การศึกษาเชิงประจักษ์ของผลกระทบของปัจจัยที่ก่อให้เกิดนวัตกรรมซึ่งมีผลต่อการดำเนินงานของผลิตภัณฑ์ใหม่: นวัตกรรมแบบสมบูรณ์และนวัตกรรมแบบค่อยเป็นค่อยไป

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THE EMPIRICAL STUDY OF THE IMPACT OF PRODUCT INNOVATION FACTORS ON PERFORMANCE OF NEW PRODUCTS: RADICAL AND INCREMENTAL PRODUCT INNOVATION

Mr. Danupol Hoonsopon

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Thesis Title	THE EMPIRICAL STUDY OF THE PRODUCT INNOVATION FACTORS ON PERFORMANCE OF NEW PRODUCT: RADICAL AND INCREMENTAL PRODUCT INNOVATION
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....Dean of the Faculty of Commerce and Accountancy
(Associate Professor Annop Tanlamai, Ph.D.)

THESIS COMMITTEE

.... Chairman
(Associate Professor Annop Tanlamai, Ph.D.)

.... Thesis Advisor
(Associate Professor Guntalee Ruenrom, Ph.D.)

.... Examiner
(Professor Emeritus Nonglak Wiratchai, Ph.D.)

.... Examiner
(Associate Professor Bhanupong Nidhiprabha, Ph.D.)

.... Examiner
(Associate Professor Pipop Udorn, Ph.D.)

.... Examiner
(Associate Professor Pradit Wanarat, Ph.D.)

.... Examiner
(Nuttapol Assarut, Ph.D.)

คนุพล หุ่นโสภณ : การศึกษาเชิงประจักษ์ของผลกระทบของปัจจัยที่ก่อให้เกิดนวัตกรรมซึ่งมีผลต่อการดำเนินงานของผลิตภัณฑ์ใหม่: นวัตกรรมแบบสมบูรณ์และนวัตกรรมแบบค่อยเป็นค่อยไป (THE EMPIRICAL STUDY OF THE PRODUCT INNOVATION FACTORS ON PERFORMANCE OF NEW PRODUCT: RADICAL AND INCREMENTAL PRODUCT INNOVATION) อ. ที่ปรึกษาวิทยานิพนธ์หลัก : รศ. ดร. กุณฑลี รื่นรมย์, 268 หน้า.

กลยุทธ์ด้านนวัตกรรมเป็นปัจจัยสำคัญ ที่ช่วยให้บริษัทสามารถเผชิญหน้ากับแรงกดดันจากปัจจัยต่างๆ ภายนอกบริษัทและกลยุทธ์ด้านนวัตกรรมยังช่วยเพิ่มผลประกอบการของบริษัท แต่อย่างไรก็ดี การศึกษาในอดีตยังมีข้อจำกัดเกี่ยวกับการศึกษาในส่วนของนวัตกรรมแบบค่อยเป็นค่อยไป ขาดความสนใจในส่วนของความแตกต่างของอิทธิพลของบางปัจจัยที่มีผลต่อนวัตกรรมแต่ละประเภท ขาดการศึกษาเกี่ยวกับนวัตกรรมของสินค้าในมุมมองของลูกค้า และขาดการพัฒนาเครื่องมือวัดที่เหมาะสมกับนิยามของนวัตกรรมแต่ละประเภท ดังนั้นสาเหตุดังกล่าวจึงนำไปสู่คำถามโดยเฉพาะผู้ที่รับผิดชอบในการพัฒนาผลิตภัณฑ์ใหม่ของบริษัทเพื่อให้บริษัทมีความได้เปรียบทางการแข่งขันในตลาด

การศึกษาในครั้งนี้มีวัตถุประสงค์เพื่อแสดงให้เห็นว่า อะไรคือปัจจัยที่มีอิทธิพลต่อนวัตกรรมแต่ละประเภททั้งนวัตกรรมแบบสมบูรณ์และนวัตกรรมแบบค่อยเป็นค่อยไป นักวิจัยยังเสนอกรอบความคิดที่อธิบายถึงปัจจัยที่มีผลต่อการสร้างนวัตกรรม นวัตกรรมแบบสมบูรณ์และนวัตกรรมแบบค่อยเป็นค่อยไป และผลการดำเนินงานของบริษัท ซึ่งปัจจัยเหล่านี้เป็นตัวแปรมาก่อน ตัวแปรส่งผ่าน และตัวแปรตาม ตามลำดับ โดยประชากรของการศึกษาได้แก่ บริษัทที่อยู่ในห้าอุตสาหกรรมได้แก่ เกษตร เทคโนโลยีชีวภาพ พลังงาน อาหาร และยา จำนวน 326 ตัวอย่าง ข้อมูลที่ได้ทั้งหมดจะนำมาวิเคราะห์ด้วยวิธี Structural Equation Modeling (SEM)

ผลการศึกษาเชิงประจักษ์ของการศึกษาในครั้งนี้ สามารถเพิ่มความเข้าใจเกี่ยวกับปัจจัยที่มีอิทธิพลต่อการสร้างนวัตกรรมแต่ละประเภท และอิทธิพลของนวัตกรรมที่มีผลต่อการดำเนินงานของบริษัททั้งนวัตกรรมแบบสมบูรณ์และนวัตกรรมแบบค่อยเป็นค่อยไปในมุมมองของลูกค้า นอกจากนี้ผู้ที่มีส่วนเกี่ยวข้องกับการพัฒนาผลิตภัณฑ์ใหม่ จะได้รับประโยชน์จากผลของการวิจัยนี้โดยสามารถใช้ทรัพยากรที่มีจำกัดภายในบริษัทได้อย่างมีประสิทธิภาพสูงสุด เพื่อให้บริษัทประสบความสำเร็จในการพัฒนาผลิตภัณฑ์ใหม่ สามารถกำหนดกลยุทธ์ที่เหมาะสมกับทรัพยากรที่มีอยู่ในบริษัท และสามารถอธิบายอิทธิพลของนวัตกรรมที่มีผลต่อการดำเนินงานของผลิตภัณฑ์ใหม่

สาขาวิชา บริหารธุรกิจ .... ลายมือชื่อนิสิต ....
ปีการศึกษา 2552 .... ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก ....

5193151226 : MAJOR BUSINESS ADMINISTRATION
KEYWORDS : RADICAL INNOVATION / INCREMENTAL INNOVATION / PERFORMANCE

DANUPOL HOONSOPON : THE EMPIRICAL STUDY OF THE PRODUCT INNOVATION FACTORS ON PERFORMANCE OF NEW PRODUCT: RADICAL AND INCREMENTAL PRODUCT INNOVATION. THESIS ADVISOR: ASSOC PROF. GUNTALEE RUENROM, Ph.D., 268 pp.

Innovation strategy is an important factor that helps firms to cope with the pressure from several business environments and increase their performance. However, previous studies are limited attention to investigating incremental product innovation, less examination of the different effects of some factors on each type of product innovation, shortage of study of product innovation from a customer perspective, and deficiency in developing measurement items to fit with the definition for each type of product innovation. So, there raise questions for managers who are responsible for developing new products in order to achieve competitive advantage in the market

This study aims to identify what factors impacted each type of product innovation: radical and incremental product innovation. A researcher proposes frameworks that demonstrate product innovation factors, radical and incremental product innovation, and performance which are antecedence, mediator, and consequence, respectively. The population in this study are firms in five industries: agriculture, biotechnological, energy, food, and pharmaceutical. The total sample sizes are 326. Structural Equation Modeling (SEM) is used for data analysis.

The empirical results of this study increase the understanding how the product innovation factors impact on a product innovation and the impact of a product innovation on the performance of firms on the context of radical and incremental product innovation from the customer perspective. Further, managers who are involved with the development of new product can achieve benefits from the results of this study by utilizing limited resources to success in developing new products, defining the appropriate strategy to fit with resources within firms, and identifying the effect of product innovation on the performance of new products.

Field of Study : Business Administration Student's Signature Danupol Hoonsopon
Academic Year : 2009 Advisor's Signature Guntalee R.

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Finally, all incompletion and drawbacks in this study are my responsibility.

Table of Contents

Chapter Page

Chapter	Page
APPENDIX E. LISREL'S SOURCE CODE OF INCREMENTAL PRODUCT INNOVATION BASED PERFORMANCE FRAMEWORK...	263
VITA..	268

List of Table

List of Figures

Figure | Page

CHAPTER I

INTRODUCTION

1.1 Rationales

Nowadays, many firms encounter competitive pressure such as competitors, demand uncertainty, technological turbulence, and economic uncertainty (Cooper, 2000; Day and Nedungadi, 1994; Zhou, Yim, and Tse, 2005).

In term of strategic management, a firm performance is determined by how well the strategic position of a firm matches the characteristics of the marketplace and the environment (Narver and Slater, 1990; Porter, 1985). Innovation strategy is one of the factors which helps firms cope with several kinds of competitive pressure (Ziamou and Ratneshwar, 2003) and increase their sales, profits, and competitive strength (Brown and Eisenhardt, 1995; Govindarajan and Kopalle, 2006; Henard and Szymanski, 2001; Schumpeter, 1934; Sivadas and Dwyer, 2000). Product innovation differentiates new products from those of competitors (Sriram, Balachander, and Kalwani, 2007; Wuyts, Stremersch, and Dutta, 2004), and differentiation from competitors leads firms to improve their performance (Cooper and Kleinschmidt, 1987; Kleinschmidt and Cooper, 1991; Olson, Slater, and Hult, 2005; Sorescu, Chandy, and Prabhu, 2003; and Zhou, Yim, and Tse, 2005).

Nevertheless, the number of new products that fail is high (Goldenberg, Lehmann, and Mazursky, 2001; Kleinschmidt and Cooper, 1991; Sivadas and Dwyer, 2000; and Zirger and Maidique, 1990). The reasons for failure are either that new products may not serve the needs of customers (Zirger and Maidique, 1990) or the cost of new products is higher than the sales of new products (Goldenberg, Lehmann, and Mazursky, 2001). Therefore, firms must find the most appropriate way to develop new products to handle these situations.

The literature suggests that only 30 percent of new products introduced in the market are radical innovations (10 percent are new-to-the world products and 20 percent are new product lines) and 70 percent of new products introduced in the market are incremental innovations (Kleinschmidt and Cooper, 1991). Wind and Mahajan (1997) demonstrate that me-too products or incremental new products (product line extensions, repositioning, or cost reductions) have a larger proportion in the market compared with radical new products. Moreover, many firms focus on incremental innovation rather than on radical innovation because radical innovation has higher risk for firms than incremental innovation does (Veryzer, 1998). However, almost all academic articles concentrate on radical innovation and neglect to analyze incremental innovation (Bhaskaran, 2006; Sorescu, Chandy, and Prabhu, 2003; Wind and Mahajan, 1997).

Innovation is defined as "a degree of creativity in the new product ideation and design processes" (Sethi, Smith, and Park, 2001). Scholars define new product innovation in various ways. The popular terms used in the academic literature are radical and incremental innovation.

Previous studies focused on new products from three perspectives: the combination of newness in technology and newness in the perception of customers (Chandy and Tellis, 1998), newness in technology (Gatignon and Xuereb, 1997), and newness in the perception of customers (Cooper, 2000). Many studies analyze the first two perspectives but not the last (Danneels, 2004; Govindarajan and Kopalle, 2006). Zirger and Maidique (1990) propose that new products will succeed if they are designed to satisfy a perceived need of customers rather than being developed to take advantage of new technology. Voss and Voss (2000) suggest that successful new products must satisfy some need or desire in the marketplace. Furthermore, products that are successful in the market must provide a solution for customers' problems (Goldenberg, Lehmann, and Mazursky, 2001). Sethi, Smith, and Park (2001) and Ziamou and Ratneshwar (2003) explain that new products need to be positioned as sufficiently different from competitors' products in the consumer's mind in order to be successful.

The process of new product development within firms plays a crucial role in affecting new product advantage and the performance of new products. Many studies propose a variety of factors in the process of new product development that influence new product advantage (Atuahene-Gima, 2005) and the performance of new products (Marinova, 2004). The process of new product development varies depending on the degree of product innovation for many reasons. Most previous studies investigate innovation factors only in term of radical product innovation (Sorescu, Chandy, and Prabhu, 2003). Few studies explore innovation factors in incremental product innovation. Additionally, some studies (Ayers, Dahlstrom, and Skinner, 1997) investigate the effect of product innovation but they do not separate types of product innovation.

Factors in the external environment such as demand uncertainty (Zhou, Yim, and David, 2005), technological turbulence (Goldenberg, Lehmann, and Mazursky, 2001), and government agency support (Kleyn, Kitney, and Atun, 2007) also affect the development of new products. However, demand uncertainty and technological turbulence have been investigated in term of radical product innovation (Zhou, Yim, and David, 2005) but they have not been tested in incremental product innovation. Further, empirical study of the impact of government support on product innovation is scarcity (Kleyn, Kitney, and Atun, 2007; Tsai and Ghoshal, 1998). Moreover, the effect of government support on each type of product innovation has not been investigated.

Major barriers for theoretical contributions and managerial implications are misunderstanding of the concept, measurement, and unit of analysis (Gatignon et al., 2002). Previous studies in innovation confuse the unit of measurement and unit of analysis (Gatignon et al., 2002), meaning the result of the studies may be inconsistent (Ehrnberg, 1995). Additionally, some studies do not report how to measure the innovation construct despite the main focus of these studies being innovation (Ehrnberg, 1995). As such, developing measurement items to match with each type of product innovation can overcome the barrier of misunderstanding.

Gaps in previous studies such as 1) limited attention to investigating incremental product innovation, 2) lack of examination of the different effects of some factors on each type of product innovation, 3) lack of study of product innovation from a customer perspective, and 4) deficiency in developing measurement items to fit with the definition for each type of product innovation raise questions for managers who are responsible for developing new products in order to achieve competitive advantage in the market (Cooper and Kleinschmidt, 1987). These managers desire to know what factors in a company's internal capabilities and the external environment affect the new product advantage and the performance of both radical and incremental product innovation. The reason is that the factors in a company's internal capabilities and in the external environment which affect each type of product innovation are different (Govindarajan and Kopalle, 2006; Han, Kim, and Srivastava, 1998; McDermott and O'Connor, 2002; Salomo, Weise, and Gemünden, 2007). Thus, the requirements of product development managers and a desire to fill gaps in previous studies lead to the development of the research questions for this study.

1.2 Research Questions

The research questions for this study are as follows:

1. What factors in a firm's internal capabilities and the external environment affect innovation in radical/incremental products from a customer perspective?

2. What is the most important factor affecting innovation in radical/incremental products from customer perspective?

1.3 Research Objectives

The objectives of this study are as follows:

1. To investigate the effect of factors in a firm's internal capabilities and the external environment on innovation in radical/incremental products from a customer perspective.

2. To develop a systematic framework of product innovation management for two types of product innovation: radical and incremental, from a customer perspective.

1.4 Scope of the Study

The scopes of this study are as follows:

1. Product innovation in this study is classified into two groups, radical and incremental product innovation.

2. This study concentrates on the impact of product innovation factors on the development of product innovation and the impact of product innovation on the performance of new product.

3. This study is conducted by selecting firms located in Thailand in five industrial sectors: agriculture, biotechnological, energy, food, and pharmaceutical.

1.5 Frameworks of Study

This study has two frameworks: radical product innovation based performance framework and incremental product innovation based performance framework. A difference between two frameworks is a mediator. For radical product innovation based performance framework, the mediator is radical product innovation, but for incremental product innovation based performance framework, the mediator is incremental product innovation. The frameworks of this study are shown in Figures 1.1 and 1.2, respectively.

Figure 1.1

Radical Product Innovation Based Performance Framework

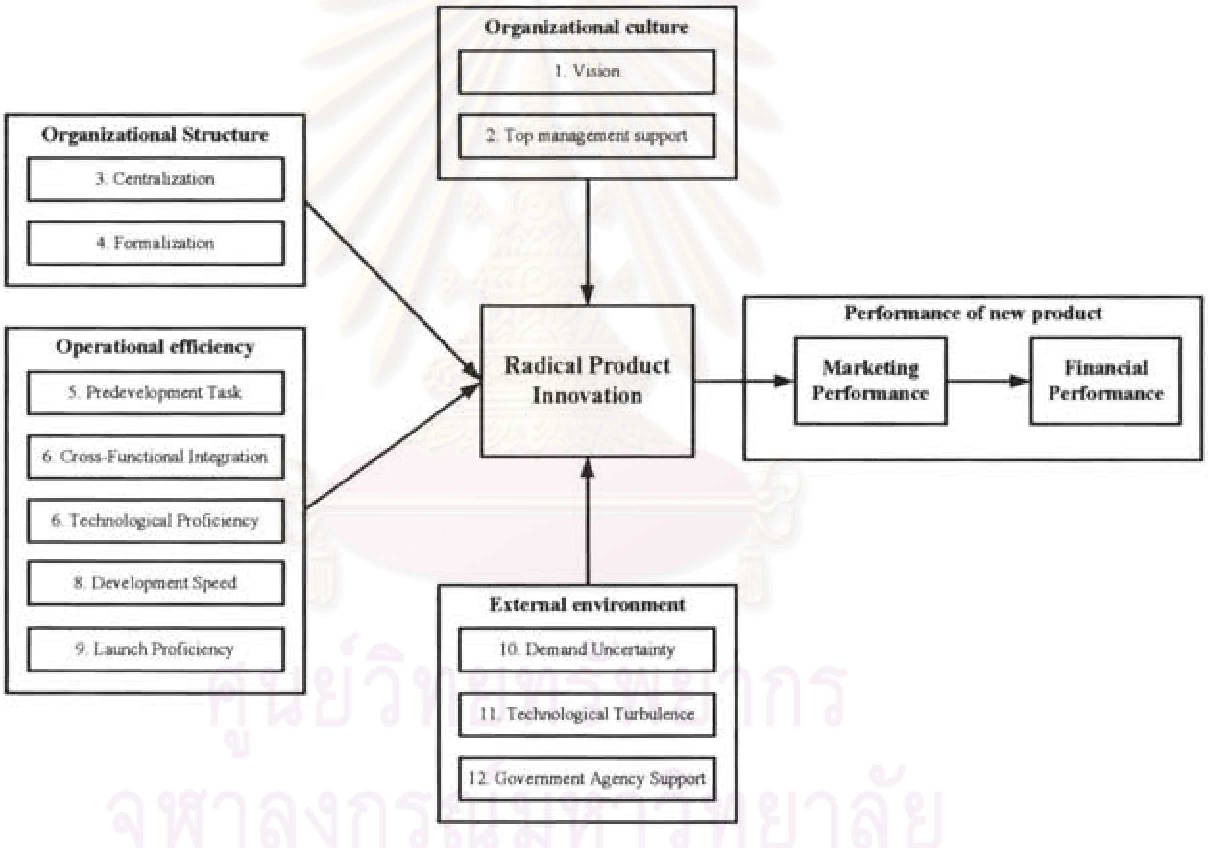
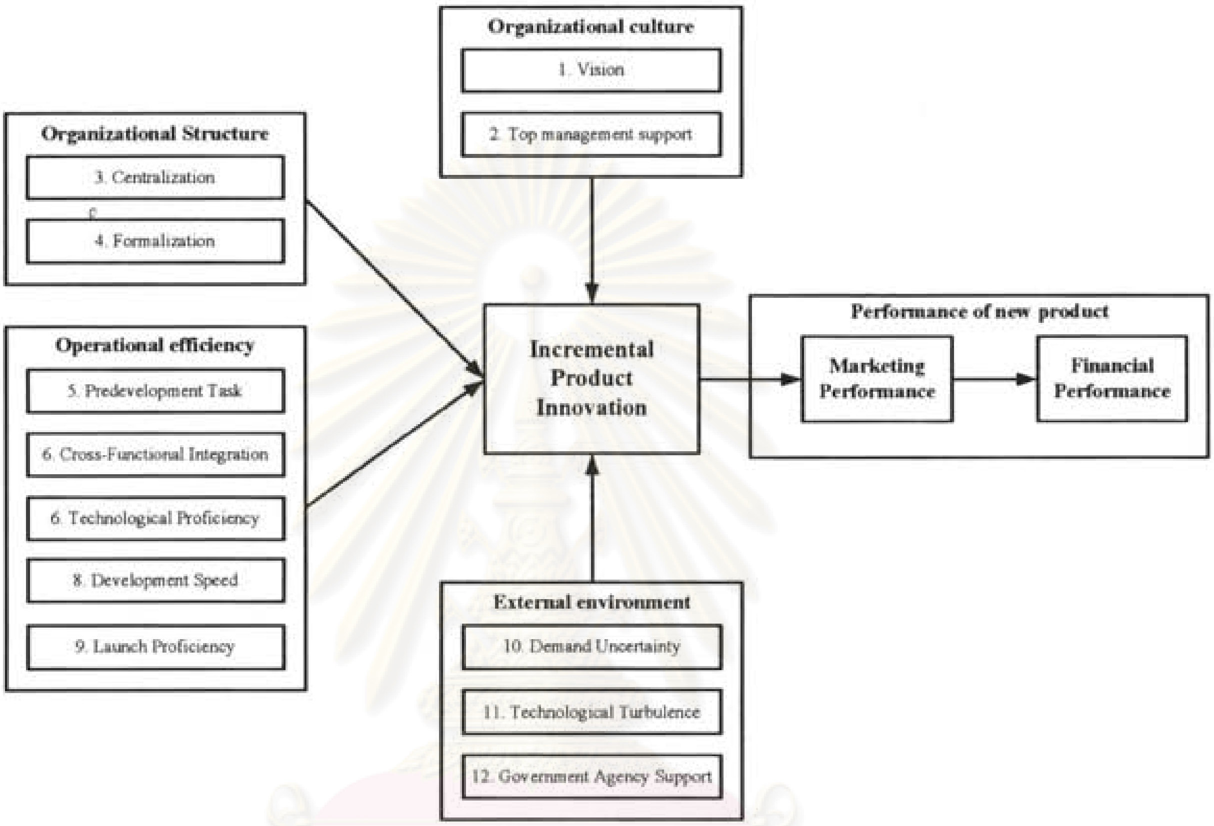


Figure 1.2

Incremental Product Innovation Based Performance Framework



1.6 Operational Definitions

Since there are several technical term used in this study, a researcher defines these technical terms as the followings:

1. Radical product innovation is defined as the development of products that have a different set of features and performance attributes that create a set of benefits different from that of existing products from the customer's perspective.

2. Incremental product innovation is defined as the development of products that have minor changes in attributes and the benefits from these changes are minimal from the customer's perspective.

3. Vision is defined as "a meshing of clarity, support, and stability of development goals and find support for its role in determining a product's market success" (Lynn and Akgün, 2001: 374).

4. Top management support is defined as the degree to which top management supports the process of new product development (Brentani and Kleinschmidt, 2004).

5. Centralization is defined as "the concentration of decision-making authority, typically impairs effectiveness, because it increases perceptions of bureaucratic structuring, which decreases the favorability of participants' attitudes toward the project and results in increased opportunism" (Sivadas and Dwyer, 2000: 34).

