.800; Bartlett's test: *p-value* = 0.000

The results of exploratory factor analysis of connectedness show that the connectedness construct consists of two dimensions, ties and informal patterns of contact/communication. These two factors accounted for 64.67 percent of the total variance. All items are loaded in these two factors as all factor loadings exceeded the cutoff point of 0.50 (Hair et al., 1998). The KMO measure of sampling adequacy indicates a satisfactory result (0.800) whereas the Bartlett's test of Sphericity is

significant at *p-value* < 0.000. From this factor analysis, one tie item, TIE4, and one informal communication item, INF5, are disregarded since loadings are well below the cutoff point (0.50) recommended by Hair et al. (1998). This elimination increases the total factor variance explained.

For absorptive construct, the 12 question items are included into the data analysis. The result of exploratory factor analysis on absorptive capacity is shown in Table 5.15 as follows:

Table 5.15 Factor of Absorptive Capacity

Dimension	Question items	Components	
		1	3
Potential- absorptive capacity	PACAP1	.693	
	PACAP2	.883	
	PACAP3	.679	
Realized-absorptive capacity	RACAP1		.723
	RACAP2		.760
	RACAP3		.774
	RACAP4		.817
	RACAP5		.704

Note: Extraction method: Principle Component Analysis
Rotation method: Varimax with Keiser Normalization
Total variance explained 2 components = 66.02%
KMO measure = 0.898; Bartlett's test: *p-value* = 0.000

The result of exploratory factor analysis of absorptive capacity is the most interesting. Initially, it shows that all items of absorptive capacity construct are loading in one factor. However, the total variance explained is very low at 53.99 percent. According to Zahra and George (2002), the two components of absorptive capacity have separate roles. It is recommended to separate them for examination, although they are complementary and difficult to explicitly determine. It is expected that each dimension should show the different action affecting innovation and/or

being affected by antecedents. Referring to the objective of the study, the testing of the two dimensions is designed to fill research gaps and an attempt to test the robustness and applicability of the re-conceptual model of absorptive capacity. It is possible that the two-factor model of absorptive capacity provides a better fit to the data than a one-factor model. Thus, absorptive capacity is forced into two factors, as recommended by Zahra and George (2002).

From Table 5.15 it is seen that the absorptive capacity construct consists of two components/dimensions, potential and realized absorptive capacity. These two factors account for 66.02 percent of the total variance explained. All items are more highly loaded in these two factors as all factor loadings exceeded the cutoff point of 0.50 (Hair et al., 1998). The KMO measure of sampling adequacy indicates a satisfactory result (0.898) whereas the Bartlett's test of Sphericity is significant at *p-value* < 0.000.

For innovation construct, all 14 question items are included into the analysis. The result of factor analysis on innovation is shown in Table 5.16. The exploratory factor analysis of innovation shows that this construct consists of two factors: marketing innovation and management innovation, as proposed. These two factors have total variance accounting for 75.04 percent. All items are loaded in these two factors as all factor loadings exceeded the cutoff point of 0.50 (Hair et al., 1998). The KMO measure of sampling adequacy indicates a satisfactory result (0.899) while the Bartlett's test is also significant at *p-value* < 0.000.

Table 5.16 Factor of Innovation

Dimension	Question items	Components	
		1	2
Marketing innovation	MKN1	.775	
	MKN2	.853	
	MKN3	.541	
	MKN4	.815	
Management innovation	MTN1		.825
	MTN2		.795
	MTN3		.789
	MTN4		.840

Note: Extraction method: Principle Component Analysis
Rotation method: Varimax with Keiser Normalization
Total variance explained 2 components = 75.04%
KMO measure = 0.899; Bartlett's test: *p-value* = 0.000

In sum, the results of exploratory factor analysis for cooperation, connectedness, absorptive capacity, and innovation are satisfactory. This analysis suggests that the construct validity for the measurement items used to evaluate these constructs does exist. Thus these measurement items are used for further data analysis.

5.4 Structural Equation Modeling Analysis

In order to test the hypotheses proposed in this study, a structural equation modeling (SEM) is performed. According to Byrne (2001), SEM is a statistical methodology that takes a confirmatory (i.e., hypothesis-testing) approach to the analysis of a structural theory bearing on some phenomenon. The term structural equation modeling conveys two important aspects of the procedure: (a) that the causal processes under study are represented by a series of structural equations, and (b) that these structural relations can be modeled pictorially to enable a clearer conceptualization of the theory under study (Byrne, 2001). SEM provides a unique

analysis that simultaneously considers the questions of both measurement and prediction (Kelloway, 1998).

In this study, AMOS (Analysis of Moment Structures) version 4.0 is used to assess the construct measures and model fitting. AMOS is the analysis of mean and covariance structures. AMOS provides numerous benefits, such as flexibility, ease of use, and many additional options (i.e., treatment of missing data, bootstrapping, and multigroup invariance analysis). The method approach used in AMOS is based on maximum likelihood estimation (MLE) and thus is theoretically based (Arbuckle and Wothke, 1999). Since AMOS is based on the MLE, it is required the data meet specific assumptions such as the relevant of continuous and normality distributed endogenous variables. Thus, preliminary checks of necessary assumptions are required.

After the assessment of assumptions, the structural equation modeling analysis is divided into two-stage process. In the first stage, the measurement model is evaluated by using Confirmatory Factor Analysis (CFA). This stage includes the assessment of construct validity by the method of parameter estimation in each construct measurement model. It deals with the latent variables and their indicators to provide a confirmatory assessment of convergent and discriminant validity (Anderson and Gerbing, 1988). In the second stage, a structural model is provided to capture the estimation of the measurement models and their structural/path relations. This stage is also used for assessment of nomological validity. This two-stage analysis has

advantages, avoiding the interaction of the measurement and structural model, and reducing the number of estimated parameters.

5.4.1 Structural Equation Modeling Assumption Checks

Like any other statistical method, structural equation modeling requires assumptions to access the powerful and flexible process. Since structural equation modeling (SEM) normally assumes linear relationships (Hair et al., 1998), the sample size, continuous variables, normal distribution, correlations and multi-collinearity among latent constructs must be checked to ensure dataset qualification before performing SEM.

5.4.1.1 Sample Size

In general, structural equation model requires a relatively large sample size for the robustness of parameter estimation. According to Comrey and Lee (1992), a sample size of 200 is fair while 300 is good. However, Hair et al. (1998) suggest that sample size (n) of more than 200 is relatively large if there are many factors affecting the required sample size. In that case, a minimum of at least five respondents for each estimated parameter with a ratio of ten respondents per parameter is considered as most appropriate (Hair et al., 1998). As the proposed research model in this study, there are approximately 46 regression weights of estimated parameters including 9 fixed and 25 estimated weights in the first order factor, 4 fixed and 5 estimated weights in the second order factor, and 3 regression paths from the independent

variable to the dependent variable. This means the structural equation modeling requires a minimum sample size of 230. This means the 305 sample size of this study presents no problem and meets the requirement of sample size in SEM.

5.4.1.2 Continuous Variable and Normal Distribution

Structural equation modeling requires the variables to be continuous and normally distributed. As all key variables used in structural model are measured on an interval scale, i.e. the five-point Likert scale, they meet the assumption for continuous variables (Zigmund, 2003). Normal distribution is conducted by the assessment of Kolmogorov-Smirnov (K-S) statistical test. The result of the K-S test on each construct is largely significant (*p-value* < 0.05), indicating a non-normal distribution of data. However, the visual inspection of the Q-Q plots for each construct illustrates no severe violations of normality as all points clustered around the straight diagonal line (see Appendix B). In sum, the test of normality shows the normal distribution of the data for both endogenous variables in structural model.

5.4.1.3 Correlations and Multicollinearity

The other assumption checks for structural equation modeling are correlations and multicollinearity among the latent variables. Normally, correlation analysis is performed to suggest a certain degree to which independent variables have predictive power and assists in indicating whether there is serious multicollinearity among independent variables.

The correlation among cooperation, connectedness, and absorptive capacity is illustrated in the correlation matrix in Table 5.17. The result shows no multicollinearity problem since all correlations among these variables are less than the threshold or cutoff point of 0.90 recommended by Hair et al. (1998). Thus, there is no problem of multicollinearity in this study.

Table 5.17 Correlation matrix among latent variables

	COOP	CONN	ACAP
COOP	1.000		
CONN	.421**	1.000	
ACAP	.506**	.359**	1.000

Note: COOP= Cooperation; CONN= Connectedness; ACAP= Absorptive capacity
** Correlation is significant at the 0.01 level (2-tailed).

5.4.2 Confirmatory Factor Analysis (CFA) of Measurement Model

A confirmatory factor analysis (CFA) is one type of factor analysis that is a statistical procedure for investigating relations between sets of observed and latent variables (Byrne, 2001). Since the measurement model is that part of the SEM dealing with latent variables and their indicators, a pure measurement model is a confirmatory factor analysis (CFA) model in which there is unmeasured covariance between each possible pair of latent variables. This is considered as a reflective model, which means that the measurement items are caused by their latent construct while latent construct is not caused by the items. Thus, the dropping of any item will not alter the meaning of the construct (Jarvis et al., 2003). As such, some measurement items can be deleted if the results of confirmatory factor analysis appear unsatisfactory or do not fit with the model evaluation.

Ideally, evaluation of model fit should derive from a variety of perspectives and be based on several criteria that can assess model fit from a diversity of perspectives (Byrne, 2001). However, the measurement model is mostly evaluated like any other structural equation modeling by using chi-square statistic (χ^2) and goodness-of-fit statistical measures. The criteria of chi-square statistics aims to ascertain non-significant results (*p-value* > 0.05) to indicate the validity of factor loadings, factor variances/covariances, and error variances in the model. Since the chi-square statistic is sensitive to the likelihood ratio test to sample size and its basis on the central (χ^2) distribution, which assumes that the model fits perfectly in the population, it has led to problems of fit that are now widely known. According to Hair et al. (1998), chi-square is appropriate for sample sizes of 100 to 200. It is not uncommon, thus, to see most chi-square statistics in the measurement model show a significant value (*p-value* < 0.001). Therefore, the chi-square is not considered as an important criteria in this study.

The researchers have addressed the chi-square (χ^2) limitations by developing goodness-of-fit indexes that take a more pragmatic approach to the evaluation process. One of the first fit statistics to address this problem is the χ^2/degree of freedom ratio, which appears as CMIN/DF in AMOS output file. Many alternative indexes of fit were considered as criteria for evaluation model-fitting such as GFI, TLI, CFI, RMSEA, etc. These criteria, commonly referred to as "subjective", "practical", or "ad hoc" indexes of fit, are typically used as adjuncts to the χ^2 statistic. In this study, the criteria of important fit indexes used for model assessment are selected as follows:

1. Absolute fit index (CMIN/DF): This is the ratio of chi-square to the degree of freedom. According to Maruyama (1998), this index is used to explain whether the residual or unexplained variance remained after model fitting is appreciable. This ratio should be less than 5.00 but it is preferred to fall beneath the recommended level of 3.00 (Byrne, 2001).

2. The incremental fit index (IFI) and Tucker-Lewis coefficient(TLI): These are called a non-normed fit index (NNFI) which are relative indices addressing the question of how well the proposed model explains the set of observed data when comparing with other possible models (Hu and Bentler, 1999). The recommended level of these fit indices is above 0.90 (Hair et. al., 1998).

3. Comparative fit index (CFI): The value for CFI ranges from 0 to 1 and is derived from the comparison of a hypothesized model with the independence model. It provides a measure of complete covariation in the data. A value >0.90 is considered representative of a well-fitting model (Bentler, 1992).

4. Root Mean Square Error of Approximation (RMSEA): This is recognized as one of the most informative criteria in covariance structure modeling. The RMSEA takes into account the error of approximation in the population addressing the question of how well the model, with unknown but optimally chosen parameter values, fit the population covariance matrix if it is available (Byrne,

2001). The recommended level is less than 0.05 or, at least, less than 0.08 (Browne and Cudeck, 1993). Recently, MacCallum et al. (1996) discussed these cut-points and note that RMSEA values ranging from 0.08 to 0.10 indicate mediocre fit.

Confirmatory factor analysis (CFA) is necessary and important to get a valid structural model. Initially, it is used to test convergent validity and the reliability of the constructs. The convergent validity assesses the degree to which two measures of the same construct are correlated (Hair et al., 1998). By using confirmatory factor analysis, convergent validity can be performed by evaluating the parameter estimates and p-values. The high value of parameter estimates and the significance of statistical *p-value* < 0.05 are the key evaluation criteria recommended by Anderson and Gerbing (1988). For construct reliability, it is suggested that a value exceeding 0.60 indicates a reliable scale. It thus is necessary that the measurement model must be addressed by the confirmatory factor analysis to assure the validity of the model. According to Byrne (2001), there is no point in proceeding to the structural model until one is satisfied that the measurement model is valid.

In this study, confirmatory factor analysis (CFA) is conducted for all latent variables such as cooperation, connectedness, absorptive capacity, and innovation. The result of the confirmatory factor analysis (CFA) of each construct is reported in the next section.

5.4.2.1 Cooperation

To assess the specific knowledge spillovers, the dimensions of cooperation actions/activities are designed and set towards the concept of unintentional aspects or un-contractual agreement between partners. Cooperation as a latent construct here consists of three factors/dimensions including joint planning, joint problem solving, and joint implementation. In terms of observed variables or indicators, a total of 11 measurement items are used to measure the three dimensions of the cooperation construct. There are thus 11 first-order variables and 3 second-order variables in the measurement model of the cooperation construct. Joint planning and joint problem solving dimensions are measured by four measurement items: JPL1 to JPL4 and JPB1 to JPB4, respectively. Joint implantation dimension is measured by three measurement items: JMP1 to JMP3. The measurement model of cooperation is illustrated in Figure 5.1.

Figure 5.1 Measurement model of Cooperation
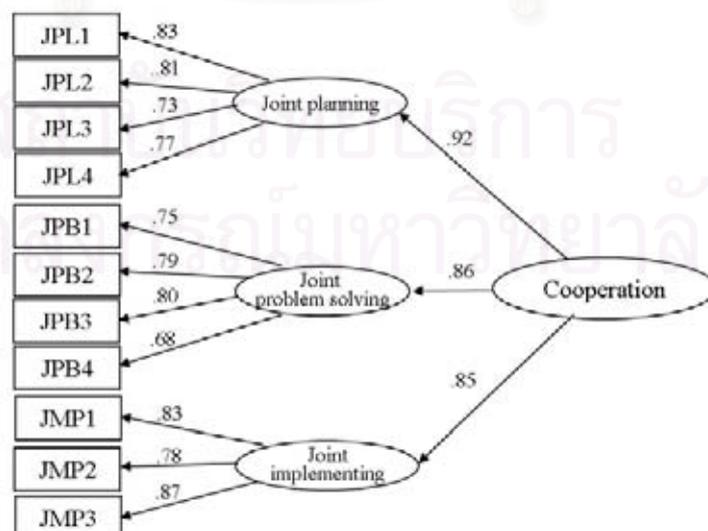
χ^2 =154.629;df=42;p=0.000, χ^2/df =3.682;IFI=0.936;TLI=0.916;CFI= 0.936;RMSEA= 0.094.

The result of the confirmatory factor analysis for cooperation shows that the measurement model is well fitting. The value of the CMIN/DF index is equal to 3.682, which is lower than the normal cutoff point of 5.00. The other fit indices are all higher than the cutoff point of 0.90 (IFI= 0.936, TLI= 0.916, CFI= 0.936). The RMSEA index equals 0.094, which is less than the 0.10 recommended by MacCallum et al. (1996). In addition, all regression coefficients between each observed variable and its corresponding dimension in the first-order confirmatory factory analysis are significant at the *p-value* < 0.001 level, with the values ranging from 0.68 to 0.87.

5.4.2.2 Connectedness

The connectedness construct consists of two factors/dimensions including ties and informal (communication). A total of 9 measurement items are used to measure these two dimensions and the connectedness construct. There are 9 first-order variables and 2 second-order variables in the measurement model of the connectedness construct. Tie dimension is measured by three measurement items, TIE1 to TIE3, and the informal communication dimension is measured by four measurement items, INF1 to INF4. Figure 5.2 illustrates the measurement model of connectedness.

Figure 5.2 Measurement model of Connectedness
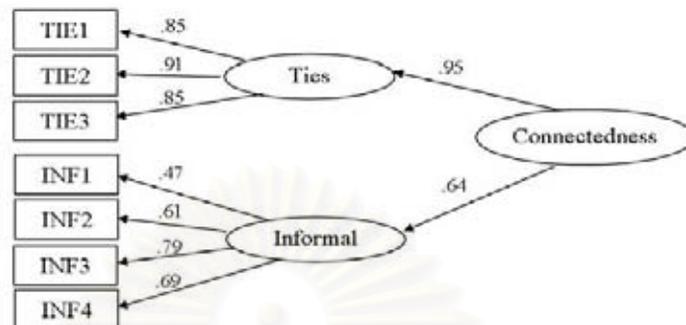
$\chi^2 = 46.335$;df=14;p=0.000; χ^2/df =3.311;IFI=0.953;TLI= 0.930;CFI= 0.953;RMSEA= 0.087.

The result of the confirmatory factor analysis for connectedness shows that the measurement model fits the data well. The CMIN/DF index is equal to 3.311, which is below the general threshold of 5.00. The other fit indices are all higher than the cutoff point of 0.90 (IFI= 0.953, TLI= 0.930, CFI= 0.953). The RMSEA index (0.087) is under the 0.10 recommended by MacCallum et al. (1996). All regression coefficients between each item and the corresponding dimension in the first-order confirmatory factory analysis are significant at the *p-value* < 0.001 level, with values ranging from 0.47 to 0.91.

5.4.2.3 Absorptive capacity

The absorptive capacity construct here consists of two components: potential and realized absorptive capacity. In the end, a total of 8 measurement items are assessed to measure these two components, with 8 first-order variables and 2

second-order variables in the measurement model of absorptive capacity construct. Potential absorptive capacity is measured by three measurement items, PACAP1 to PACAP3, and realized absorptive capacity is measured by five measurement items, RACAP1 to RACAP5. The measurement model of absorptive capacity is shown in Figure 5.3 as follows:

Figure 5.3 Measurement model of Absorptive capacity
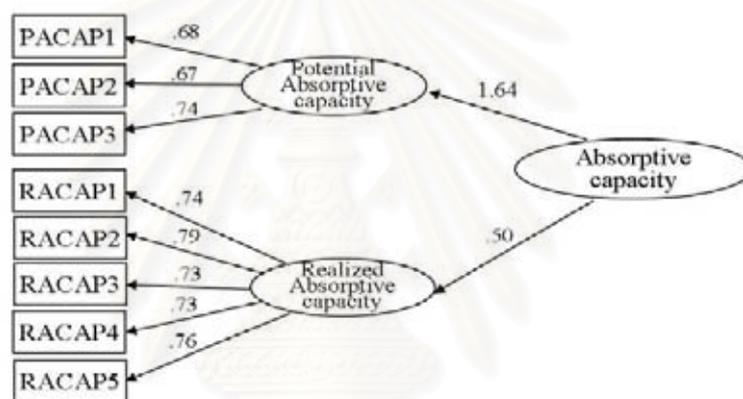
$\chi^2 = 44.338; df= 19; p=0.000, \chi^2/df = 2.334; IFI= 0.976; TLI= 0.964; CFI= 0.976; RMSEA= 0.066$

The result of the confirmatory factor analysis for absorptive capacity suggests that this measurement model fits the data well. The CMIN/DF index is equal to 2.334, which is below the referable threshold of 3.00. The other fit indices are all satisfactory, at higher than the cutoff point of 0.90 (IFI= 0.976, TLI= 0.964, CFI= 0.976). The RMSEA index (0.066) is relatively below the 0.05 recommended by Browne and Cudeck (1993) with a value of 0.066. All regression coefficients between each measurement item and its corresponding dimension in the first-order confirmatory factory analysis are significant at the *p-value* < 0.001 level, with values ranging from 0.68 to 0.79.

5.4.2.4 Innovation

The innovation construct here consists of two new dimensions: marketing innovation and management innovation. A total of 14 measurement items are designed and used to cover these two dimensions of innovation in as much detail as possible. The study ends up with 8 first-order and 2 second-order variables in the measurement model of the innovation construct. The marketing innovation dimension is measured by four measurement items, MKN1 to MKN4. The management innovation dimension is measured by four measurement items, MTN1 to MTN4. The details of the confirmatory factor analysis are presented in Figure 5.4.

Figure 5.4 Measurement model of Innovation
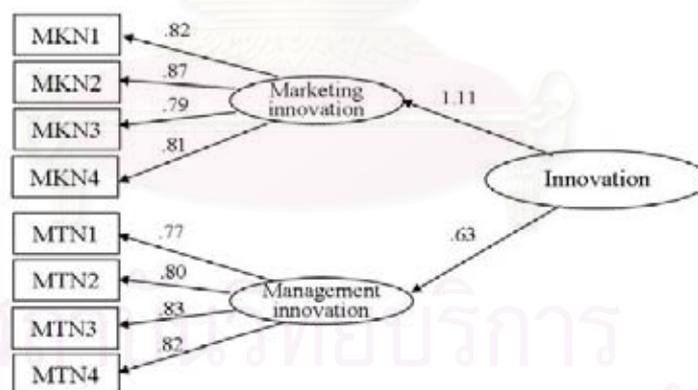
χ^2 =41.456;df=19;p=0.000,χ^2/df = 2.182;IFI= 0.985;TLI= 0.978;CFI= 0.985;RMSEA= 0.062.

The result of the confirmatory factor analysis for innovation shows that this measurement model is a well-fitting model. The CMIN/DF index is equal to 2.182, which is lower than the preferred cut-off point of 3.00. The other fit indices are all

above the threshold of 0.90 (IFI= 0.985, TLI= 0.978, CFI= 0.985). The RMSEA index (0.062) is less than the 0.08 as recommended by Browne and Cudeck (1993). All regression coefficients between each item and its corresponding dimension in the first-order confirmatory factory analysis are significant at the *p-value* < 0.001 level, with values ranging from 0.77 to 0.87.

In sum, the confirmatory factor analysis of all the constructs suggests satisfactory results. The measurement model is well fitting and valid. The reliability of the measurement model is examined by using the second-order factor analysis. Table 5.18 summarizes the measurement reliability. All findings indicate an acceptable level of reliability based on Nunnally's (1978) criteria (>0.70). The results of the confirmatory factor analysis as well as the reliability and exploratory factor analysis strongly support the existence of levels of construct validity and the adequacy of its goodness of fit to the sample data. The testing of the hypotheses is assessed by using the structural model analysis presented in the next section.

Table 5.18 Measurement reliability of Second-order factor analysis

Constructs	Cronbach's alpha
Cooperation (COOP)	0.909
Connectedness (CONN)	0.793
Absorptive capacity (ACAP)	0.881
Innovation (INNO)	0.906

Source: The author

5.4.3 The structural model

This process is the second stage of the structural equation modeling following measurement model stage. After the measurement model has shown the links between the latent variables and their observed measures (i.e., the confirmatory factor analysis model), the structural model depicts the links among the latent variables themselves. In fact, the measurement model and the structural model are two components of the full latent variable model (LV). The full or complete model means allowing for the specification of regression structure among the latent variables. Thus, in this model, the researcher can hypothesize the impact of one latent construct on another in the modeling of causal direction.

Normally, this is the stage of model parameter estimation and the examination of structural relationship among hypothesized constructs. In order to provide a rigorous and meaningful analysis, this study uses the method of model assessment by including all measurement items in the model as first- and second-order factors. This transforms the hypothesized conceptual model of this study into an AMOS graphics program. Figure 5.5 shows the overview diagram of both the measurement model and the structural model as base model.