6. Formalization is defined as "the emphasis on following rules and procedures in conducting organizational activities" (Damanpour, 1991: 589).

7. Predevelopment task is defined as the proficiency with which firms execute their prelaunch activities, such as idea generation/screening, market research, financial analyses (Henard and Szymanski, 2001).

8. Cross-functional integration is defined as the degree of multiple department cooperation such as R&D, manufacturing, marketing, finance, and other departments, representation and contribution in a process of new product development (De Luca and Atuahene-Gima, 2007).

9. Technological proficiency is defined as how proficiency a firm uses technology in the process of new product development (Gatignon and Xuereb, 1997).

10. Development speed is defined as the time it takes from the beginning of idea generation to market introduction (Droge, Jayaram, and Vickery, 2000; Langerak and Hultink, 2006).

11. Launch proficiency is defined as proficiency which firms launch or introduce new products to the market (Henard and Szymanski, 2001).

12. Demand uncertainty is defined as the changing of customer preferences regarding the attributes of a new product (Li and Calantone, 1998).

13. Technological turbulence is defined as changing of technology over time within a firm's industry, whereby new technology will be used in the manufacturing process to produce new products (Goldenberg, Lehmann, and Mazursky, 2001; Jaworski and Kohli, 1993).

14. Government agency support is defined as helping firms to develop new products of government agencies (e.g. universities, research and development agencies, and other organizations) in several ways, such as information exchange, sharing resources, and solidarity.

15. Market performance is measured in terms of customer's acceptance, customer's satisfaction, market share, and increasing of a number of customers.

16. Financial performance is measured in terms of sale quantity, revenue, and profit.

1.7 Contributions of the Study

The contributions of this study can be separated into two parts: theoretical and managerial contributions as follows:

1.7.1 Theoretical Contributions

1. Comprehensive and systematic frameworks for each type of product innovation from the customer perspective can be obtained.

2. A greater understanding of the impact of factors that have not been empirically tested before (technological proficiency, demand uncertainty, and technological turbulence) on product innovation from the customer perspective can be achieved.

3. The frontier of knowledge of resource-based view (RBV) theory, contingency theory, social capital theory, and concept of competitive advantage can be expanded.

4. The measurement items to fit with the definition of each type of product innovation are developed.

1.7.2 Managerial Contributions

1. Product managers can identify important factors to developing new products for each type of product innovation from the customer perspective.

2. Product managers can identify the effects of product innovation from the customer perspective on the performance of new products.

1.8 The Structure of the Study

In Chapter 2, literature review, a researcher reviews the theories related to this study, the definition of product innovation, and the constructs. Moreover new product innovation based performance framework is proposed for this study. Twenty eight hypotheses (each framework has fourteen hypotheses) of this study are proposed along with the model.

In Chapter 3, researcher explains research methodology, population, sample size, sampling procedure, operationalization, pretesting questionnaire, data collection, and data analysis technique used in this study.

In Chapter 4, data analysis, researcher demonstrates data collection process. Moreover, all processes of data analysis which are descriptive statistic, measurement model assessment, and structural model assessment are proposed. Further, hypothesis testing of the two proposed frameworks in this study are revealed.

Finally, in Chapters 5, the conclusions and theoretical and managerial contributions of this study are discussed. Further, the limitations and implication for future research are also proposed.

1.9 Summary

This Chapter explains the rationales of the study which come from a shortage of focusing on incremental product innovation, concentrating on product innovation from a customer perspective, and developing measurement items to measure product innovation. A researcher set research questions from rationales and set research objectives to answer these questions. Scope of the study and frameworks of study are defined to be a boundary of the study. Operational definition is defined for measure constructs in the frameworks. Finally, contributions of the study have both theoretical and managerial contributions.

CHAPTER II

LITERATURE REVIEW

Many scholars had demonstrated that product innovation played an important role in firms to survive in a competitive market (Aragón-Correa, García-Morales, and Cordón-Pozo, 2007; Cooper, 1998; Ziamou and Ratneshwar, 2003). Product innovation helped firms to differentiate themselves from competitors in the market. Firms that had differentiated products from competitors would increase their competitive advantage (Porter, 1985; Schumpeter, 1934) and improved their performance (Han, Kim, and Srivastava, 1998).

However, new products were risky (Sivadas and Dwyer, 2000). Successful new products, especially radically new products were few (Lampel, Miller, and Floricel, 1996). Firms using a low risk strategy would concentrate on incremental product innovation rather than radical product innovation, while firms using a high risk strategy would concentrate on radical product innovation rather than incremental product innovation (Maital and Seshadri, 2007: 75).

Definitions of product innovation in past literature vary. The popular terms used to classify the degree of new product innovation were radical and incremental product innovation. However, definitions of these terms differed. For example, Anderson and Tushman (1991: 27) considered radical product innovation as *"technological discontinuities that advance by an order of magnitude the technological state-of-the-art which characterizes an industry"*. On the other hand, Cooper (2000) defined radical product innovation as producing products that were radically new from a customer's perspective and that added a new perceived dimension in the perceptual map of a market. Definitions of new products also differed in terms of perspective. Some scholars, such as Anderson and Tushman (1990) and Gatignon and Xuereb (1997), defined new products from a technological perspective, but other scholars, such as Christensen (1997), Cooper (2000) and Sethi, Smith, and Park (2001), defined new products from a customer perspective.

Applying the appropriate processes for developing new products for each type of product innovation was important (Bharadwaj and Menon, 2000; Hurley and Hult, 1998). Firms that applied suitable processes to develop their new products could not only reduce risk of new products failing but also increased the performance of the new products. Nonetheless, allocating bundle of resources for developing new products was essential. Appropriately allocating a bundle resources enhanced the opportunity of firms to succeed in developing new products, increased their competitive advantage, and improved their performance as well (Bharadwaj, Varadarajan, and Fahy, 1993; Lee, Lee, and Pennings, 2001).

The external environment also contained important factors affecting the development of new product (Adler and Kwon, 2002; Li and Calantone, 1998). Firms should understand the impact of external environmental factors on each type of product innovation because each factor had different impact for each type of product innovation (Zhou, Yim, and David, 2005).

This chapter is organized as follows: first, the definition of product innovation was presented. Second, theories and concepts involved in this study, which are the resource-based view theory (RBV), contingency theory, social capital theory, the concept of competitive advantage, and the concept of product innovation management aree explained. Third, radical and incremental product innovation based performance frameworks and constructs are proposed.

2.1 Definition of Product Innovation

Innovation was defined as the extent to which there was "a degree of creativity in the new product ideation and design processes" (Sethi, Smith, and Park, 2001: 74).

Similarly, innovation was defined by Pla-Barber and Alegre (2007: 276), as "the taking up of an idea in relation to a product which is new to company".

Product innovation could be described in terms of three dimensions: technology, customers, and a combination of technology and the customer. Anderson and Tushman (1990), Gatignon and Xuereb (1997), Kristina and Dean (2005), and Pla-Barber and Alegre (2007) explained innovation from a technological perspective. Christensen (1997), Cooper (2000), Govindarajan and Kopalle (2006), Langerak and Hultink (2006), De Luca and Atuahene-Gima (2007), Olshavsky and Spreng (1996), Sethi, Smith, and Park (2001) and Ziamou and Ratneshwar (2003) explained innovation from the customer's perspective. Finally, Atuahene-Gima (2005), Booz, Allen and Hamilton (1982), Chandy and Tellis (1998), Iyer, LaPlaca, and Sharma (2006), Kleinschmidt and Cooper (1991), Veryzer (1998), and Zhou, Yim, and David (2005) explained innovation from a combination of the technological and the customer's perspectives. All of these perspectives would be described in more detail in the following paragraphs.

From the technological perspective, Kristina and Dean (2005) proposed that product innovation might be evaluated in terms of the differentiated technological characteristics of the product. The two criteria for evaluation were (1) novelty, which was the need to be dissimilar from prior technologies and (2) uniqueness, which was the need to be dissimilar from current technology. Anderson and Tushman (1991: 27) defined product innovation only in terms of radical innovation. They defined product innovation as *"technological discontinuities that advance by an order of magnitude the technological state-of-the-art which characterizes an industry"*. Anderson and Tushman (1990) explained product discontinuities as technological breakthroughs which produced fundamentally different product forms that possessed a decisive cost, performance, or quality advantage over prior product forms. Product discontinuities also represented a new way of making something, i.e., novel product architecture. Radical products were the result of technological discontinuities. Pla-Barber and Alegre (2007) suggested that product innovation must produce technologically new or significantly improved products.

From the customer's perspective, Christensen (1997) classified disruptive product innovation as involving the creation of new products bring a very different value proposition in a market than product created using previously available technologies. Disruptive innovation *"introduces a different set of features and performance attributes relative to the existing products and is offered at a lower price, a combination that is unattractive to mainstream customers at the time of product introduction due to inferior performance on the attributes that mainstream customers' value"* (Govindarajan and Kopalle, 2006: 190). Cooper (2000) suggested that radical product innovation and disruptive or discontinuous product innovation, created a new dimension to the customer's perspective. Similarly, Langerak and Hultink (2006) defined product innovation as the extent to which the products were new to the target market. Ziamou and Ratneshwar (2003) defined product innovation as creating a novel set of benefits available to customers, although the physical shape of the product offered might not be new to the market. Sethi, Smith, and Park (2001) classified product innovation in term of novelty (radical innovation) and appropriateness (incremental innovation). Novelty referred to concepts, ideas, or objects that differed from conventional practice within the domain of interest. Appropriateness referred to a given output being viewed as useful or beneficial for some market segments. De Luca and Atuahene-Gima (2007) used three criteria in which the degree of innovation could be measured that products offered were new to the firm and the industry; that the customer or client needs served were new to the firm; and that the users of the products or services were new to the firm. Olshavsky and Spreng (1996), however, noted that it was difficult for customers to form evaluations or make expectations regarding product innovation. Moreover, customers might reject new products if they were still satisfied with present products or if new products did not meet the customers' expectations. Hence, it was very important for firms to know the expectations of customers so that firms could position their new products as differentiated from their competitors.

From the technological and customer's perspective, Chandy and Tellis (1998) separated types of product innovation depending on the degree of newness of technology and the newness of the product from the customer's perspective. Types of product innovation were shown in Table 2.1.

Table 2.1

Types of Product Innovation

		Newness from customer perspective	
		Low	High
Newness of technology	High	Technological breakthrough	Radical innovation
	Low	Incremental innovation	Market breakthrough

Source: Chandy and Tellis (1998), Organizing for Radical Product Innovation: The Overlooked Role of Willingness to Cannibalize.

The classification of product innovation by Chandy and Tellis (1998) was similar to that of Veryzer (1998). Veryzer (1998) defined incremental innovation as continuous innovation and other types of innovation (market breakthrough, thechnological breakthrough, and radical innovation) as discontinuous innovation. Atuahene-Gima (2005) defined radical innovation as fundamental changes in technology for the firms that were new to the firms and introduce new benefits for emerging and existing customers. In contrast, incremental innovation referred to product improvements and line extensions that usually served the needs of existing customers. Additionally, incremental innovation involved small changes in technology and little deviation from existing products.

Booz, Allen and Hamilton (1982) considered product innovation as occurring in six areas: new-to-the-world products, the creation of new product lines, additions to existing product lines, improvements to existing products, repositioning of products, and cost reductions. Kleinschmidt and Cooper (1991) considered product innovation as: high, moderate, or low. High innovation involved the introduction of new-to-the-world products and new product lines. Moderate innovation involved improvements to existing products and additions to existing product lines. Low innovation involved repositioning products and making cost reductions.

Iyer, LaPlaca, and Sharma (2006) considered radical product innovation as having two different dimensions. Firstly, radical product innovation could be based on technology, whereby new technology is introduced that was substantially different to existing technology. Secondly, radical product innovation could be market-based, whereby firms developed new products to serve new segment of adopters. Incremental product innovation referred to product line extensions or adding modifications to existing platforms and/or products.

Zhou, Yim, and David (2005) defined innovation as incremental (continuous) or breakthrough (discontinuous). Incremental product innovation involved minor changes in technology such as simple product improvements and/or product line extensions to improve existing performance. On the other hand, breakthrough innovation involved novel, unique, or state-of-the-art technological change that created new products to transform the consumption pattern of a market. Zhou, Yim, and David (2005) further divided breakthrough innovation into technology-based and market-based innovation. Market-based innovations introduced value and benefits for a new market segment and for existing segments because these innovations changed the thinking and behavior of customers and differentiated a firm's products from its competitors.

The definitions of product innovation from the literature reviewed are summarized in Table 2.2. It classifies product innovation by degree of newness of technology and customer needs. Radical product innovation has technology, customer, and a combination of technology and customer dimensions. Gatignon and Xuereb (1997) defined radical innovation as involving high technological changes but Cooper (2000) defined radical innovation as involving highly changing customer needs. Furthermore, Christensen (1997) demonstrated that the concept of disruptive innovation was distinct from radical versus incremental product innovation because disruptive innovation involved innovation from a customer's perspective but radical and incremental innovation considered involves from a technological perspective.

Nevertheless, the meaning of disruptive innovation proposed by Christensen (1997) was similar to the meaning of radical innovation proposed by Cooper (2000) and Sethi, Smith, and Park (2001). Thus, the concepts of disruptive innovation and radical versus incremental innovation were interchangeable. This was supported by Veryzer (1998) which he proposed that discontinuous innovation could be explained in variety of ways. Terms such as radical, breakthrough, revolutionary, really new, game-changing, and boundary expanding had all been used to refer to products that involved a different set of features and performance attributes or made a novel set of benefits available from existing products or their logical extensions.

Moreover, incremental product innovation as defined by Gatignon and Xuereb (1997) was considered only from a technological dimension. However, Chandy and Tellis (1998) and Zhou, Yim, and David (2005) considered incremental and continuous product innovation from the perspective of the combination of technology and customer needs. Incremental product innovations referred to minor changes in technology, simple product improvements, or line extensions that minimally improved the existing products (Zhou, Yim, and David, 2005). Yet, Sethi, Smith, and Park (2001) considered incremental product innovation (appropriateness) only from a customer's perspective. They defined incremental product innovation as the extent to which a given output was viewed as useful or beneficial to some customers in the market.

Table 2.2

Summary of Definitions of Product Innovation

Customer needs	Technology	1	2	3	4	5	6	7	8
Low	Low				Appropriateness		Continuous	Continue	Incremental
	High		Incremental						
High	Low			Radical	Novel	Radical	Breakthrough	Discontinuous	Radical
	High	Radical	Discontinuous						

Note:

1 Gatignon and Xuereb (1997)

2 Anderson and Tushman (1990)

3 Cooper (2000)

4 Sethi, Smith, and Park (2001)

5 Iyer, LaPlaca, and Sharma (2006)

6 Zhou, Yim, and David (2005)

7 Veryzer (1998)

8 Jansen, Van Den Bosch, and Volberda (2006)

19

This study, therefore, concentrated only on the customer's perspective, because new products would succeed if new products were designed to satisfy a perceived need of customers, rather than being developed to take advantage of new technologies (Brown and Eisenhardt, 1995; Porter, 1985; Voss and Voss, 2000; Ziamou and Ratneshwar, 2003; Zirger and Maidique, 1990). Furthermore, Kuczmarski (1998) suggested that the design of new products should begin with identification of customer problems and need intensities, not within idea generation within firms. Successful new products always involved solving customer's problems (Goldenberg, Lehmann, and Mazursky, 2001).

Thus, based on the previous definitions of product innovation, radical product innovation and incremental product innovation might be defined as follows. Radical product innovation refers to ***"the development of products that have a different set of features and performance attributes that create a set of benefits different from that of existing products from the customer's perspective"*** and incremental product innovation refers to ***"the development of products that have minor changes in attributes and the benefits from these changes are minimal from the customer's perspective".***

2.2 Resource-Based View Theory (RBV)

Product innovation was one of the most important strategies firms could use to increase their competitive advantage (Henard and Szymanski, 2001; Schumpeter, 1934). The key factor in this strategy was the resources that are available to firms. Consideration of these resources was known as the *"resource-based review"* (RBV) theory.

The core concept of the RBV was that each firm holds on exclusive bundle of resources (Collis and Montgomery, 1995). The RBV thus concentrated on the internal capabilities of firms. Internal capabilities involved the strengthes and weaknesses of firms (Wernerfelt, 1984). As resources could not be accumulated simultaneously, a firm's strategies choices were limited by constrained resources. The RBV could thus explain firms had different levels of competitive advantage. Barney (1991) stated that the RBV had two assumptions: Firstly, firms in an industry had heterogeneous resources. Secondly, resources could not be perfectly mobile across firms.

Barney (1991) and Hunt and Morgan (1995) demonstrated that understanding the sources of competitive advantage was the core of strategic management. Barney (1986), Barney (1991) and Porter (1985) identified four characteristics of resources which helped to create a firm's competitive advantage; value, scarceness, imitability, and substitutability. Wernerfelt (1984) suggested that a firm should have clear understanding of these indicators in order to generate more alternative strategies than their competitors. In this way, firms would be able to produce superior, or more innovative, products than those of their competitors.

Developing new products required resources (Hunt and Morgan 1995). Radical product innovation required more resources than incremental product innovation does (Sivadas and Dwyer 2000) because the processes of developing radically new products were more complex than the processes of developing incrementally new products (Lampel, Miller, and Floricel 1996; Veryzer 1998). Moreover, developing radically new products required more technology and more staff than developing incrementally new products (Salomo, Weise, and Gemünden, 2007)

A firm's resources included all the assets within the firm such as capabilities, organizational processes, firm attributes, information, and knowledge (Daft 2006). Lee, Lee, and Pennings (2001) and Wernerfelt (1984) suggested that technological knowledge, the skills of staff, machinery, capital, company reputation, real estate, and so on represented the resources of a firm. In addition, work efficiency, effectiveness, and the ability to combine assets, staff, and organizational process were also the resources of a firm (Collis and Montgomery 1995).

Tangible and intangible resources available to firms, along with organizational capabilities, enabled firms to activate or implement strategies that improved their competitive advantage and performance (Barney, 1991; Bharadwaj, Varadarajan, and Fahy, 1993; Conner, 1991; Day and Nedungadi, 1994; Hunt and Morgan, 1995; Lee, Lee, and Pennings, 2001). Moreover, firms that had fruitful resources could increase their likelihood of survival in the industry and their performance (Castrogiovanni, 1991). Nevertheless, firms must also have the ability to convert these resources to valuable outputs to increase their competitive advantage using an appropriate marketing mix (Vorhies and Morgan, 2005).

In conclusion, a firm that owned a valuable or superior bundle of resources, and was able to choose the best strategy to convert those resources to add value for customers would increase its competitive advantage in the marketplace. Additionally, a firm desiring to develop radical new products would require more resources than to develop incremental new products.

2.3 Contingency Theory

In the business world, the external environment, such as the economy, technological changes, competitive intensity, politics, and the demand uncertainty, affected the success of firms (Drazin and Van De Ven, 1985; Jaworski and Kohli, 1993). Fluctuations in the external environment leaded successful firms to analyze opportunities and threats and decide upon the proper strategies in order to take advantage of opportunities and cope with threats (Dess, Lumpkin, and Covin, 1997).

Contingency theory emphasized the significance of situational influences on strategic management and performance of firms (Venkatraman, 1989; Zeithaml, Varadarajan, and Zeithaml, 1988), because the innovation strategy and performance of firms varied depending on the environment in which firms operated (Hambrick and Lei, 1985). One of the conceptual approaches of contingency theory proposed by Drazin and Van De Ven (1985) was the selection approach. Venkatraman (1989) suggested that this approach might be considered as a mediation perspective which posited the existence of intervening variables (e.g., the innovation strategy) between the antecedent variables (e.g., environment) and the consequent variables (e.g., performance). For example, Min, Kalwani, and Robinson (2006) suggested that truly new products were affected more by technological turbulence that was incrementally new products. However, truly new products created by market pioneers had a higher survival rate than incrementally new products created by market pioneers. So this perspective had the benefit of helping to determine the significant relationships between antecedent and consequent variables mediated by an intervening variable.

Hence, firms that understood the effect of external situations could select the appropriate innovation strategy to cope with and derive benefit from those situations.

2.4 Social Capital Theory

Schumpeter (1934: 66) suggested that what was important for incremental and radical innovation was the combination and exchange of resources. Further, Cohen and Levinthal (1990) stated that the exchange of external information and knowledge, its integration and application were also critical factors in new product innovation. The process of combining and exchanging resources to develop a new product through either radical or incremental product innovation could be explained by social capital theory.

Social capital could be defined as "the resources embedded in a social structure which were accessed and/or mobilized in purposive actions" (Lin, 1999: 35). Also, Baker (1990) defined social capital as *"a resource that actors derive from specific social structures and then use to pursuer their interests; it is created by changes in the relationship among actors"*. From these definitions, the idea of social capital contained three parts: resources accumulated in a social structure; accessibility to such social resources by actors in social structure; and the application of such social resources by actors according to their objectives. Additionally, the heart of social capital theory was the willingness to share or exchange resources within a social structure (Adler and Kwon, 2002; Portes, 1998).

Social capital theory was important for firms seeking to develop new products (Burt, 1987; Tsai and Ghoshal, 1998), because social capital helped each organization exchanged or combined resources when developing a new product (Adler and Kwon, 2002; Cohen, Nelson, and Walsh, 2002; Tsai and Ghoshal, 1998). For example, if a government agency made its resources such as information, knowledge and technology available to firms looking to develop new product, the government agency would benefit from being seen promoting industrialization (Mahmood and Rufin, 2005) or by receiving fund from firms (Kleyn, Kitney, and Atun, 2007). The firms, in turn, would benefit from increasing their performance (Langerak, Hultink, and Robben, 2004). However, the successful development of a new product depended on a firm's ability to create, use, and absorb social capital (Cohen and Levinthal, 1990; Nahapiet and Ghoshal, 1998).

Consequently, firms which had the ability to apply, combine, exchange and access resources within a social structure would increase the rate at which they successfully developed innovate new product.

2.5 Competitive Advantage

Porter (1985) proposed two sources of competitive advantage: cost advantage and differentiation. Cost advantage was the extent to which the prices of a firm's products were lower that those of their competitors in the market. Differentiation meant that firms offered unique or superior benefits to their customers that competitors did not. In addition, these unique and superior benefits must meet the customer's needs (Day and Nedungadi, 1994).

Product innovation helped firms not only to differentiate themselves from their competitors by providing unique and superior benefits to their customers (Hunt and

Morgan, 1995; Zhou, Yim, and David, 2005), but also to enhance their cost advantage over competitors by introducing similar products at a lower cost (Gatignon and Xuereb, 1997; Porter, 1985).