Figure 5.5 Structural model of Absorptive capacity: Base model
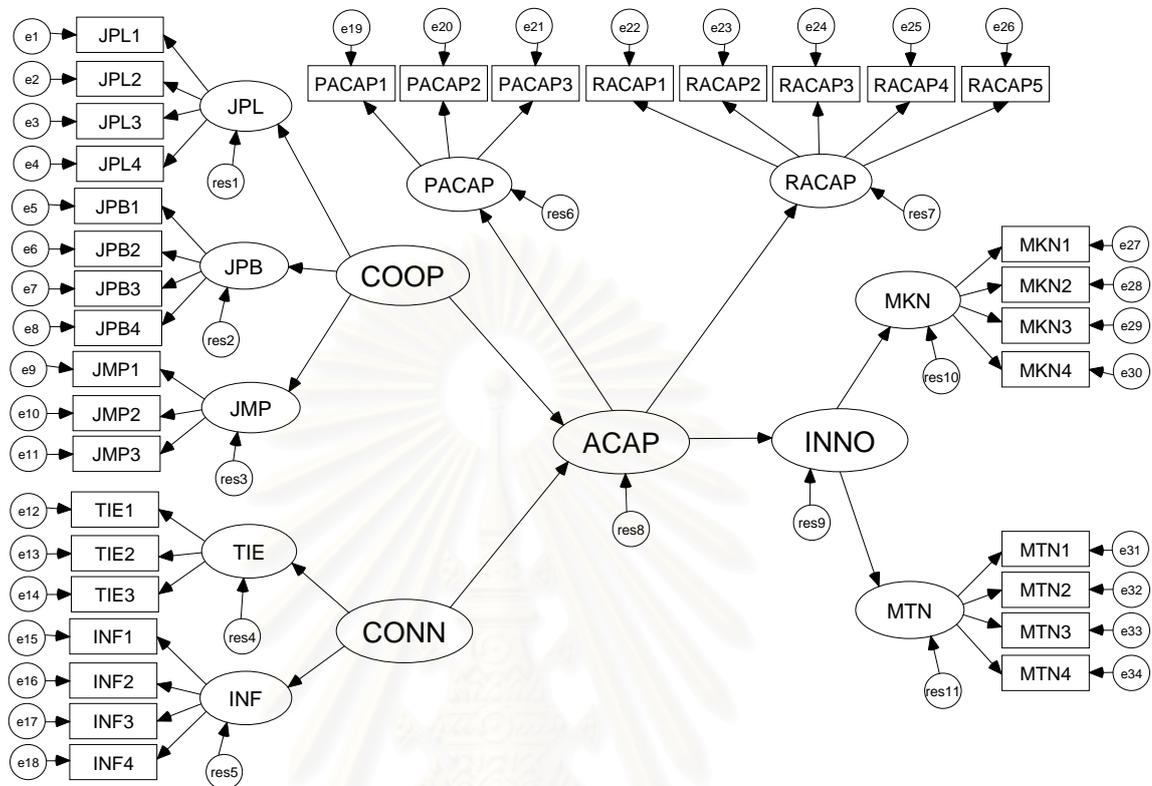
5.4.3.1 Model assessment (fitting)

Based on the proposed model and hypotheses, the structural model is constructed and the parameters estimated. The result of model assessment and parameter estimation is illustrated in Figure 5.6. To easily observe the model fitting results, the fit indices from the results of the proposed model are compared to the threshold/cutoff points as recommended by researchers, shown in Table 5.19.

Figure 5.6 Structural model for main hypotheses testing
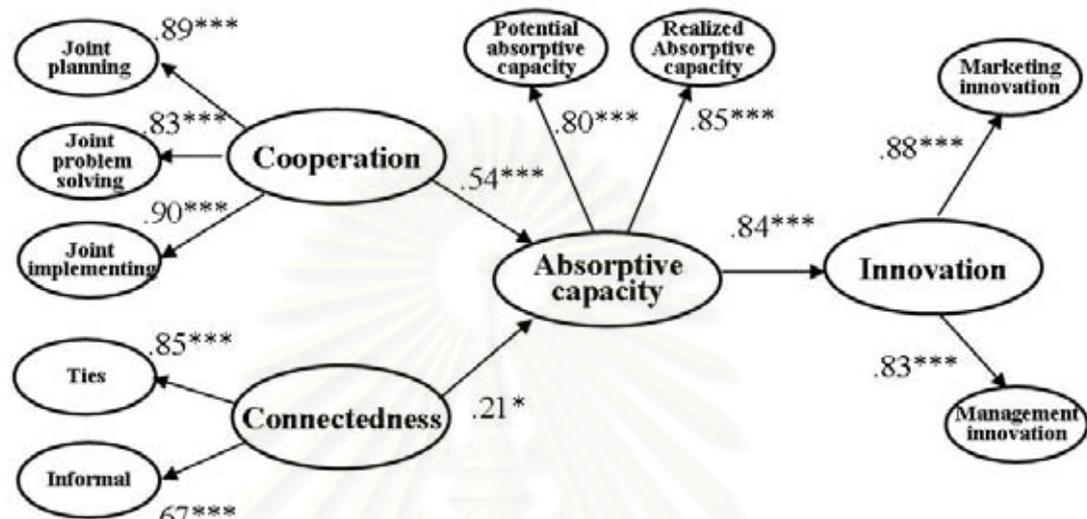
Table 5.19 Comparison of goodness-of-fit index of proposed model to the recommended points

Goodness-of-fit indices	The cutoff point	Proposed model
CMIN/DF (χ^2/df)	< 5.00 (<3.00 prefer)	1.876
IFI	> 0.90	0.919
TLI (NNFI)	> 0.90	0.912
CFI	> 0.90	0.919
RMSEA	< 0.80 (< 0.50 prefer)	0.054

Source: The author

Since the assessment of model fitting uses the same criteria as the confirmatory factor analysis or measurement model, the five main fit indices, CMIN/DF (χ^2/df), IFI, TLI, CFI, and RMSEA, are used to investigate the structural model fitting. Then the hypothesized model is estimated to examine structural relationship. The AMOS output results reveal that the model has relatively good fit with CMIN/DF (χ^2/df) =1.876; IFI=0.919; TLI=0.912; CFI=0.919; RMSEA=0.054.

Showing good fit indexes, the proposed model is an acceptable estimation for the proposed relationship among all constructs. It also addresses the question of how well the observed data fit this restricted structural model. The fit of the model and the parameter estimation to examine the testing of the hypothesis are discussed in the next section.

5.4.3.2 Hypotheses testing

This section presents the results of three main hypotheses and six sub-hypotheses being test in this study. As previously discussed, the proposed model shows the structural relationships among all constructs. Thus, Hypothesis 1 to Hypothesis 3 as well as sub-hypotheses 1a to 3b can be tested. Since this study concentrates on the absorptive capacity construct in terms of the role as mediator, its new external antecedents, and its new consequences, the overall hypotheses and sub-hypotheses examine the details of the absorptive capacity construct in each dimension. Hypothesis 1 and 2 test the direct effects of antecedents (cooperation and connectedness, called the 'spillover channel mechanism') on absorptive capacity while the sub-hypotheses 1a-1b and 2a to 2b indicate the effects of antecedents on each dimension of absorptive capacity. Simultaneously, Hypothesis 3 tests the impact of absorptive capacity on its consequence (innovation) with sub-hypotheses 3a and 3b focusing on how powerful the impact of each dimension of absorptive capacity is on innovation.

To better understand the results, all the hypotheses are put into three groups for testing. The first group examines the primary relationship between absorptive capacity and its antecedents (H1-H2) as well as its consequences (H3). Focusing on the mediating role of absorptive capacity, the second group tests the effects on and the impact of two dimensions of absorptive capacity in detail, i.e., the effects of cooperation (H1a-1b), connectedness (H2a-2b), and the influences on innovation (H3a-3b). A last group of hypotheses testing is added to ensure the accuracy of the model and to find whether there is a moderating effect from a different spiller/source of knowledge spillovers (i.e. multinational enterprise customers or Thai customer). The structural equation modeling with multi-group invariance is then performed and analyzed.

5.4.3.2.1 Group 1: Main hypotheses testing

As previously mentioned, the relationship between spillover channel mechanism (cooperation and connectedness) and absorptive capacity is explored and evaluated in this group. With the main criteria, all hypotheses are tested by analyzing the *t*-value at a significance level of 0.05 or less. Table 5.20 summarizes the relationships in the initial structural model with the results of parameter estimation and test of significance (*p-value*).

Table 5.20: Main hypotheses: Parameter estimation and the significance test

Main hypotheses	Estimated Relationship Coefficients		S.E.	C.R.	*p-value*
	Unstandardized	Standardized			
H1 : COOP ⟶ ACAP	0.361	0.535	0.081	5.959	0.000
H2 : CONN ⟶ ACAP	0.172	0.206	0.090	2.374	0.018
H3 : ACAP ⟶ INNO	1.150	0.840	0.110	10.639	0.000

Note: 1.COOP = Cooperation; CONN= Connectedness; ACAP= Absorptive capacity; INNO= Innovation

2. Estimated relationship coefficients here mean unstandardized/standardized regression weight; S.E. means standard error; C.R. is critical ratio; β is unstandardized/ standardized regression coefficient

3. t-value is significant at * *p-value* < 0.05;** *p-value* < 0.01; *** *p-value* < 0.001

1. Cooperation and Absorptive capacity

The main hypothesis aims to test the main effects of the proposed constructs. This reveals that there is significance in the structural relationship between cooperation and absorptive capacity (H1) at *p-value* < 0.001. Cooperation is significantly and positively related to absorptive capacity (*t-value* = 5.959; *p-value* = 0.000). Also, the unstandardized coefficients of the structural path are consistent with the prediction in both direction and magnitude. For estimated regression weight, cooperation is positively related to absorptive capacity with path standardized coefficient *(β)* of 0.535. Comparing to the unstandardized coefficients, standardized coefficients are better capable of representing the relative contribution of the predictors in explaining endogenous variables. In other words, the standardized coefficient of cooperation shows the power of the effect on absorptive capacity. The result of the standardized coefficient of cooperation indicates the contribution of cooperation largely explains absorptive capacity. Thus, *Hypothesis 1 is supported*.

The strong effect of cooperation is consistent with the literature. Cooperation is crucial in creation of synergy and mutual benefits. It is not uncommon to find several cooperative actions/activities between partners, especially by

contractual agreement. This study is different from most other studies, however, by here focusing on cooperation in the form of joint tasks/activities occurring from partners without contractual agreements. Implicitly, cooperation is considered as a source of knowledge that spills over from leakages during tasks. The overall measurement items are also designed to separate them from the contractual cooperation measurement items. Thus, the indication of a strong relationship between cooperation and absorptive capacity suggests strong influence of the task-oriented concept on knowledge transfer regardless of the origin of the knowledge source. The actions/activities occurring from the cooperation between spillers and recipients have enough power to facilitate the absorption ability of recipient, since the more cooperative tasks there are, the better the recipient firm's absorption ability gets. To strengthen absorptive capacity, firms therefore should attempt to cooperate with their partners regardless of whether such cooperation is covered in the contracts.

2. Connectedness and Absorptive capacity

The result of this test reveals a positive and significant relationship between connectedness and absorptive capacity (H2) at *p-value* <0.05. However, the significance is only marginal (*t-value*=2.374; *p-value*=0.018). The standardized coefficient of connectedness is not very high with positive direction (β=0.206). Compared to that of cooperation (β =0.535), the path coefficient of connectedness has only half power predictive of absorptive capacity. It indicates the contribution of cooperation largely explains absorptive capacity while connectedness may not

significantly determine absorptive capacity. However, connectedness is positively and significantly related to absorptive capacity. Thus, *Hypothesis 2 is supported.*

The low effect and minimally significant relationships between connectedness and absorptive capacity implies that absorptive capacity cannot be easily strengthened from the social-oriented concept through only the activities of connection. Connectedness is one of many paths in the social network approach. It is vital to not only enhance special information but also to enabling the acquisition of the benefits of specific group networking. It is routinely considered as the method providing familiarity and benefits. However, the concept of connectedness here is not the same as most studies. Similar to the cooperation construct, connectedness focuses on actions/activities deriving from the leakages/spillovers of knowledge, since the result proposes that connectedness, including tie strengths and informal patterns of contact, slightly affects absorption ability.

Connectedness now is considered as a strategic source of knowledge spillover to facilitate firms' dynamic capability. The recipient firm can use the connection to not only improve familiarity with its partners but also to synchronize core competencies through an increase in absorption capability. In order to strengthen absorptive capacity, firm thus should create and develop connectedness with partners regardless of whether or not it is covered in the contractual agreement.

For the details, the effect of cooperation and connectedness on each dimension of absorptive capacity is tested as sub-hypotheses testing (H1a-1b and H2a-2b) in the second group. The result of which dimension of cooperation and

connectedness affects absorptive capacity and how it explains this is also tested and evaluated in the second group.

3. Absorptive capacity and Innovation

The result of structural model reveals that absorptive capacity has a dramatically significant relationship with innovation (*t-value* = 10.639; *p-value*= 0.000). It is positively related to innovation as hypothesized with the high standardized coefficient *(β)* of 0.840. Thus, *Hypothesis 3 is supported*. This strong relationship may not be surprising since it is consistent with previous studies. However, innovation here is not tested in terms of product and process innovation, the norms for examination in preview studies. Instead, marketing innovation and management innovation are considered as new dimensions of innovation and scale measurements and testing of relationships have not yet been provided or tested. Thus, this study's results indicating a positive and significant relationship between absorptive capacity and innovation that specifically focused on marketing and management innovation are new, interesting and satisfactory.

Absorptive capacity is considered as a dynamic capability pertaining to knowledge creation and utilization that enhances a firm's ability to gain and sustain a competitive advantage achieved by innovation. Firms with well-developed absorption ability are likely to be more adept in handling their knowledge stock by internalizing, deploying, and converting knowledge into new perceptual schema or changes to existing processes. Since absorptive capacity is crucial to achieving and sustain

innovation, before thinking about innovative market and/or managerial work, firms first should focus on their level of absorption capability. With this in mind, firms will find it necessary to require, support, and develop their absorptive capacity in order to accomplish innovation.

The relationship between absorptive capacity and innovation is tested and evaluated on a dimension level not only of absorptive capacity but also of innovation. The two dimensions of absorptive capacity (potential and realized absorptive capacity) affecting innovation are elaborated as sub-hypotheses testing (H3a-3b) while two dimensions of innovation being affected by absorptive capacity are shown in the second group.

5.4.3.2.2 Group 2: Sub-hypotheses testing

Following qualification of the main Hypotheses 1 to 3, the sub-hypotheses on the relationship between dimensions of absorptive capacity and 1) its antecedents (cooperation and connectedness), 2) its consequence (innovation) are tested. The two dimensions of absorptive capacity (potential and realized absorptive capacity) may independently be affected by or affect other constructs. It thus is important to test these relationships separately. Although the former structural model (Figure 5.6) can examine all main hypotheses, it is insufficient for testing of the sub-hypotheses. Therefore, a new model is proposed for testing of the second group. Figure 5.7 illustrates the structural model for sub-hypotheses testing.

Figure 5.7 Structural model for sub-hypotheses testing
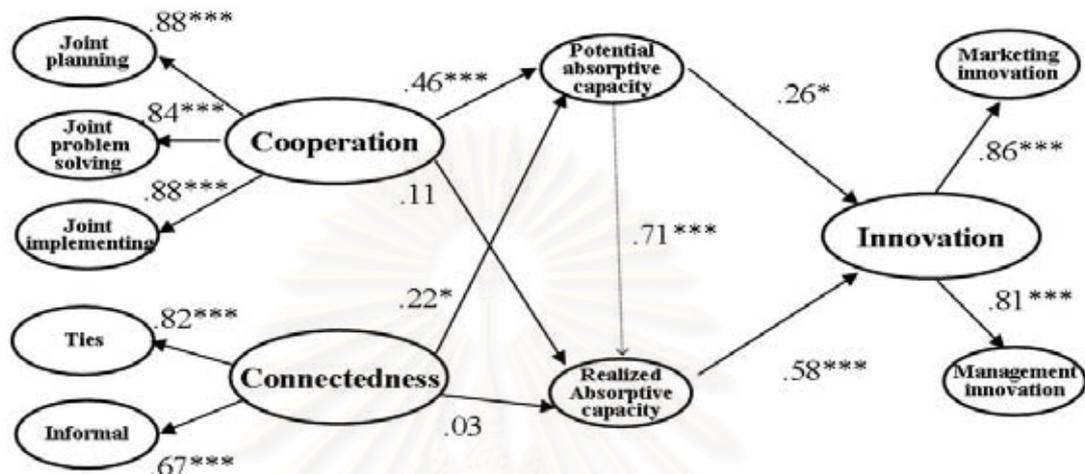
Table 5.21: Sub-hypotheses: Parameter estimation and the significance test

Sub-hypotheses/ Path of relationship	Estimated Relationship Coefficients		S.E.	C.R.	*p-value*
	Unstandardized	Standardized			
H1a: COOP → PACAP	0.319	0.464	0.066	4.858	0.000
H1b: COOP → RACAP	0.101	0.113	0.073	1.379	0.168
H2a: CONN → PACAP	0.197	0.222	0.089	2.227	0.026
H2b: CONN → RACAP	0.031	0.027	0.095	0.326	0.744
H3a:PACAP → INNO	0.347	0.261	0.159	2.182	0.029
H3b:RACAP → INNO	0.596	0.584	0.121	4.908	0.000
PACAP → RACAP	0.926	0.711	0.117	7.907	0.000

Note: 1. COOP = Cooperation; CONN= Connectedness; ACAP= Absorptive capacity; INNO= Innovation
PACAP= Potential-absorptive capacity; RACAP= Realized-absorptive capacity
2. Estimated relationship coefficients here mean unstandardized/standardized regression weight;
S.E. means standard error; C.R. means critical ratio
3. *t*-value is significant at * *p-value* < 0.05, ** *p-value* < 0.01, *** *p-value* < 0.001

All hypotheses tested in this group are also analyzed via the *t*-value at a significance level of 0.05 or less as well as the value of unstandardized/ standardized regression weights. For the result of fit measures, the model has relatively good fit

with CMIN/DF (χ^2/df) =1.853; IFI=0.922; TLI=0.915; CFI=0.921; RMSEA=0.053. Table 5.21 illustrates the summary of these structural relationships in the proposed model with the parameter estimation and *p-value*.

1. Cooperation and Potential Absorptive capacity/Realized Absorptive capacity

The result of structural model (Figure 5.7) shows the relationship between cooperation and the two components of absorptive capacity: potential and realized absorptive capacity. Cooperation is expected to significantly affect the levels of both dimensions of absorptive capacity. However, while cooperation is positively and significantly related to potential absorptive capacity (β =0.464, *p-value* = 0.000), it is positively but insignificantly related to realized absorptive capacity (β = 0.113, *p-value* = 0.168). Thus, *Hypothesis 1a is supported* while *Hypotheses 1b is not supported*.

As previously discussed, cooperation as defined by this study is different from most other studies since it looks at actions/activities deriving from the spillover channel framework. Cooperation is designed to be a tool to absorb knowledge through a step-by-step process. It is the same as a task-oriented or cognitive process, meaning it is time-consuming. Thus, cooperation might not show overall effects within the cross-sectional study. Similarly, the two components of absorptive capacity appear sequentially related, although they are idiosyncratic in the specific ways firms pursue, develop and employ them (Eisenhardt and Martin, 2000).

Potential-absorptive capacity (PACAP) makes the firm receptive to acquiring, learning and understanding external knowledge. In other words, it captures two sub-dimensions of assimilation and acquisition capabilities. While acquisition requires the role of direction and quality of learning, assimilation has one important role, that of comprehension, which promotes and allows firms to process and internalize externally generated knowledge. The profile of the respondents indicates that most cooperate with customers for a minimum five-year span, often longer. The joint cooperation over time is sufficient to generate the process of identifying, analyzing, and understanding externally generated knowledge from partners. Therefore, the positive and significant results of cooperation effecting on potential absorptive capacity suggest two main points: First that cooperation can be used for strengthening potential absorptive capacity through increasing the acquisition and assimilation capability and second that firms should consistently participate in and develop cooperative activities with partners regardless of the contractual agreement.

In contrast, the relationship between cooperation and realized absorptive capacity is positive but insignificant as proposed. Realized absorptive capacity (RACAP) is a function of transformation and exploitation capabilities. Transformation denotes internalization and conversion while exploitation deals with the application of knowledge as well as usage and implementation in reality. These capabilities relate to leveraging the knowledge that has been absorbed and creation of new processes by transforming knowledge into operations. It represents a higher innovative step than other steps in the absorption process. As such, realized absorptive capacity is more difficult to take place. Not surprisingly, simply

cooperation derived from knowledge spillovers/leakages is insufficiently strong to create realized absorptive capacity. This specific capability requires more time and the involvement of several other factors to generate and increase it. In order to effectively enhance realized absorptive capacity, the other factors need to be considered, assessed and launched together with cooperation actions/activities, and these factors include activation triggers and social integration. Details are provided and discussed in the next Chapter.

2. Connectedness and Potential Absorptive capacity/ Realized Absorptive capacity

The path coefficients between connectedness and two components of absorptive capacity are the same result as that seen for cooperation. The relationship between connectedness and potential absorptive capacity is relatively significant and positive as proposed (β = 0.222, *p-value*= 0.026), but in contrast, the relationship between connectedness and realized absorptive capacity is insignificant and has low positive value (β = 0.027, *p-value* = 0.744). Thus, *Hypothesis 2a is supported* whereas *Hypothesis 2b is not supported.*

Since connectedness is considered as spillover channel mechanism, its impact on potential absorptive capacity is crucial and satisfactory. The connection between partners now is not only for the purpose of social networking. It also becomes a vital strategic tool for the purpose of creating absorption ability, particularly that originating from spillovers or leakages. Potential absorptive capacity

comprising acquisition and assimilation capability has an important role in perceptual systematic thinking, speed and quality of learning, comprehension, and interpretation. It is a core competency needed to enhance competitive advantage. Thus, the finding that potential absorptive capacity is facilitated by connectedness implies that firms have an opportunity to achieve the ability to learn and analyze without cost. In order to leverage this advantage, companies should develop relationship and/or create new connections with other partners to access knowledge from their spillovers.

On the other hand, the results show that connectedness does not affect realized absorptive capacity, which is comprised of transformation and exploitation. This indicates that connectedness in the spillover mechanism does not have enough power to influence the conversion and implementation capability of recipient firms. Behind this finding are two points.

The first point is that it is difficult for these abilities within realized absorptive capacity to take place the absorption process. The second point is that realized absorptive capacity is complementary and follows potential absorptive capacity. Firms cannot possibly exploit knowledge without first acquiring it. Similarly, firms can acquire and assimilate knowledge but might not have the capability to transform and exploit the knowledge for new task/activity generation. Regarding the origin of spillovers, firms thus cannot use only connection to determine realized absorptive capacity. To effectively use connectedness, therefore, firms should consider and provide other factors supporting the relationship between connectedness and realized absorptive capacity such as social integration within firms to link potential and realized absorptive capacity.

3. Potential-absorptive capacity/ Realized-absorptive capacity and Innovation

For sub-hypotheses testing, the absorptive capacity construct is replaced by its two components; potential absorptive capacity and realized absorptive capacity. The structural model is tested and reveals that the relationship between potential absorptive capacity and innovation is positive and slightly significant at *p-value*< 0.05 (β = 0.261, *p-value* = 0.029). Similarly, realized absorptive capacity is positively and significantly related to innovation as proposed (β=0.584, *p-value* = 0.000). The findings of these relationships are consistent with the literature (e.g. Zahra and George, 2002; Eisenhardt and Martin, 2000; Kogut and Zander, 1996). Thus, *Hypotheses 3a and 3b are supported.*

The development of a firm's potential absorptive capacity is path dependent, and determines its success or failure. Firms with well-developed capabilities of acquisition and assimilation are likely to better adapt their knowledge stock and internalize this knowledge. Potential absorptive capacity helps firms track changes in their industries more effectively. It plays an important role in renewing a firm's knowledge base and the skills necessary to compete in changing markets. The finding of potential absorptive capacity influencing innovation underscores the crucial and necessary role of acquisition and assimilation capability to enhance company competitiveness in dynamic markets. Therefore, a company should create and continually develop their potential absorptive capacity to sustain innovation.

Realized absorptive capacity consisting of transformation and exploitation capability reflects a firm's ability to leverage the knowledge that has been absorbed,

the process of bisociation, and the role of re-codification of knowledge. Potential absorptive capacity is used to acquire and analyze new learning while realized absorptive capacity helps a company develop a new perceptual schema or changes to existing processes. In addition, it helps to further convert knowledge to enhance performance and yields competitive advantage, particularly innovation. For example, most electronics and electrical firms require knowledge leveraging and recombining knowledge skills to pursue new marketing actions/activities and/or new managerial conceptual development. In order to accomplish innovation, a company thus needs to focus on creating and developing its realized absorptive capacity. In sum, both realized and potential absorptive capacity are required to achieve and sustain a high level of innovation.

4. Dimension level data analysis testing

In order to better manage absorptive capacity, this study examines the proposed model at the dimension level. The effects of dimensions of cooperation (joint planning, joint problem solving, and joint implementing), connectedness (tie strengths and informal pattern of contact), and innovation (marketing innovation and management innovation) are tested and evaluated. Since these dimensions may independently affect and/or be affected by potential and realized absorptive capacity, the testing of these relationships may be helpful to provide a solid explanation. To provide more details, a third structural model is provided to ascertain relationships among constructs in the dimension level. Figure 5.8 illustrates the structural model for this particular testing.

Figure 5.8: Structural model for dimension level testing
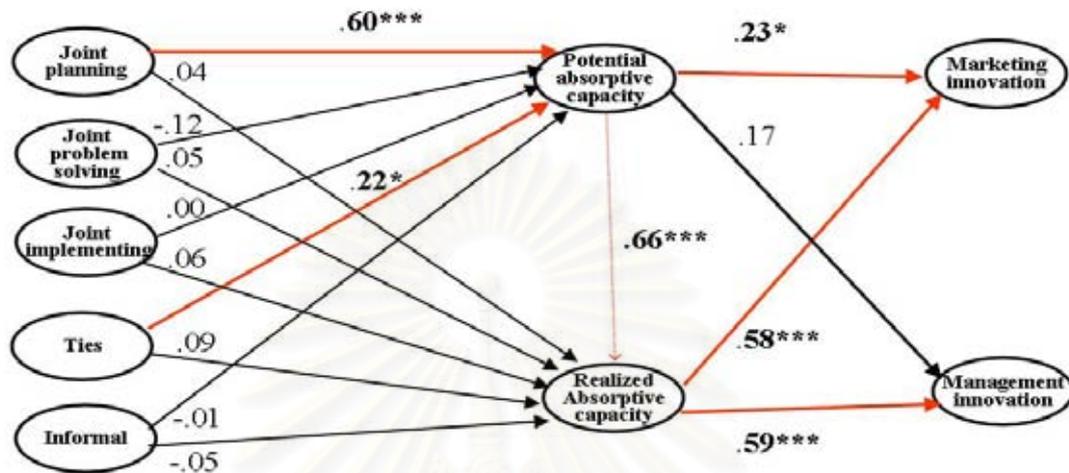
Table 5.22 Dimension level testing: Parameter estimation and the significance test

Dimension-level Paths relationships	Estimated Relationship Coefficients		S.E.	C.R.	*p*-value
	Unstandardized	Standardized			
JPL ⟶ PACAP	**0.405**	**0.596**	0.093	**4.368**	**0.000**
JPL ⟶ RACAP	0.031	0.038	0.101	0.308	0.758
JPB ⟶ PACAP	-0.087	-0.119	0.094	-0.925	0.355
JPB ⟶ RACAP	0.048	0.054	0.097	0.503	0.615
JMP ⟶ PACAP	0.002	0.003	0.076	0.024	0.981
JMP ⟶ RACAP	0.045	0.058	0.078	0.574	0.566
TIE ⟶ PACAP	**0.174**	**0.215**	0.069	**2.506**	**0.012**
TIE ⟶ RACAP	0.085	0.086	0.072	1.175	0.240
INF ⟶ PACAP	-0.011	-0.013	0.077	-0.148	0.882
INF ⟶ RACAP	-0.051	-0.048	0.079	-0.652	0.515
PACAP ⟶ MKN	**0.281**	**0.230**	0.117	**2.406**	**0.016**
PACAP ⟶ MTN	0.201	0.174	0.115	1.755	0.079
RACAP ⟶ MKN	**0.579**	**0.579**	0.096	**6.049**	**0.000**
RACAP ⟶ MTN	**0.561**	**0.595**	0.094	**5.968**	**0.000**
PACAP ⟶ RACAP	**0.810**	**0.661**	0.109	**7.434**	**0.000**

Note: 1. COOP = Cooperation; JPL= joint planning; JPB= joint problem solving; JMP= joint implementing;
CONN= connectedness; TIE = Tie strength; INF = Informal patterns of contact; ACAP= Absorptive
capacity; PACAP= Potential-absorptive capacity; RACAP= Realized-absorptive capacity; INNO=
INNO=Innovation; MKN= marketing innovation; MTN= management innovation

2. Estimated relationship coefficients here mean unstandardized/standardized regression weight ;
S.E. means standard error; C.R. means critical ratio

3. *t*-value is significant at * *p-value* < 0.05, ** *p-value* < 0.01, *** *p-value* < 0.001

All hypotheses tested in this group are again analyzed against the *t*-value at a significance level of 0.05 or less as well as the value of unstandardized/ standardized regression weights. The result of fit measures shows the model has relatively good fit with CMIN/DF (χ^2/df) =1.888; IFI=0.921; TLI=0.911; CFI=0.920; RMSEA=0.053. Table 5.22 reports the result of these structural relationships in the specific model with parameter estimation and test of significance (*p-value*).

The result of dimension level testing reveals that six relationship paths are both positive and significant. The first and second path, joint planning and ties strengths, are positively and significantly related to potential-absorptive capacity (β = 0.596; *p-value* = 0.000 and β=0.215; *p-value* = 0.012, respectively). The third path, potential absorptive, capacity is only positive and relatively significant related to marketing innovation at *p-value* < 0.05 (β= 0.230; *p-value* = 0.016) but not to management innovation. The fourth and fifth path, the relationship between realized absorptive capacity and marketing innovation/management innovation, are strongly positive and significant at *p-value* < 0.001 (β= 0.579; *p-value* = 0.000 and β = 0.561; *p-value* = 0.000, respectively). The final path in this dimension level testing is the relationship between potential absorptive capacity and realized absorptive capacity consistent with literature (e.g. Zahra and George, 2002). Except for these six relationship paths, the rest are all insignificant, with most having positive value and some having negative value, such as joint problem solving and informal contact/ communication.

Analysis of the cooperation dimension reveals only joint planning has strong positive and significant influence on potential absorptive capacity. Since planning implies discussion and presentation of the systematic thinking of planners, the recipient firm has a chance to increase its capability in the sense of learning, understanding, and analyzing. In addition, by nature, planning activities distinctive. Planning requires free thinking, and open mind, and unlimited imagination. These characteristics alone would stand to provide more benefit to participants in joint planning actions/activities from both incoming and outgoing knowledge spillovers. Joint problem solving and joint implementing are essentially the second and third stages of joint actions/activities programs. Thus, it may not be able to find the effect of these actions/ activities at any point of time but it may be possible to see the impact over the long term cooperative effort. However, the study indicates that the more a company engages in joint planning actions/activities with customers, the more it strengthens its potential absorptive capacity. To take advantage of spillover channels through the cooperation mechanism, therefore, a company firm should try to access and take part in joint planning actions/activities with partners in activities such as analysis of market trends, setting up new distribution channels and decisions regarding pricing or marketing strategy plans.

The connectedness dimension analysis shows that only the dimension of ties strength has a strong positive and significant effect on potential absorptive capacity. Consistent with literature and social network/capital (e.g., Bøllingtoft and Ulhøi, 2005; Lindberg-Repo and Gro¨nroos, 2004; Raghuram et al., 2001), this result provides evidence that a degree of tie is a necessary and useful link to create social

embeddedness and a networking system. Since social capital is composed of individual and collective social networks, ties and structures help the individual get access to information and know-how. In particular, strong ties tend to be related to problem solving (Hansen, 1999). The results from previous studies (e.g. Eisenhardt and Tabrizi, 1995; Uzzi, 1997; Kate et al., 2000; Uzzi and Lancaster, 2003) reveal that strong ties are useful for information exchange since those involved are more intimate with each other and thus more motivated to provide information to the others (Bøllingtoft and Ulhøi, 2005).

The analysis of the dimensional level of connectedness, thus, shows a positive and significant relationship path for tie strength and absorptive capacity and suggests that the higher the degree of tie strength with customers, the more a company strengthens its own potential absorptive capacity. Therefore, any actions/activities used to increase tie strength with customer (i.e. lunch or dinner talks, joining clubs together, etc.) are strongly recommended.

In the analysis of the absorptive capacity and innovation dimension, the two main components of absorptive capacity (potential and realized absorptive capacity) are separately examined to find the different roles and impact on different dimensions of innovation (marketing and management innovation). The analysis reveals that there are three main significant relationship paths between these constructs.

The first relationship path, potential absorptive capacity, has impact on realized absorptive capacity. Consistent with the literature, the result confirms that both potential absorptive capacity and realized absorptive capacity can have separate but complementary roles. According to Zahra and George (2002), both subsets of absorptive capacity coexist at all times and fulfill a necessary but insufficient condition to improve firm's competitiveness alone. It is recognized that although firms have potential absorptive capacity (or acquisition and assimilation capabilities), they vary in their ability to create value from their knowledge base because of variations in their realized absorptive capacity (or transformation and exploitation capabilities). Since this relationship path has a positive and strong effect, companies must possess the vital link tying potential absorptive capacity to realized absorptive capacity. For example, the actions/activities of the social integration mechanism (i.e. trust, commitment) between units/functions within a company must be developed and encouraged in order to ease the transformation of the new knowledge acquired.

The second relationship path, potential absorptive capacity, has slight effect on only marketing innovation. The result of simultaneous tests of the two components of absorptive capacity and two dimensions of innovation shows a solid explanation why certain companies are more efficient than others in using absorptive capacity. This distinguishing role and impact between potential absorptive capacity and realized absorptive capacity implies that some firms may be inefficient in leveraging their potential absorptive capacity and therefore cannot improve their management innovation.

Compared to realized absorptive capacity, potential absorptive capacity is considered as fundamental to a firm's dynamic capability and is easier facilitated in the broad dimensional level than in the deep dimensional level. Thus, it is logical that potential absorptive capacity is only able to exert sufficient effect on marketing innovation because this particular innovation may evolve out of the immediacy of a competitive marketing situation. In addition, marketing innovation may be considered as 'new to the company' rather than 'new to the overall market'. Thus, a firm's potential absorptive capacity can sustain this particular marketing innovation. On the other hand, management innovation requires a longer time to learn and requires more depth to transform and interpret the result since it is affected by the many various external and internal factors of each firm. Therefore, potential absorptive capacity consisting of only acquisition and assimilation capabilities does not have strength enough to influence management innovation.

The third relationship path, realized absorptive capacity, has positive and strong impact on both marketing innovation and management innovation. As previously mentioned, realized absorptive capacity as innovative capability is more difficult to strengthen and may preferably occur at the deep dimensional level. In addition, innovation created from realized absorptive capacity is acceptable as 'new and innovative tasks/actions for both firm and market'. Thus, realized absorptive capacity has a dramatic influence on both marketing and management innovation. At the same time, realized absorptive capacity is probably facilitated by potential absorptive capacity creation. The process of realized absorptive capacity creation requires a substantial amount of time to achieve transformation of the new

knowledge, combine it with existing knowledge, and exploit/apply it to commercial ends. As such, realized absorptive capacity has more effect than potential absorptive capacity on marketing innovation.

By focusing on managing absorptive capacity, the findings of different impacts of two components of absorptive capacity on innovation can be more discussed and elaborated to the managerial implication such as management guideline in the next chapter.

5.4.3.2.3 Group 3: Multi-group invariance testing

Testing on this last group is performed by using multi-group invariance analysis. This additional testing is provided to discover and better understand the moderating effect of different spillers/sources of knowledge spillovers. Since the study focuses on the demand side of the supply chain, customers of respondent firms are considered as spillers or sources of knowledge spillovers. As such, the spillers are categorized into two subgroups: multinational enterprise (MNE) customer and Thai customer. These two subgroups are analyzed to find whether there are differences in the structural models based on spiller group.

The structural model for multi-group analysis is then applied to discuss the results of these differences. All results of testing in this group are also analyzed by using a t-value at a significance level of 0.05 or less. The examination reveals that there are significant differences between subgroups of MNE customer and Thai

customer. This has implication on the moderating effect of a different spiller on the proposed model.

Table 5.23 summarizes the two subgroups and their structural relationships. The initial structural model, including main and sub-hypotheses testing, are also shown as references for comparison.

Table 5.23: Multi-groups invariance analysis based on subgroups of spillers
(MNE customer and Thai customer)

Relationship paths	Initial Structural model	Spiller/source of knowledge spillovers	
		MNE-customer	**Thai-customer**
COOP → ACAP	0.535***	0.576***	0.504***
COOP → PACAP	0.464***	0.532***	0.469***
COOP → RACAP	0.113	0.162	- 0.028
CONN → ACAP	0.206*	**0.005**	**0.401****
CONN → PACAP	0.222*	**-0.071**	**0.433***
CONN → RACAP	0.027	0.044	- 0.039
ACAP → INNO	0.846***	0.821***	0.864***
PACAP → INNO	0.261*	**0.080**	**0.507**
RACAP → INNO	0.584***	**0.720***	**0.374***
PACAP → RACAP	0.846***	0.656***	0.894***

Comparison of the Structural Models for main hypotheses : $\chi^2 = 9.401$; df =3; p-value =0.024
Comparison of the Structural Models for sub-hypotheses : $\chi^2 = 15.929$; df =6; p-value =0.014

Note: 1. COOP = Cooperation; CONN= Connectedness; ACAP= Absorptive capacity;
    PACAP= Potential-absorptive capacity; RACAP= Realized-absorptive capacity; INNO= Innovation
2. Figures shown in the column represent standardized coefficients
3. The significance is based on *t*-test at * *p-value* < 0.05, ** *p-value* < 0.01, *** *p-value* < 0.001

Comparison of both the main and sub-hypotheses structural models shows that there are significant differences between the MNE customer group and Thai customer group. In the structural model of the main hypotheses, the chi-square difference test (χ^2=9.401; df =3; *p-value* = 0.024) provides evidence that the structural paths of MNE customer and Thai customer are different. The main path that is different is the relationship of connectedness to absorptive capacity. The result

reveals that the relationship between connectedness and absorptive capacity is insignificant in the MNE-customer subgroup (β=0.005; *p-value* = 0.970), while it is positive and significant at *p-value*<0.01 (β= 0.401;*p-value* = 0.001) in the Thai customer subgroup.

In the sub-hypotheses structural model, the chi-square difference test (χ^2 =15.929; df =6; *p-value* =0.014) shows that the structural paths of MNE customers and Thai customers are again different. There are three main different paths in this analysis. The first path, connectedness, is negative and insignificantly (β = -0.071; *p-value* = 0.628) related to potential absorptive capacity in the MNE customer group but is positive and strongly significant at *p-value* < 0.001(β = 0.433; *p-value* = 0.000) in the Thai customer group. The second path, the relationship between potential absorptive capacity and innovation, is not significant (β= 0.080; *p-value* = 0.592) for the MNE customer group but is relatively significant at *p-value* < 0.01 (β= 0.507; *p-value* = 0.009) for the Thai customer group. The final path is the relationship path for realized absorptive capacity to innovation. This shows a strongly significant relationship for the MNE customer group at *p-value* < 0.001 (β= 0.720; *p-value* = 0.000) but a rather relatively insignificant relationship for the Thai customer group at *p-value* < 0.05 (β= 0.374; *p-value* = 0.043).

A possible explanation of the differences is the effect that nationality has on cooperation, connectedness, and absorptive capacity. Since firms coming from different regions may assign business priority to different issues, the focus on actions/activities of the MNE customer and the Thai customer may also be different.

For example, Japanese firms strongly support cooperation within the group (i.e. Japanese keiretsu groups) whereas US firms focus on cost and operational efficiency. In contrast, Thai firms will place greater importance on relationships and networking. In other words, the MNE customer will be more focused on the task-oriented actions/activities involved in doing business with partners while the Thai customer requires both task-oriented and people/social-oriented actions/ activities when undertaking business with a partner. In order to increase potential absorptive capacity, thus, a company needs to provide and use effective cooperation actions/activities (i.e. joint planning) with the MNE customer. With a Thai customer, the firm should concentrate on creating more social ties or networking in order to access incoming knowledge spillovers.

In sum, the multi-group invariance analysis indicates that there are different effects on absorptive capacity from the different spillers/sources of knowledge spillovers. In other words, the spiller/source of knowledge spillovers has a moderating effect on the absorptive capacity proposed model. Thus, firms should use different strategies with care and attention to their effectiveness.

5.5 The Summary

The findings from data analysis and hypotheses testing conclude that the proposed conceptual model of absorptive capacity is well-fitted and developed and able to explain absorptive capacity in the manner expected. The three main hypotheses and six sub-hypotheses are tested by analyzing the two structural models.

The findings and discussion as well as the research summary, contribution, and implication are given in the next chapter. Finally, Table 5.24 summaries the results of hypotheses testing in this study.

Table 5.24 Summary of hypotheses testing results

Hypotheses	The statement	Results
H1	There is a significant and positive relationship between cooperation and absorptive capacity	Supported
H1a	There is a significant and positive relationship between cooperation and potential absorptive capacity	Supported
H1b	There is a significant and positive relationship between cooperation and realized absorptive capacity	Not Supported
H2	There is a significant and positive relationship between connectedness and absorptive capacity	Supported
H2a	There is a significant and positive relationship between connectedness and potential absorptive capacity	Supported
H2b	There is a significant and positive relationship between connectedness and realized absorptive capacity	Not Supported
H3	There is a significant and positive relationship between absorptive capacity and innovation	Supported
H3a	There is a significant and positive relationship between potential absorptive capacity and innovation	Supported
H3b	There is a significant and positive relationship between realized absorptive capacity and innovation	Supported

CHAPTER VI

CONCLUSION AND RECOMMENDATION

This chapter provides the conclusion of the study. The chapter first starts with the research summary, including the explanation of how the research findings accomplish the research objectives and key answers to research questions. Then, the theoretical contributions as well as managerial implications are discussed. Finally, the chapter sums up with the limitations and suggestions for future research.

6.1 Conclusion

6.1.1 Research Summary

The study aims to develop the framework of absorptive capacity by pinpointing its importance as mediator. Drawing on the spillover channel framework, the relationship between the new antecedent, spillover channel mechanism (cooperation and connectedness), and absorptive capacity is identified. The relationship between absorptive capacity and its consequence, innovation (with new dimensions of marketing and management innovation), is proposed and the conceptual model of absorptive capacity consisting of the relationships among these constructs is developed based on the spillover channel framework and previous literature.

The Electronics and Electrical (E&E) Industry is selected to empirically test the proposed model. E&E is a knowledge-based industry in which competitive advantage is gained though innovation. It is thus expected that knowledge absorption capabilities are already present within E&E firms. In addition, supply chain integration among supply chain members is encouraged and routinely present. There is a relationship between firms and their customers/suppliers both under contractual agreements and without contractual agreements. It also provides several actions/ activities of cooperation and connections that are suitable for proposed model testing. Thus, the research questionnaire was developed and sent to 2,158 E&E firms in Thailand. A total of 451 questionnaires were returned, with 305 usable for data analysis, a response rate of 14.13 percent.

Based on this set of questionnaires, then, data analysis is conducted and used for hypotheses testing. In the data analysis, respondent profiles are shown and explained with descriptive analysis. The measurement of reliability and validity of all constructs and items analysis are then evaluated. The results are satisfactory with a fairly high range of reliability (0.728-0.934) and adequate range of validity with total variance explained (64.67%-75.04%). This means that these measures are appropriate to use for further analysis. During the hypotheses testing, the proposed research model was constructed using structural equation modeling (SEM), which is well suited to analyzing data via the confirmatory approach for inferential purposes. In addition, the use of structural equation modeling procedures can incorporate both unobserved (i.e. latent) and observed variables. It also helps to estimate the point and/or interval indirect effect of the relationship.

The hypotheses testing were divided into two groups with three structural models. The first group used the structural model to test three main hypotheses. The results of this testing are all supported. The second group used the structural model to investigate six sub-hypotheses. Most were supported, the exceptions being the paths from cooperation and connectedness to realized absorptive capacity. In order to obtain greater detail, dimension level testing was additionally done by constructing a third structural model. Analysis of the dimension level structural model shows that only joint planning and ties strengths are significant and positively related to potential absorptive capacity. The remaining paths from other dimension of antecedents to potential absorptive capacity or realized absorptive capacity are insignificant. Testing found that the paths from realized absorptive capacity to both marketing innovation and management innovation are positive and significant; it was also found that the path from potential absorptive capacity to marketing innovation is significant but insignificant to management innovation.

The hypotheses were also tested using the multi-group invariance analysis to explore the moderating effect of spiller/source of knowledge spillovers. The specific source here means the customer, which is divided into two subgroups (multinational enterprise or MNE customer and Thai customer). A structural model for multi-group invariance analysis was constructed to find the applicable results of differences. The model reveals that there are differences between subgroups. The main differences are in two relationship paths. For the MNE customer group, the path of connectedness to absorptive capacity is insignificant, as is the relationship between potential absorptive capacity and innovation; at the same time, realized absorptive capacity is highly

significant related to innovation. There was a large contrast for the Thai customer group, where the path of connectedness to absorptive capacity is positive and significant and both potential absorptive capacity and realized absorptive capacity are significant and positively related to innovation.

The data analysis and hypotheses testing results convince that the proposed conceptual model of absorptive capacity is well-fitted and developed. It can explain the absorptive capacity in the particular manner expected. The findings of the study are then discussed to answer the research questions and to provide more insight into the absorptive capacity model.

6.1.2 Research findings and discussion

To develop a better understanding of the absorptive capacity re-conceptual model and to explore the relationships between cooperation, connectedness, absorptive capacity, and innovation, six objectives are proposed. Based on a comprehensive literature review and structural equation modeling analysis, the study answers the research questions and achieved the six proposed research objectives. The statement of each objective and summary of how each is accomplished is given below.

Objective 1: To provide the comprehensive theoretical and practical perspectives of absorptive capacity.

It is recognized that absorptive capacity is a component of core competency in the enhancement of a company's competitive advantage, particularly in terms of innovation. Following several literature reviews, this study provides additional insight into the absorptive capacity framework. The details of antecedents and consequences are discussed and the missing issues or gaps pinpointed. The proposed absorptive capacity model is developed from both theoretical and practical perspectives. Then the new antecedent as knowledge source and new consequences are identified and simultaneous testing done. Results of the study show how each component of absorptive capacity (potential and realized) is managed with regards to the effect of the new antecedent (spillover channel mechanism). In addition, the results reveal how potential and realized absorptive capacity are managed in order to effectively influence innovation. The different impacts of potential absorptive capacity and realized absorptive capacity are also illustrated in the study. Finally, the importance of the role of absorptive capacity as mediator is provided and supported.

Objective 2: To examine if and how spillover channel mechanism influences absorptive capacity.

An important external factor influencing absorptive capacity is knowledge sourced from outside the firm. Knowledge spillovers are consistently considered as always occurring, but overlooked in many studies. This study aims to explore the importance and impact of this particular factor on absorptive capacity. Although knowledge spillover is abstract and difficult to measure, the study initiates a mechanism that is believed to be representative of knowledge spillovers. Drawing on

literature review and the spillover channel framework, a spillover channel mechanism is developed in order to investigate the proposed relationship. Fundamentally, the spillover channel framework categorizes the channel of knowledge spillovers on the basis of spillover characteristics and consideration of spillover methods. It is implicitly assumed that firms get knowledge spillovers from the transmission of task and/or social action/ activities. Therefore, a spillover channel mechanism consisting of cooperation and connectedness is identified as the main factor affecting absorptive capacity in this study.

In order to achieve the 'how', in addition, the study reviews the literature and undertakes surveys to examine the relationship between these constructs. The proposed factor – the spillover channel mechanism - is investigated in terms of the cooperation and connectedness construct standing for task and social orientation, respectively. Then, the relationship between cooperation/connectedness and absorptive capacity are explored and identified. This shows that both cooperation and connectedness positively affect absorptive capacity, particularly potential absorptive capacity. Importantly, cooperation has a stronger influence than connectedness. Implicitly, the task orientation should be of more interest as a strategic tool for acquiring and analyzing capability.

Objective 3: To investigate how absorptive capacity affects innovation and whether the impacts of potential and realized absorptive capacity are different and if so, how.

Similar to the second objective, this study achieves this objective by conducting literature review and surveys to investigate the relationship between absorptive capacity and innovation. To effectively accomplish the objective and also support the perception of the importance of the mediating role of absorptive capacity, all relationships among constructs are simultaneously examined. The examination reveals a strong positive impact of absorptive capacity on innovation. There is a different impact in terms of magnitude between potential absorptive capacity and realized absorptive capacity. The impact of realized absorptive capacity is double that of potential absorptive capacity, suggesting that the important role for realized absorptive capacity is to accomplish innovation while the role of potential absorptive capacity is to sustain innovation.

Objective 4: To explore the relationships among spillover channel mechanism, absorptive capacity, and innovation.

A total of three main hypotheses and six sub-hypotheses are proposed to investigate the relationships among these constructs. The sub-hypotheses are separately tested since potential absorptive capacity and realized absorptive capacity play different roles that may have different effects on or be affected by other constructs in the model. Based on these hypotheses, two structural models of absorptive capacity are developed. The first structural model is provided to test the three main hypotheses and absorptive capacity is considered as one construct consisting of two components, potential absorptive capacity and realized absorptive capacity. The second structural model of absorptive capacity is proposed for sub-

hypotheses testing. Thus, potential absorptive capacity and realized absorptive capacity are treated as different constructs in the model. The models are illustrated in Figure 6.1 and 6.2, respectively.

Figure 6.1 Structural model of absorptive capacity for main hypotheses testing
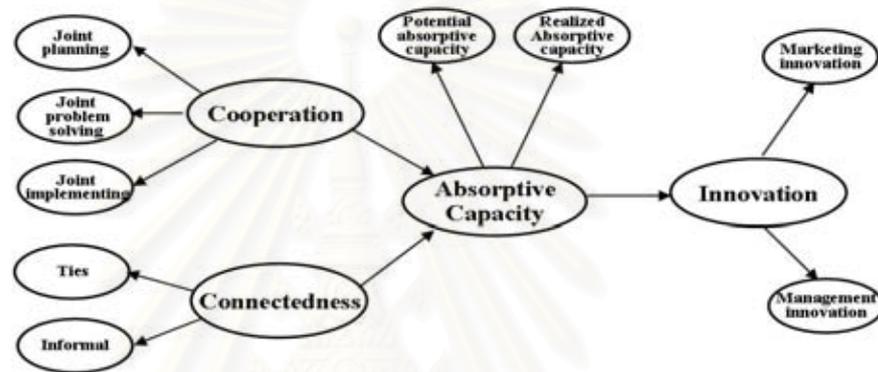
Figure 6.2 Structural model of absorptive capacity for sub-hypotheses testing
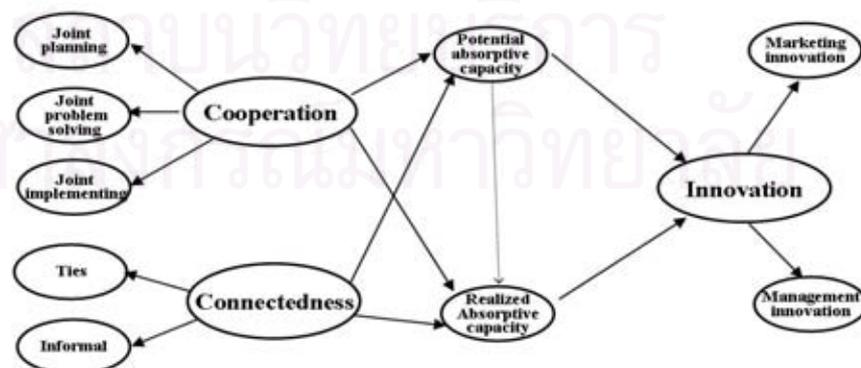
Objective 5: To empirically test the fit of the absorptive re-conceptual model in the context of a Thai setting.