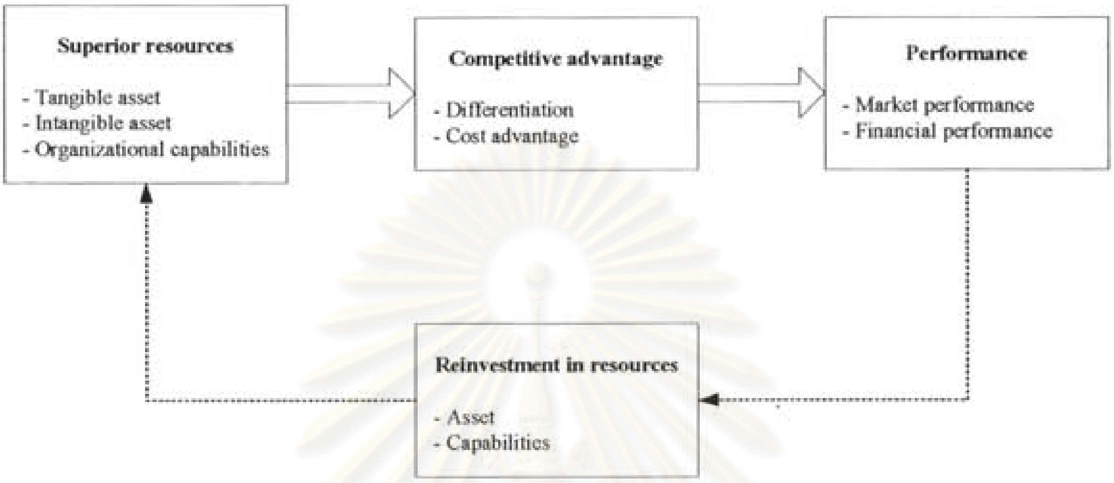
Firms could survive and prosper in a competitive market by continuously responding to changing opportunities and threats (White, Varadarajan, and Dacin, 2003). The key factors were customers and competitors (Homburg, Grozdanovic, and Klarmann, 2007). Firms should determine customers' needs and ascertain product information from competitors, so that they could develop new products according to the customers' needs and differentiated them from their competitors. Responding to customers and competitors was important in improving a firms' performance in area like customer satisfaction, profits, and market share (Day and Wensley, 1988; Homburg, Grozdanovic, and Klarmann, 2007). Performance was a key indicator used to measure the competitive advantage of firms.

Continuous investment in resources also helped firms to sustain their competitive advantage in the long-run (Bharadwaj, Varadarajan, and Fahy, 1993; Day and Wensley, 1988). Possessing resources, which were not imitable, tradable, or substitutable, leaded firms to reach sustainability (Dierickx and Cool, 1989). Furthermore, Porter (1985) demonstrated that sustained competitive advantage could be achieved when firms resisted erosion by changing customers and competitors. A model of sustainable competitive advantage was shown in Figure 2.1.

Firms that understood and responded to their customers and competitors in the market could develop new products that could deliver either superior benefits to their customers or could have cost advantages over their competitors which would increase their competitive advantage.

Figure 2.1

Model of Sustainable Competitive Advantage



Adapted form Bharadwaj, Varadarajan, and Fahy (1993), Day and Wensley (1988), and Porter (1985).

2.6 Product Innovation Management

Maital and Seshadri (2007: 29) defined innovation management as *"the process of creating and implementing a business design surrounding a creative idea, with the goal of transforming an invention into an innovation, and ultimately to achieve sustained competitive advantage, leading to growth and profit, in the marketplace"*. Iyer, LaPlaca and Sharma (2006), Khilji, Mroczkowski, and Bernstein (2006), and Sethi, Smith, and Park (2001) proposed a model of innovation management which had three major stages: product development, commercialization of new products, and the performance of new products. A model of product innovation management was shown in Figure 2.2.

Figure 2.2

Model of Product Innovation Management

Source: Maital and Seshadri (2007), Innovation Management: Strategies, Concepts and Tools for Growth and Profit

In the model of product innovation management, product development processes played an important role, because they influenced the commercialization new products and the performance of new products (Khilji, Mroczkowski, and Bernstein, 2006). Previous literature suggested several factors in the product development processes (such as administrative mechanism, predevelopment tasks, technological proficiency, launch proficiency, development speed, cross-functional integration, and senior management support) that affected the commercialization of new products (Atuahene-Gima, 2005) and the performance of new product (Marinova, 2004).

Nevertheless, the product development process requirements for each type of product innovation were different (McDermott and O'Connor 2002). Radical product innovation required different processes than incremental product innovation (Chandy and Tellis, 2000; Veryzer, 1998). Chandy and Tellis (2000) stated that radical product innovation required greater technological capabilities than incremental product innovation. Dell'Era and Verganti (2007) demonstrated that development of radical new products demands superior predevelopment tasks, such as finding consumption patterns in the market, than did development of incremental new products.

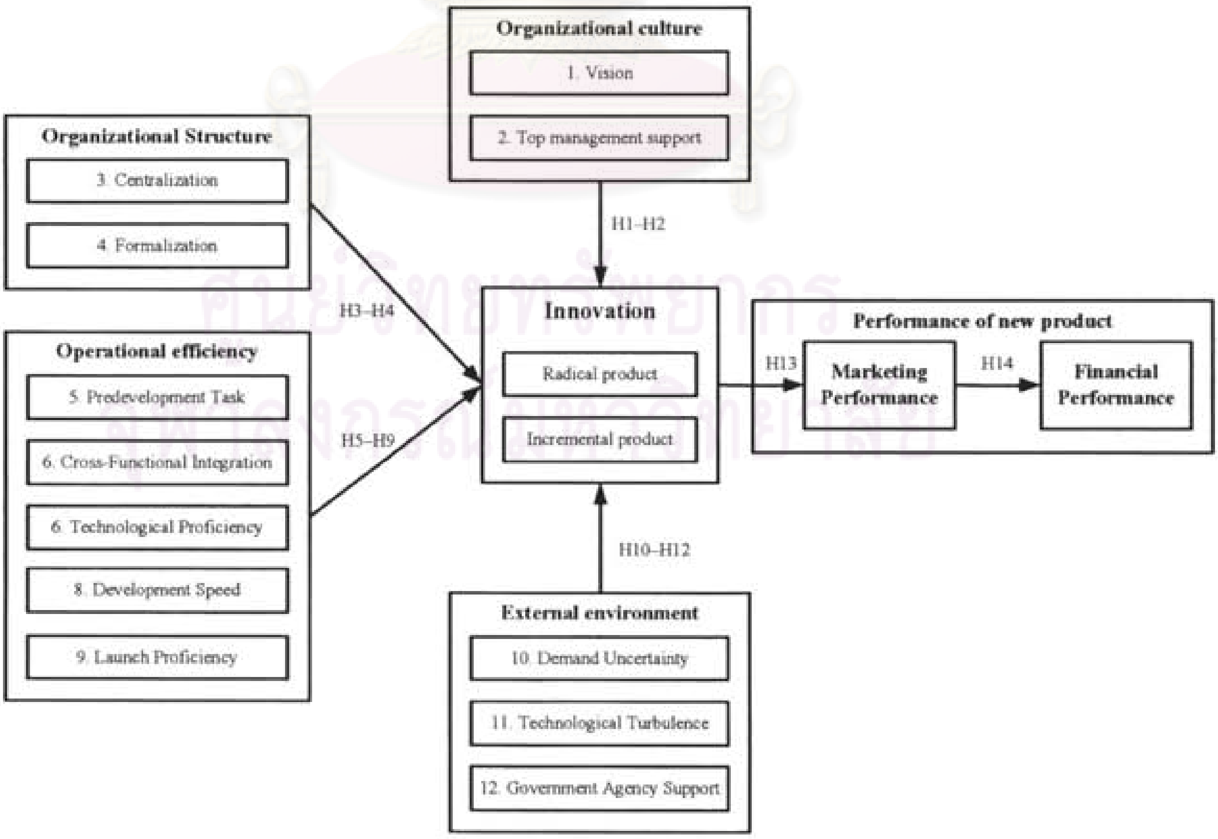
As a result, understanding the factors in the product development process that affected the performance of each type of new product was essential for firms. Firms that appropriately organized the factors in the product development process for each type of new product would improve the performance of the new products.

2.7 Radical and Incremental Product Innovation Based Performance Framework

In the radical and incremental product innovation based performance framework, there are five groups of constructs: organizational culture, organizational structure, operational efficiency, external environment, product innovation, and performance. The proposed framework is shown in Figure 2.3.

Figure 2.3

Radical and Incremental Product Innovation Based Performance Framework



2.7.1 Innovation

From the definitions of *"innovation"* defined in this chapter, the characteristics of radical and incremental products were quite different. Poorly defined constructs leaded to problems of reliability, validity, and convergence (MacKenzie, 2003) which made interpreting results unreliable. Designing measurement items to fit each type of product innovation was necessary (Gatignon et al., 2002; Zhou, Yim, and Tse, 2005) and these measure should make sense (Harmancioglu, Droge, and Calantone, 2009). However, measurement items for radical and incremental product innovation from a customer perspective, comprehensively explained the differences between the innovation characteristics, were scarce in literature. For example, Jansen, Van Den Bosch, and Volberda (2006) developed a scale for each type of product innovation (which they termed exploratory and exploitation innovation) for financial services not for product characteristics. In addition, much previous literature concentrated on radical product innovation and neglected incremental product innovation, hence a death of measurement items of incremental product innovation (De Luca and Atuahene-Gima, 2007; Zhou, Yim, and David, 2005).

As a result, this study develops measures of radical and incremental product innovation in terms of the customer perspective and of product characteristics so that the results of study could overcome a problem of confusion between the antecedents (product innovation factors) and the mediators (radical and incremental product innovation).

However, to measure the degree of product innovation by using self-ranking product innovation had pros and cons. Langerak and Hultink (2006: 209-210) revealed four advantages and three limitations of self-ranking product innovation. The first advantage of self-ranking was effective because subjective measurement could capture the perceptions of respondents on the degree of product innovation. Second, objective measures on product innovation were not possible to achieve. The reasons were either objective data about the degree of product innovation were not available or a researcher wanted to get rid of a considerable set of items to measure the degree of product innovation. Third, self-ranking was reliable and valid. Dess and Robinson (1984) suggested that subjective measurement derived from the attitudes of respondents had a strong correlation with objective measurement in their evaluation. Finally, self-ranking had been used in previous product innovation research such as De Luca and Atuahene-Gima (2007) and Gatignon and Xuereb (1997).

There were three limitations of using self-ranking. First, evaluation of the degree of product innovation by respondents had variation. The chance of variation of evaluating the degree of product innovation was increase if a researcher defined a wide range of self-ranking for evaluating the degree of product innovation. So, a researcher might encounter the problem of classify type of new product. Second, self-ranking lacked of external confirmation of respondents' answers so it might decrease reliability and validity of an evaluation of respondents. Finally, respondents might overestimation of the degree of innovation in their products. Classification of product innovation in the study might not correct. For example, some respondents might evaluate their products as radical product even though their products were incremental product. Despite the limitations of self-ranking, this study used self-ranking to classify product innovation and consideration was given to these limitations in interpretation of the results.

2.7.2 Performance of New Products

Organizational performance had become an important construct in empirical research into innovation management. Song and Parry (1997) said that new products that were superior to competitors, would improve firms' performance, where performance was measured by profitability, market share, loyalty, and customer satisfaction. Henard and Szymanski (2001) revealed scales to measure the performance of product innovation in such terms as return on investment (ROI), market share, sales revenue, and profit, where these terms could be operationalized through objective data derived from firms' balance sheets. However, many researchers encountered obstacles to obtaining reliable and valid objective data, such as profit and revenue, when they measured the performance of firms (Dess and Robinson, 1984). For example, in private firms, many managers might not allow researchers access to financial data. In large firms, it was hard for researchers to gather data because data might be scattered across in many divisions, strategic business units (SBUs), or even countries.

Hence, Dess and Robinson (1984) suggested that subjective measurement derived from the attitudes of managers had a strong correlation with objective measurement in their firms. Although objective data was preferred, Dess and Robinson (1984) and Im and Workman (2004) recommended that researchers who wanted to utilise subjective data in empirical study should consider under two aspects: (1) that objective data were not available and (2) that researchers desired to remove a considerable set of items that measure the performance of firms. Song and Parry (1997) proposed that subjective measurement could capture the perceptions of informants that underlined their decision-making and allowed comparisons across competitors, economic situations, and goals.

Customer satisfaction and the assessment of success versus failure could be measured in term of product innovation and these terms could be operationalized through subjective data derived from the attitudes of managers (Gatignon and Xuereb, 1997; Jaworski and Kohli, 1993; Kleinschmidt and Cooper, 1991). Henard and Szymanski (2001) also suggested that using multi-item scales to measure the performance of product innovation was better than using a single-item scale.

Alam (2003) classified the performance of new products into three groups of criteria: namely financial, customer, and opportunity criteria. Financial criteria were profitability, sales growth, market share, operation costs, and return on investment (Brown and Eisenhardt, 1995). Customer criteria were customer satisfaction, the number of new customers, customer loyalty, image with customers, and customer complaints. Opportunity criteria were improved profitability of other products, and providing a platform for other new products, and improved new product development (NPD) capabilities. Langerak, Hultink, and Robben (2004) divided new product performance into two dimensions: namely market and financial dimensions. The market dimension consisted of customer acceptance, customer satisfaction, and market share. The financial dimension consisted of return on investment (ROI), profitability, and sales growth.

In summary, this study measures the performance of product innovation in relative terms which objective measures (such as a percentage of sale growths) are translated into subjective measures (such as a percentage of sale growth in seven-point Likert scale) by asking respondents to rate their performances in Likert scale. Also, a researcher separates the performance of new products into two dimensions, financial and marketing. The financial dimension covers profitability, sales growth, and revenue. The marketing dimension covers customer acceptance, customer satisfaction, the number of new customers, and market share.

2.7.3 Organizational Culture

Organizational culture refers to a system of shared values, beliefs, and meaning held by staff in an organization that characterized the ways the firm manages its business (Barney, 1986). Organizational cultures play an important role in developing new products (Brentani and Kleinschmidt, 2004). So, firms must define a pattern of organizational culture which matches the type of new products they wish to develop (Damanpour, 1991; Jansen, Van Den Bosch, and Volberda, 2006). This study will investigate the effect of organizational culture, specifically vision and top management support, on product innovation.

2.7.3.1 Vision

Larwood et al. (1995: 740) suggested that vision was *"the art of seeing things invisible"*. Lynn and Akgün (2001: 374) defined vision as *"a meshing of clarity, support, and stability of development goals and find support for its role in determining a product's market success"*. Vision influenced the strategic planning of firms (Larwood et al., 1995) such as determining what type of new product firms should produce. Vision support must match an organization's resources and market needs (Brown and Eisenhardt, 1995) and to help ensure objectives and strategy within the development team (Tessarolo, 2007). Further, vision clarity helped staffs in the development team know how to develop new products (Manimala, Jose, and Thomas, 2005) and to reduce the need for redesign and respecification (Kessler and Chakrabarti, 1996). Moreover, vision stability was also important because firms that change vision frequently would create confusion, ambiguity, and conflict within the development team (Lynn and Akgün, 2001). So, product innovation would be benefit from a clear, supportive, and stable vision.

It is hypothesized in this study that vision affects product innovation positively. This leads to the following hypotheses.

H1a: Vision has a positive impact on radical product innovation.

H1b: Vision has a positive impact on incremental product innovation.

2.7.3.2 Top Management Support

Top management support referred to degree to which top management supported the process of new product development (Brentani and Kleinschmidt, 2004).

Products that were supported by and receive commitment from top management were likely to be successful (Brown and Eisenhardt, 1995; Manimala, Jose, and Thomas, 2005; Zirger and Maidique, 1990). Without top management support, resources and capital required to develop new products might not be forthcoming. This could be a major impediment to develop new products. Brentani and Kleinschmidt (2004) demonstrated that the top management providing guidelines for the development process would improve the quality and performance of new products. Furthermore, top managers could stimulate staffs to improve their performances by expressing positive or proactive attitudes (Kuczmarski, 1998) and could reduce development time or communication problems. In addition, monitoring of the process of new product development by top management stimulated staff to develop more innovative new products (Sethi, Smith, and Park, 2001).

In this study, the role of top management support in the process of product innovation is hypothesized as follows.

H2a: Top management support has a positive impact on radical product innovation.

H2b: Top management support has a positive impact on incremental product innovation.

2.7.4 Organizational Structure

Robbins and Coulter (2005: 234) defined organizational structure as *"the formal arrangement of jobs within an organization"*. Previous literature demonstrated the impact of organizational structure on product innovation (Damanpour, 1991; Jansen, Van Den Bosch, and Volberda, 2006). The effect of organizational structure was different depending on the type of product innovation. This study would explore two types of organizational structure and their impact on product innovation: centralization and formalization.

2.7.4.1 Centralization

Sivadas and Dwyer (2000: 34) defined centralization as *"the concentration of decision-making authority, typically impairs effectiveness, because it increases perceptions of bureaucratic structuring, which decreases the favorability of participants' attitudes toward the project and results in increased opportunism"*.

Centralization influenced product innovation (Lukas and Menon, 2004). Jansen, Van Den Bosch, and Volberda (2006) revealed that centralization decreased radical product innovation because centralization limited communication channels between management and staff and reduced idea and solution generation within the development team (Damanpour, 1991; Jaworski, and Kohli, 1993; Sheremata, 2000).

On the other hand, centralization had a positive impact on incremental product innovation (Cardinal, 2001). Because the development of incrementally new products typically involved small, less radical change, and improvements to products need relatively quick (Jansen, Van Den Bosch, and Volberda, 2006) and the speed of decision making (Sheremata, 2000). Thus, contradiction was important here, because it improved the efficiency of information processing.

In this study, the role of centralization is hypothesized as follows.

H3a: Centralization has a negative impact on radical product innovation.

H3b: Centralization has a positive impact on incremental product innovation.

2.7.4.2 <u>Formalization</u>

Formalization reflected *"the emphasis on following rules and procedures in conducting organizational activities"* (Damanpour, 1991: 589).

Formalization detrimentally affected radical product innovation, because formalization constructed a framework in the new product development process that reduced the creation of new ideas and decreased the use of developing new products (Damanpour, 1991). Moreover, formalization restricted the planning to and control of unexpected environments (Salomo, Weise, and Gemünden, 2007). Furthermore, formalization decreased market generation and intelligence dissemination (Jaworski and Kohli, 1993), because it limited attention to diversion from existing knowledge and finding customers needs (Jansen, Van Den Bosch, and Volberda, 2006).

In contrast, formalization positively affected incremental product innovation (Jansen, Van Den Bosch, and Volberda, 2006). This was because incremental product innovation involved use existing routines and because it was related to improving existing benefits extant in a product according to customers needs (Zhou, Yim, and David, 2005). Formalization assisted responses to known environmental phenomena or routine jobs (Olson, Slater, and Hult, 2005). It decreased variations in working processes by ensuring rules or procedures were followed (Benner and Tushman, 2003). Thus, formalization helped firms to increase efficiency in incremental new product innovation (Benner and Tushman, 2002; Zander and Kogut, 1995).

Consequently, the role of formalization in this study is hypothesized as follows.

H4a: Formalization has a negative impact on radical product innovation.

H4b: Formalization has a positive impact on incremental product innovation.

2.7.5 Operational Efficiency

Many scholars (e.g., Cooper and Kleinschmidt, 1987; Danneels, 2002; Olson et al., 2001; Song and Parry, 1997) explained the importance of operational efficiency to developing new products. Operational efficiency referred to the processes involved with developing new products and the implementation of those processes (Henard and Szymanski, 2001). Operational efficiency consisted of predevelopment tasks, cross-functional integration, technological proficiency, development speed, and launch proficiency. The impact of these factors was described below.

2.7.5.1 Predevelopment Task

Operational efficiency in terms of predevelopment tasks referred to the proficiency with which firms executed their prelaunch activities, such as idea generation/screening, market research, financial analyses (Henard and Szymanski, 2001). At this stage, a decision was made as to whether or not to launch the actual product development process (Salomo, Weise, and Gemünden, 2007). Brown and Eisenhardt (1995), Cooper and Kleinschmidt (1987), and Song and Parry (1996) suggested that operational efficiency in the predevelopment task was a critically important aspect of the internal organization of a firm that leaded to product success. Cooper and Kleinschmidt (1994: 26) revealed that *"the greatest differences between winners and losers are found in the quality of predevelopment activities"*. Predevelopment tasks comprised defining a target market, ascertaining the needs of customers, developing product specifications, making clear product concepts, determining broad preliminary markets, and making technical assessments.

Predevelopment tasks helped firms to better allocate resources for each stage of the development of new products, including responding to customers' needs, and improving their products advantages over competitors (Bonner and Walker, 2004; Danneels, 2002; Sethi, 2000). Bonner and Walker (2004) proposed that information from customers was required for developing both radical and incremental product innovation. Developing highly innovative product required greater proficiency in the predevelopment tasks than did developing less innovative products (Kleinschmidt and Cooper, 1991). However, predevelopment tasks were important for both types of product innovation.

Thus, in this study, the affect of predevelopment tasks on product innovation is hypothesized as follows.

H5a: Predevelopment tasks have a positive impact on radical product innovation

H5b: Predevelopment tasks have a positive impact on incremental product innovation

2.7.5.2 Cross-Functional Integration

Cross-functional integration referred to the degree of multiple department cooperation such as R&D, manufacturing, marketing, finance, and other departments, representation and contribution in a process of new product development (De Luca and Atuahene-Gima, 2007).

Olson et al. (2001) suggested that a high level of cooperation among R&D, operations, and marketing departments would improve the quality of a new product. The benefit of cross-functional integration among these departments was sharing information, perspectives, problem solving and best practices within the development team (Luo, Slotegraaf, and Pan, 2006; Sethi, Smith, and Park, 2001). Cross-functional integration also meant firms integrate functional specifics and skills from various departments, with the result that integration among departments would reduce the need for redesign and respecification, thereby helping firms to decrease development time, lower the cost of development, and develop new products to meet customer's needs (Song and Parry, 1997; Zirger and Maidique, 1990).

Olson et al. (2001) further stated that the need for cross-functional integration was higher when firms decided to develop highly innovative products than when they developed less innovative products. However, cross-functional integration was important for both radical and incremental innovation (Sethi, Smith, and Park, 2001). Accordingly, in this study, the role of cross-functional integration is hypothesized as follows.

H6a: Cross-functional integration has a positive impact on radical product innovation.

H6b: Cross-functional integration has a positive impact on incremental product innovation.

2.7.5.3 Technological Proficiency

Technological proficiency referred to how proficiency a firm uses technology in the process of new product development (Gatignon and Xuereb, 1997). Chandy and Tellis (2000); Danneels (2002); Phene, Fladmoe-Lindquist, and Marsh (2006); Song and Parry (1996); and Wernerfelt (1984) stated that technological proficiency, such as manufacturing and engineering know-how, enhanced the opportunity of firms to create new products. Golish, Besterfield-Sacre, and Shuman (2008) summarized the five-stages of the technology development processes: (1) opportunity identification; (2) design and development; (3) testing and preproduction; (4) introduction and production; and (5) life-cycle management. Technology that had been commercialized in the market must serve customer needs (Slater and Mohr, 2006).