Based on the model developed for the fourth objective, all hypotheses and sub-hypotheses are tested as applying to the Electrical and Electronics (E&E) Industry in Thailand. The results show that the structural model of absorptive capacity in this study fit well with the data. Most of the proposed relationships are positive and statistically significant, excepting the relationship path between the spillover channel mechanism and realized absorptive capacity.

This study not only achieved the proposed research objectives, but also provides interesting and specific findings corresponding to the research purposes and objectives as follows:

1. Findings of overall proposed model

Most of the relationship paths are supported in hypotheses testing except the paths of the spillover channel mechanism (cooperation and connectedness) to realized absorptive capacity. These findings provide further insight as follows:

1.1 **Cooperation:** This has the greatest influence on absorptive capacity, especially potential absorptive capacity. Derived from the spillover channel of linkage effect, cooperation is considered a task-oriented mechanism. It is the main mechanism by which a recipient firm can strengthen its acquisition and assimilation capability. Cooperation recommended involves joint actions/activities regardless of

whether covered by contractual agreements, such as joint planning, joint problem solving, and joint implementation. In particular, joint planning activities with customers (i.e. marketing strategy, pricing strategy, analysis of market trends, establishing distribution channels, setting marketing management plans) have dramatically positive impacts on a company's potential absorptive capacity creation and are strongly suggested.

1.2 **Connectedness**: This is the second most important factor affecting absorptive capacity, especially potential absorptive capacity. Drawing on the spillover channel of human mobility, connectedness implies a people-oriented or social-oriented mechanism. It is another crucial mechanism that a recipient firm should appropriate in order to increase its acquisition and assimilation capability. The connectedness suggested is degree of ties and the form/pattern of contact regardless of whether this occurs within the environment of a contractual agreement or not and specifically suggests strong ties and informal contact/communication. The research shows particularly that ties strength is the most important factor affecting potential absorptive capacity. Thus, any actions/activities increasing the degree of ties strength between the firm and its customer (i.e. lunch/dinner-talks, joining the same club) are all strongly recommended.

1.3 **Absorptive capacity:** This is a dynamic capability considered as vital to enhancing a company's competitive advantage. The two main components (potential and realized absorptive capacity) are simultaneously examined to find their different roles and impacts. The findings reveal that realized absorptive capacity has a stronger

influence than potential absorptive capacity on innovation, especially management innovation. As such, absorptive capacity is a crucial factor upon which the firm must focus and pay great attention to in order to sustain and/or achieve innovation. The recommendation for managing absorptive capacity is that a company must pay close attention to both potential and realized absorptive capacity, including the four sub-dimensions of acquisition, assimilation, transformation and exploitation capability. Although the study reveals that the impact on innovation of realized absorptive capacity (i.e. transformation and exploitation capability/dimension) is dramatically positive and stronger than the impact of potential absorptive capacity (i.e. acquisition and assimilation capability/dimension), a company must focus on both components/subsets of absorptive capacity. The findings clearly show that potential absorptive capacity is also strongly positively related to realized absorptive capacity.

This is consistent with the literature reviewed, with the reasons based on the absorptive capacity theoretical framework (Zahra and George, 2002) since potential and realized absorptive capacity have separate but complementary roles. Both subsets of absorptive capacity coexist at all times and fulfill a necessary but insufficient condition to improve firm's competitiveness on their own. The point here is the efficiency factor created between realized absorptive capacity and potential absorptive capacity. It is recognized that firms vary in their ability to create value from their knowledge base because of variations in their ability to transform and exploit knowledge. In firms with a high efficiency factor, realized absorptive capacity can approach potential absorptive capacity (Zahra and George, 2002). In other words, firms that achieve/maintain a high efficiency factor created primarily through realized

absorptive capacity can more easily increase their competitive advantage. Therefore, supporting actions/activities considered as efficiency factors (i.e. establishing social integration mechanism between units/functions within firm) of realized and potential absorptive capacity are strongly recommended.

The findings of the simultaneous testing of two components of absorptive capacity provide a solid explanation as to why certain firms are more efficient than others in using absorptive capacity. Despite the importance of potential absorptive capacity, realized absorptive capacity is the primary source of innovation, particularly management innovation. The study reveals that potential absorptive capacity has no significant influence on management innovation while realized absorptive capacity has strong impact on both marketing and management innovation. This difference between potential absorptive capacity and realized absorptive capacity shows that some firms are inefficient in leveraging their potential absorptive capacity and therefore cannot improve management innovation. As such, these findings are useful for creation of different strategies for how these two components contribute toward building competitive advantage in terms of innovation.

Another interesting finding for absorptive capacity is the development of a new multi-item scale measurement. The study modifies the multi-item scale used as a subjective measurement in order to support and complement the traditional proxy index used as an objective measurement of absorptive capacity. The strong reliability and validity measurement after confirmatory factor analysis ensures the applicability and usefulness of the scale. Similarly, the multi-item scale measurement of marketing

innovation and management innovation initiated and adapted from literature and interviews is acceptable and satisfactory. These findings are important for not only filling in the gaps, but also extend the body of research knowledge for further study.

In sum, the study provides many interesting findings such as a new antecedent drawing on the spillover channel framework, new outcome/consequence (marketing and management innovation), new multi-item scale measurement, and a distinctive management of the different roles of potential and realized absorptive capacity. These findings can be applied for effective management of absorptive capacity (more details in the contribution section). Other findings of interest encourage discussion relating to the moderating and mediating effects. The interesting findings suggests this absorptive capacity conceptual model as applicable in a Thai setting, as seen in Figure 6.3.

Figure 6.3 Absorptive capacity research conceptual model
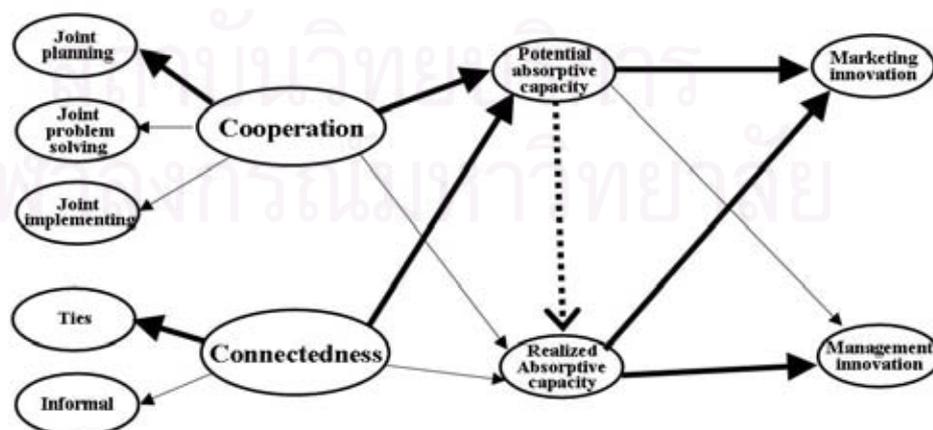
2. Findings of moderating effect (Spiller/Source of knowledge spillovers)

This study examines the robustness and moderating effect. The proposed absorptive capacity structural model is investigated by multi-group invariance analysis. Based on two groups of spiller or sources of knowledge spillovers (MNE and Thai customers), the findings show that there is a moderating effect depending on the spillers. Most of the relationship paths between MNE and Thai customer subgroups are the same, except four paths (i.e. the path of connectedness to absorptive capacity in the main hypotheses study and the two paths of connectedness to potential absorptive capacity, potential absorptive capacity to innovation, and realized absorptive capacity to innovation in the sub-hypotheses study). These findings provide further insights as follows:

2.1 MNE customer group: This is recognized as the main spiller in 161 respondent firms in this study. The result of multi-group invariance analysis shows that the relationship path of connectedness between a firm and its MNE customer to both potential and realized absorptive capacity is not significant. Thus, connectedness actions/activities (i.e. ties strength and informal contact/communication) between a firm and its MNE customer are not an applicable mechanism to generate acquisition, assimilation, transformation, and exploitation capability. It was found that only realized absorptive capacity has influence on innovation (both marketing and management innovation).

Instead of connectedness, therefore, a firm should utilize more cooperation actions/activities, especially joint planning, between itself and its MNE customer in order to strengthen its absorptive capacity, particularly potential absorptive capacity. To achieve innovation, the firm should place greater emphasis on managing realized absorptive capacity. To this end, integration mechanisms or efficiency factors within a firm (i.e. effective organizational structure, interfaced communication system, etc.) acting as links to potential absorptive capacity and realized absorptive capacity are also strongly recommended.

2.2 Thai customer group: This is acknowledged as the main spiller in 144 respondent firms in this study. In contrast to the MNE customer group, results show a strong relationship between connectedness and potential absorptive capacity. In other words, connectedness - especially ties strength - between a firm and its Thai customers is a beneficial mechanism by which it can strengthen its acquisition capability and assimilation capability. Potential absorptive capacity has a more significant influence and stronger power than realized absorptive capacity on innovation.

Compared to the MNE customer, both cooperation and connectedness actions/activities between a company and its Thai customer can be used to increase its absorptive capacity, particularly potential absorptive capacity. Importantly, a firm can directly concentrate on managing potential absorptive capacity to enhance innovation. It implies that acquisition and assimilation capability play vital role in accomplishing innovation when the spiller is a Thai customer. However, comparison of the

effectiveness and efficiency of innovation occurring from different spillers are out of the scope of this study. Figure 6.4 and Figure 6.5 illustrate the results of the absorptive capacity model based on different spillers, the MNE customer and Thai customer.

Figure 6.4: Absorptive capacity model based on MNE customer as spiller
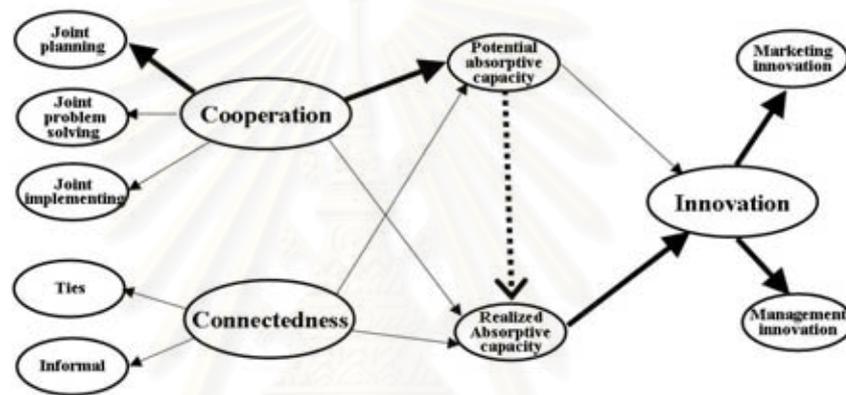
Figure 6.5: Absorptive capacity model based on Thai customer as spiller
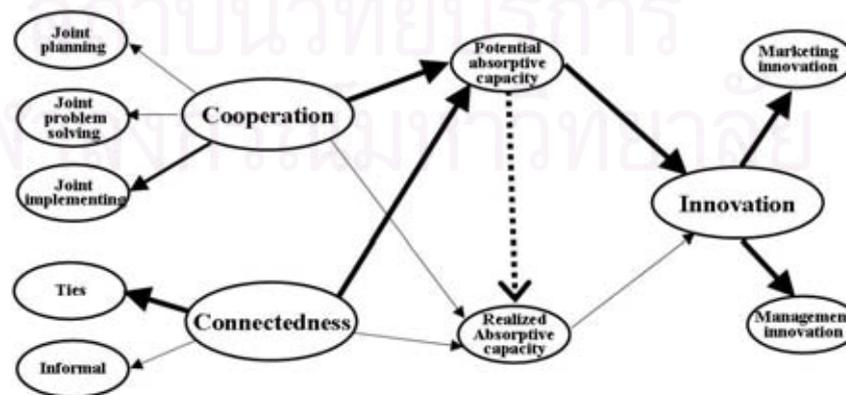
3. Findings of mediating effect (absorptive capacity)

This study is aimed at gap-filling and to this end, many gaps in the absorptive capacity conceptual model have been filled and discussed, such as the simultaneous testing of two main components, new factors provided (antecedent and outcome), the development of a multi-item scale index for subjective measurement, and the new view of a strong effective intervening role. In order to better understand the strong mediating effect of absorptive capacity, the study elaborates and provides additional testing for more discussion.

According to Preacher and Hayes (2004), a variable is considered a mediator to the extent to which it carries the influence of a given independent variable (IV) to a given dependent variable (DV). In general, mediation can be said to occur when (1) the IV significantly affects the mediator, (2) the IV significantly affects the DV in the absence of the mediator, (3) the mediator has a significant unique effect on the DV, and (4) the effect of the IV on the DV shrinks upon the addition of the mediator to the model. These criteria can be used to informally judge whether or not mediation is occurring. The test for mediation can be performed using two methods. The first method is the analysis of direct, indirect, and total effects in the structural equation modeling (SEM). This method yields coefficients of all exogenous and mediating factors together with the predictive indicator such as r^2 of each variable. To enable mediation effect testing, thus, new paths are intentionally added to see all direct, indirect and total effects. Figure 6.6, Table 6.1 and Table 6.2 show all results of this specific structural model of absorptive capacity for mediation testing purpose.

Figure 6.6: Specific structural model for mediation effect testing
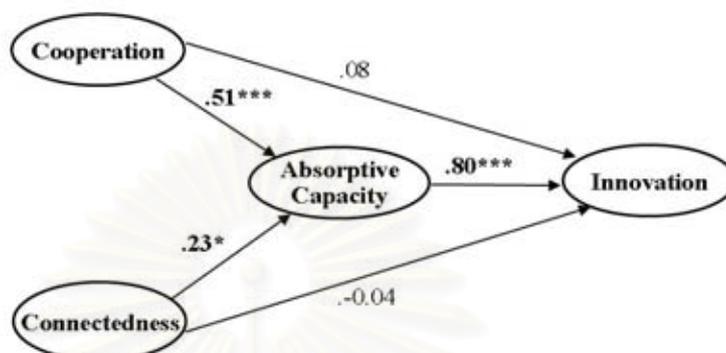
Table 6.1: Mediation effect testing: Parameter estimation and the significance test

Paths of relationships	Estimated Relationship Coefficients		S.E.	C.R.	*p-value*
	Unstandardized	Standardized			
COOP ⟶ ACAP	0.343	0.512	0.063	5.465	0.000
CONN ⟶ ACAP	0.186	0.225	0.077	2.413	0.016
ACAP ⟶ INNO	1.108	0.805	0.135	8.232	0.000
COOP ⟶ INNO	0.072	0.078	0.080	0.900	0.368
CONN ⟶ INNO	-0.042	-0.036	0.095	-0.436	0.663

Note: 1. COOP = Cooperation; CONN= Connectedness; ACAP= Absorptive capacity; INNO= Innovation
    2. *t*-value is significant at * *p-value* < 0.05, ** *p-value* < 0.01, *** *p-value* < 0.001

Table 6.2: Direct effects, indirect effects, and total effects of the relationships

Relationship paths	Unstandardized			Standardized		
	Direct	Indirect	Total	Direct	Indirect	Total
COOP ⟶ ACAP	0.343		0.348	0.512		0.512
CONN ⟶ ACAP	0.186		0.186	0.225		0.225
ACAP ⟶ INNO	1.108		1.108	0.805		0.805
COOP ⟶ INNO	0.072	0.380	0.452	0.078	**0.412**	0.491
CONN ⟶ INNO	-0.042	0.207	0.165	-0.036	**0.181**	0.145

The testing reveals that the relationship between cooperation/connectedness and innovation is not statistically significant, which is not surprising since the study did not hypothesize these relationships. Based on the spillover concept, cooperation and connectedness in this study are different from previous studies, dealing with cooperation/connectedness actions/activities between partners regardless of contractual agreement and possibly consisting of informal contracts or routine tasks/patterns. The main point is occurrence of knowledge transfer from leakage or unintentional purposes, which is called 'spillovers'. Thus, the effect on innovation should be mediated by absorptive capacity.

The results shown in Table 6.2 suggest that while the direct relationship between cooperation/connectedness and innovation are not statistically significant, the regression coefficients for the indirect relationship are estimated at 0.38 and 0.27, respectively. In this case, cooperation and connectedness can influence innovation through absorptive capacity. The significance of these mediating effects can be further tested by the Sobel test as recommended by MacKinnon et al. (1995), detailed in the second method.

The second method is the significance test of mediating relationships. Instead of using traditional calculation, MacKinnon and Dwyer (1993) and MacKinnon et al. (1995) have popularized a statistically based method by which mediation may be formally assessed, called the "Sobel test". The purpose of the Sobel test is to test whether a mediator carries the influence of an independent to a

dependent variable. The formula for Sobel test is as follows (MacKinnon et al., 1995):

$$z\text{-value} = a*b/\text{SQRT}(b^2*s_a^2 + a^2*s_b^2)$$

where; a = raw (unstandardized) regression coefficient for the association between independent variable and mediator.
s_a = standard error of a.
b = raw coefficient for the association between the mediator and the DV (when the IV is also a predictor of the DV).
s_b = standard error of b.

The reported *p-values* are drawn from the unit normal distribution under the assumption of a two-tailed *z-test* of the hypothesis that the mediated effect equals zero in the population. The calculation is based on the results of a specific structural model (Figure 6.6). For the significance of the mediating effect of absorptive capacity on the relationship between cooperation and innovation, the value of a, b, s_a, and s_b are equal to 0.343, 0.063, 1.108, 0.135 respectively. The calculated *z-value* is 7.246 which indicates that the mediating effect of absorptive capacity is significant at *p-value* < 0.001. Similarly, the significance of the mediating effect of absorptive capacity on the relationship between connectedness and innovation, has a value of a, b, s_a, and s_b equal to 0.186, 0.077, 1.108, 0.135 respectively. The calculated *z-value* is 3.164 which indicates that the mediating effect of absorptive capacity is significant at *p-value* < 0.001.

Thus, this additional testing shows that there is significance for absorptive capacity in the role of mediator. This finding supports the main purpose of this study, which is to investigate and show a new view of a strong effective intervening role of absorptive capacity.

In conclusion, this section provides a research summary as well as interesting findings and discussion. The research objectives and research questions are all completed based on the literature review and data analysis. The contribution and implication are then evaluated and supported in the next section.

6.2 The Contribution of the Study

This study provides several contributions, both theoretical and modeling and methodological. The details are discussed below.

6.2.1Theoretical and Modeling Contribution

Since one main objective of this study is to fill some research gaps, most of the results of the study show various benefits in the sense of theory and model completion. Thus, the theoretical and modeling contribution of this study can be seen in many aspects as follows:

1. Gap-filling and empirically testing the completion of an absorptive capacity re-conceptual model. Previous studies in absorptive capacity paid attention to either its important factors/outcomes or its dimensions/measurements. None has filled in all gaps by testing the completion of the framework at the same time, which this study does do. In addition, the recent absorptive capacity re-conceptualization by Zahra and George (2002) proposes a full model and implies the importance of the mediator role of absorptive capacity. This study broadens the absorptive capacity

concept and concurrently fills many gaps relating to the re-conceptual model. The empirical test of the study shows that all gaps regarding the absorptive capacity concept are filled and supports the claim that well-managed absorptive capacity is a strategic tool for competitive advantage, particularly innovation.

2. Broadening the spillover channel concept. Previous literature found that the diffusion channel affects absorptive capacity. Diffusion channels in previous studies were defined as formal channels based on contractual agreements between partners, such as licensing or purchase of equipment (Liu et.al., 2003). This study broadens the channel concept into a spillover channel that is informal and based on leakage/spillovers such as linkage effect, human mobility, and demonstration effect, a construct that has been overlooked and neglected. This study develops the spillover channel concept and initiates its characteristics into a multi-dimensional variable called the 'spillover channel mechanism' consisting of the cooperation and connectedness dimensions.

Then, the spillover channel mechanism is examined to discover if there is any influence on absorptive capacity and innovation. The results show positive and significant direct effects on a company's absorptive capacity and indirect effects on innovation. Thus, any company's decisions on this core competency issue should take this special mechanism into account, specifically looking at: 1) cooperation (how joint planning activities can be increased, how to set up and increase other joint problem solving or joint implementing activities between partners); and 2) connectedness (if and how strong tie strength is with a customer, how to increase the

degree of ties). The empirical test of this study implicitly confirms the spillover channel mechanism as a new and effective tool to manage absorptive capacity. In other words, the study highlights the important role of task-oriented (cooperation) and people-oriented (connectedness) mechanisms on creation of the core competency for a company. Companies are encouraged to pay more attention to these factors, both now and in the future.

3. Building an integrated framework that incorporates knowledge spillovers, absorptive capacity, and competitive advantage. Previous literature paid attention to firm success or competitiveness regardless of its absorptive capacity and knowledge spillovers. None explored how to select and manage absorptive capacity as a strategic tool for innovation creation. This study establishes new linkages/relationships among all constructs. According to Meyer (2004), the studies of absorptive capacity and knowledge spillovers are crucial with the upward trend for growth of foreign direct investment (FDI) but seldom studied in international business (IB). The difficulty of measurement and creation of new linkages, means the study of absorptive capacity and knowledge spillovers should be more prevalent and considered as advance research, particularly in the IB arena. Thus, this study contributes not only to filling the gaps but also to advanced research, responding with new insights into the integrated framework of knowledge spillovers, absorptive capacity, and innovation.

4. Adding new variables/constructs to increase alternatives in absorptive capacity creation, particularly potential absorptive capacity. This study adds: (1) joint planning; (2) ties strength; (3) joint implementation (for only the Thai customer group).

a) Joint planning in previous studies refers to one pattern in formal actions/activities between partners (Te'eni, 2000). The emphasis on cooperation with partners lies in a company's decision on whether it will cooperate only within the contractual agreement or not. Traditional thought is that when joint planning in cooperation occurs without contractual agreements, the degree of knowledge transfer tends to be low and thus this is rarely a focus for companies. This study shows different paradigm. Despite occurring from spillovers, joint planning in this study is shown as an important factor influencing innovation through the mediated effect of absorptive capacity. The significant and positive effect of joint planning adds a new alternative for absorptive capacity creation, particularly potential absorptive capacity.

b) Ties strength is used in traditional studies as a common construct in communication literature. It is developed from previous studies and in-depth interviews. In order to explore the importance of this role, the concept of degree of tie is developed and tested to find the direct and indirect impact on absorptive capacity and innovation. It is discovered that the tie strength between a company and its customer is a significant factor influencing its absorptive capacity, especially when the tie strength is with the Thai customer. Although the power of tie strength has little effect on realized absorptive capacity, its effect on potential absorptive capacity is

acceptable and satisfactory. This study thus claims a contribution that tie strength is a critical construct developed as a new alternative for absorptive capacity creation.

c). Joint implementing refers to the extent to which the behavior in the relationships captures the degree of joint solutions to relevant problems. As with joint planning, companies seldom are concerned about joint implementing actions/activities if not covered by a contractual agreement. Within the new paradigm based on the spillover channel framework, joint implementing in this study seems an interesting factor affecting innovation through the mediated influences of potential absorptive capacity, but it is an applicable tool for interaction with Thai customers only. However, the positive value and relative significance of joint implementing contributes to add a new alternative.

5. Providing a test of the indirect relationship between the spillover channel mechanism and innovation, where absorptive capacity is determined as an important mediator for this relation, which previous research has never done. The results confirm that absorptive capacity (both potential absorptive capacity and realized absorptive capacity) is an important mediator for a firm's competitive advantage, particularly innovation, as expected. As seen in the findings of the mediating effect as reported in the previous section, the importance of the mediating role of absorptive capacity is illustrated, both the power and the significance of its mediation. In sum, absorptive capacity has mediation power and its mediation power as calculated using the Sobel test is dramatically significant at *p-value* < 0.001.

6. Serving as a theoretical replication of theories related to absorptive capacity and knowledge spillovers. The study develops the proposed model from theory initiated in a Western environment and tests the theoretical applicability in an emerging Eastern country such as Thailand.

6.2.2 Methodological Contribution

The study shows methodological contribution in terms of scale/ measurement development, completion of dimension testing, and research methodology as follows:

1. The completion test for multiple dimensions of absorptive capacity. Since the two components of absorptive capacity dealt with here are important but with different roles, the study develops and examines each component separately. Based on literature reviews and interviews, the two components of absorptive capacity are measured and tested and capture all four dimensions of absorptive capacity simultaneously, whereas previous research did not capture all dimensions. Thus, the study contributes to gap-filling research in the sense of completing multi-dimensional testing.

2. Adding the multi-item scale index measurement for the absorptive capacity construct. Previous studies always examined absorptive capacity using R&D investment or R&D expenditure as a proxy. Since absorptive capacity is crucial to determining competitive advantage as a core competency, determination should not

depend upon only objective measurement. The development of subjective measurement for absorptive capacity in this study adds more benefit and validity to the measurement issue.

3. Initiating and developing a new multi-item scale measurement for innovation, particularly marketing innovation and management innovation. Based on previous literature and interviews, the study develops a new multi-item scale for marketing and management innovation. The results show high reliability and validity of these new scale/measurement indices not only in exploratory factor analysis but also in confirmatory factor analysis.

4. Using multiple approaches for data collection. This study uses both qualitative and quantitative research methods for data collection, including in-depth interviews, mailed surveys, and follow-up interviews to obtain various types of information essential for analysis and meaningful interpretation.

In sum, the study provides theoretical, modeling, and methodological contributions such as gap-filling and broadening of the absorptive capacity concept as well as the spillover channel concept, building an integrated framework, adding new variables and so on.

6.3 The Implication of the study

The results of this study provide many implications for both the management and policy levels.

6.3.1 Managerial Implication

This study provides at least three managerial implications in this study:

1. Better decisions on strategic planning. The conceptual model and the empirical findings have specific implications for management decisions pertaining to improving absorptive capacity. For instance, Williamson (1967) argues that information gets lost or at least distorted if it is transferred through different layers of hierarchy. Thus, direct contact among employees from different departments, units and the like should lead to a more efficient transfer of knowledge and a subsequently higher absorptive capacity.

2. Providing criteria for faster decision making. According to important factors affecting outcomes via management of absorptive capacity found in this study, managers may concentrate on set criteria such as an 'absorptive capacity management checklist' when formulating strategic plans or when auditing their strategies. Table 6.3 shows an example of a checklist.

3. Providing guidelines for management in strengthening absorptive capacity. The overall findings offer strong empirical support for the intuitive notion that well-managed absorptive capacity can increase both marketing innovation and management innovation. In addition, the findings demonstrate the importance of each element of the spillover channel mechanism that can help firm make more rapid decisions on using cooperation or connectedness in the right direction, including

striving to meet management's desired absorptive capacity level, illustrating effective selection and management of their spillover channel mechanism and absorptive capacity.

In addition, the study recommends that pursuing success means firms need to focus on how to select appropriate a spillover channel mechanism that matches different customers. For the multinational enterprise (MNE) customer, it is essential to allocate resources with emphasis on cooperation in order to enhance absorptive capacity, especially potential absorptive capacity. For Thai customers, it is more important to allocate resources by emphasizing cooperation and connectedness to improve the potential absorptive capacity of the firm.

Further guidelines in managing absorptive capacity are discussed in specific aspects (see more details in Table 6.3) as follows:

 a) To increase potential absorptive capacity effectiveness, firms should put more efforts on joint planning and degree of tie strength. In particular, with the MNE customer, joint planning should be emphasized regardless of whether it is covered contractually or not. For the Thai customer, attention should be paid to the degree of tie strength and joint implementing actions/activities. Unlike with an MNE customer, a company can appropriate an effective spillover channel mechanism through both cooperation and connectedness actions/activities between it and its Thai customer.

b) To increase realized absorptive capacity efficiency, companies should place more emphasis on increasing potential absorptive capacity, since potential and realized absorptive capacity have complementary roles. Both subsets of absorptive capacity coexist at all times and fulfill a necessary but insufficient condition to improve a company's performance on their own. Firms cannot possibly exploit knowledge without first acquiring it. According to Zahra and George (2002), realized absorptive capacity involves transforming and exploiting the assimilated knowledge by incorporating it into the firm's operations. Thus, it implies that potential absorptive capacity has effects on or linkages to realized absorptive capacity. This study confirms that realized absorptive capacity is positively and significantly influenced by potential absorptive capacity. In order to increase realized absorptive capacity, thus, strategies should focus on increasing of potential absorptive capacity.

In order to increase the relationship between potential absorptive capacity and realized absorptive capacity, in addition, firms should look to improving social integration mechanisms within firms. Although social integration mechanisms can facilitate the sharing and eventual exploitation of knowledge, there are several barriers within components of the social mechanism, such as structural (Garvin, 1993), cognitive (Garud and Nayyar, 1994), behavioral (David, 1985), and political (Foster, 1986), that may stifle knowledge sharing and integration. In general, these dimensions of social interaction influence the creation of knowledge (Zahra and George,2002). Firms that use social integration mechanisms to build connections within firms are therefore positioned to make their employees aware of the types of data that constitute their potential absorptive capacity. These mechanisms also

facilitate the free flow of information, allowing the firm to transform and exploit this information. Consequently, social integration mechanisms can reduce or lower barriers to information sharing and increase efficiency of assimilation capability and transformation capability of potential absorptive capacity and realized absorptive capacity.

c) To increase marketing innovation, companies should pay more attention to managing realized absorptive capacity and potential absorptive capacity. In particular, if the spiller/source of knowledge spillover is an MNE customer, the company should emphasize well-developed realized absorptive capacity; if the spiller is a Thai customer, firms should place more emphasis on well-managed potential absorptive capacity.

d) To increase management innovation, a company should highlight adding and developing realized absorptive capacity towards transformation capability and exploitation capability since the relationship path of potential absorptive capacity and management innovation is not significant in a direct line. However, the path of potential absorptive capacity and realized absorptive capacity is strongly positive and significant. Thus, the firm should take care to increase potential absorptive capacity comprising of acquisition and assimilation capability. Implicitly, the accomplishment of marketing innovation depends upon improving and developing not only realized absorptive capacity but also potential absorptive capacity. Potential absorptive capacity should be firstly be put into practice.

Firms should emphasize different strategies to enhance marketing innovation with different customers. For MNE customers, for example, firms should put more attention upon managing realized absorptive capacity. In contrast, firms should pursue better management of potential absorptive capacity for their Thai customers. In order to improve understanding, this study provides a summary of management guidelines with a checklist for effective and efficient managing of absorptive capacity and innovation. Table 6.3 summarizes the special management guidelines based on the results of the study.

Table 6.3 Summary of management guidelines

Alternative to increase Absorptive Capacity (ACAP)	Sequence of Emphasized strategies to well-managed ACAP		
	Overall	**If spiller is MNE-customer**	**If spiller is Thai-customer**
Absorptive capacity (ACAP)	1. ↑ Cooperation 2. ↑ Connectedness	1. ↑ Cooperation	1. ↑ Cooperation 2. ↑ Connectedness
Potential absorptive capacity	1. ↑ Joint planning 2. ↑ Tie strength	1. ↑ Joint planning	1. ↑ Tie strength 2. ↑ Joint implementing
Realized absorptive capacity	1. ↑ Potential-ACAP	1. ↑ Potential-ACAP	1. ↑ Potential-ACAP
Alternative to increase innovation	**Sequence of Emphasized strategies to enhance innovation**		
Innovation	1. ↑ ACAP 2. ↑ Realized-ACAP 3. ↑ Potential-ACAP	1. ↑ ACAP 2. ↑ Realized-ACAP	1. ↑ ACAP 2. ↑ Potential-ACAP 3. ↑ Realized-ACAP
Marketing innovation	1. ↑ Realized-ACAP 2. ↑ Potential-ACAP	1. ↑ Realized-ACAP	1. ↑ Potential-ACAP
Management innovation	1. ↑ Realized-ACAP	1. ↑ Realized-ACAP	1. ↑ Potential-ACAP

Source : The author

Note : The sequence of emphasized strategy is arranged from the highest power of estimated parameter coefficient value to the lowest power of that value

6.3.2 Public policy Implications

The results of the study of the absorptive capacity conceptual model, including its new antecedent and consequence, show a variety of academic and managerial viewpoints. These points have beneficial implications not only for company management but at the public sector policy level. Since the Thai government is fully aware of the importance of developing and strengthening SMEs in order to propel them into becoming the main driver of national economic development, many related public offices, government agencies and organizations must perform their duties in carrying out these policies.

The findings from this study can help those agencies and organizations formulate a better plan and implementation of SME promotion, whether in terms of business consultant, feasibility study, financial facilities, export promotion, or market expansion. The results of the study not only provide insightful information to help better understand the important role of absorptive capacity to achieve innovation, but also to guide in the creation of alternative actions/activities from the spillover channel mechanism for effective policy implementation. Details of the applicability of the research findings to policy makers are given below.

1. Improve the managerial competency of Electrical and Electronics (E&E) firms. The government should provide SME managers or new entrepreneurs with sufficient information to assist them to increase competitiveness and ability to keep up with global changes. For instance, consulting, training, and educating managers

should be conducted sequentially in order to better understand (1) how to select and manage their spillover channel mechanisms; (2) how the relevant element/factor of spillover channel mechanism such as cooperation and connectedness influence their absorptive capacity and innovation and how the impact of these factors vary with respect to type of customer; (3) how cooperation and connectedness help to improve absorptive capacity and innovation; and (4) how to develop firm's strength/core competency in those areas in a creative way.

2. Provide directions for better strategic planning support. For example, the results of this study suggest that joint planning action/activity between a company and its customers is an important and effective mechanism to facilitate its potential absorptive capacity, especially with MNE customers. In order to promote this particular interaction growth, the government should establish direct channels for networking or clustering so that E&E firms and their MNE customers have a greater chance to set joint plans together in specific areas such as control systems, marketing mix programs, and/or new products launched in that channel. In addition, the government should pay attention to solving problems in indirect channels such as modern trade in which small E&E firms do not have many cooperative actions/activities with MNE customers. This means there is less chance they can improve their absorptive capacity, which will critically affect its innovation.

Based on the suggestions above, the government should provide the following supports: (1) arranging trade fairs or marketing events (e.g. E&E consolidation conferences/seminars, E&E road show, E&E knowledge dissemination

meetings, etc.); and (2) establishing an E&E center with a comfortable environment to support interaction between partners, and this would include seminar rooms, rooms set aside for planning, etc. It would also be ideal to set up an effective website that would provide a database and be accessible by all E&E firms and related E&E industry without charge or at low cost.

Recently, there is the concept emerging of setting up 'industrial districts'. This concept involves establishing an area for specialized industrial production. This is closely related to the work of Marshall (1925) and his theory of external economies, which can develop within an agglomeration of firms in the same industry. These external economies are a result of links between firms, organizations and institutions within a geographical area. The external economies include access to a labor market with specialized skills and the development of specialized inputs and services, and knowledge spillovers that arise. Thus, this nature of external economies will lower transaction costs and raise benefits of firms in that district (Pilotti 2000). In other words, this concept encourages the development of knowledge spillovers to give firms an advantage not only in lower transaction costs but also access to knowledge and experience developed in other firms. Literature would suggest that the government should continue to act on this concept and apply this particularly to the E&E industry.

3. Provide advanced research and educational opportunity. The government should support future research and educational programs focused on the (knowledge) spillover channel mechanism and absorptive capacity as new and critical areas to

enhance competitiveness. In order to succeed in this implication, collaboration between the government, E&E firms, and academic institutions is strongly recommended. This would result in initiation and development of suitable educational programs and advanced research topics. For example, a training program in relevant topics (i.e. strategy for effective and competitive absorptive capacity management, tactics for incoming knowledge spillover achievement) would be provided.

In sum, the spillover channel mechanism is a necessary and important strategic tool to not only strengthen and facilitate a company's absorptive capacity, but also indirectly to supporting and enhancing its innovation. These mechanisms should no longer be overlooked. Importantly, the spillover channel mechanism cannot be effectively used without the mediating role of absorptive capacity. Thus, the crucial issue is managing absorptive capacity with effectiveness and efficiency. At the very least, this study provides a new indicator for increasing and developing absorptive capacity. In addition, the study of absorptive capability comprising potential and realized absorptive capacity offers intriguing insights for both researchers and practitioners. Since absorptive capacity is acknowledged as a multifaceted construct in which one facet is important core competence, the new insights from this study can be both useful and helpful to develop strategic plans for sustainable competitive advantages. Therefore, management of absorptive capacity has emerged as an issue creating value to firms, society, and the country for a better future.

6.4 Limitations and Suggestions for Future Research

Although the study achieves its objectives and completely answers all questions and makes both theoretical contributions and managerial implications, there are limitations to the study, such as the type of research, scope of the study, and the generalizability since it was a single industry approach. Thus, future research is suggested to not only overcome the limitations but also extend the body of knowledge in this particular area.

6.4.1 Limitations

Similar to other studies, perfect research is impossible. There are three main limitations in this study.

1. The type of research survey. This study is a cross-sectional research survey. As previously mentioned, most constructs in the study may be prevalent in a longitudinal study. Since some constructs relate to characteristics of process such as cooperation and absorptive capacity, it implies that those constructs occur but are time-consuming. The more time spent, the better the affect. Therefore, replicated research using a longitudinal survey is suggested in the future research to overcome this limitation. In addition, this study examines the relationship between firms and customers only on the demand side of the supply chain, excluding the supply side, which may show different results using the supplier-manufacturer relationship

viewpoint. Thus, future research capturing both supply and demand sides is needed and would be valuable to complete the dimensionality of innovation.

2. The generalizability of the study. Internal validity considerations often take precedence over external validity and the results, even though strong, are limited to their generalizability. Since this study concerns only one industry, Electronics and Electrical (E&E), the generalizability of the findings to other industries should be made with care. As such, future study would increase the understanding of the construct by adopting the following research suggestions.

3. Some important factors may have been omitted. Despite the time and effort devoted to the study, some important factors may have been omitted. Thus, a more comprehensive conceptual framework related to relevant knowledge spillover and absorptive capacity construct need to be developed and examined empirically in the future. For example, relationship of variables (power, conflict, commitment) or the characteristics of knowledge variables (tacit, explicit) should be explored thoroughly.

6.4.2 Suggestions for Future Research

Based on the limitations of the study, the specific suggestions for future research are provided as follows:

1. A longitudinal survey research designed to collect data from the same sample over a period of time should be considered. As with a learning process, absorptive capacity should be considered as time-consuming process. Therefore, it may be fruitful to explore the absorptive capacity in terms of absorption process by using a longitudinal study.

2. Since the generalizability of the empirical results should be considered, future studies might focus on different industries to assess the validity of the role of the spillover channel mechanism in a firm's absorptive capacity and the innovation relationships found in this study. Although the conceptual framework appears to be broadly applicable to any category of manufacturing, it must be verified. For instance, it would be interesting to investigate whether the model remains workable in the services sector, such as financial consultant, law firms, banking, retail versus wholesale, and so on. It should be recognized that the weighted importance of each variable seems to be varied across industries, particularly absorptive capacity construct. For example, absorptive capacity may be more important for knowledge-based sector but it might be less crucial in some service-based sectors.

3. In order to best study the absorptive capacity model framework, future research should add considerations on the complexity and segment of absorptive capacity. For instance, the target population should be segmented based on absorptive capacity of the individual, social bonding characteristics within firms, and the environment supporting the

absorption process. In addition, a future study focusing on the sophistication and complexity of the absorption process should closely consider the four dimensions of absorptive capacity instead of two components since it may more clearly illustrate the different results of each dimensional effect.

This study opens up three interesting issues for future research, particularly in the international business arena. The first is the need to replicate this research model by studying other industries, such as another business in the knowledge-based industry (i.e. automotive business), non-knowledge based industry (i.e. retail business), and service industry (i.e. banking, insurance business), where a spillover channel mechanism (cooperation and connectedness) between company and customer exists. For example, recent research reveals that inter-organizational connectivity becomes a solid ground for customer integration in the automotive industry whereas a close connection with the customer seems to have more effect on company value and competitiveness in hypermarkets, since these businesses have more chance to interact with their customers, it is possible to obtain the same result but see a different impact from the spillover channel mechanism. Such a study should propose to find out whether the results are applicable, useful and generalizable. However, replication of this research model should be done with caution, with the research design and methodology depending upon the characteristics of firm-customer relationship in each industry.

Secondly, this study selects the relationship between firms and their customers which is downstream integration or demand-side in the supply chain relationship. However, the supply-side or upstream integration in supply chain management such as the relationship between firms and their suppliers should be considered in future research. The study of complete upstream and downstream integration in supply chain will give more value and help discover the difference in spillover channel mechanisms used downstream and upstream in supply chain management. The result may be used in the creation and development of suitable strategies for different sides of the supply chain integration. Thus, future research should capture both demand and supply sides together. In addition, replication of this research model should add more relevant supply chain integration variables such as supplier integration factors (i.e. trust, commitment) and customer integration factors (i.e. communication, resource sharing, and information compatibility) in order to have a research model that offers a complete view of supply chain integration.

Finally, the study indicates the importance of potential absorptive capacity affecting realized absorptive capacity. Although it is consistent with the literature, there are still few detailed studies of the crucial relationship. This study proposes and suggests that the social integration mechanism (i.e. organizational communication, organizational flat-structure) within a firm plays a pivotal role in this relationship path. However, it should be explored, empirically tested, and extended to include any new determinants/factors representing effective and efficient social integration mechanism. For example, recent research reveals that the proximity between firms, the style of leadership, and competition and/or cooperative situation are all factors

affecting the potential to transform knowledge in each step of the learning process for each firm within same cluster. It is possible to posit that these factors may be an effective social integration mechanism that will facilitate the relationship between potential absorptive capacity and realized absorptive capacity. Therefore, future research is recommended to find out what important factors are used to link potential absorptive capacity to realized absorptive capacity and how this is accomplished.

In conclusion, this study is the first important step in validating the role of the knowledge spillover channel, a company's absorptive capacity, and the relationship to innovation. For scholars, the implications of the findings appear to be precise. Future research should replicate the model in diverse situations with mixed environments and over time in order to increase confidence in the nature and power of the conceptual framework. For managers, the implications provide a more understandable and clearer viewpoint on their company's absorption capability. Although generalizability of the results is limited given the exploratory nature of the research, another research replicating and testing the proposed model used in this study is called for. When similar results are produced, managerial implications can be made more precisely. Substantial absorptive capacity then must be a foundation for business success and sustainable competitive advantage.

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APPENDIX A:

Research questionnaire

Managing Absorptive Capacity:
The Effect of Spillover Channel Mechanism and The Impact on Innovation
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This study consists of five sections and takes about 20 minutes to finish. Please be assured that your response is **strictly confidential** and only aggregate results are reported.

Section 1 : About yourself and your company

Instruction: Please mark (**X**) at your response in the following questions. For the question with blank spaces, please fill in the number or contents.

1. Does your specific job in the company involve the management that concerns on setting or developing new process / program/ practices dealing with your company as a whole?
   ☐ Yes
   ☐ No (Please forward this questionnaire to the person you see fit for. Thank you)

2. Which category best describes your position?
   ☐ President, Owner
   ☐ Chief Executive Officer, Managing Director, General Manager
   ☐ Chief Operation Officer
   ☐ Deputy Managing Director, Assistant General Manager
   ☐ Other please specify_____

3. What category is your business in E&E industry according to the classification of BOI?
   ☐ Electrical category
   ○ Industrial equipments
   ○ Consumer electrical products
   ○ Parts and components
   ○ Integrated production of electrical appliances or parts
   ○ Other please specify_____

   ☐ Electronic category
   ○ Industrial equipments
   ○ Consumer electronic products
   ○ Parts and supplies
   ○ Integrated production of electronic products
   ○ Material for micro-electronics
   ○ Electronic design
   ○ Other please specify_____

   ☐ Related to electrical and electronic category
   ○ Software
   ○ E-commerce
   ○ Other please specify_____

4. How long has your company been in the electrical and electronics industry?
   ☐ Less than 1 year   ☐ 1-3 years   ☐ 4-5 years
   ☐ 6-10 years   ☐ 11-20 years   ☐ more than 20 years

5. How many employees (salary and man-day earners) are there in your company?
   ☐ Less than 10   ☐ 10-49   ☐ 50-99
   ☐ 100-199   ☐ 200-499   ☐ more than 500

6. What is your company employee turnover rate within one year?
- ☐ Less than 1%   ☐ 1-3%   ☐ 4-5%
- ☐ 6-10%   ☐ 11-15%   ☐ More than 15%

7. Does your company have R&D unit/department or business development unit/department?
- ☐ No
- ☐ Yes please specify the number of staff _____

8. In the year 2005, what was your company total annual sale?
- ☐ less than 100 M.bht.   ☐ 100-200 M.bht.   ☐ 201-300 M.bht.
- ☐ 301-400 M.bht.   ☐ 401-500 M.bht.   ☐ more than 500 M.bht.

9. Which of the follows is your firm size according to registered capital?
- ☐ Small-sized enterprise (less than 50 million baht)
- ☐ Medium-sized enterprise (between 50-200 million baht)
- ☐ Large-sized enterprise (more than 200 million baht)

10. What is your ownership structure?
- ☐ Single owner
  - ◯ Thai   ◯ Foreign country_____
- ☐ Joint venture
  - ◯ Thai/Thai   ◯ Thai/Foreign country_____
- ☐ Other please specify_____

11. In E&E industry, are you a supplier of other manufacturers?
- ☐ Yes   If so, you are   ◯ Direct tier 1 , or   ◯ Direct tier 2-3
- ☐ No

12. In E&E industry, are you a manufacturer?
- ☐ Yes   If so, you are   ◯ OEM,   ◯ ODM , or   ◯ OBM
- ☐ No

13. What are the proportion of your customers and suppliers?

Type of customer/supplier company	Proportion (%)	
	Your customer	Your supplier
1.Thai company in Thailand		
2.MNE company in Thailand (country_____)		
3.Foreign country _____		
4.Other please specify_____		
Total	100%	100%

14. Who do you think is your main source of spillovers the knowledge? **Please fill the rank with the number** (1-2-3…) in front of each source with the ranking from the most important source (number 1) to the least important source (number 6):

Rank	Source of spillover the knowledge
	Your customer: Thai firm in Thailand
	Your customer: MNE in Thailand
	Your customer: foreign country
	Your supplier: Thai firm in Thailand
	Your supplier: MNE in Thailand
	Your supplier: foreign country

15. Do you think you have other sources of spillovers the knowledge?

☐ Yes   If so, it is (you can answer more than one)

◯ Public (e.g. EEI)

◯ Academic institution (e.g. university)

◯ Other please specify_____

☐ No

16. How does the knowledge is spilled over to your company? **Please mark (X)** at the mean which is best representing to get knowledge spillover from each source. **The answer may be more than one choice**. (*Remark* : (1) *'Cooperation'* here refers to cooperation such as joint planning and decision making (2) *'Connectedness'* here refers relationship between your firm and customers/suppliers).

Source of knowledge spillover	The means of knowledge spillover		
	Cooperation	Connectedness	Other please specify
Your customer: Thai firm in Thailand			
Your customer: MNE in Thailand			
Your customer: foreign country			
Your supplier: Thai firm in Thailand			
Your supplier: MNE in Thailand			
Your supplier: foreign country			

Section 2 : Spillover channel mechanism

Instruction: Please mark (**X**) at the number best representing the extent to which your company can receive knowledge spillover from external source regarding to they are your customers through each of the following spillover channel mechanisms.

A. Cooperation with **your main customer** in the same electrical and electronic industry

17. How many years of business relationship between your company and your main customer?

☐ Less than 1 year   ☐1-3 years   ☐ 4-5 years

☐ 6-10 years   ☐11-15 years   ☐ more than 15 years

18. During the time of your business relationship, does your company have any special cooperation with your main customer?

☐Yes , It is……..

◯ Marketing R&D

◯ Product development

◯ Technology transfer

◯ Management system development

◯ Other please specify_____

☐No.

19. Please indicate how you perceive **the level of cooperation** between your company and your main customer in order to access/acquire the spillovers of knowledge. Considering only your main customer into 2 groups: multinational enterprise (MNE) and Thai firm. *(**Remark**: please **choose only one** as your main source from the cooperation. Otherwise, if your company gets knowledge spillovers from both sources, **two responses per statement are required**.)*

Extremely low	Low	Neither low Nor high	High	Extremely high
1	2	3	4	5

Your company gets knowledge spillover through the joint planning and decision making by…..	Main source is your MNE customer					Main source is your Thai customer				
1....planning volume demands for each quarter/seasons together.	1	2	3	4	5	1	2	3	4	5
2…planning and decision in long term marketing strategic plans.	1	2	3	4	5	1	2	3	4	5
3....planning and decision in setting up pricing strategy	1	2	3	4	5	1	2	3	4	5
4....analyzing market trends and new distribution channels	1	2	3	4	5	1	2	3	4	5
5…analyzing responses to marketing promotion	1	2	3	4	5	1	2	3	4	5
6....planning to purchase of inputs, order sharing, common use of specialized equipment	1	2	3	4	5	1	2	3	4	5
7…when dealing with problems that arise in course of tasks together	1	2	3	4	5	1	2	3	4	5
8….by regularly negotiating with clear role and responsibilities	1	2	3	4	5	1	2	3	4	5
9….by setting up standard conflict resolution between firms	1	2	3	4	5	1	2	3	4	5
10...by regularly exchanging of know-how and market/product information	1	2	3	4	5	1	2	3	4	5
11…setting up control system for standardized tasks together	1	2	3	4	5	1	2	3	4	5
12…setting up standard manual in course of tasks together	1	2	3	4	5	1	2	3	4	5
13…establishing long term marketing management together	1	2	3	4	5	1	2	3	4	5
14…setting up standard of work procedures together.	1	2	3	4	5	1	2	3	4	5
15…evaluating the joint performance.	1	2	3	4	5	1	2	3	4	5

B. Connectedness with your **main customer** in the same electrical and electronic industry

20. How often does your company have contact with your main customer *within one month*?
☐ Only 1 time   ☐ 1-2 times   ☐ 2-4 times
☐ 4-6 times   ☐ 6-8 times   ☐ more than 8 times

21. For each of the following contact channels, which channel is frequently used to contact with your main customer. Please rank with the number (1-2-3-…..)from the most frequently used to the least frequently used.