Technological proficiency could increase a firm's competitive advantage by allowing it to produce superior new products, for example, products that met customer needs and had higher quality (Song and Parry, 1997). It could also reduce the cost of new products (Gatignon and Xuereb, 1997). These benefits would improve the performance of new products (Cooper and Kleinschmidt, 1987; Lee, Lee, and Pennings, 2001).

However, incrementally new products had only minor changes in attributes, such as changes in designs or increased functionality compared to existing products from the customer's perspective (Ziamou and Ratneshwar, 2003). Damanpour (1991) suggested that developing incrementally new products required less technological proficiency than developing radically new products. Therefore, in this study, the role of technical proficiency is hypothesized as follows.

H7a: Technological proficiency has a positive impact on radical product innovation.

H7b: Technological proficiency has no impact on incremental product innovation.

2.7.5.4 Development Speed

Development speed was defined as the time it took from the beginning of idea generation to market introduction (Droge, Jayaram, and Vickery, 2000; Langerak and Hultink, 2006). Cordero (1991) noted that competitive pressures such as shortening of product life cycle (PLC) were higher than in the past. Many firms were concerned that it was necessary to rapidly develop new products and introduce them before competitors did to serve customer needs (Filippini, Salmaso, and Tessarolo, 2004). The shortening of the PLC forced firms to increase development speed to avoid product obsolescence from the customer's perspective (Cordero, 1991).

Ali (2000) showed that incrementally product innovation involved faster development speed than radical product innovation because incremental product innovation did not require major changes in core products and processes (Iyer, LaPlaca and Sharma, 2006; Manimala, Jose, and Thomas, 2005; Siguaw, Simpson, and Enz, 2006). The characteristics or benefits of incrementally new products did not differ much compared to existing products (Maital and Seshadri, 2007). Thus, firms introducing incrementally new products faster than their competitors would benefit from the first mover advantage (Min, Kalwani, and Robinson, 2006). Moreover, reducing development time could lower costs by decreasing man-hours and overheads, which lowers the price of the new product. This was a major advantage for incrementally new products (Mallick and Schroeder, 2005). Thus, firms that desired to produce incrementally new products should concentrate on development speed so that the firm could introduce new products before competitors and reduced the cost of production. These benefits were at the heart of the product advantage of incrementally new products.

However, the pressure for rapid development speed required for radically new products had adverse affects on the product advantage (Lukas and Menon, 2004). Sethi (2000) revealed that increasing the development speed creates time pressure for the development team, reducing the time available for molding the firms' technology, manufacturing, and marketing. Incomplete molding of these factors would decrease the advantage of the new product compared with their competitors. Furthermore, the development team might not have enough time to think of the best ways to produce superior new products (Karau and Kelly, 1992; Mallick and Schroeder, 2005). As a result, firms that desired to produce radically new products must be concerned with the effect of time pressure on the quality of the new product. Firms should allocate enough time to avoid problems.

Accordingly, in this study, the influence of development speed is hypothesized as follows.

H8a: Development speed has a negative impact on radical product innovation.

H8b: Development speed has a positive impact on incremental product innovation.

2.7.5.5 <u>Launch Proficiency</u>

Henard and Szymanski (2001) defined launch proficiency as proficiency which firms launched or introduced new product to the market. Langerak, Hultink, and Robben (2004) separated launch proficiency into three dimensions: launch budgeting, launch strategy, and launch tactics. Launch budgeting was the money allocated for developing, implementing, and monitoring the launch strategy and the tactics of new products (Langerak, Hultink, and Robben, 2004). Launch strategies involved planning for segmentation, target markets, and positioning new products (Hsieh, Tsai, and Hultink, 2006). Launch tactics covered the activities used to leverage competitive advantage of new products using marketing mix elements such as product, price, place, promotion, and timing (Guiltinan, 1999).

From the business perspective, new products were not successful until they were introduced into the marketplace (Trott, 2005). Effective launch activities increased product advantage (Song and Parry, 1997) and the chance of success of new products launched into the market (Guiltinan, 1999; Hsieh and Tsai, 2007). Hsieh, Tsai, and Hultink (2006) demonstrated that firms must choose appropriate launch strategies for each type of product innovation taking into account a dynamic external environment. For example, firms should choose an appropriate target market to match their products. Moreover, firms should choose proper media to advertise their new products to fit with the perception of their customers. Consequently, both radical and incremental new products required suitable launch strategies to gain product advantage over competitors.

Consequently, in this study, the role of launch proficiency is hypothesized as follows.

H9a: Launch proficiency has a positive impact on radical product innovation.

H9b: Launch proficiency has a positive impact on incremental product innovation.

2.7.6 External Environment

This study investigates the effect of the external environment on product innovation. Li and Calantone (1998) suggested external environmental factors, such as demand uncertainty and technological turbulence had an effect on the development of new products. Furthermore, government agency support also had an effect on development of new products (Adler and Kwon, 2002). These factors are explained below.

2.7.6.1 Demand Uncertainty

Li and Calantone (1998) defined demand uncertainty as the changing of customer preferences regarding the attributes of a new product. Today, customers were more sophisticated and demand more than they did in the past (Jaworski and Kohli, 1993).

Demand uncertainty had negatively affected radically new products, because customers changed their preferences and demands so that a new product might not fit with these preferences and demands (Day and Wensley, 1988; Wind and Mahajan, 1997). Moreover, sophisticated customers might require superior benefits from a new product, which the new product could not provide.

The impact of demand uncertainty on incremental product innovation was similar to that on radical product innovation. However, demand uncertainty for incrementally new products was lower than for radically new products (Min, Kalwani, and Robinson, 2006). The objective of introducing incrementally new products was to maintain customers in potential markets or stable markets (Iyer, LaPlaca, and Sharma, 2006; Sethi, Smith, and Park, 2001). In a stable market, changing in customer demand was small (Zhou, Yim, and David, 2005) compared with new and sophisticated markets (Wind and Mahajan, 1997). Hence, in this study, the role of demand uncertainty is hypothesized as follows.

H10a: Demand uncertainty has a negative impact on radical product innovation.

H10b: Demand uncertainty has no impact on incremental product innovation.

2.7.6.2 Technological Turbulence

Technological turbulence was defined as changing of technology over time within a firm's industry (Jaworski and Kohli, 1993), whereby new technology would be used in the manufacturing process to produce new products (Goldenberg, Lehmann, and Mazursky, 2001).

Technological turbulence could change the preferences or needs of customers because new technology could introduce new benefits or attributes to customers in the market (Narver and Slater, 1990). In developing radically new products, firms might encounter unexpected phenomena, such as technological turbulence (Wind and Mahajan, 1997). This would affect radical product innovation because competitors would develop new products using early technologies that could offer new benefits or attributes that a firm's new products could not (Li and Calantone, 1998).

The effect of technological turbulence on incrementally new products was lower than on radically new products (Min, Kalwani, and Robinson, 2006). The main purpose of introducing incrementally new products was to maintain customers in potential markets or stable markets (Iyer, LaPlaca, and Sharma, 2006; Sethi, Smith, and Park, 2001). Customers in these markets did not change their preferences nor needs from existing new product too much (Olshavsky and Spreng, 1996). Consequently, the new benefits or attributes of new product derived from technological turbulence might not be interesting to these customers. Thus, in this study, the impact of technological turbulence is hypothesized as follows.

H11a: Technological turbulence has a negative impact on radical product innovation.

H11b: Technological turbulence has no impact on incremental product innovation.

2.7.6.3 Government Agency Support

External networks, such as other firms in the same industry or supporting industries and government agencies (e.g. universities, research and development agencies, and other organizations) played an important role in helping firms to develop new products (Adler and Kwon, 2002; Kleyn, Kitney, and Atun, 2007; Lee, Lee, and Pennings, 2001). Examples of benefits that firms derived from an external network were information exchange (Lee, Lee, and Pennings, 2001), sharing resources (Kogut and Zander, 1992), and solidarity (Adler and Kwon, 2002).

However, previous literature had concentrated on the network of firms in the same industry or supporting industries (Pennings and Harianto, 1992; Sivadas and Dwyer, 2000). Additionally, empirical studies that revealed the impact of government support on product innovation were scarce (Kleyn, Kitney, and Atun, 2007; Tsai and Ghoshal, 1998). Moreover, the effect of government support on each type of product innovation had not been investigated.

Thus, in this study, the effect of government agency support on product innovation is hypothesized as follows.

H12a: Government agency support has a positive impact on radical product innovation.

H12b: Government agency support has a positive impact on incremental product innovation.

2.7.7 Product Innovation and Market Performance

It was very important to deliver superior quality new product to customers (Brown and Eisenhardt, 1995; Day and Wensley, 1988). Langerak, Hultink, and Robben (2004: 82) defined new product advantage as *"the benefits that customers get from the new products"*. Many past studies (Cooper and Kleinschmidt, 1987;

Kleinschmidt and Cooper, 1991; Langerak, Hultink, and Robben, 2004; Song and Parry, 1997) revealed that attributes of product innovation, such as the quality of new products, uniqueness, reliability, lower costs, and newness, could differentiate a firm's new products from those of its competitors and these attributes could raise the performance of firms.

Product innovation increased market share (Hua and Wemmerlöv, 2006). New products that met customer preferences affected the market share of firms (Robinson, 1990). Min, Kalwani, and Robinson (2006) demonstrated that firms that introduced new products to the market before competitors tended to have a higher market share than competitors. Therefore, in this study, the effect of product innovation on market performance is hypothesized as follows.

H13a: Radical product innovation has a positive impact on market performance.

H13b: Incremental product innovation has a positive impact on market performance.

2.7.8 Market Performance and Financial Performance

Buzzell, Gale, and Sultan (1975) and Prescott, Kohli, and Venkatraman (1984) suggested that market share and ROI had a positive relationship, in that, the higher market share, the greater the firm's profit margin. Further, Zeithaml (2000) demonstrated that market share could increase the sales of firms. Loveman (1998) and Reichheld, Markey Jr, and Hopton (2000) revealed that customer loyalty had a positive correlation with profitability and revenue growth. Additionally, customer satisfaction improved the financial performance of firms (Anderson, Fornell, and Mazvancheryl, 2004). In this study, the effect of product innovation on financial performance is hypothesized as follows.

H14a: Radical product innovation has a positive impact on financial performance.

H14b: Incremental product innovation has a positive impact on market performance.

2.8 Summary

This chapter explains relevant theories and concepts in order to support two proposed frameworks, radical and incremental product innovation based performance frameworks. Further, literature related to product innovation research are reviewed and twenty eight hypotheses to test the proposed frameworks are developed.

CHAPTER III

RESEARCH METHODOLOGY

The objective of this chapter is to present the methodology used in this research. The research methodology includes defining population, sample size, sampling procedure, operationalization, questionnaire pretesting, data collection, and data analysis techniques.

3.1 Defining Population

Government agencies such as the National Innovation Agency (NIA), National Science and Technology Development Agency (NSTDA), National Center for Genetic Engineering and Biotechnology (BIOTEC), Department of Business Development (DBD), and Office of the National Economic and Social Development Board (NESDB) aware the importance of innovation to the economy of Thailand. These agencies try to stimulate the private sector to acknowledge the importance of innovation within firms to improve their performance and to create competitive advantage. For example, the Tenth National Economic and Social Development Plan launched by NESDB provides guidelines on how to formulate strategy to encourage innovation in Thailand (NESDB, 2008).

Because Thailand is an agricultural country, many government agencies have attempted to establish innovation strategy based on the abundance of biological resources. For instance, the NIA has set up a program providing funds and specialists to support participating firms in specific areas such as biotechnology, energy, and the environment (NIA, 2008). Furthermore, the NSTDA promotes research and development into new products in various sectors, such as food, agriculture, energy, environment, and the automobile and electrical and electronic sectors. The desired benefits to the Thai economy from promotion of R&D by NSTDA are a decrease in imported products, an increase in Thai export values, upgraded competitiveness of firms in Thailand, and decreased trade barriers from environmental regulations (NSTDA, 2008). Also, BIOTEC has proposed Thailand's national biotechnology policy framework, which has the goal of enhancing the competitive advantage of the country by promoting biotechnological development (BIOTEC, 2008).

As a result of the previous reasons, the population and sampling frame in this study are firms, which are manufacturers and have their own products, in the agriculture, biotechnological, energy, food, and pharmaceutical industrial sectors. These firms are located in Thailand. Lists of firms are derived from various sources, such as BIOTEC, DBD, The Federation of Thai Industries (FTI), National Food Institute (NFI), NIA, and the Siamlist database. The unit of analysis in this study is managers or higher in the agriculture, biotechnological, energy, food, and pharmaceutical industry sectors who have responsibility for or involvement in developing new products.

3.2 Sample Size

A topic of sample size has been argued in previous literature and there is consensus agreement about the best sample size to be used in structural equation modeling (SEM) (Boomsma and Hoogland, 2001; Jackson, 2007; Tanaka, 1987). Hair et al. (2006) suggest that SEM requires a large sample size to produce a reliable result of parameter estimation. McDonald and Ho (2002) say that estimating parameters by using maximum likelihood or the generalized least square method requires a very large sample size for a robust result. Jackson (2007) proposes that a ratio of sample size per an estimated parameter should be greater than 10 for demonstrating adequate sample size.

However, Weston and Gore Jr. (2006) reveal that appropriate sample size, therefore, should be larger than 200. Similarly, Kline (1998) argues that a sample size exceeding 200 is considered large. Boomsma and Hoogland (2001) suggest that a sample size lower than 200 generates problems of nonconvergence and improper solution. Anderson and Gerbing (1988) suggest that a sample size should be greater than 150 for obtaining parameter estimates that have adequately small standard error for practical use. Furthermore, Boomsma (1987) demonstrates that a sample size greater than 100 is large enough to have robustness and few biases in estimating parameters by the maximum likelihood method.

Therefore, this study uses a sample size of 200 for each of radical and incremental frameworks. Total sample size in this study is 400.

3.3 Sampling Procedure

The sampling frame in this study is drawn from Thailand top innovative companies 2007, Thailand Biotech Guide 2007/2008, FTI, NFI, NIA, and Siamlist Database Marketing. Siamlist Database Marketing gathers a list of registered firms with DBD. The population in the Siamlist database is approximately 10,000 firms. A researcher expected that the response rate of this study would be approximately 20% then a researcher used judgmental sampling technique to pick 2,000 samples. Therefore, the number of returned questionnaires is 400. When a researcher completed the sampling frame from the databases, final questionnaires were sent to all firms in the sampling frame by mail.

3.4 Operationalization

The measurement items for all constructs in the proposed framework were evaluated and adapted to fit with the Thai environment. That is, the measurement items of constructs were adapted and borrowed from previous literature (such as Langerak, Hultink, and Robben, 2004; Song and Parry, 1996) while some constructs (radical and incremental product innovation constructs) were newly created. The measurement items derived from previous literature were translated into Thai language for a better understanding by respondents. The accuracy of the translation was checked by the back translation technique (Craig and Douglas, 2000). The procedure is that a questionnaire in English is translated into Thai by a bilingual translator who is fluent with both Thai and English. This questionnaire is then translated back to English by another bilingual translator who is also fluent with both Thai and English. The original and back translated English questionnaires are then compared by a third person (who earned a doctoral degree in business administration) to check the quality of the translation. After selecting the measurement items for all constructs in Thai, a researcher confirmed the content validity of the measurement items by interviewing one dissertation advisor and six practitioners in the agriculture, biotechnological, energy, food, and pharmaceutical sectors to comment on the validity of these measurement items.

The degree of product innovation in this study is measured using the self-ranking method. Pros and cons of self-ranking are discussed in Chapter 2. Another method for assessing the degree of product innovation is content analysis (Chandy and Tellis, 2000). Kolbe and Burnett (1991) provided the strengths and weaknesses of content analysis. The advantages of content analysis are unobtrusive evaluation of communication and the ability to assess the characteristics of product innovation on message content. However, the disadvantages of content analysis are bias of researchers in evaluating product innovation and the lack of knowledge to evaluate the degree of product innovation in some products.

Based on the strengths and limitations of the self-ranking and content analysis methods, this study uses the self-ranking method to classify product innovation and the limitations of self-ranking are considered in interpretation of the results.

Therefore, the measure for rating the degree of new product innovation in this study is adapted from Zhou, Yim, and Tse (2005). Respondents rate their new product ranging from 1 (no innovation) to 6 (radical innovation) based on how well their products correspond to the following definition of innovative products:

"Products that involve a different set of features and performance attributes which make a novel set of benefits available compared to existing products from a customer perspective"

If respondents rate their new products from 1 to 3, this can be considered incremental product innovation. If respondents rate their new products from 4 to 6, this can be considered radical product innovation.

All measurement items are measured by 7-point Likert scales. The measurement items for all constructs are presented below.

3.4.1 Financial Performance (FP)

The measure contains 3 items which are adapted from De Luca and Atuahene-Gima (2007).

- Sales quantity of the new product meets the company's target (FP1).
- Profit of the new product meets the company's target (FP2).
- Revenue of the new product meets the company's target (FP3).

3.4.2 Marketing Performance (MP)

The measure contains 4 items which are adapted from Alam (2003), Im and Workman (2004), and Langerak, Hultink, and Robben (2004).

- Customers' acceptance of the new product meets the company's target (MP1).
- Customers' satisfaction with the new product meets the company's target (MP2).
- New product's ability to gain market share meets the company's target (MP3).
- Increased number of customers after the launch of the new product meets the company's target (MP4).

3.4.3 Vision (VIS)

The measure contains 4 items which are adapted from Lynn and Akgün (2001) and Tessarolo (2007)

- Clear vision about the characteristics of the new product to be manufactured (VIS1).
- Clear understanding of the needs of the targeted customers (VIS2).
- All related departments shared the same objectives for the new product to be manufactured (VIS3).
- Clear and consistent policies towards the goals of the new product from inception of the idea to the distribution of the product in the market (VIS4).

3.4.4 Top Management Support (TOP)

The measure contains 3 items which are adapted from Cooper and Kleinschmidt (1987).

- Full support in the resources needed for new product development (TOP1).
- Guidance for the new product development approach (TOP2).
- Consistent encouragement of employees to present constructive idea about new product development (TOP3).

3.4.5 Centralization (CEN)

The measure contains 3 items which are adapted from Ayers, Dahlstrom, and Skinner (1997), Olson, Slater, and Hult (2005) and Sivadas and Dwyer (2000). Additionally, the scored answers to these items derived from returned questionnaires are inversed before analyzing the data.

- Middle and lower-level managers have freedom within their boundary of responsibility (CEN1).
- Middle and lower-level managers have freedom in their decisions within their boundary of responsibility (CEN2).

- Problems occurring during product development are fixed according to supervisory steps within the boundary of responsibility (CEN3).

3.4.6 Formalization (FOR)

The measure contains 3 items which are adapted from Ayers, Dahlstrom, and Skinner (1997) and Olson, Slater, and Hult (2005).

- Responsibilities of each employee have been clearly assigned (FOR1).
- Company has clearly assigned the line of work for employees (FOR2).
- Documents are made in writing for communications between departments (FOR3).

3.4.7 Predevelopment Task (PRE)

The measure contains 5 items which are adapted from Cooper and Kleinschmidt (1987), Salomo, Weise, and Gemünden (2007), Song and Parry (1996), and Verworn, Herstatt, and Nagahira (2008).

- Initial assessment of the demand in the market (PRE1).
- Initial assessment about whether new product development is consistent with the company's policies (PRE2).
- Evaluated product concept is used in the company's business plan (PRE3).
- Duties and responsibilities for new product development have been assigned to certain executives and employees (PRE4).
- Budget is allocated for new product development /product improvement (PRE5).

3.4.8 Cross-Functional Integration (CRO)

The measure contains 3 items which are adapted from Homburg, Workman, and Jensen (2002), Luo, Slotegraaf, and Pan (2006), and Song and Parry (1996).

- All departments cooperated well with new product development (CRO1).
- Problems occurring during new product development are frequently discussed between departments (CRO2).
- Decisions during new product development are jointly made between all departments (CRO3).

3.4.9 Technological Proficiency (TEC)

The measure contains 5 items which are adapted from Gatignon and Xuereb (1997) and Song and Parry (1996).

- Initial assessment of machinery and technology of the company (TEC1).
- Consideration is given towards the design and characteristics prior to actual production (TEC2).
- Modern technology is used in new product development (TEC3).
- Model or sample of the product is created for testing purposes prior to product launch into the market (TEC4).
- Good quality control in the production process (TEC5).

3.4.10 Development Speed (SPD)

The measure contains 3 items which are adapted from Langerak and Hultink (2006).

- The company is able to develop new product in shorter period of time compared with product development in the past (SPD1).

- The company is able to develop new product in shorter period of time compared with product development from similar competitors (SPD2).
- The company is satisfied with the present speed of new product development (SPD3).

3.4.11 Launch Proficiency (LAU)

The measure contains 6 items which are adapted from Langerak, Hultink, and Robben (2004).

- Budget is allocated for new product launch (LAU1).
- Target customers are appropriate for the new product (LAU2).
- New product is appropriately positioned in the market (LAU3).
- Pricing strategy is appropriate for the new product (LAU4).
- Distribution strategy is appropriate for the new product (LAU5).
- Promotion strategy is appropriate for the new product (LAU6).

3.4.12 Demand Uncertainty (DEM)

The measure contains 3 items which are adapted from Jaworski and Kohli (1993).

- Customers always look for new products that satisfy their needs (DEM1).
- The new product meets the demand of new customers who did not buy the company's products before (DEM2).
- New customers and existing customers have different requirements for the new product (DEM3).

3.4.13 Technological Turbulence (TECT)

The measure contains 3 items which are adapted from Jaworski and Kohli (1993).

- Technology within the industry the company operates in changes rapidly (TECT1).

- Changing technology creates opportunity for the company (TECT2).
- Changing technology in the industry has created a vast number of innovative ideas for new products within the company (TECT3).

3.4.14 Government Agency Support (GOV)

The measure contains 5 items which new scales have been developed in this study.

- Government agencies provide the company with useful information for new product development (GOV1).
- Government agencies give technological support to the company for use in new product development (GOV2).
- Government agencies give the company management counseling for new product development (GOV3).
- Government agencies support the company financially or they find sources of financial support for the company for new product development (GOV4).
- Government agencies give tax incentives to the company for new product development (GOV5).

3.4.15 Radical Product Innovation (RAD)

The measure contains 3 items which are adapted from Cheng and Shiu (2008), Garcia and Calantone (2002), and Jansen, Van Den Bosch, and Volberda (2006)

- A significant improvement compared with competitors' in the eyes of the customers (RAD1).
- Special benefits for customers that is not found in the competitors' products (RAD2).
- Can substitute for similar products in the eyes of the customers (RAD3).

3.4.16 Incremental Product Innovation (INC)

The measure contains 3 items which are adapted from Atuahene-Gima (2005), Garcia and Calantone (2002), Jansen, Van Den Bosch, and Volberda (2006), and Sethi, Smith, and Park (2001)

- New product is slightly improved compared with the competitors' in the eyes of the customers (INC1).
- Benefits gained from new product changes only slightly in the eyes of the customers (INC2).
- New product is an improved version that matches the requirements of the customers better than the existing product (INC3).

3.5 Pretesting Questionnaire

Pretesting a questionnaire is an important step in questionnaire design. The benefit of pretesting the questionnaire is to check the appropriateness of structure, language, and measurement items before sending the questionnaires to respondents.

This study used personal interviews to pretest the preliminary questionnaire. Reynolds and Diamantopoulos (1998) suggested that personal interviews are a useful method to pretest questionnaires because in-depth interviews with respondents help a researcher to detect errors of ambiguity in language and meaning of measurement items better than a pretest questionnaire sent by mail. One dissertation advisor and six practitioners who are managing directors of the targeted firms were interviewed for checking validity of the preliminary questionnaire. This step was used to check for any confusion in the questions, any inability to answer the questions on the past of respondents, and the content validity of the preliminary questionnaire questionnaire. After all revisions, a final questionnaire was completed and sent to respondents in the sampling frame by mail.

3.6 Data Collection

Because of the problem of low response rate when using the mail survey method (Aaker, Kumar, and Day, 2007), this study uses several techniques to increase the response rate as much as possible. Techniques used in this study are: (1) using all firms in a sampling frame; (2) using personal contacts with firms in sampling frame; (3) promising to send an executive summary to respondents after the completion of the study; and (4) following-up with firms that do not return the questionnaire within the time frame via telephone and mail.

A researcher sent a first wave questionnaire to 2,000 firms on 1 October 2008 and waited for returned questionnaire. A total returned questionnaires in the first wave were 228. Therefore, a researcher sent a follow-up questionnaire to 1,500 firms to increase a response rate on 1 December 2008. Afterward, a researcher made a follow up for nonresponse firms via telephone. A total returned questionnaires in the second wave were 164. Combining the first and the second wave questionnaires, a total returned questionnaires were 392 which would be adequate for data analysis. A response rate was 19.6 percent. Summary of data collection activities and time periods is presented in Table 3.1.

Table 3.1

Activities and Time Periods of Collecting the Data

Activities	**Time Periods**							
	9/08	**10/08**	**11/08**	**12/08**	**1/09**	**2/09**	**3/09**	**4/09**
1. Sending 1st wave questionnaire		★						
2. Waiting for questionnaire return		←—	—→					
3. Gather list of firms not return questionnaire			←→					
4. Sending a follow-up questionnaire				★				
5. Follow up				←—	——	——	——	—→

The reasons for long period of the follow up activity were the extent to which two well-trained staffs can contract firms about forty firms per day. In one month, eight hundred firms were contracted (40 firms x 20 working days). Further, during late December 2008 and early January 2009, firms did not want to contact with staffs. Firms told staffs to contact after 15 January 2009 for convenience of firms. Therefore, this study had a long period of follow up activity. The total questionnaires returned were 392 from 2,000 firms (response rate is 19.6%). Of 392 returned questionnaires, 66 questionnaires were not usable because (1) respondents denied to participate in this study, (2) respondents incompletely answered questionnaire, (3) firms were not manufacturers, and (4) firms were manufacturer but they were not in the scope of the study. After cleaning the data, questionnaires that would be used for the analysis were 326. Firms which had radical product innovation were 204 and incremental product innovation were 122. Total returned questionnaires for each type of product innovation is shown in Table 3.2.

Table 3.2

Total Returned Questionnaires for Each Type of Product Innovation

Type of product innovation	Frequency	Percentage
Radical innovation	204	62.6
Incremental innovation	122	37.4
Total	326	100

It appears that data collection for the study took several months. Therefore, it is concerned that a problem of internal invalidity might occur. To confirm internal validity of the data, a researcher tests internal validity of the data with a method recommended by Armstrong and Overton (1977), Terborg, Howard, and Maxwell (1980) and Zmud and Armenakis (1978). They suggest that if the result of t-test shows insignificant of mean differences between early and late responses, it can be concluded that a long period of collecting data in the study will not generate the problem of internal invalidity. Therefore, a researcher tests mean differences of all variables in questionnaire between the first responses during 1 October to 31

December, 2008 (167 samples) and the second responses during 1 January to 31 March, 2009 (159 samples). The results of testing mean differences between early and late responses of observed variables are shown in Table 3.3 and the results of testing mean differences between early and late responses of constructs are shown in Table 3.4.

Table 3.3

Testing for Mean Differences of Observed Variables

Variables	p-value
VIS1	0.359
VIS2	0.303
VIS3	0.220
VIS4	0.072
TOP1	0.112
TOP2	0.289
TOP3	0.180
CEN1	0.753
CEN2	0.609
CEN3	0.354
FOR1	0.420
FOR2	0.440
FOR3	0.342
PRE1	0.183
PRE2	0.109
PRE3	0.053
PRE4	0.081
PRE5	0.054
CRO1	0.779
CRO2	0.507
CRO3	0.148
TEC1	0.071
TEC2	0.058
TEC3	***0.000***
TEC4	***0.022***
TEC5	0.194
SPD1	***0.032***
SPD2	0.104
SPD3	0.948
LAU1	***0.025***
LAU2	0.200
LAU3	0.135

Table 3.3

Testing for Mean Differences of Observed Variables (Cont.)

Variables	p-value
LAU4	0.218
LAU5	0.365
LAU6	0.446
DEM1	0.229
DEM2	0.258
DEM3	0.286
TECT1	0.852
TECT2	0.262
TECT3	0.481
GOV1	0.734
GOV2	0.330
GOV3	0.975
GOV4	0.059
GOV5	***0.010***
RAD1	0.124
RAD2	0.169
RAD3	***0.032***
INC1	0.118
INC2	0.415
INC3	0.066
MP1	0.274
MP2	0.052
MP3	0.811
MP4	0.555
FP1	0.560
FP2	0.475
FP3	0.804

Table 3.4

Testing for Mean Differences of Constructs

Variables	p-value
VIS	.160
TOP	.147
CEN	.672
FOR	.770
PRE	***.047***
CRO	.373
TEC	***.011***
SPD	.178
LAU	.125
DEM	.611
TECT	.543
GOV	.171
RAD	***.048***
INC	.881
MP	.541
FP	.896

The results in Table 3.3 and Table 3.4 show that early and late responses have equality of means for all variables at a level of significance 0.05 except TEC3, TEC4, SPD1, LAU1 GOV5, and RAD3. Further, all constructs except PRE, TEC, and RAD constructs have equality of means at a level of significance 0.05. With a majority of equality of means of variables and constructs in the model, it can be concluded that this study has not been affected by internal invalidity from the long period of collecting the data.

3.7 Data Analysis Technique

The reliability of the sixteen constructs was tested by using Cronbach's alpha (α) (Cronbach, 1951) which is widely used to test the internal consistency of multi-items scale (DeVellis, 2003; Peter, 1979). SPSS 13.0 for Window was used in this analysis.

This study uses structural equation modeling (SEM) to analyze the data derived from respondents. In addition, SEM can be used to analyze the total effect of exogenous variables on endogenous variable in the structural model. A two-steps approach was used to test the structural model as recommended by Anderson and Gerbing (1988). The software used for analyzing the data in this study was LISREL 8.52.

The first step was to test the measurement model. This step tests the validity of a measurement model including convergent validity, discriminant validity, and construct validity. Further, assessment of the fit of a measurement model between the observed and estimated covariance matrix is taken. Confirmatory factor analysis (CFA) technique is used to assess fit and validity.

Next, the second step was to test the theoretical framework. This step tests the fit of the hypothetical framework by comparing the observed covariance matrix and the estimated covariance matrix. In addition, twenty eight hypotheses for a radical and incremental product innovation based performance framework are tested in this step.

3.8 Summary

The objective of this chapter is to explain the research methodology used in this study. The populations of this study are firms in the agriculture, biotechnological, energy, food, and pharmaceutical industrial sectors. The list of firms is derived from several sources such as BIOTEC, DBD, FTI, NFI, NIA, and Siamlist. Sample size in this study is 200 for each framework. This study uses simple random sampling technique to select 2,000 samples from the sampling frame. Operationalization in this study is adapted from previous literature and newly created by a researcher. The number of measurement items is seventeen. The preliminary questionnaire is pretested for appropriateness of structure, language, and measurement items. A researcher collects the data by sending a questionnaire to all samples by mail and following up firms that do not reply mail via telephone. A total usable questionnaire is 326 and a response rate is 16.3%. Finally, CFA is used for assessing fit and validity of measurement model and SEM is used to test the validity of structural models and to test the impacts between constructs in frameworks.

CHAPTER IV

DATA ANALYSIS

In this chapter, reliability, validity, measurement and structural models assessment, and hypothesis testing for radical and incremental based performance framework are analyzed.

The total numbers of observed variables in this study are sixty two. These variables and abbreviations of them and their constructs are already shown in Chapter 3. Variables in this study are classified into two groups: forty nine observed variables are exogenous variables, and thirteen observed variables are endogenous variables.

For exogenous variables, they are grouped into twelve constructs. They are vision (four variables), top management support (three variables), centralization (three variables), formalization (three variables), predevelopment task (five variables), cross-functional integration (three variables), technological proficiency (five variables), development speed (three variables), launch proficiency (six variables) demand uncertainty (three variables), technological proficiency (three variables), and government agency support (five variables).

Endogenous variables are grouped into four constructs. They are radical product innovation (three variables), incremental product innovation (three variables), financial performance (three variables), and market performance (four variables).

Abbreviations of all constructs and observed variables in this study are presented in Table 4.1. The meaning of abbreviation of observed variables are shown in operationalization section in Chapter 3.

Table 4.1

Abbreviations of Exogenous Latent and
Endogenous Latent Constructs and Variables

Constructs	Abbreviation	
	Construct	Observed Variable
Vision	VIS	VIS1, VIS2, VIS3, and VIS4
Top management support	TOP	TOP1, TOP2, and TOP3
Centralization	CEN	CEN1, CEN2, and CEN3
Formalization	FOR	FOR1, FOR2, and FOR3
Predevelopment task	PRE	PRE1, PRE2, PRE3, PRE4, and PRE5
Cross-functional integration	CRO	CRO1, CRO2, and CRO3
Technological proficiency	TEC	TEC1, TEC2, TEC3, TEC4, and TEC5
Development speed	SPD	SPD1, SPD2, and SPD3
Launch proficiency	LAU	LAU1, LAU2, LAU3, LAU4, LAU5, and LAU6
Demand uncertainty	DEM	DEM1, DEM2, and DEM3
Technological proficiency	TECT	TECT1, TECT2, and TECT3
Government agency support	GOV	GOV1, GOV2, GOV3, GOV4, and GOV5
Radical product innovation	RAD	RAD1, RAD2, and RAD3
Incremental product innovation	INC	INC1, INC2, and INC3
Financial performance	FP	FP1, FP2, and FP3
Market performance	MP	MP1, MP2, MP3, MP4

4.1 Respondent Profiles

The data is collected from respondents whose firms are in agriculture, biotechnological, energy, food, and pharmaceutical industrial sectors. This study classifies product innovation into two types, radical and incremental product innovation. Respondents rate their new products by using a six-point Likert scale from 1 (least innovative) to 6 (most innovative) to a question ***"Products that involve a different set of features and performance attributes which make a novel set of benefits available compared to existing products in customer's perspective"***. If respondents rate their products between 1 and 3, their products are classified as incremental product innovation. If respondents rate their products between 4 and 6, their products are classified as radical product innovation.

The characteristics of respondents (respondents' profile, position of respondents, firm age, and firm's income, firm size) are shown as the following.

4.1.1 Position of Respondents

For radical product innovation, approximately 40 percent of respondents' position is managing directors and nearly 15 percent of respondents is R&D managers. For incremental product innovation nearly 41 percent of respondents are managing directors and almost 8 percent of respondents are marketing managers and vice managing directors. An Example of others positions of respondents is general manger and subordinate, secretary, and staffs. Table 4.2 shows position of respondents.

Table 4.2

Position of Respondents

Position	Radical innovation		Incremental innovation	
	Frequency	Percentage	Frequency	Percentage
Managing director	79	39.9	49	41.2
Vice managing director	8	4.0	9	7.6
Factory manager	12	6.1	6	5.0
R&D manager	29	14.6	5	4.2
QA and/or QC manager	8	4.0	3	2.5
Marketing manager	16	8.1	10	8.4
Accounting and/or financial manager	6	3.0	5	4.2
Others	46	20.2	32	26.9
Total	204	100	122	100

4.1.2 Firm's Income

Firm's income is demonstrated in Table 4.3. For radical product innovation, 88 of respondents' firms (43.1%) have income between 1 to 100 million Bath and 51 of respondents' firms (25%) have income greater than 300 million Bath. For incremental product innovation, 51 and 15 percent of respondents' firms have income between 1 to100 million Baths and higher than 300 million Bath, respectively.

Table 4.3

Firm's Income

Income (Million Bath)	Radical innovation		Incremental innovation	
	Frequency	Percentage	Frequency	Percentage
Less than 1	22	10.8	17	13.9
1-100	88	43.1	62	50.8
101-200	14	6.9	12	9.8
201-300	12	5.9	3	2.5
Higher than 300	51	25.0	18	14.8
N.A.	17	8.3	10	8.2
Total	204	100	122	100

Note: N.A. is not available

4.1.3 Firm Age

Table 4.4 shows age of respondents' firms. For radical product innovation, around 50 percent of respondents' firms are founded within 10 years and nearly 15 percent of respondents' firms are founded more than 30 years. For incremental product innovation, 31 and 26 of respondents' firms are established within 6 to10 years and within 5 years, respectively.

Table 4.4

Firm Age

Years of establishment	Radical innovation		Incremental innovation	
	Frequency	Percentage	Frequency	Percentage
1-5 Years	47	23.0	26	21.3
6-10 Years	46	22.5	31	25.4
11-15 Years	26	12.8	14	11.5
16-20 Years	32	15.7	17	13.9
21-25 Years	15	7.4	6	4.9
26-30 Years	11	5.4	11	9.1
Higher than 30 Years	27	13.2	17	13.9
Total	204	100	122	100

4.1.4 Firm Size

Firm size is shown in Table 4.5. For radical product innovation, the majority (102 samples or 50 percent) of firm's employees are between 1 and 50 employees. Further, firms, which have employees higher than 200, are 49 or 24 percent. For incremental product innovation, 57 firms or 47 percent have a number of employees lower than 50 employees. 30 firms or 25 percent have a number of employees more than 200.

Table 4.5

Firm Size

Number of employees	Radical innovation		Incremental innovation	
	Frequency	Percentage	Frequency	Percentage
1-50	102	50.0	57	46.7
51-100	18	8.8	14	11.5
101-150	9	4.4	5	4.1
151-200	16	7.9	10	8.2
Higher than 200	49	24.0	30	24.6
N.A.	10	4.9	6	4.9
Total	204	100	122	100

Note: N.A. is not available

4.1.5 Type of Industry

Table 4.6 shows frequency and percentage of type of industry. For radical product innovation, food industry is the largest proportion of samples in this survey (48.5% or 99 samples). For incremental product innovation, a majority of sample comes from food industry (65 samples or 53.3% of total sample size).

Table 4.6

Type of Industry

Industry	**Radical innovation**		**Incremental innovation**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Agriculture	28	13.7	16	13.1
Biotechnology	18	8.8	7	5.7
Energy	8	3.9	3	2.5
Food	99	48.5	65	53.3
Pharmaceutical	33	16.2	21	17.2
Others	18	8.8	10	8.2
Total	204	100.0	122	100.0

4.2 Preliminary Analysis

The idea of preliminary analysis is to initially investigate all variables in the proposed model. This section also reveals the results of testing validity of observed variables in this study. There are fifteen constructs (twelve exogenous constructs and three endogenous constructs) for each radical and incremental product innovation based performance framework. A researcher uses confirmatory factor analysis (CFA) technique to test validity. Four variables (firm's income, firm age, firm size, and type of industry) are investigated mean differences among groups for each variable. The objective of testing the mean difference is to determine whether these four variables should be added into the model as control variables.

4.2.1 Comparing Mean Difference of Each Variable

This section presents the results of testing the mean differences of four variables which are type of industry, firm's income, firm age, and firm size by using the analysis of variance (ANOVA). If the findings do not reveal a significant difference of mean of all variables, thus these four variables will not be included into radical and incremental product innovation based performance frameworks so as to decrease an unnecessary complexity of the models.

- *Different Types of Industry*

A researcher tests mean differences between different types of industry. There are five industries in this study: agriculture, biotechnology, energy, food, pharmaceutical. However, some products are not grouped into these five industries. So, they are others. Therefore, mean differences among six industries are tested and the findings are presented in Table 4.7. A basic assumption of ANOVA states that variances must be equal across groups. The finding of Levene's test shows that all sixteen constructs except GOV have equal variances across groups at a level of significance 0.05. The results of mean differences show that ten constructs (CEN, FOR, CRO, TEC, SPD, LAU, DEM, INC, MP, and FP) do not have mean differences among six industries at a level of significance 0.05. Another six constructs (VIS, TOP, PRE, TECT, GOV, and RAD) have a mean that at least one industry has a mean difference from other industries at a level of significance 0.05.

Table 4.7

Mean Difference among Type of Industry

Construct	Levene's test (Sig.)	F	Sig.
VIS	.304	3.092	.010
TOP	.866	2.475	.032
CEN	.694	1.367	.236
FOR	.706	0.804	.548
PRE	.761	2.666	.022
CRO	.176	1.819	.109
TEC	.509	1.936	.088
SPD	.782	1.347	.244
LAU	.662	1.295	.266
DEM	.910	1.501	.189
TECT	.318	3.145	.009
GOV	.009	3.120	.009
INC	.393	0.853	.514
RAD	.286	2.984	.012
MP	.381	1.518	.184
FP	.624	0.319	.901

To further investigate a mean difference among six industries by separating type of product innovation, the results of mean differences of constructs of radical product innovation based performance framework are shown in Table 4.8 and those of incremental product innovation based performance framework are shown in Table 4.9.

Table 4.8

Mean Differences among Type of Industry of

Radical Product Innovation Based Performance Framework

Construct	Levene's test (Sig.)	F	Sig.
VIS	.457	1.679	.141
TOP	.342	1.606	.160
CEN	.341	1.299	.266
FOR	.673	0.881	.495
PRE	.998	1.144	.338
CRO	.553	0.906	.478

Table 4.8

Mean Differences among Type of Industry of

Radical Product Innovation Based Performance Framework (Cont.)

Construct	**Levene's test (Sig.)**	**F**	**Sig.**
TEC	.563	0.555	.734
SPD	.857	0.194	.964
LAU	.706	0.316	.903
DEM	.582	1.182	.319
TECT	.439	1.864	.102
GOV	.006	3.150	.009
RAD	.090	2.160	.060
MP	.291	0.649	.663
FP	.048	0.695	.628

Table 4.9

Mean Differences among Type of Industry of

Incremental Product Innovation Based Performance Framework

Construct	**Levene's test (Sig.)**	**F**	**Sig.**
VIS	.794	1.984	.086
TOP	.584	1.626	.159
CEN	.786	0.560	.730
FOR	.075	0.944	.456
PRE	.536	1.749	.129
CRO	.248	1.114	.357
TEC	.527	1.789	.121
SPD	.653	1.976	.088
LAU	.992	1.452	.211
DEM	.966	2.070	.074
TECT	.284	1.674	.146
GOV	.902	0.659	.655
INC	.238	2.566	.031
MP	.201	1.556	.178
FP	.211	1.296	.271

In Table 4.8, Levene's test shows that all fifteen constructs except GOV and FP have equal variances across groups at a level of significance 0.05. Only one construct (GOV) of radical product innovation based performance framework has a significant mean difference among industries. In Table 4.9, Levene's test shows that all fifteen constructs have equal variances across groups at a level of significance 0.05. Only one construct (INC) of incremental product innovation based performance framework has a mean difference among industries at a level of significance 0.05.

Therefore, it can be concluded from the analysis that different types of industry do not have an impact upon the analysis of both models. Thus, this variable will be excluded from the model.

- *Firm's Income*

A researcher tests mean differences among groups of firm's income. Firm's income is classified by income per year of firm which firm's income is separated into three groups: less than 50 Million Bath per year, 50-200 Million Bath per year, and higher than 200 Million Bath per year. Therefore, mean differences among groups of firm's income are presented in Table 4.10. The results in Table 4.74 show Levene's test that all sixteen constructs except INC have equal variances across groups at a level of significance 0.05. The results of mean differences show that fourteen constructs (VIS, TOP, CEN, FOR, PRE, CRO, TEC, SPD, LAU, DEM, GOV, INC, RAD, and FP) do not have mean differences among groups of firm's income at a level of significance 0.05. Another two constructs (TECT and MP) have a mean that at least one group of firm's income has a mean difference from other groups at a level of significance 0.05.

Table 4.10

Mean Differences among Firm's Income

Construct	Levene's test (Sig.)	F	Sig.
VIS	.299	0.583	.559
TOP	.103	0.309	.735
CEN	.078	0.231	.794
FOR	.714	1.190	.306
PRE	.332	1.460	.234
CRO	.507	0.100	.904
TEC	.501	1.846	.160
SPD	.823	0.628	.534
LAU	.701	2.649	.072
DEM	.990	0.032	.968
TECT	.450	4.724	.010
GOV	.964	0.411	.663
INC	.030	0.039	.962
RAD	.223	0.001	.999
MP	.321	4.278	.015
FP	.055	1.347	.262

In Table 4.11, Levene's test shows that all fifteen constructs have equal variances across groups at a level of significance 0.05. All fifteen constructs except MP of radical product innovation based performance framework do not have mean differences among groups. For incremental product innovation based performance framework, Levene's test shows that all fifteen constructs have equal variances across groups and all fifteen constructs have an equality of means among groups of firm's income. The results are shown in Table 4.12.

Therefore, it can be concluded from the analysis that different groups of firm's income do not have an impact upon the analysis of both models. Thus, this variable will be excluded from the model.

Table 4.11

Mean Differences between Firm's Income

of Radical Product Innovation Based Performance Framework

Construct	Levene's test (Sig.)	F	Sig.
VIS	.461	0.224	.800
TOP	.777	0.561	.572
CEN	.887	1.247	.290
FOR	.302	1.202	.303
PRE	.783	1.206	.302
CRO	.310	0.110	.895
TEC	1.000	0.256	.774
SPD	.090	0.677	.510
LAU	.754	1.081	.342
DEM	.462	0.848	.430
TECT	.748	2.062	.130
GOV	.966	0.161	.852
RAD	.336	0.698	.499
MP	.843	3.145	.045
FP	.382	0.565	.570

Table 4.12

Mean Differences between Firm's Income of

Incremental Product Innovation Based Performance Framework

Construct	Levene's test (Sig.)	F	Sig.
VIS	.229	0.639	.530
TOP	.160	0.873	.421
CEN	.246	0.919	.402
FOR	.943	0.008	.992
PRE	.248	0.021	.980
CRO	.410	0.076	.927
TEC	.196	1.149	.321
SPD	.913	0.639	.530
LAU	.470	0.258	.773
DEM	.308	0.056	.945
TECT	.080	2.012	.139
GOV	.872	0.498	.609
INC	.126	0.120	.887
MP	.058	0.508	.603
FP	.086	0.170	.844

- *Firm Size*

The means among groups of firm size is examined. Firm size is separated into three groups by using a number of employees as criterion: less than 50 employees, 50-200 employees, and higher than 200 employees. The findings in Table 4.13 show that all sixteen constructs except FP have equal variances across groups at a level of significance 0.05. Fourteen constructs (VIS, TOP, FOR, PRE, CRO, TEC, SPD, LAU, TECT, GOV, INC, RAD, MP, and FP) do not have mean differences among firm size at a level of significance 0.05. Another two constructs (CEN and DEM) have a mean that at least one group of firm's income has a mean difference from other groups at a level of significance 0.05.