Rank	Contact channel
	Face-to-face
	Telephone
	Written letters, correspondence
	Computer linkage (e.g. e-mail, internet)
	Seminars/conferences
	Other please specify_____

22. Please indicate the **degree of informal contact** between your company and your main customer in order to access/acquire the spillovers of knowledge. Considering only your main customer, it is divided into 2 groups: multinational enterprise(MNE) and Thai firm *(**Remark**: please **choose only one** as your main source from the informal contact. **Otherwise,** if your company gets knowledge spillovers from both sources, **two responses per statement are required**.).*

Extremely Low	Low	Neither High Nor Low	High	Extremely High
1	2	3	4	5

Knowledge spillover from main customer through the informal contact as following **……**	Main source is your MNE customer					Main source is your Thai customer				
1. Most of communication used is casual, informal, word-of-mouth channel	1	2	3	4	5	1	2	3	4	5
2. Contacts between both of you are personal contact	1	2	3	4	5	1	2	3	4	5
3. The terms of your relationship have recognized without writing down in detail.	1	2	3	4	5	1	2	3	4	5
4. Their knowledge flows are provided to you in detail	1	2	3	4	5	1	2	3	4	5
5. Informal mode is always used to deal whenever you need knowledge sharing and exchange with these firms	1	2	3	4	5	1	2	3	4	5

23. Please indicate the **degree of strong tie** between your company and your main customer company in order to access/acquire the spillovers of knowledge. Considering only your main customer within Thailand, it is divided into 2 groups: multinational enterprise(MNE) and Thai firm *(**Remark**: please **choose only one** as your main source from the degree of strong tie. **Otherwise,** if your company gets knowledge spillovers from both sources, **two responses per statement are required**.)*

Strongly disagree	Disagree	Neither agree Nor disagree	Agree	Strongly agree
1	2	3	4	5

Knowledge spillover through the degree of strong tie as following…….	Main source is your MNE customer					Main source is your Thai customer				
1…dealing with problem solving together regardless the supervisor's command	1	2	3	4	5	1	2	3	4	5
2…feeling comfortable to contact together	1	2	3	4	5	1	2	3	4	5
3…ease of acquiring/access the knowledge from each other	1	2	3	4	5	1	2	3	4	5
4…spending time together outside the workplace (e.g. joint lunch, joint in clubs)	1	2	3	4	5	1	2	3	4	5

24. In conclusion, please indicate **how you perceive the level of tie strength** between your staffs and your main customer staffs. Please mark (**X**) at the number best representing the level of tie strength from the lowest level (level 1) to the highest level (level 10) (*Remark: please **choose only one** as your main source from the level of tie strength of staffs. Otherwise, if your company gets knowledge **spillovers from both sources**, **please answer both 24.1 and 24.2**)*

24.1 Your main source is MNE customer

Staffs	Level of tie strength
1.Operational staffs	Lowest: 1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : 10 : Highest
2.Executive staffs	Lowest: 1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : 10 : Highest

24.2 Your main source is Thai customer

Staffs	Level of tie strength
1.Operational staffs	Lowest: 1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : 10 : Highest
2.Executive staffs	Lowest: 1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : 10 : Highest

Section 3: Absorptive capacity

Instruction: Please mark (**X**) at the number best representing the extent of your company's absorptive capacity.

25. Please indicate how you perceive the **degree of your company's absorptive capacity** in each of the following statement.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
1	2	3	4	5

Your company has capability to…..

1…acquire new knowledge by frequent interaction with your main customer	1	2	3	4	5
2…acquire new knowledge by collecting industry information through informal means (e.g. lunch with industry friends)	1	2	3	4	5
3…acquire new knowledge by periodically organizing special meetings with your main customer.	1	2	3	4	5
4....fast recognize shifts in market (e.g. competition, regulation)	1	2	3	4	5
5....quickly analyze and interpret changing market demands.	1	2	3	4	5
6....quickly understand the new opportunities to serve the clients.	1	2	3	4	5
7….regularly consider the consequences of changing market demands in terms of new products and services.	1	2	3	4	5
8….quickly recognize the usefulness of new external knowledge to existing knowledge.	1	2	3	4	5
9….periodically meet with your customer company to discuss consequences of market trends and new product development.	1	2	3	4	5
10…easily implement new products and services.	1	2	3	4	5
11…constantly consider how to better exploit knowledge.	1	2	3	4	5
12…clearly know how activities between firms should be performed.	1	2	3	4	5

Section 4: Marketing innovation and management innovation

*Instruction***:** Please mark (**X**) at the number best representing the extent to which the level of marketing innovation and managerial innovation in your company.

26. Please indicate the perception of **marketing innovation** that your think your company has received from the knowledge spillovers from your main customer.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
1	2	3	4	5

According to knowledge spillover, your company has marketing innovation by…

1. …establish the new market segments you serve	1	2	3	4	5
2. …set the new positioning for your new market	1	2	3	4	5
3. …expand the new or emerging markets	1	2	3	4	5
4. …set new pricing strategy to overcome the competitors	1	2	3	4	5
5. …create new ways of distributing/selling the products	1	2	3	4	5
6. …improve service for end customers and/or create new after-sales service	1	2	3	4	5
7. …establish new promotion and/or new advertising strategy	1	2	3	4	5
8. …create and develop strategies to compete in the market that would not have been possible otherwise.	1	2	3	4	5
9…..other please specify_____	1	2	3	4	5

27. Please indicate the perception of **management innovation** that your think your company has received from the knowledge spillovers from your main customer.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
1	2	3	4	5

According to knowledge spillover, your company has management innovation by…

1…initial new paradigm and set up new management policy	1	2	3	4	5
2…rearrange day-to-day technical routines and informal procedures	1	2	3	4	5
3…change and set up new management practices	1	2	3	4	5
4…create new ways to set up strategic plans	1	2	3	4	5
5…set up new control system	1	2	3	4	5
6…initiate the new culture/sub-culture	1	2	3	4	5
7…other please specify_____	1	2	3	4	5

Section 5: Problems and suggestions

28. Please indicate the problems and suggestions that your company found from spillovers the knowledge from your main customer in order to improve your firm's absorptive capacity to enhance the marketing innovation and managerial innovation.

_____
_____
_____
_____
_____
_____
_____

Thank you for completing the questionnaire. The result of this survey will be given to you in a summary report. If you would like a copy of this report, please attach name-card or provide with the following:

Name of respondent	
Address	
Telephone	

*******Thank you for your kind cooperation*******

แบบสอบถาม เรื่อง "การจัดการความสามารถในการดูดซับความรู้: ผลกระทบของกลไกจากช่องทางการแพร่กระจายความรู้ และผลกระทบต่อนวัตกรรม"

แบบสำรวจฉบับนี้ประกอบด้วย 5 กลุ่มคำถามหลักซึ่งจะใช้เวลาในการตอบคำถามทั้งสิ้นโดยประมาณ 30 นาที ทั้งนี้ คำตอบทุกข้อของท่านจะถูก<u>เก็บไว้เป็นความลับ</u> เฉพาะผลการวิจัยที่แสดงถึงภาพรวมของอุตสาหกรรมเท่านั้นที่จะมีการรายงานต่อไป

ส่วนที่ 1 : ข้อมูลเกี่ยวกับตัวท่านและบริษัท

<u>คำชี้แจง:</u> กรุณาทำเครื่องหมาย (X) สำหรับคำตอบของท่านในแต่ละคำถามต่อไปนี้ ส่วนคำถามที่เว้นว่างไว้ กรุณาใส่ตัวเลขหรือข้อความเป็นคำตอบ

1. งานส่วนใหญ่ของท่านในบริษัทเกี่ยวข้องกับการกำหนด หรือ การพัฒนาปรับปรุง กระบวนการใหม่/โครงการใหม่/ การปฏิบัติงานใหม่ๆ ที่เกี่ยวข้องกับบริษัทของท่านในภาพรวม ใช่หรือไม่ ?

☐ ใช่
☐ ไม่ใช่ (กรุณาส่งต่อแบบสำรวจฉบับนี้ให้กับบุคคลที่มีความรับผิดชอบตามที่อ้างถึง ขอบคุณค่ะ)

2. ตำแหน่งของท่านในบริษัท จัดอยู่ในประเภทใดต่อไปนี้?

☐ ประธานกรรมการบริหาร , เจ้าของกิจการ
☐ ผู้บริหารระดับสูง, กรรมการผู้จัดการ, ผู้จัดการทั่วไป
☐ ผู้บริหารฝ่ายปฏิบัติการ
☐ ผู้ช่วยกรรมการผู้จัดการ, ผู้ช่วยผู้จัดการทั่วไป
☐ อื่นๆ โปรดระบุ_____

3. ท่านคิดว่าบริษัทของท่านจัดอยู่ในประเภทใดของอุตสาหกรรมอิเลคทรอนิกส์และเครื่องใช้ไฟฟ้า จากการแบ่งประเภทของคณะกรรมการส่งเสริมการลงทุน(BOI)

☐ กลุ่มอิเลคทรอนิกส์ (Electronics)
  ◯ กิจการผลิตผลิตภัณฑ์อิเลคทรอนิกส์
  ◯ กิจการผลิตชิ้นส่วน/อุปกรณ์ที่เป็น หรือ ที่ใช้กับผลิตภัณฑ์อิเลคทรอนิกส์)
  ◯ อื่นๆโปรดระบุ_____
☐ กลุ่มเครื่องใช้ไฟฟ้า (Electrical)
  ◯ กิจการผลิตเครื่องใช้ไฟฟ้า สำหรับที่ใช้กับงานอุตสาหกรรม
  ◯ กิจการผลิตเครื่องใช้ไฟฟ้า
  ◯ กิจการผลิตชิ้นส่วน/อุปกรณ์ที่เป็น หรือ ที่ใช้กับเครื่องใช้ไฟฟ้า
  ◯ อื่นๆโปรดระบุ_____
☐ กลุ่มที่เกี่ยวข้องกับอิเลคทรอนิกส์และ/หรือเครื่องใช้ไฟฟ้า
  ◯ กิจการซอฟท์แวร์
  ◯ กิจการออกแบบทางอิเลคทรอนิคส์
  ◯ กิจการพาณิชย์อิเลคทรอนิกส์
  ◯ อื่นๆ โปรดระบุ_____

4. บริษัทของท่านประกอบธุรกิจในอุตสาหกรรมอิเลคทรอนิกส์และเครื่องใช้ไฟฟ้า เป็นเวลานานเท่าไร?

☐ น้อยกว่า 1 ปี   ☐ 1-5 ปี   ☐ 6-10 ปี

☐ 11-15 ปี   ☐ 16-20 ปี   ☐ มากกว่า 20 ปี

5. บริษัทของท่านมีพนักงานประจำ ทั้งแบบเงินเดือนและค่าแรงรายวัน จำนวนเท่าไร?

☐ น้อยกว่า 50 คน   ☐ 50-99 คน   ☐ 100-199 คน

☐ 200-499 คน   ☐ 500-1,000 คน   ☐ มากกว่า 1,000 คน

6. บริษัทของท่านมีอัตราการเข้าออกของพนักงาน(ภายในหนึ่งปี) คิดเป็นกี่เปอร์เซ็นต์?

☐ น้อยกว่า 1 %   ☐ 1-5 %   ☐ 6-10 %

☐ 11-15%   ☐ 16-20 %   ☐ มากกว่า 20 %

7. บริษัทของท่านมีแผนก/ฝ่าย/ส่วนงาน วิจัยและพัฒนา (R&D)หรือ การพัฒนาธุรกิจ หรือไม่?

☐ มี กรุณาระบุจำนวนพนักงาน_____คน   ☐ ไม่มี

8. ในปี 2548 ที่ผ่านมา บริษัทของท่านมียอดขายรวมคิดเป็นจำนวนทั้งสิ้นเท่าใด?

☐ น้อยกว่า 100 ล้านบาท   ☐ 100-500 ล้านบาท   ☐ 501-1,000 ล้านบาท

☐ 1,001-2,500 ล้านบาท   ☐ 2,501-5,000 ล้านบาท   ☐ มากกว่า 5,000 ล้านบาท

9. หากแบ่งตามทุนจดทะเบียน บริษัทของท่านจัดอยู่ในประเภทใด?

☐ ธุรกิจขนาดย่อม (สินทรัพย์น้อยกว่า 50 ล้านบาท)

☐ ธุรกิจขนาดกลาง (สินทรัพย์อยู่ระหว่าง 50-200 ล้านบาท)

☐ ธุรกิจขนาดใหญ่ (สินทรัพย์มากกว่า 200 ล้านบาท)

10. บริษัทของท่านมีลักษณะ โครงสร้างผู้ถือหุ้นอย่างไร?

☐ กิจการแบบเจ้าของคนเดียว

◯ เจ้าของเป็นคนไทย   ◯ เจ้าของเป็นต่างชาติ โปรดระบุประเทศ_____

☐ กิจการแบบร่วมทุน

◯ คนไทย:คนไทย   ◯ ไทย:ต่างชาติ โปรดระบุประเทศ_____

☐ อื่นๆ โปรดระบุ_____

11. ในอุตสาหกรรมอิเลคทรอนิกส์และเครื่องใช้ไฟฟ้า, ท่านคือผู้ผลิตใช่หรือไม่ ?

☐ ใช่ โดยเป็นผู้ผลิตประเภท......

◯ OEM (หมายถึง รับจ้างผลิตชิ้นส่วน)

◯ ODM (หมายถึง ให้บริการการออกแบบ)

◯ OBM (หมายถึง ขายสินค้า/อุปกรณ์ภายใต้ชื่อตนเอง)

☐ ไม่ใช่

12. ในอุตสาหกรรมอิเลคทรอนิกส์และเครื่องใช้ไฟฟ้า, ท่านคือซัพพลายเออร์ใช่หรือไม่ ?

    ☐ ใช่   โดยเป็น......   ◯ ซัพพลายเออร์โดยตรง (เทียร์ 1)

                              ◯ ซัพพลายเออร์โดยตรง (เทียร์ 2 หรือ 3)

    ☐ ไม่ใช่

13. ลูกค้า และ ซัพพลายเออร์ของท่าน ประกอบด้วยประเภทใดบ้างและมีสัดส่วนเท่าไร?

ประเภทของบริษัท/ตลาด	เป็นลูกค้าของท่าน		เป็นซัพพลายเออร์ของท่าน	
	สัดส่วน (%)	โปรดระบุ ชื่อ ประเทศที่สำคัญ	สัดส่วน (%)	โปรดระบุ ชื่อ ประเทศที่สำคัญ
1.บริษัทข้ามชาติ (ที่ตั้งอยู่ในประเทศ)				
2.บริษัทคนไทย (ที่ตั้งอยู่ในประเทศ)		---		---
3.ตลาดส่งออก (ต่างประเทศ)				
4.อื่นๆ โปรดระบุ_____				
คิดเป็นสัดส่วน(%)รวมทั้งสิ้น	100%	---	100%	---

14. จากลูกค้าและซัพพลายเออร์ประเภทต่างๆข้างต้น ท่านคิดว่า ใครเป็นแหล่งสำคัญที่แพร่กระจายความรู้ให้กับบริษัทท่าน กรุณาเรียงลำดับเป็นตัวเลข (1-2-3…) จากแหล่งที่สำคัญมากไปแหล่งที่สำคัญน้อย

ลำดับที่	แหล่งแพร่กระจายความรู้
	ลูกค้าบริษัทข้ามชาติ (ที่ตั้งอยู่ในประเทศ)
	ลูกค้าบริษัทคนไทย (ที่ตั้งอยู่ในประเทศ)
	ลูกค้าจากตลาดต่างประเทศ
	ซัพพลายเออร์บริษัทข้ามชาติ (ที่ตั้งอยู่ในประเทศ)
	ซัพพลายเออร์บริษัทคนไทย (ที่ตั้งอยู่ในประเทศ)
	ซัพพลายเออร์จากตลาดต่างประเทศ

15. ลูกค้าและซัพพลายเออร์ มีการแพร่กระจายความรู้ให้กับบริษัทท่าน ด้วยวิธีการใด? อาจตอบได้มากกว่า 1 คำตอบ *(คำชี้แจง : (1) ' ความร่วมมือ' หมายถึง การร่วมมือในระหว่างการทำงานร่วมกัน เช่น ร่วมกันวางแผนตัดสินใจ (2) 'ความสัมพันธ์' หมายถึง ความใกล้ชิดหรือสายสัมพันธ์ระหว่างบริษัทของท่านและลูกค้า/ซัพพลายเออร์)*

แหล่งแพร่กระจายความรู้	วิธีการแพร่กระจายความรู้		
	ความร่วมมือ	ความสัมพันธ์	อื่นๆ (โปรดระบุ)
ลูกค้าบริษัทข้ามชาติ (ที่ตั้งอยู่ในประเทศ)			
ลูกค้าบริษัทคนไทย (ที่ตั้งอยู่ในประเทศ)			
ลูกค้าจากตลาดต่างประเทศ			
ซัพพลายเออร์บริษัทข้ามชาติ (ที่ตั้งอยู่ในประเทศ)			
ซัพพลายเออร์บริษัทคนไทย (ที่ตั้งอยู่ในประเทศ)			
ซัพพลายเออร์จากตลาดต่างประเทศ			

16. ท่านคิดว่า มีแหล่งอื่นๆที่แพร่กระจายความรู้ให้กับบริษัทท่านหรือไม่?

☐ มี จาก....... (สามารถตอบได้มากกว่า 1 คำตอบ)

◯ ภาครัฐ (สถาบันไฟฟ้าและอิเลคทรอนิกส์)

◯ สถาบันการศึกษา (เช่น มหาวิทยาลัย)

◯ อื่นๆ โปรดระบุ_____

☐ ไม่มี

ส่วนที่ 2 : กลไกจากช่องทางการแพร่กระจายความรู้

คำชี้แจง: ส่วนที่สอง เน้นแหล่งความรู้ที่มาจากลูกค้าในประเทศเท่านั้น (ประกอบด้วย 2 กลุ่มคือ บริษัทข้ามชาติ และ บริษัทคนไทย) โปรดเลือกตอบเฉพาะลูกค้าหลักเพียงกลุ่มเดียว ซึ่งเป็นแหล่งสำคัญที่แพร่กระจายความรู้ให้กับบริษัทท่าน (กรณีท่านคิดว่าเป็นแหล่งสำคัญเท่าเทียมกัน กรุณาตอบลูกค้าหลักทั้งสองกลุ่ม)

A. ความร่วมมือ (Cooperation) กับลูกค้าหลัก ที่มีกิจการอยู่ในอุตสาหกรรมอิเลคทรอนิกส์และเครื่องใช้ไฟฟ้าเท่านั้น

17. ท่านและลูกค้าหลักของท่าน มีการทำธุรกิจกันมาเป็นเวลานานเท่าไร?

☐ น้อยกว่า 1 ปี   ☐ 1-5 ปี   ☐ 6-10 ปี

☐ 11-15 ปี   ☐ 16-20 ปี   ☐ มากกว่า 20 ปี

18. ในระหว่างการทำธุรกิจที่ผ่านมา ท่านกับลูกค้าหลักของท่าน มีความร่วมมือแบบพิเศษใดๆ บ้างหรือไม่?

☐ มี ได้แก่ ◯ การวิจัยและพัฒนาด้านตลาด

◯ การพัฒนาด้านผลิตภัณฑ์

◯ การแลกเปลี่ยนด้านเทคโนโลยี่

◯ การพัฒนาระบบบริหารจัดการ (เช่น ระบบประเมินผล ระบบคู่มือการปฏิบัติงาน เป็นต้น)

◯ อื่นๆ โปรดระบุ_____

☐ ไม่มี

19.   กรุณาแสดงความคิดเห็นต่อ   <u>ลักษณะของความร่วมมือในการทำงาน</u>   ที่มีส่วนทำให้ท่านได้รับความรู้ซึ่งแพร่กระจายมา
เลือกตอบเฉพาะลูกค้าหลักกลุ่มใดกลุ่มหนึ่งเท่านั้น (กรณีสำคัญเท่าๆกัน กรุณาตอบทั้งสองกลุ่ม) โดยทำเครื่องหมาย (X) ลงบน
ตัวเลขที่แสดงถึงระดับความมากน้อยในแต่ละข้อความดังต่อไปนี้

น้อยที่สุด	น้อย	ปานกลาง	มาก	มากที่สุด
1	2	3	4	5

บริษัทท่านได้ความรู้แพร่กระจายมาจากการร่วมมือกับลูกค้าหลักในการ.......	แหล่งความรู้หลัก คือ ลูกค้าข้ามชาติ					แหล่งความรู้หลัก คือ ลูกค้าคนไทย				
19.1..วางแผนปริมาณความต้องการสินค้าในไตรมาส/ช่วงเวลาต่างๆร่วมกัน	1	2	3	4	5	1	2	3	4	5
19.2..กำหนดและตัดสินใจร่วมกันในการวางแผนกลยุทธ์การตลาดระยะยาว	1	2	3	4	5	1	2	3	4	5
19.3..วางแผนและตัดสินใจร่วมกันในการกำหนดกลยุทธ์ด้านราคาผลิตภัณฑ์	1	2	3	4	5	1	2	3	4	5
19.4..วิเคราะห์แนวโน้มตลาดและสร้างช่องทางใหม่ๆในการกระจายสินค้า	1	2	3	4	5	1	2	3	4	5
19.5..วิเคราะห์ผลการตอบสนองจากการส่งเสริมทางการตลาดร่วมกัน	1	2	3	4	5	1	2	3	4	5
19.6..วางแผนการจัดซื้อวัตถุดิบ, กำหนดการสั่งซื้อสินค้า,และการร่วมมือ กำหนแนวทางการใช้อุปกรณ์หรือเทคนิคเฉพาะทาง/แบบพิเศษร่วมกัน	1	2	3	4	5	1	2	3	4	5
19.7...กำหนดวิธีการเผชิญ/รับมือกับปัญหาที่เกิดจากการทำงานร่วมกัน (เช่น ปัญหาจากการผลิตสินค้า หรือ ปัญหาจากปริมาณการส่งมอบสินค้า เป็นต้น)	1	2	3	4	5	1	2	3	4	5
19.8.. เจรจาต่อรองร่วมกันโดยสม่ำเสมอ และมีการกำหนด/แบ่งบทบาทหรือ ความรับผิดชอบต่อปัญหาต่างๆอย่างชัดเจน	1	2	3	4	5	1	2	3	4	5
19.9...กำหนดแนวทางมาตรฐานในการแก้ปัญหาจากการปฏิบัติงานร่วมกัน	1	2	3	4	5	1	2	3	4	5
19.10...แลกเปลี่ยนความรู้/เทคโนโลยี่ และข้อมูลการตลาด/การผลิตร่วมกัน อย่างสม่ำเสมอ เพื่อเป็นแนวทางแก้ไขปัญหาร่วมกัน	1	2	3	4	5	1	2	3	4	5
19.11..สร้างระบบควบคุมมาตรฐานการทำงานร่วมกัน	1	2	3	4	5	1	2	3	4	5
19.12..จัดทำคู่มือมาตรฐานการปฏิบัติงานร่วมกัน	1	2	3	4	5	1	2	3	4	5
19.13..จัดตั้งแนวทางบริหารตลาดในระยะยาว สำหรับลูกค้าเป้าหมายร่วมกัน	1	2	3	4	5	1	2	3	4	5
19.14..สร้างกระบวนการ/วิธีปฏิบัติงานที่เป็นมาตรฐานร่วมระหว่างบริษัท	1	2	3	4	5	1	2	3	4	5
19.15...สร้างระบบประเมินผลการปฏิบัติงานร่วมกัน	1	2	3	4	5	1	2	3	4	5

B.ความสัมพันธ์ (Connectedness) กับลูกค้าหลัก ที่มีกิจการอยู่ในอุตสาหกรรมอิเลคทรอนิกส์และเครื่องใช้ไฟฟ้าเท่านั้น

20. บริษัทท่านมีการติดต่อกับลูกค้าหลัก *โดยเฉลี่ยประมาณกี่ครั้งภายในเวลา 1 เดือน?*

☐ 1-5 ครั้ง (หรือ สัปดาห์ละครั้ง)   ☐6-10 ครั้ง (หรือสัปดาห์ละ 2 ครั้ง)
☐ 11-20 ครั้ง(หรือเกือบทุกวัน วันละครั้ง)   ☐มากกว่า 20 ครั้ง (หรือทุกวัน วันละหลายๆครั้ง)

21. บริษัทท่านและลูกค้าหลัก ใช้ช่องทางการติดต่อสื่อสารแบบใดบ่อยครั้งมากที่สุด เรียงลำดับด้วยตัวเลข (1-2-3.....) จากการใช้บ่อยครั้งที่สุด(ลำดับ 1) ไปถึงการใช้น้อยครั้งที่สุด