Table 4.13

Mean Differences among Firm Size

Construct	Levene's test (Sig.)	F	Sig.
VIS	.157	1.816	.164
TOP	.830	2.371	.095
CEN	.112	3.139	.045
FOR	.681	0.184	.832
PRE	.544	0.245	.783
CRO	.912	2.972	.053
TEC	.404	0.419	.658
SPD	.157	2.539	.081
LAU	.352	0.110	.896
DEM	.272	4.194	.016
TECT	.632	0.737	.480
GOV	.376	0.584	.558
INC	.403	2.769	.066
RAD	.139	0.137	.872
MP	.193	0.423	.655
FP	.012	0.315	.730

In Table 4.14, Levene's test shows that all fifteen constructs except RAD have equal variances across groups at a level of significance 0.05. All fifteen constructs except CRO of radical product innovation based performance framework do not have mean differences among groups. In Table 4.15, all fifteen constructs have equal variances across groups. Only one construct (INC) of incremental product innovation based performance framework has a different mean among groups of firm size at a level of significance 0.05.

Therefore, it can be concluded from the analysis that different groups of firm size do not have an impact upon the analysis of both models. Thus, this variable will be excluded from the model.

Table 4.14

Mean Differences between Firm Size of

Radical Product Innovation Based Performance Framework

Construct	Levene's test (Sig.)	F	Sig.
VIS	.344	1.589	.207
TOP	.100	2.773	.065
CEN	.640	2.293	.104
FOR	.882	0.102	.903
PRE	.306	0.524	.593
CRO	.790	3.407	.035
TEC	.743	0.583	.559
SPD	.222	1.893	.153
LAU	.660	0.083	.921
DEM	.466	2.350	.098
TECT	.287	0.509	.602
GOV	.496	0.650	.523
RAD	.047	1.214	.299
MP	.829	0.678	.509
FP	.137	0.707	.495

Table 4.15

Mean Differences between Firm Size of

Incremental Product Innovation Based Performance Framework

Construct	Levene's test (Sig.)	F	Sig.
VIS	.652	1.007	.369
TOP	.419	0.838	.435
CEN	.557	1.531	.221
FOR	.174	0.099	.906
PRE	.460	0.118	.889
CRO	.684	0.680	.509
TEC	.211	1.498	.228
SPD	.639	1.401	.251
LAU	.202	0.328	.721
DEM	.361	2.704	.071
TECT	.697	1.285	.281
GOV	.348	0.097	.908
INC	.147	4.477	.014
MP	.211	0.290	.749
FP	.058	0.018	.983

- Firm Age

A researcher tests mean differences among groups of firm age. Firm age is divided into three groups; firms are found less than 10 years, 10-20 years, and more than 20 years. The results show that all sixteen constructs except FP have equal variances across groups at a level of significance 0.05. Sixteen constructs except INC do not have mean differences among groups of firm age. The findings are shown in Table 4.16.

Table 4.16

Mean Differences among Firm Age

Construct	Levene's test (Sig.)	F	Sig.
VIS	.065	2.519	.082
TOP	.653	2.197	.113
CEN	.188	2.121	.122
FOR	.727	0.157	.855
PRE	.118	1.856	.158
CRO	.624	1.306	.272
TEC	.800	0.267	.766
SPD	.656	2.995	.051
LAU	.163	0.025	.975
DEM	.091	2.129	.121
TECT	.399	0.822	.440
GOV	.399	1.071	.344
INC	.493	4.548	.012
RAD	.265	0.878	.417
MP	.087	0.641	.527
FP	.009	0.046	.955

In Table 4.17, Levene's test shows that all fifteen constructs have equal variances across groups at a level of significance 0.05. All fifteen constructs of radical product innovation based performance framework do not have mean differences among groups. In Table 4.18, for incremental product innovation based performance framework, all fifteen constructs except MP have equal variances across groups. Ten constructs (TOP, CEN, FOR, CRO, TEC, LAU, TECT, GOV, MP, and FP) have an equality of means among groups and five constructs (VIS, PRE, SPD, DEM, and INC) have mean differences at least one groups of firm age at a level of significance 0.05.

Therefore, it can be concluded from the analysis that firm age does not have an impact upon the analysis of both models. Thus, this variable will be excluded from the model.

Table 4.17

Mean Differences between Firm Age of

Radical Product Innovation Based Performance Framework

Construct	Levene's test (Sig.)	F	Sig.
VIS	.128	0.657	.520
TOP	.167	1.309	.272
CEN	.082	0.878	.417
FOR	.599	0.723	.486
PRE	.360	0.166	.847
CRO	.467	0.356	.701
TEC	.258	0.446	.641
SPD	.746	0.918	.401
LAU	.195	1.763	.174
DEM	.609	0.144	.866
TECT	.627	0.485	.616
GOV	.630	0.034	.967
RAD	.099	0.646	.525
MP	.565	0.165	.848
FP	.342	0.521	.595

Table 4.18

Mean Differences between Firm Age of

Incremental Product Innovation Based Performance Framework

Construct	Levene's test (Sig.)	F	Sig.
VIS	.580	5.171	.007
TOP	.786	1.824	.166
CEN	.229	1.267	.285
FOR	.695	2.296	.105
PRE	.397	5.413	.006
CRO	.070	2.838	.063
TEC	.920	1.722	.183
SPD	.627	3.667	.029
LAU	.065	2.639	.076
DEM	.826	3.263	.042
TECT	.861	0.663	.517
GOV	.218	2.686	.072
INC	.525	3.290	.041
MP	.042	1.586	.209
FP	.144	1.264	.286

Finally, a researcher verifies the difference between radical and incremental product innovation based performance frameworks by comparing the mean differences between the constructs of two frameworks. The results in Table 4.19 show that all constructs have differences in means between each construct at a level of significance 0.05.

Table 4.19

Testing Equality of Means of Constructs between Radical and Incremental Product Innovation

	t-test for Equality of Means	
	t	Sig. (2-tailed)
VIS	-7.950	.000
TOP	-7.312	.000
CEN	-6.464	.000
FOR	-3.357	.001
PRE	-6.103	.000
CRO	-5.590	.000
TEC	-6.147	.000
SPD	-6.712	.000
LAU	-6.467	.000
DEM	-5.156	.000
TECT	-4.597	.000
GOV	-2.898	.004
FP	-5.871	.000
MP	-8.561	.000

4.2.2 Radical Product Innovation Based Performance Framework

- **Vision**

Vision (VIS) construct is measured by four observed variables (VIS1-VIS4). Correlation matrix, means, and standard deviation are shown in Table 4.20. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.594 which is the correlation between VIS1 and VIS3 and the highest correlation is 0.753 which is the correlation between VIS1 and VIS2. Bartlett's test of sphericity Chi-Square is 484.352 at a level of significance 0.05, Kaiser-Meyer-Olkin Measure of sampling adequacy (KMO) is 0.792, and all observed variables have a measure of sampling adequacy (MSA) between 0.780 and 0.802. It can be concluded that a correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.20

Correlation Matrix, Means, and Standard Deviation of Vision Construct

	VIS1	VIS2	VIS3	VIS4
VIS1	1.000			
VIS2	.753	1.000		
VIS3	.594	.638	1.000	
VIS4	.689	.654	.733	1.000
$\overline{X}$	5.416	5.287	5.129	5.287
S.D.	1.208	1.191	1.215	1.260

The findings of confirmatory factor analysis (CFA) are shown in Figure 4.1 and Table 4.21. In Figure 4.1, a researcher fixes parameter (VIS2) to 1 as a reference indicator of model. It is because VIS2 is the lowest factor loading compared with other observed variables in a model. The benefit of fixed parameter is an easier comparison of a magnitude of factor loading between observed variables in the model. Covariance of VIS is 0.79. Table 4.21 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 3.74, p=0.15) and root mean square error of approximation (RMSEA) is 0.065. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.75 (VIS2) to 0.89 (VIS4). All standardized factor loadings have a significant impact at a level of significance 0.01. Composite reliability (R^2) is the percentage of variance of construct explained by observed variable. R^2 has ranged from 0.56 (VIS2) to 0.80 (VIS4). It can be concluded that all observed variables should be included in the further analysis.

Figure 4.1

The Results of CFA of Vision Model

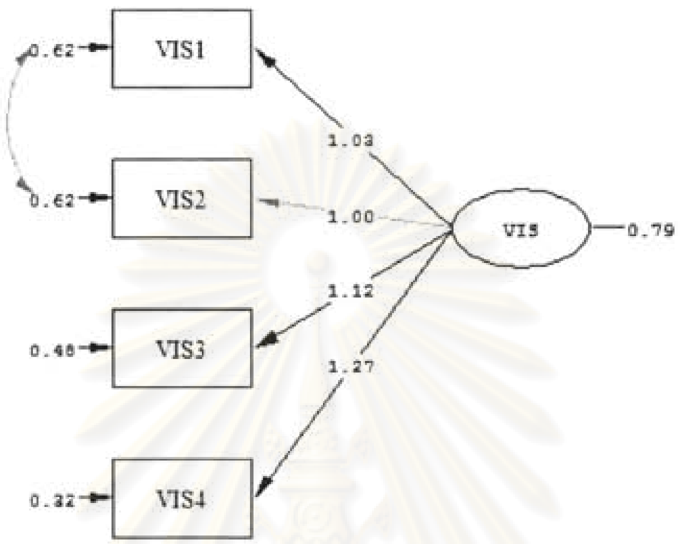


Table 4.21

Standardized Factor Loading, t-Value, and

Composite Reliability of Vision Model

Variables	Factor Loading			R^2
	λ	SE.	t	
VIS1	0.76	0.07	13.93	0.57
VIS2	0.75	-	-	0.56
VIS3	0.82	0.10	11.29	0.67
VIS4	0.89	0.11	11.71	0.80
$\chi^2 = 3.72$	df = 2	p = 0.15	RMSEA = 0.065	

- **Top Management Support**

Top management support (TOP) construct is measured by three observed variables (TOP1-TOP3). Correlation matrix, means, and standard deviation are shown in Table 4.22. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.614 which is the correlation between TOP1 and TOP3 and the highest correlation is

0.813 which is the correlation between TOP1 and TOP2. Bartlett's test of sphericity Chi-Square is 341.218 at a level of significance 0.05, KMO is 0.701, and all observed variables have MSA between 0.645 and 0.832. It can be concluded that a correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.22

Correlation Matrix, Means, and Standard Deviation of Top Management Support Construct

	TOP1	TOP2	TOP3
TOP1	1.000		
TOP2	.813	1.000	.
TOP3	.614	.674	1.000
$\overline{X}$	5.733	5.614	5.342
S.D.	1.119	1.154	1.212

The findings of CFA are shown in Figure 4.2 and Table 4.23. In Figure 4.2, a researcher fixes parameter (TOP3) to 1 as a reference indicator of model. It is because TOP3 is the lowest factor loading compared with other observed variables in a model. Covariance of TOP is 0.75. Table 4.23 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.00, p=0.99) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.71 (TOP3) to 0.94 (TOP2). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.51 (TOP3) to 0.89 (TOP2). It can be concluded that all observed variables should be included in the further analysis.

Figure 4.2

The Results of CFA of Top Management Support Model

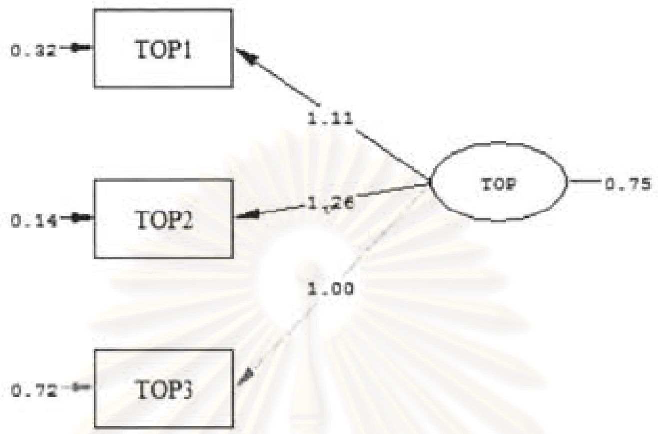


Table 4.23

Standardized Factor Loading, t-Value, and

Composite Reliability of Top Management Support Model

Variables	Factor Loading			R^2
	λ	SE.	t	
TOP1	0.86	0.09	11.79	0.74
TOP2	0.94	0.11	12.04	0.89
TOP3	0.71	-	-	0.51
$\chi^2 = 0.00$	df = 1	p = 0.99	RMSEA = 0.000	

- **Centralization**

Centralization (CEN) construct is measured by three observed variables (CEN1-CEN3). Correlation matrix, means, and standard deviation are shown in Table 4.24. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.695 which is the correlation between CEN1 and CEN3 and the highest correlation is 0.872 which is the correlation between CEN1 and CEN2. Bartlett's test of sphericity Chi-Square is 446.711 at a level of significance 0.05, KMO is 0.716, and all observed

variables have MSA between 0.657 and 0.867. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.24

Correlation Matrix, Means, and Standard Deviation of Centralization Construct

	CEN1	CEN2	CEN3
CEN1	1.000		
CEN2	.872	1.000	
CEN3	.695	.731	1.000
$\overline{X}$	5.157	5.088	5.137
S.D.	1.129	1.167	1.158

The findings of CFA are shown in Figure 4.3 and Table 4.25. In Figure 4.3, a researcher fixes parameter (CEN3) to 1 as a reference indicator of model. It is because CEN3 is the lowest factor loading compared with other observed variables in a model. Covariance of CEN is 0.78. Table 4.25 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.00, p=1.00) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.76 (CEN3) to 0.96 (CEN2). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.58 (CEN3) to 0.92 (CEN2). It can be concluded that all observed variables should be included in the further analysis.

Figure 4.3

The Results of CFA of Centralization Model

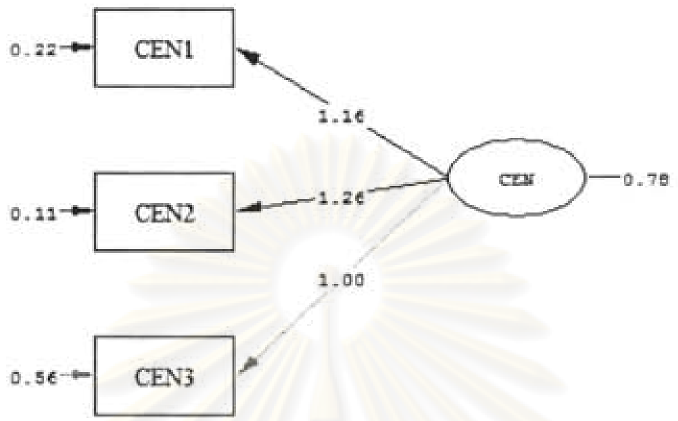


Table 4.25

Standardized Factor Loading, t-Value, and Composite Reliability of Centralization Model

Variables	Factor Loading			R^2
	λ	SE.	t	
CEN1	0.91	0.08	14.24	0.83
CEN2	0.96	0.09	14.61	0.92
CEN3	0.76	-	-	0.58
$\chi^2 = 0.00$	df = 1	p = 1.00	RMSEA = 0.000	

- **Formalization**

Formalization (FOR) construct is measured by three observed variables (FOR1-FOR3). Correlation matrix, means, and standard deviation are shown in Table 4.26. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.625 which is the correlation between FOR1 and FOR3 and the highest correlation is 0.867 which is the correlation between FOR1 and FOR2. Bartlett's test of sphericity Chi-Square is 399.119 at a level of significance 0.05, KMO is 0.689, and all observed variables have

MSA between 0.631 and 0.878. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.26

Correlation Matrix, Means, and Standard Deviation of Formalization Construct

	FOR1	FOR2	FOR3
FOR1	1.000		
FOR2	.867	1.000	
FOR3	.625	.664	1.000
$\overline{X}$	5.039	5.054	4.759
S.D.	1.364	1.354	1.370

The findings of CFA are shown in Figure 4.4 and Table 4.27. In Figure 4.4, a researcher fixes parameter (FOR3) to 1 as the reference indicator of model. It is because FOR3 is the lowest factor loading compared with other observed variables in a model. Covariance of FOR is 0.90. Table 4.27 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.00, p=0.99) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.69 (FOR3) to 0.96 (FOR2). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.48 (FOR3) to 0.92 (FOR2). It can be concluded that all observed variables except FOR3 should be included in the further analysis because FOR3 has factor loading lower than recommended value ($\lambda < 0.7$) (Hair et al., 2005).

Figure 4.4

The Results of CFA of Formalization Model

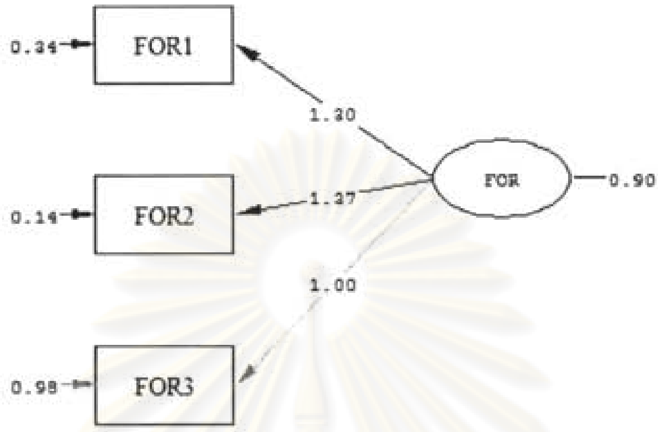


Table 4.27

Standardized Factor Loading, t-Value, and

Composite Reliability of Formalization Model

Variables	Factor Loading			R^2
	λ	SE.	t	
FOR1	0.90	0.11	11.94	0.82
FOR2	0.96	0.12	11.97	0.92
FOR3	0.69	-	-	0.48
$\chi^2 = 0.00$	df = 1	p = 0.99	RMSEA = 0.000	

- **Predevelopment Task**

Predevelopment task (PRE) construct is measured by five observed variables (PRE1-PRE5). Correlation matrix, means, and standard deviation are shown in Table 4.28. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.386 which is the correlation between PRE1 and PRE5 and the highest correlation is 0.763 which is the correlation between PRE1 and PRE2. Bartlett's test of sphericity

Chi-Square is 479.585 at a level of significance 0.05, KMO is 0.780, and all observed variables have MSA between 0.755 and 0.879. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.28

Correlation Matrix, Means, and Standard Deviation of Predevelopment task Construct

	PRE1	PRE2	PRE3	PRE4	PRE5
PRE1	1.000				
PRE2	.763	1.000			
PRE3	.617	.636	1.000		
PRE4	.431	.434	.507	1.000	
PRE5	.386	.426	.460	.656	1.000
$\overline{X}$	5.005	5.267	4.985	5.282	5.356
S.D.	1.295	1.167	1.314	1.157	1.210

The findings of CFA are shown in Figure 4.5 and Table 4.29. In Figure 4.5, a researcher fixes parameter (PRE5) to 1 as a reference indicator of model. It is because PRE5 is the lowest factor loading compared with other observed variables in a model. Covariance of PRE is 0.44. Table 4.29 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.92, p=0.82) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.55 (PRE5) to 0.85 (PRE3). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.30 (PRE5) to 0.72 (PRE3). It can be concluded that all observed variables except PRE5 should be included in the further analysis because PRE5 has factor loading lower than 0.7.

Figure 4.5

The Results of CFA of Predevelopment Task Model

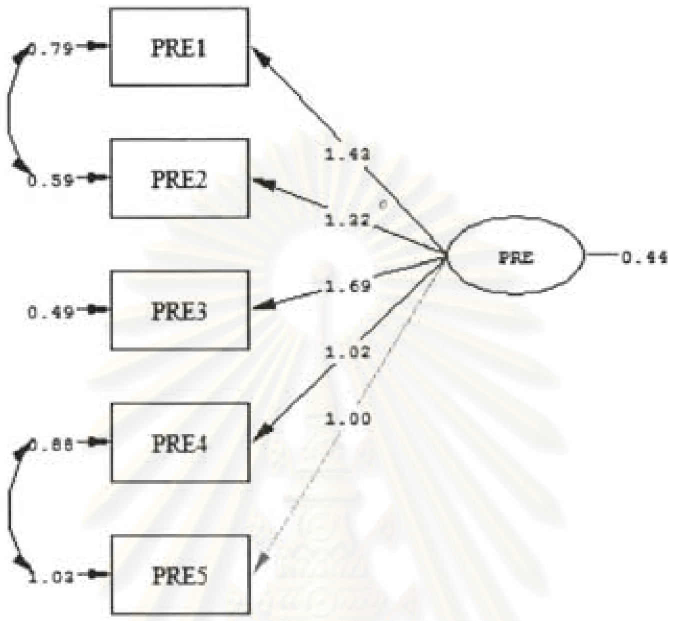


Table 4.29

Standardized Factor Loading, t-Value, and

Composite Reliability of Predevelopment Task Model

Variables	Factor Loading			R^2
	λ	SE.	t	
PRE1	0.73	0.19	7.29	0.53
PRE2	0.75	0.17	7.42	0.56
PRE3	0.85	0.22	7.52	0.72
PRE4	0.59	-	-	0.34
PRE5	0.55	0.11	8.70	0.30
$\chi^2 = 0.92$	df = 3	p = 0.82	RMSEA = 0.000	

- **Cross-functional Integration**

Cross-functional integration (CRO) construct is measured by three observed variables (CRO1-CRO3). Correlation matrix, means, and standard deviation are shown in Table 4.30. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.663 which is the correlation between CRO1 and CRO3 and the highest correlation is 0.739 which is the correlation between CRO2 and CRO3. Bartlett's test of sphericity Chi-Square is 329.670 at a level of significance 0.05, KMO is 0.734, and all observed variables have MSA between 0.691 and 0.761. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.30

Correlation Matrix, Means, and Standard Deviation of Cross-functional Integration Construct

	CRO1	CRO2	CRO3
CRO1	1.000		
CRO2	.738	1.000	
CRO3	.663	.739	1.000
$\overline{X}$	5.355	5.217	5.025
S.D.	1.170	1.252	1.310

The findings of CFA are shown in Figure 4.6 and Table 4.31. In Figure 4.6, a researcher fixes parameter (CRO1) to 1 as a reference indicator of model. It is because CRO1 is the lowest factor loading compared with other observed variables in a model. Covariance of CRO is 0.90. Table 4.31 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.00, p=0.97) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.81 (CRO1 and CRO3) to 0.91 (CRO2). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.66 (CRO1 and CRO3) to 0.82 (CRO2). It can be concluded that all observed variables should be included in the further analysis.

Figure 4.6

The Results of CFA of Cross-functional Integration Model

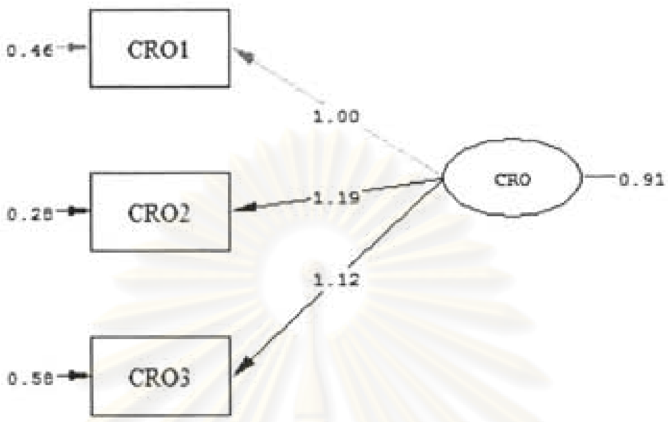


Table 4.31

Standardized Factor Loading, t-Value, and

Composite Reliability of Cross-functional Integration Model

Variables	Factor Loading			R^2
	λ	SE.	t	
CRO1	0.81	-	-	0.66
CRO2	0.91	0.08	14.59	0.82
CRO3	0.81	0.09	13.10	0.66
$\chi^2 = 0.00$	df = 1	p = 0.97	RMSEA = 0.000	

- **Technological Proficiency**

Technological proficiency (TEC) construct is measured by five observed variables (TEC1-TEC5). Correlation matrix, means, and standard deviation are shown in Table 4.32. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.437 which is the correlation between TEC1 and TEC5 and the highest correlation is 0.650 which is the correlation between TEC4 and TEC5. Bartlett's test of sphericity Chi-Square is 449.501 at a level of significance 0.05, KMO is 0.828, and all observed

variables have MSA between 0.805 and 0.850. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.32

Correlation Matrix, Means, and Standard Deviation of Cross-functional Integration Construct

	TEC1	TEC2	TEC3	TEC4	TEC5
TEC1	1.000				
TEC2	.620	1.000			
TEC3	.569	.529	1.000		
TEC4	.472	.607	.603	1.000	
TEC5	.437	.555	.520	.650	1.000
$\overline{X}$	5.089	5.493	4.946	5.433	5.862
S.D.	1.279	1.287	1.354	1.289	1.058

The findings of CFA are shown in Figure 4.7 and Table 4.33. In Figure 4.7, a researcher fixes parameter (TEC1) to 1 as a reference indicator of model. It is because TEC1 is the lowest factor loading compared with other observed variables in a model. Covariance of TEC is 0.53. Table 4.33 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.84, p=0.84) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.57 (TEC1) to 0.85 (TEC4). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.32 (TEC1) to 0.72 (TEC4). It can be concluded that all observed variables except PRE5 should be included in the further analysis because PRE5 has factor loading lower than 0.7.

Figure 4.7

The Results of CFA of Technological Proficiency Model

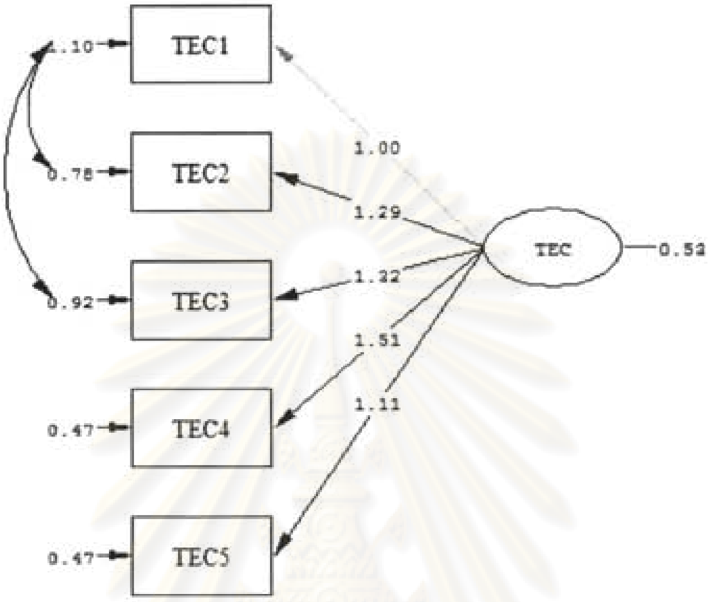


Table 4.33

Standardized Factor Loading, t-Value, and

Composite Reliability of Technological Proficiency Model

Variables	Factor Loading			R^2
	λ	SE.	t	
TEC1	0.57	-	-	0.32
TEC2	0.73	0.14	8.99	0.53
TEC3	0.71	0.16	8.41	0.50
TEC4	0.85	0.19	7.84	0.72
TEC5	0.76	0.15	7.52	0.58
$\chi^2 = 0.84$	df = 5	p = 0.84	RMSEA = 0.000	

- **Development Speed**

Development speed (SPD) construct is measured by three observed variables (SPD1-SPD3). Correlation matrix, means, and standard deviation are shown in Table 4.34. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.703 which is the correlation between SPD1 and SPD3 and the highest correlation is 0.758 which is the correlation between SPD2 and SPD3. Bartlett's test of sphericity Chi-Square is 352.433 at a level of significance 0.05, KMO is 0.745, and all observed variables have MSA between 0.711 and 0.769. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.34

Correlation Matrix, Means, and Standard Deviation of Cross-functional Integration Construct

	SPD1	SPD2	SPD3
SPD1	1.000		
SPD2	.752	1.000	
SPD3	.703	.758	1.000
$\overline{X}$	5.195	5.070	4.960
S.D.	1.251	1.262	1.490

The findings of CFA are shown in Figure 4.8 and Table 4.35. In Figure 4.8, a researcher fixes parameter (SPD1) to 1 as a reference indicator of model. It is because SPD1 is the lowest factor loading compared with other observed variables in a model. Covariance of SPD is 1.09. Table 4.35 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.00, p=0.95) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.84 (SPD1 and SPD3) to 0.90 (SPD2). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.70 (SPD1) to 0.81 (SPD2). It can be concluded that all observed variables should be included in the further analysis.

Figure 4.8

The Results of CFA of Development Speed Model

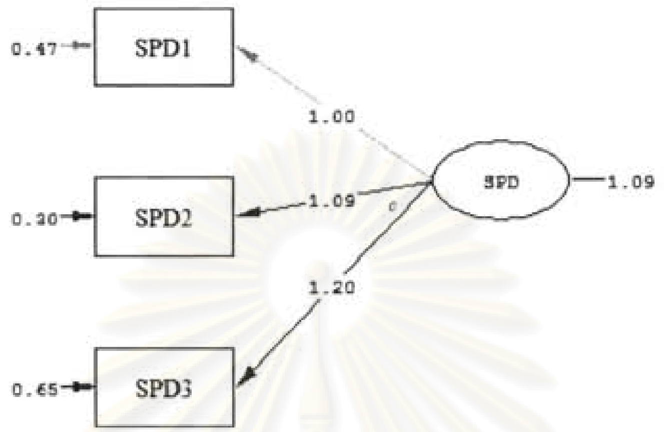


Table 4.35

Standardized Factor Loading, t-Value, and

Composite Reliability of Development Speed Model

Variables	Factor Loading			R^2
	λ	SE.	t	
SPD1	0.84	-	-	0.70
SPD2	0.90	0.07	15.56	0.81
SPD3	0.84	0.08	14.30	0.71
$\chi^2 = 0.00$	df = 1	p = 0.95	RMSEA = 0.000	

- **Launch Proficiency**

Launch proficiency (LAU) construct is measured by six observed variables (LAU1-LAU6). Correlation matrix, means, and standard deviation are shown in Table 4.36. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.573 which is the correlation between LAU1 and LAU4 and the highest correlation is 0.810 which is the correlation between LAU2 and LAU3 and between LAU3 and

LAU4. Bartlett's test of sphericity Chi-Square is 943.985 at a level of significance 0.05, KMO is 0.877, and all observed variables have MSA between 0.849 and 0.912. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.36

Correlation Matrix, Means, and Standard Deviation of Launch Proficiency Construct

	LAU1	LAU2	LAU3	LAU4	LAU5	LAU6
LAU1	1.000					
LAU2	.657	1.000				
LAU3	.633	.810	1.000			
LAU4	.597	.717	.810	1.000		
LAU5	.573	.652	.725	.714	1.000	
LAU6	.649	.622	.680	.635	.788	1.000
$\overline{X}$	4.760	5.190	5.120	5.150	5.040	4.900
S.D.	1.280	1.219	1.221	1.182	1.245	1.250

The findings of CFA are shown in Figure 4.9 and Table 4.37. In Figure 4.9, a researcher fixes parameter (LAU1) to 1 as a reference indicator of model. It is because LAU1 is the lowest factor loading compared with other observed variables in a model. Covariance of LAU is 0.81. Table 4.37 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 13.49, p=0.06) and RMSEA is 0.068. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.70 (LAU1) to 0.93 (LAU3). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.50 (LAU1) to 0.87 (LAU3). It can be concluded that all observed variables should be included in the further analysis.

Figure 4.9

The Results of CFA of Launch Proficiency Model

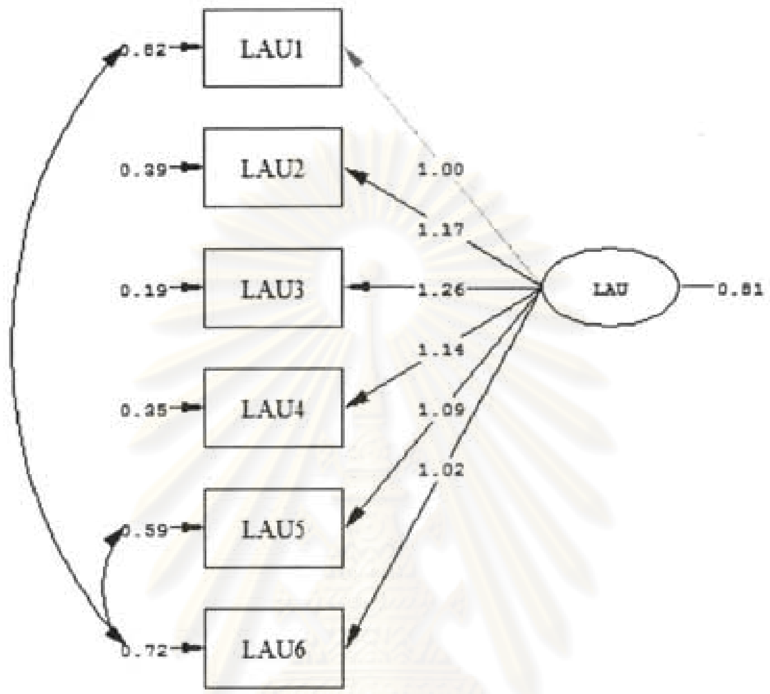


Table 4.37

Standardized Factor Loading, t-Value, and

Composite Reliability of Launch Proficiency Model

Variables	Factor Loading			R^2
	λ	SE.	t	
LAU1	0.70	-	-	0.50
LAU2	0.86	0.10	11.66	0.74
LAU3	0.93	0.10	12.55	0.87
LAU4	0.87	0.10	11.76	0.75
LAU5	0.79	0.10	10.71	0.62
LAU6	0.73	0.09	11.60	0.54
$\chi^2 = 13.49$	df = 7	p = 0.06	RMSEA = 0.068	

- **Demand Uncertainty**

Demand uncertainty (DEM) construct is measured by three observed variables (DEM1-DEM3). Correlation matrix, means, and standard deviation are shown in Table 4.38. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.171 which is the correlation between DEM1 and DEM3 and the highest correlation is 0.408 which is the correlation between DEM2 and DEM3. Bartlett's test of sphericity Chi-Square is 55.701 at a level of significance 0.05, KMO is 0.573, and all observed variables have MSA between 0.550 and 0.632. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.38

Correlation Matrix, Means, and Standard Deviation of Demand Uncertainty Construct

	DEM1	DEM2	DEM3
DEM1	1.000		
DEM2	.305	1.000	
DEM3	.171	.408	1.000
$\overline{X}$	5.185	4.940	4.910
S.D.	1.288	1.321	1.379

The findings of CFA are shown in Figure 4.10 and Table 4.39. In Figure 4.10, a researcher fixes parameter (DEM1) to 1 as a reference indicator of model. It is because DEM1 is the lowest factor loading compared with other observed variables in a model. Covariance of DEM is 0.21. Table 4.39 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.00, p=0.99) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.36 (DEM1) to 0.85 (DEM2). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.13 (DEM1) to 0.73 (DEM2). It can be concluded that DEM1 and DEM3 are not included in the further analysis because DEM1 and DEM3 have factor loading lower than 0.7.

Figure 4.10

The Results of CFA of Demand Uncertainty Model

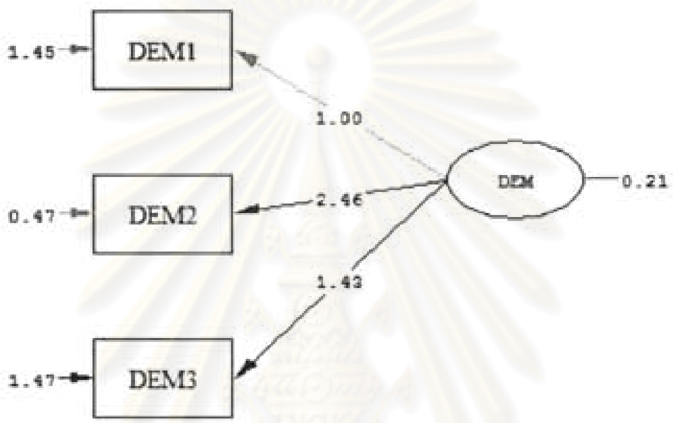


Table 4.39

Standardized Factor Loading, t-Value, and

Composite Reliability of Demand Uncertainty Model

Variables	Factor Loading			R^2
	λ	SE.	t	
DEM1	0.36	-	-	0.13
DEM2	0.85	0.53	4.62	0.73
DEM3	0.48	0.37	3.84	0.23
$\chi^2 = 0.00$	df = 2	p = 0.99	RMSEA = 0.000	

- **Technological Turbulence**

Technological turbulence (TECT) construct is measured by three observed variables (TECT1-TECT3). Correlation matrix, means, and standard deviation are shown in Table 4.40. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.556 which is the correlation between TECT1 and TECT2 and the highest correlation is 0.741 which is the correlation between TECT2 and TECT3. Bartlett's test of sphericity Chi-Square is 250.588 at a level of significance 0.05, KMO is 0.696, and all observed variables have MSA between 0.651 and 0.814. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.40

Correlation Matrix, Means, and Standard Deviation of Technological Turbulence Construct

	TECT1	TECT2	TECT3
TECT1	1.000		
TECT2	.556	1.000	
TECT3	.593	.741	1.000
$\overline{X}$	4.749	5.266	4.864
S.D.	1.438	1.253	1.388

The findings of CFA are shown in Figure 4.11 and Table 4.41. In Figure 4.11, a researcher fixes parameter (TECT1) to 1 as a reference indicator of model. It is because TECT1 is the lowest factor loading compared with other observed variables in a model. Covariance of TECT is 0.92. Table 4.41 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.00, p=0.99) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.67 (TECT1) to 0.89 (TECT3). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.44 (TECT11) to 0.79 (TECT3). It can be concluded that all observed variables should be included in the further analysis.

Figure 4.11

The Results of CFA of Technological Turbulence Model

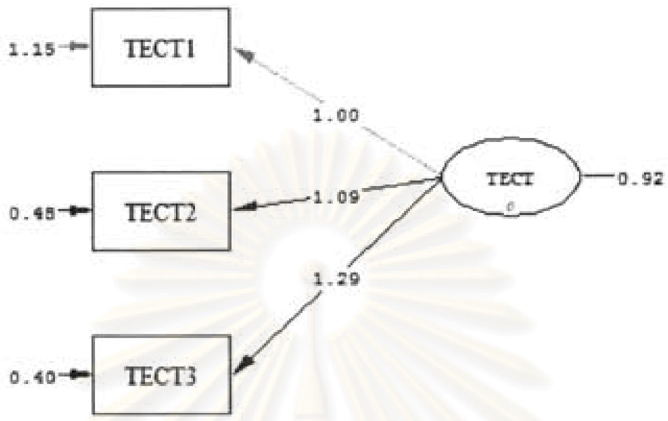


Table 4.41

Standardized Factor Loading, t-Value, and

Composite Reliability of Technological Turbulence Model

Variables	Factor Loading			R^2
	λ	SE.	t	
TECT1	0.67	-	-	0.44
TECT2	0.83	0.11	9.86	0.70
TECT3	0.89	0.13	9.89	0.79
$\chi^2 = 0.00$	df= 1	p = 0.99	RMSEA = 0.000	

- **Government Agency Support**

Government agency support (GOV) construct is measured by five observed variables (GOV1-GOV5). Correlation matrix, means, and standard deviation are shown in Table 4.42. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.519 which is the correlation between GOV1 and GOV5 and the highest correlation is 0.882 which is the correlation between GOV1 and GOV2. Bartlett's test of sphericity Chi-Square is 961.344 at a level of significance 0.05, KMO is 0.831, and all observed variables have MSA between 0.786 and 0.874. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.42

Correlation Matrix, Means, and Standard Deviation of Government Agency Support Construct

	GOV1	GOV2	GOV3	GOV4	GOV5
GOV1	1.000				
GOV2	.882	1.000			
GOV3	.840	.881	1.000		
GOV4	.644	.726	.714	1.000	
GOV5	.519	.595	.641	.788	1.000
$\overline{X}$	3.171	2.955	2.990	2.497	2.427
S.D.	1.624	1.519	1.586	1.642	1.649

The findings of CFA are shown in Figure 4.12 and Table 4.43. In Figure 4.12, a researcher fixes parameter (GOV5) to 1 as a reference indicator of model. It is because GOV5 is the lowest factor loading compared with other observed variables in a model. Covariance of GOV is 1.02. Table 4.43 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 7.40, p=0.06) and RMSEA is 0.085. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.62 (GOV5) to 0.96 (GOV2). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.38 (GOV5) to 0.93 (GOV2). It can be concluded that all observed variables except GOV5 should be included in the further analysis because GOV5 has factor loading lower than 0.7.

Figure 4.12

The Results of CFA of Government Agency Support Model

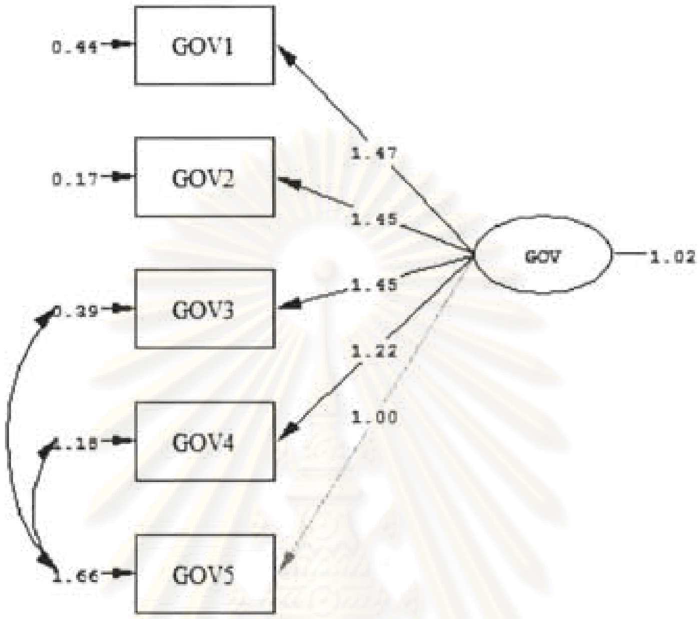


Table 4.43

Standardized Factor Loading, t-Value, and

Composite Reliability of Government Agency Support Model

Variables	Factor Loading			R^2
	λ	SE.	t	
GOV1	0.91	0.14	10.24	0.83
GOV2	0.96	0.14	10.56	0.93
GOV3	0.92	0.13	10.96	0.85
GOV4	0.75	0.09	13.72	0.56
GOV5	0.62	-	-	0.38
$\chi^2 = 7.40$	df = 3	p = 0.06	RMSEA = 0.085	

- **Radical Product innovation**

Radical product innovation (RAD) construct is measured by three observed variables (RAD1-RAD3). Correlation matrix, means, and standard deviation are shown in Table 4.44. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.479 which is the correlation between RAD2 and RAD3 and the highest correlation is 0.721 which is the correlation between RAD1 and RAD2. Bartlett's test of sphericity Chi-Square is 224.484 at a level of significance 0.05, KMO is 0.667, and all observed variables have MSA between 0.618 and 0.784. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.44

Correlation Matrix, Means, and Standard Deviation of Radical Product Innovation Construct

	RAD1	RAD2	RAD3
RAD1	1.000		
RAD2	.721	1.000	
RAD3	.573	.479	1.000
$\overline{X}$	5.317	5.347	5.427
S.D.	1.157	1.297	1.288

The findings of CFA are shown in Figure 4.13 and Table 4.45. In Figure 4.13, a researcher fixes parameter (RAD3) to 1 as a reference indicator of model. It is because RAD3 is the lowest factor loading compared with other observed variables in a model. Covariance of RAD is 0.63. Table 4.45 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.00, p=0.98) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.62 (RAD3) to 0.93 (RAD1). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.38 (RAD3) to 0.86 (RAD1). It can be concluded that all observed variables except RAD3 are included in the further analysis because RAD3 has factor loading lower than 0.7.

Figure 4.13

The Results of CFA of Radical Product Innovation Model

Table 4.45

Standardized Factor Loading, t-Value, and

Composite Reliability of Radical Product Innovation Model

Variables	Factor Loading			R^2
	λ	SE.	t	
RAD1	0.93	0.16	8.57	0.86
RAD2	0.78	0.14	8.77	0.60
RAD3	0.62	-	-	0.38
$\chi^2 = 0.00$	df = 1	p = 0.98	RMSEA = 0.000	

- **Market Performance**

Market performance (MP) construct is measured by four observed variables (MP1-MP4). Correlation matrix, means, and standard deviation are shown in Table 4.46. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.499 which is the correlation between MP2 and MP4 and the highest correlation is 0.722 which is the correlation between MP3 and MP4. Bartlett's test of sphericity Chi-Square is 382.053 at a level of significance 0.05, KMO is 0.756, and all observed variables have MSA between 0.749 and 0.764. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.46

Correlation Matrix, Means, and Standard Deviation of Market Performance Construct

	MP1	MP2	MP3	MP4
MP1	1.000			
MP2	.702	1.000		
MP3	.584	.560	1.000	
MP4	.538	.499	.722	1.000
$\overline{X}$	5.261	5.372	4.543	4.658
S.D.	1.186	1.060	1.377	1.320

The findings of CFA are shown in Figure 4.14 and Table 4.47. In Figure 4.14, a researcher fixes parameter (MP4) to 1 as a reference indicator of model. It is because MP4 is the lowest factor loading compared with other observed variables in a model. Covariance of MP is 0.67. Table 4.47 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.13, p=0.94) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.62 (MP4) to 0.86 (MP1). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.39 (MP4) to 0.74 (MP1). It can be concluded that MP3 and MP4 are not included in the further analysis because MP3 and MP4 have factor loading lower than 0.7.