ลำดับที่	ช่องทางการติดต่อสื่อสาร
	การพบหน้าโดยตรง
	การโทรศัพท์
	การเขียนหนังสือ/จดหมายโต้ตอบทางธุรกิจ
	การใช้คอมพิวเตอร์ (เช่น อีเมล์,อินเตอร์เน็ต)
	การร่วมในงานสัมมนา หรือการประชุมตามสถานที่ต่างๆ
	อื่นๆ โปรดระบุ_____

22.   กรุณาแสดงความคิดเห็นต่อวิธีการติดต่อสื่อสารแบบไม่เป็นทางการระหว่างบริษัทท่านกับลูกค้าหลัก   ที่มีส่วนทำให้บริษัทท่านได้รับความรู้ซึ่งแพร่กระจายมา   เลือกตอบเฉพาะลูกค้าหลักกลุ่มใดกลุ่มหนึ่งเท่านั้น   (กรณีเป็นแหล่งความรู้หลักเท่าเทียมกันกรุณาตอบทั้งสองกลุ่ม) โดยทำเครื่องหมาย (X) ลงบนตัวเลขที่แสดงถึงระดับความมากน้อยในแต่ละข้อความดังต่อไปนี้

ไม่เห็นด้วยอย่างมาก	ไม่เห็นด้วย	เฉยๆ	เห็นด้วย	เห็นด้วยอย่างมาก
1	2	3	4	5

ความรู้แพร่กระจายจากลูกค้าหลัก ด้วยลักษณะการติดต่อ สื่อสารแบบไม่เป็นทางการ ดังนี้.....	แหล่งความรู้หลัก คือ ลูกค้าข้ามชาติ					แหล่งความรู้หลัก คือ ลูกค้าคนไทย				
22.1 ส่วนใหญ่ติดต่อหรือสื่อสารด้วยการเจรจาพูดคุยกัน	1	2	3	4	5	1	2	3	4	5
22.2 ลักษณะที่ใช้เป็นการติดต่อสื่อสารส่วนบุคคล (personnel contact)	1	2	3	4	5	1	2	3	4	5
22.3 ความสัมพันธ์ระหว่างบริษัทท่านและลูกค้าหลัก เป็นที่รับรู้กันเองได้ โดยไม่ต้องมีการเขียนรายละเอียดเป็นลายลักษณ์อักษร	1	2	3	4	5	1	2	3	4	5
22.4 ความรู้ที่แพร่กระจายมาจากการติดต่อแบบไม่เป็นทางการ สามารถให้เนื้อหา/รายละเอียด ที่เป็นประโยชน์กับบริษัทท่านได้	1	2	3	4	5	1	2	3	4	5
22.5 เมื่อต้องการแบ่งปัน/แลกเปลี่ยนความรู้ระหว่างกัน มักใช้วิธีการ ติดต่อ สื่อสารแบบไม่เป็นทางการ	1	2	3	4	5	1	2	3	4	5

23. กรุณาแสดงความคิดเห็นต่อ <u>ระดับความผูกพันระหว่างบริษัทท่านกับบริษัทลูกค้าหลัก</u> ที่มีส่วนทำให้บริษัทท่านได้รับความรู้ ซึ่งแพร่กระจายมา *เลือกตอบเฉพาะลูกค้าหลักกลุ่มใดกลุ่มหนึ่งเท่านั้น* (กรณีเป็นแหล่งความรู้หลักเท่าเทียมกัน กรุณาตอบทั้งสอง กลุ่ม) โดยทำเครื่องหมาย (X) ลงบนตัวเลขที่แสดงถึงระดับความมากน้อยในแต่ละข้อความดังต่อไปนี้

น้อยที่สุด	น้อย	ปานกลาง	มาก	มากที่สุด
1	2	3	4	5

ความรู้แพร่กระจายจากลูกค้าหลัก มาทางความสนิทสนมผูกพันระหว่างกัน ดังนี้.....	แหล่งความรู้หลัก คือ ลูกค้าข้ามชาติ					แหล่งความรู้หลัก คือ ลูกค้าคนไทย				
23.1 เมื่อเกิดปัญหาในระดับปฏิบัติการ บุคลากรทั้งสองบริษัทมีความคุ้นเคย และ สามารถติดต่อเพื่อแก้ปัญหากันโดยตรง โดยไม่ต้องผ่านผู้บริหารระดับสูง	1	2	3	4	5	1	2	3	4	5
23.2 บุคลากรทั้งสองบริษัท มีความรู้สึกสบายและสะดวกใจในการติดต่อกัน	1	2	3	4	5	1	2	3	4	5
23.3 บุคลากรทั้งสองบริษัท สามารถแสวงหา/เข้าถึงข้อมูลการทำงานระหว่าง กันและกันได้	1	2	3	4	5	1	2	3	4	5
23.4 บุคลากรทั้งสองบริษัท มีความคุ้นเคยและใช้เวลาพบปะพูดคุย นอก สถานที่ทำงานร่วมกัน (เช่น ทานอาหาร,สังสรรค์ในสโมสร เป็นต้น)	1	2	3	4	5	1	2	3	4	5

24. โดยสรุปแล้ว กรุณาแสดงความคิดเห็นที่มีต่อ <u>ระดับความผูกพัน</u> ในความสัมพันธ์ระหว่างพนักงานทั้งสองบริษัท ที่มีส่วนทำ ให้บริษัทท่านได้รับความรู้แบบแพร่กระจาย *เลือกตอบเฉพาะความสัมพันธ์กับลูกค้าหลักกลุ่มใดกลุ่มหนึ่งเท่านั้น* (กรณีเป็นแหล่ง ความรู้หลักเท่าเทียมกัน กรุณาตอบทั้งสองกลุ่ม) โดยทำเครื่องหมาย (X) ลงบนตัวเลขที่แสดงถึงระดับความผูกพันได้ดีที่สุด จาก ระดับความผูกพันน้อยที่สุด (ระดับ 1) ไปถึงระดับความผูกพันมากที่สุด (ระดับ 10)

24.1 กรณีแหล่งความรู้หลัก คือ <u>**ลูกค้าบริษัทข้ามชาติ**</u>

บุคลากร/ภาพรวม	ระดับความผูกพันระหว่างบริษัท
1. ระดับปฏิบัติการ	น้อยที่สุด:_1_:_2_:_3_:_4_:_5_:_6_:_7_:_8_:_9_:_10_:มากที่สุด
2 .ระดับบริหาร	น้อยที่สุด:_1_:_2_:_3_:_4_:_5_:_6_:_7_:_8_:_9_:_10_:มากที่สุด

24.2 กรณีแหล่งความรู้หลัก คือ <u>**ลูกค้าบริษัทคนไทย**</u>

บุคลากร/ภาพรวม	ระดับความผูกพันระหว่างบริษัท
1. ระดับปฏิบัติการ	น้อยที่สุด:_1_:_2_:_3_:_4_:_5_:_6_:_7_:_8_:_9_:_10_:มากที่สุด
2 .ระดับบริหาร	น้อยที่สุด:_1_:_2_:_3_:_4_:_5_:_6_:_7_:_8_:_9_:_10_:มากที่สุด

ส่วนที่ **3:** ความสามารถในการดูดซับความรู้

คำชี้แจง: ส่วนที่สามเน้นที่ความสามารถในการดูดซับความรู้ของบริษัทท่าน

25. กรุณาแสดงความคิดเห็นต่อ<u>ระดับความสามารถในการซึมซับความรู้ของบริษัทท่าน</u> โดยทำเครื่องหมาย (X) ลงบนตัวเลขที่แสดงถึงระดับความมากน้อยในแต่ละข้อความดังต่อไปนี้

น้อยที่สุด	น้อย	ปานกลาง	มาก	มากที่สุด
1	**2**	**3**	**4**	**5**

บริษัทท่านมีความสามารถในการ.............

25.1..แสวงหาความรู้ใหม่ๆ โดยมีปฏิสัมพันธ์บ่อยๆ กับลูกค้าหลัก	1	2	3	4	5
25.2..แสวงหาความรู้ใหม่ๆโดยเก็บรวบรวมความรู้ด้วยวิธีการแบบไม่เป็นทางการ(เช่น การสังสรรค์กับเพื่อนนักธุรกิจในอุตสาหกรรมเดียวกัน, การพูดคุยกับคู่ค้าทางการค้า เป็นต้น)	1	2	3	4	5
25.3..แสวงหาความรู้ใหม่ๆ โดยจัดทำหรือดำเนินการประชุมหรือสังสรรค์พิเศษกับลูกค้า อย่างสม่ำเสมอ	1	2	3	4	5
25.4..ตระหนักถึงการเปลี่ยนแปลงทางการตลาด (เช่น การแข่งขัน,กฎกติกา)ได้อย่างรวดเร็ว	1	2	3	4	5
25.5. วิเคราะห์และแสดงผลให้เห็นถึงการเปลี่ยนแปลงความต้องการของตลาดได้อย่างรวดเร็ว	1	2	3	4	5
25.6..เข้าใจและเล็งเห็นโอกาสใหม่ๆเพื่อตอบสนองลูกค้าได้อย่างรวดเร็ว	1	2	3	4	5
25.7..พิเคราะห์ถึงผลลัพธ์ของการเปลี่ยนแปลงความต้องการทางการตลาดในรูปของการนำเสนอสินค้าและบริการใหม่ๆตลอดเวลา	1	2	3	4	5
25.8..ตระหนักถึงความมีประโยชน์ของความรู้แพร่กระจายจากลูกค้าหลักที่มีต่อความรู้เดิมที่มีอยู่แล้วในองค์การ ได้อย่างรวดเร็ว	1	2	3	4	5
25.9..พบปะสังสรรค์กับลูกค้าหลักเป็นระยะๆอย่างสม่ำเสมอ เพื่อหารือผลลัพธ์จากแนวโน้มการตลาดและการพัฒนาผลิตภัณฑ์ใหม่ๆ ตลอดเวลา	1	2	3	4	5
25.10..ง่ายในการลงมือปฏิบัติ/ดำเนินการเกี่ยวกับสินค้า-บริการ ใหม่ๆขององค์การ	1	2	3	4	5
25.11..พิเคราะห์ได้อย่างชัดเจนว่าจะใช้ประโยชน์จากความรู้ใหม่ให้พัฒนาดีขึ้นได้อย่างไร	1	2	3	4	5
25.12..พิเคราะห์ได้อย่างชัดเจนว่าในระหว่างบริษัทท่านกับลูกค้าหลัก ควรมีการดำเนินงานหรือการปฏิบัติต่อกิจกรรมงานที่มีร่วมกันได้อย่างไรให้ประสพความสำเร็จ	1	2	3	4	5

ส่วนที่ 4: นวัตกรรมทางการตลาด และ นวัตกรรมทางการบริหาร

คำชี้แจง: ส่วนที่สี่เน้นการสร้างนวัตกรรมของบริษัทท่าน

26. กรุณาแสดงความคิดเห็นต่อ<u>นวัตกรรมทางการตลาดของบริษัทท่าน</u> โดยทำเครื่องหมาย (X) ลงบนตัวเลขที่แสดงถึงระดับความมากน้อยในแต่ละข้อความดังต่อไปนี้

น้อยที่สุด	น้อย	ปานกลาง	มาก	มากที่สุด
1	2	3	4	5

ความรู้ที่แพร่กระจายจากลูกค้าหลัก ทำให้บริษัทท่านมีนวัตกรรมทางการตลาด โดยการ.......

26.1...สร้างฐานกลุ่มลูกค้าใหม่ (ขยายส่วนแบ่งตลาดในกลุ่มใหม่)	1	2	3	4	5
26.2...สร้าง/กำหนดตำแหน่งทางการตลาดใหม่ ที่สอดคล้องกับตลาดของบริษัทท่าน	1	2	3	4	5
26.3...สร้าง/ขยายกิจการสู่ตลาดใหม่โดยเฉพาะตลาดที่มีการเติบโตหรือมีกำลังซื้อสูง	1	2	3	4	5
26.4...จัดตั้งกลยุทธ์ด้านราคาแบบใหม่ที่สามารถได้เปรียบเชิงแข่งขัน	1	2	3	4	5
26.5...สร้างช่องทางการตลาดแบบใหม่ ในการกระจายหรือขายสินค้าของบริษัทท่าน	1	2	3	4	5
26.6...จัดตั้งระบบบริการแบบใหม่ตอบสนองลูกค้า รวมทั้งการบริการหลังการขายแบบใหม่	1	2	3	4	5
26.7...จัดทำวิธีส่งเสริมการขายรูปแบบใหม่ๆ และ/หรือ สร้างกลยุทธ์โฆษณาแบบใหม่	1	2	3	4	5
26.8...สร้างและพัฒนากลยุทธ์การตลาดแบบใหม่ที่สามารถได้เปรียบคู่แข่งขัน	1	2	3	4	5
26.9...อื่นๆ โปรดระบุ_____	1	2	3	4	5

27. กรุณาแสดงความคิดเห็นต่อ<u>นวัตกรรมทางการจัดการของบริษัทท่าน</u> โดยทำเครื่องหมาย (X) ลงบนตัวเลขที่แสดงถึงระดับความมากน้อยในแต่ละข้อความดังต่อไปนี้

น้อยที่สุด	น้อย	ปานกลาง	มาก	มากที่สุด
1	2	3	4	5

ความรู้ที่แพร่กระจายมาจากลูกค้าหลัก ทำให้บริษัทท่านมีนวัตกรรมทางการจัดการ โดยการ.......

27.1...สร้างกรอบแนวคิดใหม่ (new paradigm)และใช้กำหนดนโยบายบริหารแบบใหม่	1	2	3	4	5
27.2...จัดตั้งกิจกรรมการทำงานประจำตลอดจนกระบวนการปฏิบัติงานแบบใหม่ในองค์การ	1	2	3	4	5
27.3...สร้างรูปแบบใหม่ให้กับการทำงานที่เกี่ยวกับการสนับสนุนงานบริหาร (เช่น รูปแบบของช่องทางการสื่อสารแบบใหม่ระหว่างแผนก/ฝ่าย เป็นต้น)	1	2	3	4	5
27.4...จัดทำการวางแผนเชิงกลยุทธ์แนวใหม่ สำหรับองค์การ	1	2	3	4	5
27.5...จัดตั้งระบบการควบคุมองค์การแบบใหม่	1	2	3	4	5
27.6...สร้างวัฒนธรรมใหม่ในองค์การ (เช่น การสร้างค่านิยมส่งเสริมการเรียนรู้ระยะยาวสไตล์ญี่ปุ่น โดยกำหนดให้มีการเขียนคู่มือมาตรฐานการปฏิบัติงานอย่างสม่ำเสมอ เป็นต้น)	1	2	3	4	5
27.7...อื่นๆ โปรดระบุ_____	1	2	3	4	5

ส่วนที่ 5 : ปัญหาอุปสรรคและข้อเสนอแนะ

28.กรุณาแสดงความคิดเห็นต่อปัญหาอุปสรรมและ/หรือข้อเสนอแนะ ที่อาจทำให้บริษัทท่านเพิ่ม/ปรับปรุงความสามารถในการซึม
ซับความรู้ให้เกิดประโยชน์ยิ่งขึ้น

_____
_____
_____
_____
_____
_____

ขอขอบพระคุณที่ท่านกรุณาสละเวลาในการตอบแบบสอบถามฉบับนี้อย่างสมบูรณ์ ผลที่ได้จากการศึกษานี้จะจัดทำและเสนอในรูป
รายงานสรุป หากท่านประสงค์จะได้รายงานนี้ กรุณาแนบนามบัตรหรือกรอกรายละเอียดเพิ่มเติมในตารางด้านล่างนี้ :

ชื่อผู้ตอบแบบสอบถาม	
ที่อยู่	
โทรศัพท์	

*******ขอขอบพระคุณอีกครั้งสำหรับความร่วมมือ*******
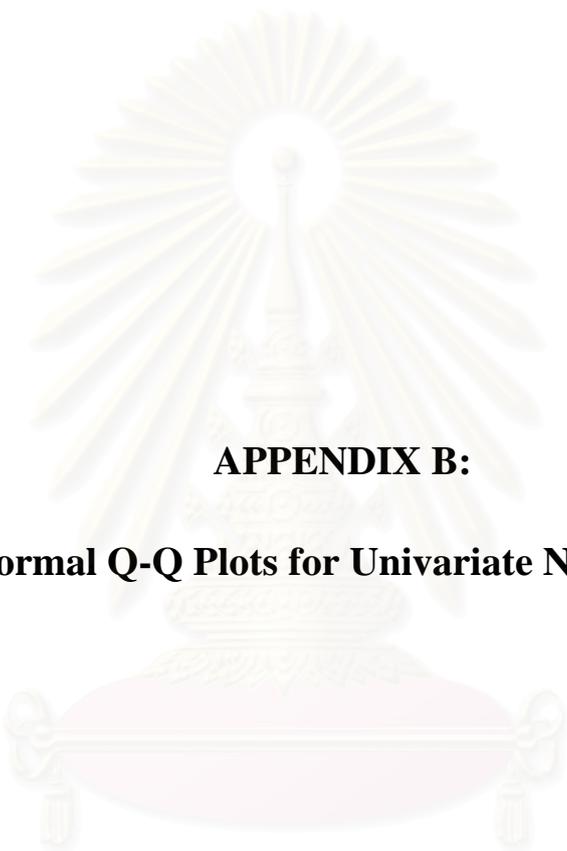
APPENDIX B:

Normal Q-Q Plots for Univariate Normality

Kolmogorov-Smirnov statistical test of univariate normality

Tests of Normality

	Kolmogorov-Smirnov(a)			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
COOP	.053	305	.041	.991	305	.070
CONN	.077	305	.000	.970	305	.000
ACAP	.067	305	.002	.990	305	.035
INNO	.071	305	.001	.980	305	.000

a Lilliefors Significance Correction

Normal Q-Q Plot of Cooperation (COOP)
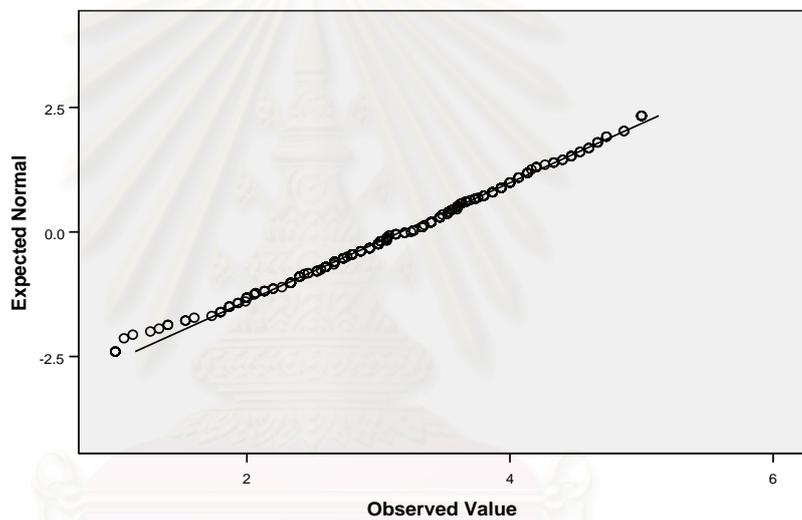
Normal Q-Q Plot of Connectedness (CONN)
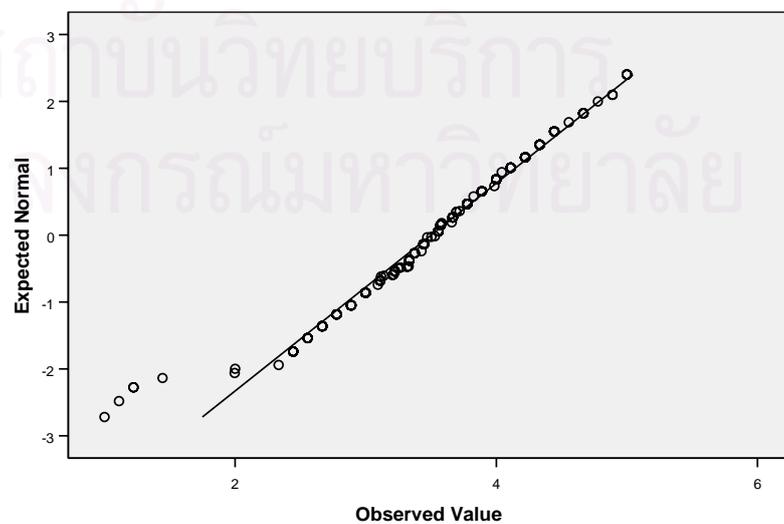
Normal Q-Q Plot of Absorptive capacity (ACAP)
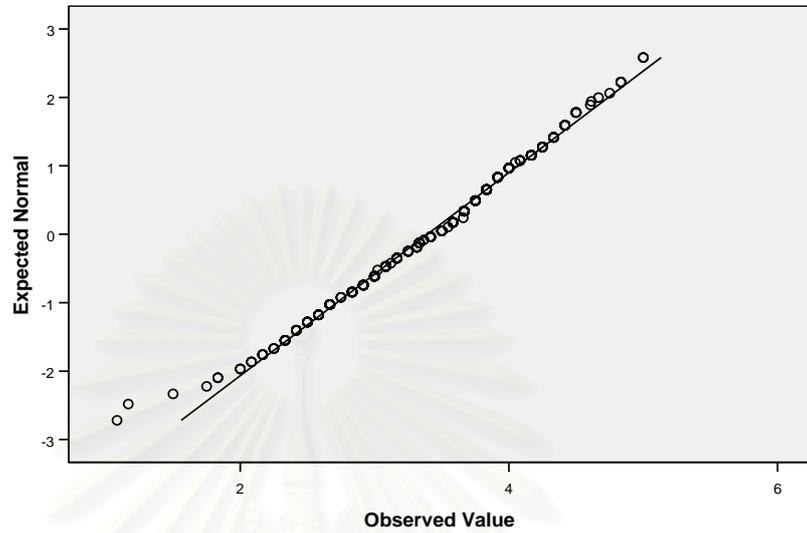
Normal Q-Q Plot of Innovation (INNO)
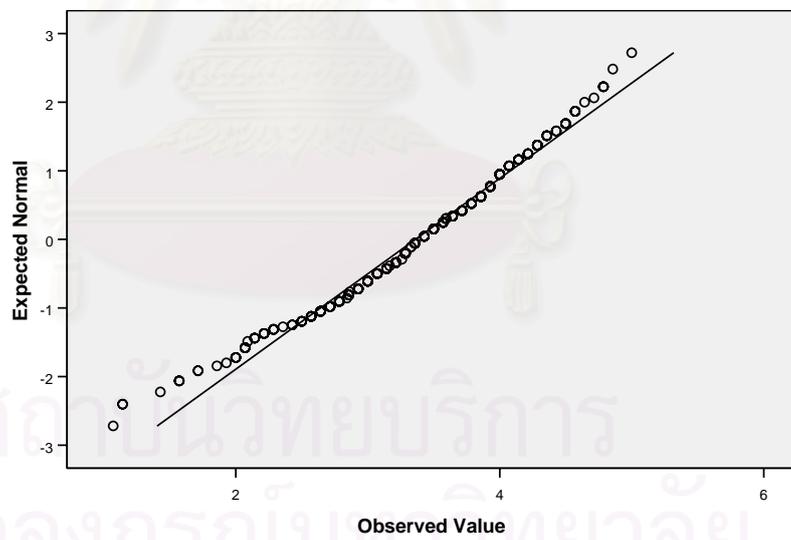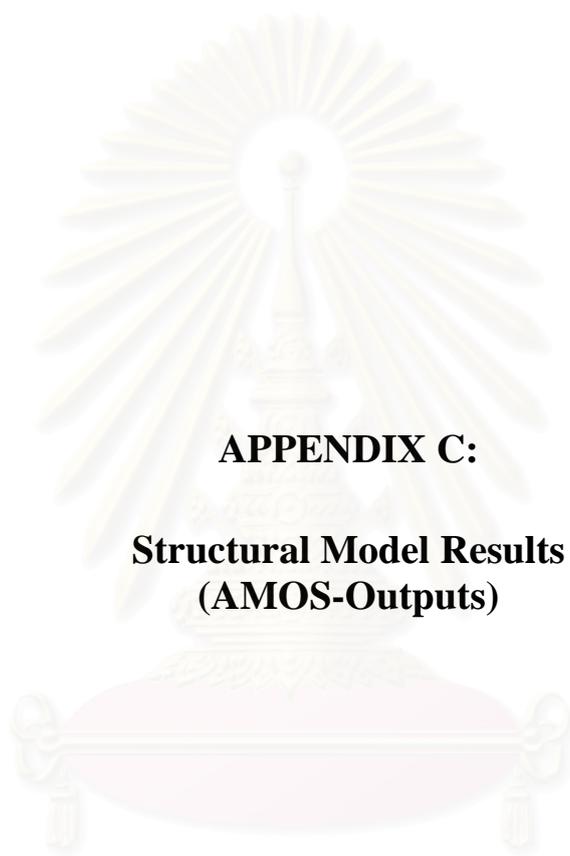
APPENDIX C:

**Structural Model Results
(AMOS-Outputs)**

I. Structural model of ACAP : Main hypotheses output

Regression Weights

		Estimate	S.E.	C.R.	P	Label
Absorptive Capacity <--Cooperation		0.361	0.061	5.959	0.000	
Absorptive Capacity <--Connectedness		0.172	0.072	2.374	0.018	
informal<-- Connectedness		0.557	0.092	6.069	0.000	
Innovation<-- Absorptive Capacity		1.150	0.108	10.639	0.000	
jmpl <-- Cooperation		1.024	0.094	10.873	0.000	
jplan <-- Cooperation		1.000				
ties <-- Connectedness		1.000				
jpbr <-- resjpb		1.182	0.124	9.506	0.000	
INF1 <-- informal		0.876	0.122	7.203	0.000	
pacap <-- Absorptive Capacity		1.000				
jpbr <-- Cooperation		0.886	0.086	10.333	0.000	
racap <-- Absorptive Capacity		1.195	0.109	10.958	0.000	
mtinno <-- Innovation		0.805	0.073	10.994	0.000	
mkinno<-- Innovation		1.000				
JMP2 <-- jmpl		1.089	0.070	15.581	0.000	
JPL2 <-- jplan		1.086	0.076	14.215	0.000	
JPL1 <-- jplan		1.000				
JPL3 <-- jplan		0.905	0.072	12.519	0.000	
MKN4 <-- mkinno		1.000				
MKN1 <-- mkinno		1.054	0.056	18.912	0.000	
MKN2 <-- mkinno		1.084	0.061	17.814	0.000	
MKN3 <-- mkinno		1.018	0.061	16.719	0.000	
TIE1 <-- ties		0.898	0.069	13.006	0.000	
TIE2 <-- ties		1.015	0.065	15.502	0.000	
MTN4 <-- mtinno		1.000				
MTN3 <-- mtinno		0.993	0.064	15.485	0.000	
MTN2 <-- mtinno		1.105	0.067	16.404	0.000	
MTN1 <-- mtinno		1.103	0.070	15.793	0.000	
RACAP1<-- racap		0.884	0.065	13.702	0.000	
RACAP2<-- racap		0.835	0.063	13.319	0.000	
RACAP3<-- racap		1.022	0.070	14.704	0.000	
PACAP2<-- pacap		1.000				
PACAP3<-- pacap		0.888	0.077	11.553	0.000	
JPB2 <-- jpbr		0.895	0.071	12.626	0.000	
JPB1 <-- jpbr		0.911	0.082	11.159	0.000	
JPB3 <-- jpbr		1.000				
JMP1 <-- jmpl		1.033	0.073	14.196	0.000	
TIE3 <-- ties		1.000				
INF2 <-- INF1		0.050	0.080	0.630	0.528	
INF4 <-- informal		1.000				
INF3 <-- informal		1.371	0.140	9.812	0.000	
INF2 <-- informal		1.177	0.174	6.754	0.000	
JPL4 <-- jplan		1.015	0.075	13.607	0.000	
JPB4 <-- jpbr		1.000	0.074	13.512	0.000	

PACAP1<--	pacap	1.033	0.083	12.473	0.000
RACAP4<--	racap	1.000			
RACAP5<--	racap	0.893	0.063	14.178	0.000
JMP3 <--	jmpl	1.000			

Standardized Regression Weights

		Estimate
Absorptive_Capacity <--Cooperation		0.535
Absorptive_Capacity <--Connectedness		0.206
informal<--	Connectedness	0.668
Innovation<--	Absorptive_Capacity	0.840
jmpl <--	Cooperation	0.898
jplan <--	Cooperation	0.894
ties <--	Connectedness	0.850
jpbr <--	resjpb	0.556
INF1 <--	informal	0.506
pacap <--	Absorptive_Capacity	0.803
jpbr <--	Cooperation	0.831
racap <--	Absorptive_Capacity	0.849
mtinno <--	Innovation	0.829
mkinno<--	Innovation	0.879
JMP2 <--	jmpl	0.848
JPL2 <--	jplan	0.783
JPL1 <--	jplan	0.772
JPL3 <--	jplan	0.701
MKN4 <--	mkinno	0.820
MKN1 <--	mkinno	0.865
MKN2 <--	mkinno	0.832
MKN3 <--	mkinno	0.799
TIE1 <--	ties	0.715
TIE2 <--	ties	0.890
MTN4 <--	mtinno	0.775
MTN3 <--	mtinno	0.802
MTN2 <--	mtinno	0.840
MTN1 <--	mtinno	0.815
RACAP1<--	racap	0.745
RACAP2<--	racap	0.728
RACAP3<--	racap	0.790
PACAP2<--	pacap	0.710
PACAP3<--	pacap	0.681
JPB2 <--	jpbr	0.737
JPB1 <--	jpbr	0.657
JPB3 <--	jpbr	0.774
JMP1 <--	jmpl	0.774
TIE3 <--	ties	0.808
INF2 <--	INF1	0.042
INF4 <--	informal	0.546

INF3 <--	informal	0.760
INF2 <--	informal	0.568
JPL4 <--	jplan	0.754
JPB4 <--	jpbr	0.788
PACAP1<--	pacap	0.733
RACAP4<--	racap	0.768
RACAP5<--	racap	0.766
JMP3 <--	jmpl	0.779

Covariances

	Estimate	S.E.	C.R.	P	Label
Cooperation <-->Connectedness	0.289	0.049	5.868	0.000	

Correlations

	Estimate
Cooperation <-->Connectedness	0.539

Fit Measures

Fit Measure	Default model	Saturated	Independence	Macro
Discrepancy	976.583	0.000	6161.074	CMIN
Degrees of freedom	522	0	561	DF
P	0.000		0.000	P
Number of parameters	73	595	34	NPAR
Discrepancy / df	1.871		10.982	CMINDF
RMR	0.069	0.000	0.357	RMR
GFI	0.843	1.000	0.217	GFI
Adjusted GFI	0.821		0.170	AGFI
Parsimony-adjusted GFI	0.740		0.205	PGFI
Normed fit index	0.841	1.000	0.000	NFI
Relative fit index	0.830		0.000	RFI
Incremental fit index	0.919	1.000	0.000	IFI
Tucker-Lewis index	0.913		0.000	TLI
Comparative fit index	0.919	1.000	0.000	CFI
Parsimony ratio	0.930	0.000	1.000	PRATIO
Parsimony-adjusted NFI	0.783	0.000	0.000	PNFI
Parsimony-adjusted CFI	0.855	0.000	0.000	PCFI
Noncentrality parameter estimate	454.583	0.000	5600.074	NCP
NCP lower bound	370.456	0.000	5351.055	NCPLO
NCP upper bound	546.520	0.000	5855.574	NCPHI
FMIN	3.212	0.000	20.267	FMIN
F0	1.495	0.000	18.421	F0
F0 lower bound	1.219	0.000	17.602	F0LO
F0 upper bound	1.798	0.000	19.262	F0HI
RMSEA	0.054		0.181	RMSEA
RMSEA lower bound	0.048		0.177	RMSEALO
RMSEA upper bound	0.059		0.185	RMSEAHI
P for test of close fit	0.131		0.000	PCLOSE
Akaike information criterion (AIC)	1122.583	1190.000	6229.074	AIC
Browne-Cudeck criterion	1141.580	1344.833	6237.921	BCC
Bayes information criterion	1651.590	5501.770	6475.461	BIC
Consistent AIC	1467.166	3998.586	6389.564	CAIC
Expected cross validation index	3.693	3.914	20.490	ECVI
ECVI lower bound	3.416	3.914	19.671	ECVILO
ECVI upper bound	3.995	3.914	21.331	ECVIHI
MECVI	3.755	4.424	20.519	MECVI
Hoelter .05 index	180		31	HFIVE
Hoelter .01 index	187		32	HONE

II. Structural model of ACAP : Sub-hypotheses output

Regression Weights

		Estimate	S.E.	C.R.	P	Label
pacap <--	Cooperation	0.319	0.066	4.858	0.000	
pacap <--	Connectedness	0.197	0.089	2.227	0.026	
racap <--	Cooperation	0.101	0.073	1.379	0.168	
racap <--	Connectedness	0.031	0.095	0.326	0.744	
racap <--	pacap	0.926	0.117	7.907	0.000	
informal<--	Connectedness	0.630	0.105	6.016	0.000	
Innovation<--	racap	0.596	0.121	4.908	0.000	
Innovation<--	pacap	0.347	0.159	2.182	0.029	
jmpl <--	Cooperation	1.004	0.093	10.743	0.000	
jplan <--	Cooperation	1.000				
ties <--	Connectedness	1.000				
jpbr <--	resjpb	1.050	0.115	9.096	0.000	
INF1 <--	informal	0.804	0.110	7.330	0.000	
jpbr <--	Cooperation	0.885	0.086	10.344	0.000	
mtinno <--	Innovation	0.811	0.073	11.144	0.000	
mkinno<--	Innovation	1.000				
JMP2 <--	jmpl	1.084	0.068	15.907	0.000	
JPL2 <--	jplan	1.064	0.073	14.603	0.000	
JPL1 <--	jplan	1.000				
JPL3 <--	jplan	0.888	0.069	12.818	0.000	
MKN4 <--	mkinno	1.000				
MKN1 <--	mkinno	1.037	0.053	19.658	0.000	
MKN2 <--	mkinno	1.070	0.058	18.512	0.000	
MKN3 <--	mkinno	1.003	0.058	17.264	0.000	
TIE1 <--	ties	0.895	0.068	13.129	0.000	
TIE2 <--	ties	1.011	0.065	15.645	0.000	
MTN4 <--	mtinno	1.000				
MTN3 <--	mtinno	0.965	0.061	15.874	0.000	
MTN2 <--	mtinno	1.076	0.064	16.913	0.000	
MTN1 <--	mtinno	1.074	0.066	16.250	0.000	
RACAP1<--	racap	0.928	0.066	13.972	0.000	
RACAP2<--	racap	0.866	0.065	13.380	0.000	
RACAP3<--	racap	1.062	0.072	14.841	0.000	
PACAP2<--	pacap	1.000				
PACAP3<--	pacap	1.073	0.096	11.187	0.000	
JPB2 <--	jpbr	0.897	0.071	12.620	0.000	
JPB1 <--	jpbr	0.914	0.082	11.168	0.000	
JPB3 <--	jpbr	1.000				
JMP1 <--	jmpl	1.018	0.071	14.323	0.000	
TIE3 <--	ties	1.000				
INF2 <--	INF1	0.052	0.079	0.652	0.514	
INF4 <--	informal	1.000				
INF3 <--	informal	1.256	0.125	10.080	0.000	
INF2 <--	informal	1.077	0.157	6.858	0.000	

JPL4	<--	jplan	0.981	0.071	13.728	0.000
JPB4	<--	jpbr	1.002	0.074	13.500	0.000
PACAP1	<--	pacap	1.221	0.104	11.786	0.000
RACAP4	<--	racap	1.000			
RACAP5	<--	racap	0.921	0.065	14.168	0.000
JMP3	<--	jmpl	1.000			

Standardized Regression Weights

			Estimate
pacap	<--	Cooperation	0.464
pacap	<--	Connectedness	0.222
racap	<--	Cooperation	0.113
racap	<--	Connectedness	0.027
racap	<--	pacap	0.711
informal	<--	Connectedness	0.670
Innovation	<--	racap	0.584
Innovation	<--	pacap	0.261
jmpl	<--	Cooperation	0.880
jplan	<--	Cooperation	0.879
ties	<--	Connectedness	0.820
jpbr	<--	resjpb	0.541
INF1	<--	informal	0.508
jpbr	<--	Cooperation	0.841
mtinno	<--	Innovation	0.808
mkinno	<--	Innovation	0.861
JMP2	<--	jmpl	0.854
JPL2	<--	jplan	0.788
JPL1	<--	jplan	0.785
JPL3	<--	jplan	0.706
MKN4	<--	mkinno	0.827
MKN1	<--	mkinno	0.866
MKN2	<--	mkinno	0.836
MKN3	<--	mkinno	0.801
TIE1	<--	ties	0.716
TIE2	<--	ties	0.890
MTN4	<--	mtinno	0.788
MTN3	<--	mtinno	0.803
MTN2	<--	mtinno	0.842
MTN1	<--	mtinno	0.817
RACAP1	<--	racap	0.749
RACAP2	<--	racap	0.724
RACAP3	<--	racap	0.786
PACAP2	<--	pacap	0.615
PACAP3	<--	pacap	0.683
JPB2	<--	jpbr	0.738
JPB1	<--	jpbr	0.658
JPB3	<--	jpbr	0.773

JMP1	<--	jmpl	0.772
TIE3	<--	ties	0.810
INF2	<--	INF1	0.043
INF4	<--	informal	0.588
INF3	<--	informal	0.761
INF2	<--	informal	0.568
JPL4	<--	jplan	0.748
JPB4	<--	jpbr	0.788
PACAP1	<--	pacap	0.721
RACAP4	<--	racap	0.750
RACAP5	<--	racap	0.758
JMP3	<--	jmpl	0.785

Covariances

		Estimate	S.E.	C.R.	P	Label
Cooperation	<-->Connectedness	0.292	0.050	5.845	0.000	

Correlations

		Estimate
Cooperation	<-->Connectedness	0.555

Fit Measures

Fit Measure	Default model	Saturated	Independence	Macro
Discrepancy	961.850	0.000	6161.074	CMIN
Degrees of freedom	519	0	561	DF
P	0.000		0.000	P
Number of parameters	76	595	34	NPAR
Discrepancy / df	1.853		10.982	CMINDF
RMR	0.070	0.000	0.357	RMR
GFI	0.845	1.000	0.217	GFI
Adjusted GFI	0.822		0.170	AGFI
Parsimony-adjusted GFI	0.737		0.205	PGFI
Normed fit index	0.844	1.000	0.000	NFI
Relative fit index	0.831		0.000	RFI
Incremental fit index	0.922	1.000	0.000	IFI
Tucker-Lewis index	0.915		0.000	TLI
Comparative fit index	0.921	1.000	0.000	CFI
Parsimony ratio	0.925	0.000	1.000	PRATIO
Parsimony-adjusted NFI	0.781	0.000	0.000	PNFI
Parsimony-adjusted CFI	0.852	0.000	0.000	PCFI
Noncentrality parameter estimate	442.850	0.000	5600.074	NCP
NCP lower bound	359.543	0.000	5351.055	NCPLO
NCP upper bound	533.972	0.000	5855.574	NCPHI
FMIN	3.164	0.000	20.267	FMIN
F0	1.457	0.000	18.421	F0
F0 lower bound	1.183	0.000	17.602	F0LO
F0 upper bound	1.756	0.000	19.262	F0HI
RMSEA	0.053		0.181	RMSEA
RMSEA lower bound	0.048		0.177	RMSEALO
RMSEA upper bound	0.058		0.185	RMSEAHI
P for test of close fit	0.171		0.000	PCLOSE
Akaike information criterion (AIC)	1113.850	1190.000	6229.074	AIC
Browne-Cudeck criterion	1133.627	1344.833	6237.921	BCC
Bayes information criterion	1664.598	5501.770	6475.461	BIC
Consistent AIC	1472.594	3998.586	6389.564	CAIC
Expected cross validation index	3.664	3.914	20.490	ECVI
ECVI lower bound	3.390	3.914	19.671	ECVILO
ECVI upper bound	3.964	3.914	21.331	ECVIHI
MECVI	3.729	4.424	20.519	MECVI
Hoelter .05 index	182		31	HFIVE
Hoelter .01 index	189		32	HONE

III. Structural model of ACAP: Dimension level output

Regression Weights

		Estimate	S.E.	C.R.	P	Label
pacap <--	jplan	0.405	0.093	4.368	0.000	
pacap <--	jpbr	-0.087	0.094	-0.925	0.355	
pacap <--	jmpl	0.002	0.076	0.024	0.981	
pacap <--	ties	0.174	0.069	2.506	0.012	
pacap <--	informal	-0.011	0.077	-0.148	0.882	
racap <--	pacap	0.810	0.109	7.434	0.000	
racap <--	jplan	0.031	0.101	0.308	0.758	
racap <--	jpbr	0.048	0.096	0.503	0.615	
racap <--	jmpl	0.045	0.078	0.574	0.566	
racap <--	ties	0.085	0.072	1.175	0.240	
racap <--	informal	-0.051	0.079	-0.652	0.515	
INF1 <--	informal	0.681	0.096	7.130	0.000	
mkinno <--	pacap	0.281	0.117	2.406	0.016	
mtinno <--	pacap	0.201	0.115	1.755	0.079	
mkinno <--	racap	0.578	0.096	6.049	0.000	
mtinno <--	racap	0.561	0.094	5.968	0.000	
JMP2 <--	jmpl	1.034	0.064	16.193	0.000	
JPL2 <--	jplan	1.078	0.077	14.002	0.000	
JPL1 <--	jplan	1.000				
JPL3 <--	jplan	0.901	0.072	12.433	0.000	
MKN4 <--	mkinno	1.000				
MKN1 <--	mkinno	1.132	0.064	17.806	0.000	
MKN2 <--	mkinno	1.182	0.069	17.175	0.000	
MKN3 <--	mkinno	1.097	0.069	15.883	0.000	
TIE1 <--	ties	0.896	0.069	12.975	0.000	
TIE2 <--	ties	1.008	0.065	15.431	0.000	
MTN4 <--	mtinno	1.000				
MTN3 <--	mtinno	0.987	0.062	15.831	0.000	
MTN2 <--	mtinno	1.112	0.065	17.148	0.000	
MTN1 <--	mtinno	1.103	0.068	16.306	0.000	
RACAP1 <--	racap	0.907	0.062	14.541	0.000	
RACAP2 <--	racap	0.834	0.061	13.625	0.000	
RACAP3 <--	racap	1.021	0.067	15.149	0.000	
PACAP2 <--	pacap	1.000				
PACAP3 <--	pacap	0.961	0.086	11.201	0.000	
JPB2 <--	jpbr	0.894	0.071	12.605	0.000	
JPB1 <--	jpbr	0.909	0.082	11.132	0.000	
JPB3 <--	jpbr	1.000				
JMP1 <--	jmpl	0.955	0.067	14.292	0.000	
TIE3 <--	ties	1.000				
INF2 <--	INF1	0.057	0.077	0.743	0.457	
INF4 <--	informal	1.000				
INF3 <--	informal	1.070	0.114	9.387	0.000	
INF2 <--	informal	0.906	0.135	6.717	0.000	

JPL4 <--	jplan	0.983	0.075	13.058	0.000
JPB4 <--	jpbr	1.009	0.074	13.635	0.000
PACAP1<--	pacap	1.114	0.093	12.034	0.000
RACAP4<--	racap	1.000			
RACAP5<--	racap	0.885	0.061	14.405	0.000
JMP3 <--	jmpl	1.000			

Standardized Regression Weights

		Estimate
pacap <--	jplan	0.596
pacap <--	jpbr	-0.119
pacap <--	jmpl	0.003
pacap <--	ties	0.215
pacap <--	informal	-0.013
racap <--	pacap	0.661
racap <--	jplan	0.038
racap <--	jpbr	0.054
racap <--	jmpl	0.058
racap <--	ties	0.086
racap <--	informal	-0.048
INF1 <--	informal	0.512
mkinno<--	pacap	0.230
mtinno <--	pacap	0.174
mkinno<--	racap	0.579
mtinno <--	racap	0.595
JMP2 <--	jmpl	0.864
JPL2 <--	jplan	0.791
JPL1 <--	jplan	0.779
JPL3 <--	jplan	0.711
MKN4 <--	mkinno	0.787
MKN1 <--	mkinno	0.854
MKN2 <--	mkinno	0.832
MKN3 <--	mkinno	0.788
TIE1 <--	ties	0.717
TIE2 <--	ties	0.888
MTN4 <--	mtinno	0.776
MTN3 <--	mtinno	0.796
MTN2 <--	mtinno	0.843
MTN1 <--	mtinno	0.813
RACAP1<--	racap	0.759
RACAP2<--	racap	0.722
RACAP3<--	racap	0.783
PACAP2<--	pacap	0.668
PACAP3<--	pacap	0.677
JPB2 <--	jpbr	0.735
JPB1 <--	jpbr	0.655
JPB3 <--	jpbr	0.773

JMP1	<--	jmpl	0.769
TIE3	<--	ties	0.811
INF2	<--	INF1	0.048
INF4	<--	informal	0.671
INF3	<--	informal	0.767
INF2	<--	informal	0.568
JPL4	<--	jplan	0.742
JPB4	<--	jpbr	0.793
PACAP1	<--	pacap	0.727
RACAP4	<--	racap	0.762
RACAP5	<--	recap	0.753
JMP3	<--	jmpl	0.813

Covariances

			Estimate	S.E.	C.R.	P	Label
jplan	<-->	jpbr	0.595	0.074	7.997	0.000	
jmpl	<-->	jpbr	0.621	0.078	7.975	0.000	
jmpl	<-->	jplan	0.682	0.084	8.145	0.000	
jmpl	<-->	ties	0.298	0.057	5.218	0.000	
ties	<-->	informal	0.286	0.049	5.852	0.000	
jplan	<-->	ties	0.286	0.054	5.299	0.000	
jplan	<-->	informal	0.206	0.052	3.956	0.000	
ties	<-->	jpbr	0.307	0.052	5.875	0.000	
jmpl	<-->	informal	0.125	0.053	2.377	0.017	
jpbr	<-->	informal	0.227	0.050	4.499	0.000	

Correlations

			Estimate
jplan	<-->	jpbr	0.741
jmpl	<-->	jpbr	0.716
jmpl	<-->	jplan	0.734
jmpl	<-->	ties	0.382
ties	<-->	informal	0.511
jplan	<-->	ties	0.395
jplan	<-->	informal	0.309
ties	<-->	jpbr	0.455
jmpl	<-->	informal	0.174
jpbr	<-->	informal	0.364

Fit Measures

Fit Measure	Default model	Saturated	Independence	Macro
Discrepancy	951.742	0.000	6161.074	CMIN
Degrees of freedom	504	0	561	DF
P	0.000		0.000	P
Number of parameters	91	595	34	NPAR
Discrepancy / df	1.888		10.982	CMINDF
RMR	0.066	0.000	0.357	RMR
GFI	0.848	1.000	0.217	GFI
Adjusted GFI	0.821		0.170	AGFI
Parsimony-adjusted GFI	0.718		0.205	PGFI
Normed fit index	0.846	1.000	0.000	NFI
Relative fit index	0.828		0.000	RFI
Incremental fit index	0.921	1.000	0.000	IFI
Tucker-Lewis index	0.911		0.000	TLI
Comparative fit index	0.920	1.000	0.000	CFI
Parsimony ratio	0.898	0.000	1.000	PRATIO
Parsimony-adjusted NFI	0.760	0.000	0.000	PNFI
Parsimony-adjusted CFI	0.827	0.000	0.000	PCFI
Noncentrality parameter estimate	447.742	0.000	5600.074	NCP
NCP lower bound	364.592	0.000	5351.055	NCPLO
NCP upper bound	538.697	0.000	5855.574	NCPHI
FMIN	3.131	0.000	20.267	FMIN
F0	1.478	0.000	18.421	F0
F0 lower bound	1.199	0.000	17.602	F0LO
F0 upper bound	1.772	0.000	19.262	F0HI
RMSEA	0.054		0.181	RMSEA
RMSEA lower bound	0.049		0.177	RMSEALO
RMSEA upper bound	0.059		0.185	RMSEAHI
P for test of close fit	0.101		0.000	PCLOSE
Akaike information criterion (AIC)	1133.742	1190.000	6229.074	AIC
Browne-Cudeck criterion	1157.422	1344.833	6237.921	BCC
Bayes information criterion	1793.189	5501.770	6475.461	BIC
Consistent AIC	1563.290	3998.586	6389.564	CAIC
Expected cross validation index	3.729	3.914	20.490	ECVI
ECVI lower bound	3.456	3.914	19.671	ECVILO
ECVI upper bound	4.029	3.914	21.331	ECVIHI
MECVI	3.807	4.424	20.519	MECVI
Hoelter .05 index	179		31	HFIVE
Hoelter .01 index	186		32	HONE

IV. Structural model of ACAP : Multigroup-invariance output

Nested Model Comparisons (for Main hypotheses)

Assuming model Free model to be correct:

	DF	CMIN	P	NFI Delta-1	IFI Delta-2	RFI rho-1	TLI rho-2
Default model	3	9.401	0.024	0.001	0.002	0.001	0.001

Nested Model Comparisons (for Sub-hypotheses)

Assuming model Free model to be correct:

	DF	CMIN	P	NFI Delta-1	IFI Delta-2	RFI rho-1	TLI rho-2
Default model	6	15.929	0.014	0.002	0.003	0.001	0.001

BIOGRAPHY

Miss Surasvadee Rajkulchai was born on June 15, 1963. She earned a Bachelor degree of Science (Business Administration) with Second Class Honours, Kasetsart University in 1985. Then, she graduated a Master degree of Business Administration Program major General Management, National Institute of Development Administration (NIDA) in 1995. For her experiences, she had worked in marketing arena in various industries such as real estate and property, paper and pulp, and consumer-products. In addition, she had experienced in areas of system analysis and development, including research and development, in service industry such as finance and banking. After the turning to academic career and the determination to further extend her knowledge, she decided to study in Joint Doctoral Program in Business Administration program major International Business in 2002.