Figure 4.14

The Results of CFA of Market Performance Model

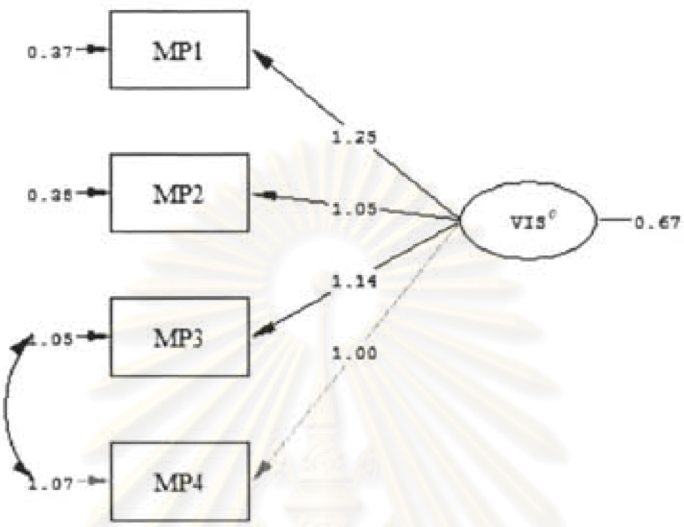


Table 4.47

Standardized Factor Loading, t-Value, and

Composite Reliability of Market Performance Model

Variables	Factor Loading			R^2
	λ	SE.	t	
MP1	0.86	0.14	8.77	0.74
MP2	0.81	0.12	8.71	0.66
MP3	0.67	0.10	11.23	0.45
MP4	0.62	-	-	0.39
$\chi^2 = 0.13$	df= 2	p = 0.94	RMSEA = 0.000	

- **Financial Performance**

Financial performance (FP) construct is measured by three observed variables (FP1-FP3). Correlation matrix, means, and standard deviation are shown in Table 4.48. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.722 which is the correlation between FP1 and FP2 and the highest correlation is 0.827 which is the correlation between FP1 and FP3. Bartlett's test of sphericity Chi-Square is 453.843 at a level of significance 0.05, KMO is 0.729, and all observed variables have MSA between 0.666 and 0.774. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.48

Correlation Matrix, Means, and Standard Deviation of Financial Performance Construct

	FP1	FP2	FP3
FP1	1.000		
FP2	.722	1.000	
FP3	.827	.821	1.000
$\overline{X}$	4.632	4.632	4.557
S.D.	1.301	1.328	1.381

The findings of CFA are shown in Figure 4.15 and Table 4.49. In Figure 4.15, a researcher fixes parameter (FP1) to 1 as a reference indicator of model. It is because FP1 is the lowest factor loading compared with other observed variables in a model. Covariance of FP is 1.23. Table 4.49 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.00, p=0.98) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.85 (FP1 and FP2) to 0.97 (FP3). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.72 (FP2) to 0.94 (FP3). It can be concluded that all observed variables should be included in the further analysis.

Figure 4.15

The Results of CFA of Financial Performance Model

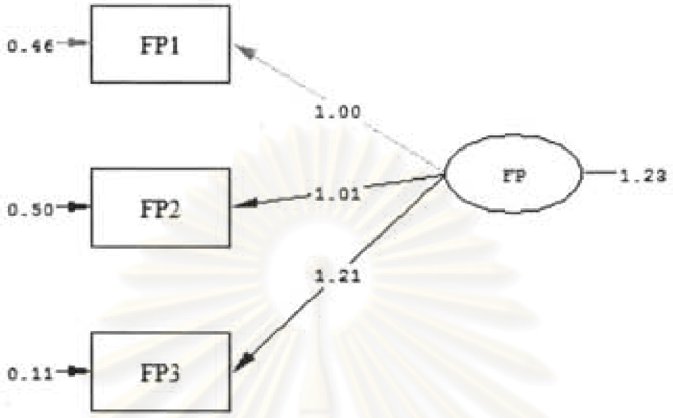


Table 4.49

Standardized Factor Loading, t-Value, and

Composite Reliability of Financial Performance Model

Variables	Factor Loading			R^2
	λ	SE.	t	
FP1	0.85	-	-	0.73
FP2	0.85	0.06	15.81	0.72
FP3	0.97	0.06	19.26	0.94
$\chi^2 = 0.00$	df = 1	p = 0.98	RMSEA = 0.000	

From the preliminary analysis, all fifty nine measurement items except FOR3, PRE4, PRE5, TEC1, DEM1, DEM3, TECT1, GOV5, RAD3, MP3, and MP4 have standardized factor loading higher than 0.7. The loading that lower than 0.7 is considered to be deleted from the model. Therefore, these eleven variables are deleted from a measurement model.

4.3.2 Incremental Product Innovation Based Performance Framework

- **Vision**

Vision (VIS) construct is measured by four observed variables (VIS1-VIS4). Correlation matrix, means, and standard deviation are shown in Table 4.50. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.676 which is the correlation between VIS1 and VIS2 and the highest correlation is 0.820 which is the correlation between VIS3 and VIS4. Bartlett's test of sphericity Chi-Square is 362.474 at a level of significance 0.05, KMO is 0.794, and all observed variables have a measure of sampling adequacy (MSA) between 0.749 and 0.860. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.50

Correlation Matrix, Means, and Standard Deviation of Vision Construct

	VIS1	VIS2	VIS3	VIS4
VIS1	1.000			
VIS2	.676	1.000		
VIS3	.683	.741	1.000	
VIS4	.802	.696	.820	1.000
$\overline{X}$	4.091	4.322	4.066	4.165
S.D.	1.683	1.572	1.662	1.588

The findings of CFA are shown in Figure 4.16 and Table 4.51. In Figure 4.16, a researcher fixes parameter (VIS2) to 1 as a reference indicator of model. It is because VIS2 is the lowest factor loading compared with other observed variables in a model. Covariance of VIS is 1.53. Table 4.51 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.84, p=0.66) and root mean square error of approximation (RMSEA) is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.78 (VIS2) to 0.93 (VIS3). All standardized factor loadings have a significant impact at a level of significance 0.01. Composite reliability (R^2) is the percentage of variance of construct explained by observed variable. R^2 has ranged from 0.61 (VIS2) to 0.86 (VIS3). It can be concluded that all observed variables should be included in the further analysis.

Figure 4.16

The Results of CFA of Vision Model

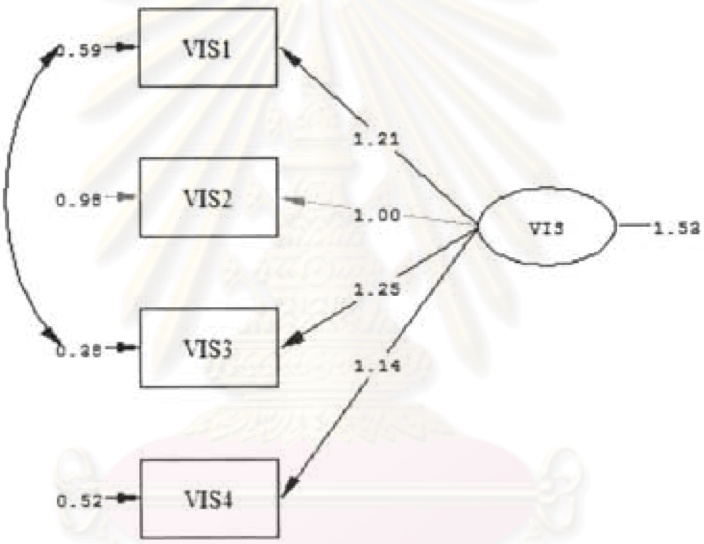


Table 4.51

Standardized Factor Loading, t-Value, and Composite Reliability of Vision Model

Variables	Factor Loading			R^2
	λ	SE.	t	
VIS1	0.89	0.12	10.54	0.79
VIS2	0.78	-	-	0.61
VIS3	0.93	0.11	11.18	0.86
VIS4	0.89	0.10	11.51	0.79
$\chi^2 = 0.84$	df = 2	p = 0.66	RMSEA = 0.000	

- **Top Management Support**

Top management support (TOP) construct is measured by three observed variables (TOP1-TOP3). Correlation matrix, means, and standard deviation are shown in Table 4.52. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.673 which is the correlation between TOP1 and TOP3 and the highest correlation is 0.838 which is the correlation between TOP1 and TOP2. Bartlett's test of sphericity Chi-Square is 232.135 at a level of significance 0.05, KMO is 0.718, and all observed variables have MSA between 0.663 and 0.846. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.52

Correlation Matrix, Means, and Standard Deviation of Top Management Support Construct

	TOP1	TOP2	TOP3
TOP1	1.000		
TOP2	.838	1.000	
TOP3	.673	.714	1.000
$\overline{X}$	4.826	4.587	4.223
S.D.	1.520	1.636	1.635

The findings of CFA are shown in Figure 4.17 and Table 4.53. In Figure 4.17, a researcher fixes parameter (TOP3) to 1 as a reference indicator of model. It is because TOP3 is the lowest factor loading compared with other observed variables in a model. Covariance of TOP is 1.53. Table 4.53 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.00, p=0.99) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.76 (TOP3) to 0.94 (TOP2). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.57 (TOP3) to 0.89 (TOP2). It can be concluded that all observed variables should be included in the further analysis.

Figure 4.17

The Results of CFA of Top Management Support Model

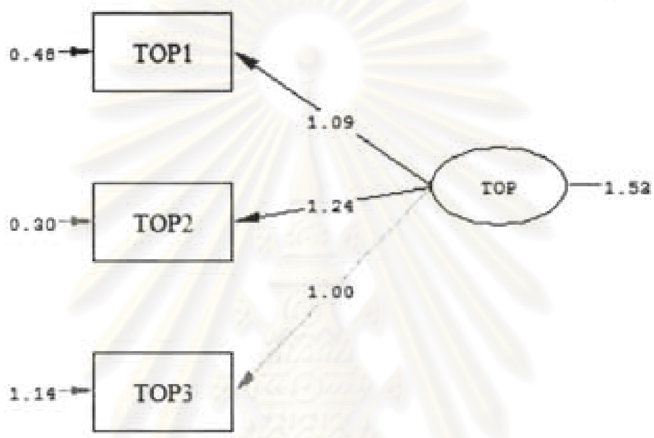


Table 4.53

Standardized Factor Loading, t-Value, and

Composite Reliability of Top Management Support Model

Variables	Factor Loading			R^2
	λ	SE.	t	
TOP1	0.89	0.10	10.45	0.79
TOP2	0.94	0.11	11.37	0.89
TOP3	0.76	-	-	0.57
$\chi^2 = 0.00$	df = 2	p = 0.99	RMSEA = 0.000	

- **Centralization**

Centralization (CEN) construct is measured by three observed variables (CEN1-CEN3). Correlation matrix, means, and standard deviation are shown in Table 4.54. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.573 which is the correlation between CEN1 and CEN3 and the highest correlation is 0.830 which is the correlation between CEN1 and CEN2. Bartlett's test of sphericity Chi-Square is 194.774 at a level of significance 0.05, KMO is 0.679, and all observed variables have MSA between 0.627 and 0.868. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.54

Correlation Matrix, Means, and Standard Deviation of Centralization Construct

	CEN1	CEN2	CEN3
CEN1	1.000		
CEN2	.830	1.000	
CEN3	.573	.605	1.000
$\overline{X}$	4.455	4.289	4.190
S.D.	1.304	1.326	1.344

The findings of CFA are shown in Figure 4.18 and Table 4.55. In Figure 4.18, a researcher fixes parameter (CEN3) to 1 as a reference indicator of model. It is because CEN3 is the lowest factor loading compared with other observed variables in a model. Covariance of CEN is 0.76. Table 4.55 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.00, p=0.99) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.65 (CEN3) to 0.94 (CEN2). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.42 (CEN3) to 0.88 (CEN2). It can be concluded that all observed variables except CEN3 should be included in the further analysis because CEN3 has factor loading lower than 0.7.

Figure 4.18

The Results of CFA of Centralization Model

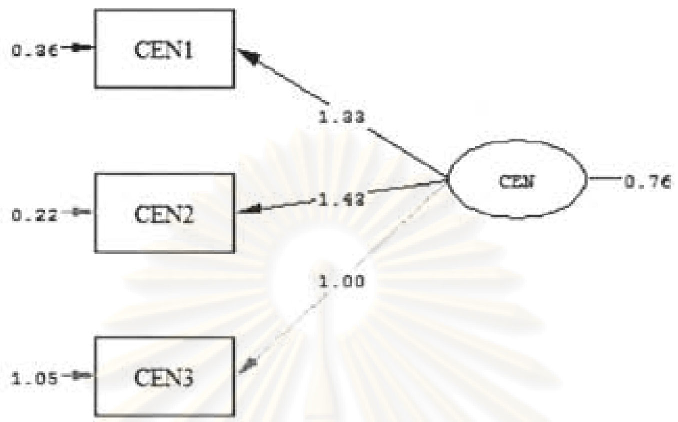


Table 4.55

Standardized Factor Loading, t-Value, and Composite Reliability of Centralization Model

Variables	Factor Loading			R^2
	λ	SE.	t	
CEN1	0.89	0.16	8.11	0.79
CEN2	0.94	0.17	8.52	0.88
CEN3	0.65	-	-	0.42
$\chi^2 = 0.00$	df = 2	p = 0.99	RMSEA = 0.000	

- **Formalization**

Formalization (FOR) construct is measured by three observed variables (FOR1-FOR3). Correlation matrix, means, and standard deviation are shown in Table 4.56. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.624 which is the correlation between FOR1 and FOR3 and the highest correlation is 0.882 which is the correlation between FOR1 and FOR2. Bartlett's test of sphericity Chi-Square is

243.415 at a level of significance 0.05, KMO is 0.683, and all observed variables have MSA between 0.626 and 0.896. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform should be the next step of data analysis.

Table 4.56

Correlation Matrix, Means, and Standard Deviation of Formalization Construct

	FOR1	FOR2	FOR3
FOR1	1.000		
FOR2	.882	1.000	
FOR3	.624	.651	1.000
$\overline{X}$	4.592	4.600	4.200
S.D.	1.381	1.368	1.627

The findings of CFA are shown in Figure 4.19 and Table 4.57. In Figure 4.19, a researcher fixes parameter (FOR3) to 1 as a reference indicator of model. It is because FOR3 is the lowest factor loading compared with other observed variables in a model. Covariance of FOR is 1.27. Table 4.57 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.00, p=0.99) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.68 (FOR3) to 0.97 (FOR2). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.47 (FOR3) to 0.94 (FOR2). It can be concluded that all observed variables except FOR3 should be included in the further analysis because FOR3 has factor loading lower than 0.7.

Figure 4.19

The Results of CFA of Formalization Model

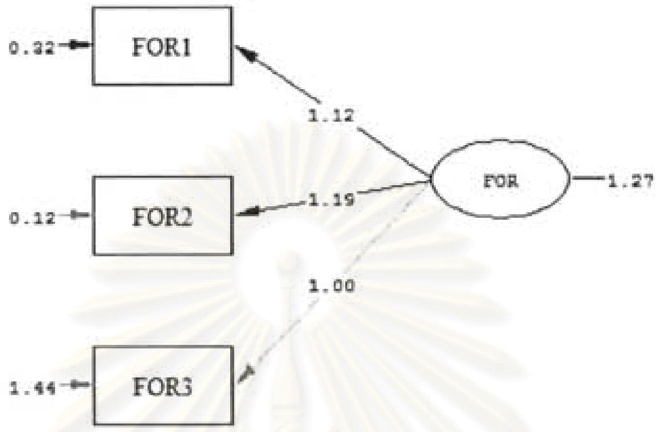


Table 4.57

Standardized Factor Loading, t-Value, and Composite Reliability of Formalization Model

Variables	Factor Loading			R^2
	λ	SE.	t	
FOR1	0.91	0.12	9.26	0.83
FOR2	0.97	0.12	9.80	0.94
FOR3	0.68	-	-	0.47
$\chi^2 = 0.00$	df = 2	p = 0.99	RMSEA = 0.000	

- **Predevelopment Task**

Predevelopment task (PRE) construct is measured by five observed variables (PRE1-PRE5). Correlation matrix, means, and standard deviation are shown in Table 4.58. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.582 which is the correlation between PRE1 and PRE5 and the highest correlation is 0.803 which is the correlation between PRE1 and PRE2. Bartlett's test of sphericity Chi-Square is 457.463 at a level of significance 0.05, KMO is 0.830, and all observed

variables have MSA between 0.796 and 0.857. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.58

Correlation Matrix, Means, and Standard Deviation of Predevelopment task Construct

	PRE1	PRE2	PRE3	PRE4	PRE5
PRE1	1.000				
PRE2	.803	1.000			
PRE3	.762	.796	1.000		
PRE4	.704	.688	.615	1.000	
PRE5	.582	.629	.608	.779	1.000
$\overline{X}$	4.261	4.429	4.151	4.529	4.613
S.D.	1.548	1.510	1.538	1.419	1.513

The findings of CFA are shown in Figure 4.20 and Table 4.59. In Figure 4.20, a researcher fixes parameter (PRE5) to 1 as a reference indicator of model. It is because PRE5 is the lowest factor loading compared with other observed variables in a model. Covariance of PRE is 1.07. Table 4.59 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 8.56, p=0.07) and RMSEA is 0.097. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.68 (PRE5) to 0.91 (PRE2). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.47 (PRE5) to 0.84 (PRE2). It can be concluded that all observed variables except PRE5 should be included in the further analysis because PRE5 has factor loading lower than 0.7.

Figure 4.20

The Results of CFA of Predevelopment Task Model

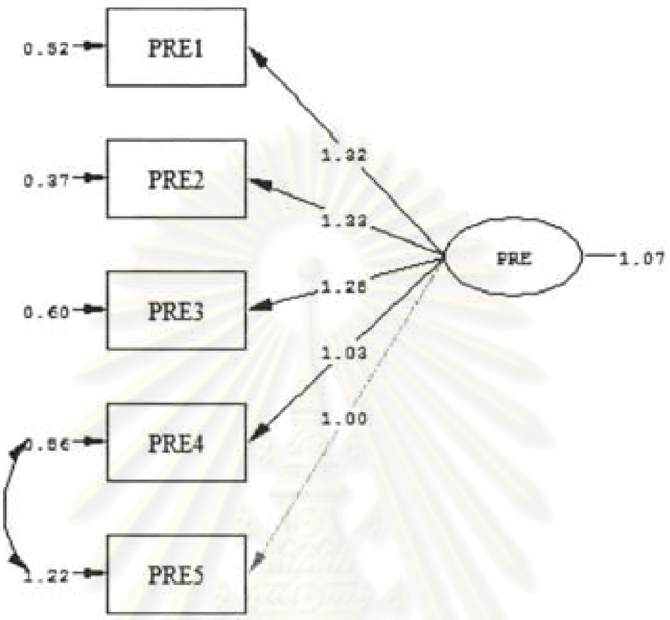


Table 4.59

Standardized Factor Loading, t-Value, and

Composite Reliability of Predevelopment Task Model

Variables	Factor Loading			R^2
	λ	SE.	t	
PRE1	0.88	0.15	8.77	0.78
PRE2	0.91	0.15	8.98	0.84
PRE3	0.86	0.15	8.58	0.74
PRE4	0.76	0.09	11.28	0.57
PRE5	0.68	-	-	0.47
$\chi^2 = 8.56$	df = 4	p = 0.07	RMSEA = 0.097	

- **Cross-functional Integration**

Cross-functional integration (CRO) construct is measured by three observed variables (CRO1-CRO3). Correlation matrix, means, and standard deviation are shown in Table 4.60. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.770 which is the correlation between CRO1 and CRO2 and the highest correlation is 0.837 which is the correlation between CRO2 and CRO3. Bartlett's test of sphericity Chi-Square is 266.472 at a level of significance 0.05, KMO is 0.754, and all observed variables have MSA between 0.724 and 0.819. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.60

Correlation Matrix, Means, and Standard Deviation of Cross-functional Integration Construct

	CRO1	CRO2	CRO3
CRO1	1.000		
CRO2	.770	1.000	
CRO3	.775	.837	1.000
$\overline{X}$	4.612	4.488	4.182
S.D.	1.350	1.427	1.517

The findings of CFA are shown in Figure 4.21 and Table 4.61. In Figure 4.21, a researcher fixes parameter (CRO1) to 1 as a reference indicator of model. It is because CRO1 is the lowest factor loading compared with other observed variables in a model. Covariance of CRO is 0.91. Table 4.61 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.00, p=0.97) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.85 (CRO1) to 0.92 (CRO3). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.71 (CRO1) to 0.84 (CRO3). It can be concluded that all observed variables should be included in the further analysis.

Figure 4.21

The Results of CFA of Cross-functional Integration Model

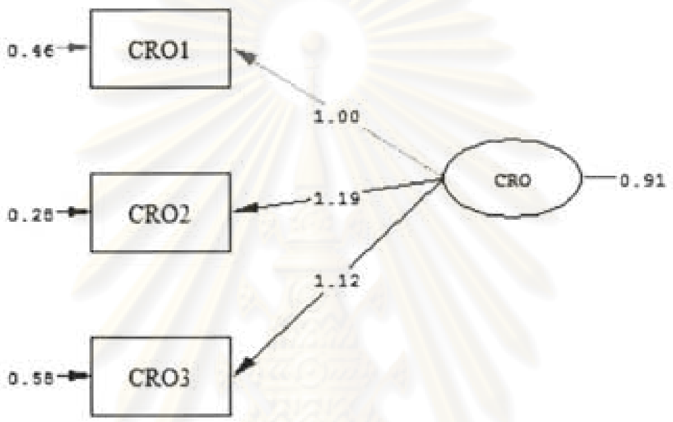


Table 4.61

Standardized Factor Loading, t-Value, and

Composite Reliability of Cross-functional Integration Model

Variables	**Factor Loading**			R^2
	λ	**SE.**	**t**	
CRO1	0.85	-	-	0.71
CRO2	0.91	0.09	13.24	0.83
CRO3	0.92	0.09	13.35	0.84
$\chi^2 = 0.00$	df = 1	p = 0.97	RMSEA = 0.000	

- **Technological Proficiency**

Technological proficiency (TEC) construct is measured by five observed variables (TEC1-TEC5). Correlation matrix, means, and standard deviation are shown in Table 4.62. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.574 which is the correlation between TEC3 and TEC4 and the highest correlation is 0.742 which is the correlation between TEC2 and TEC3. Bartlett's test of sphericity Chi-Square is 339.004 at a level of significance 0.05, KMO is 0.877, and all observed variables have MSA between 0.844 and 0.908. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.62

Correlation Matrix, Means, and Standard Deviation of Cross-functional Integration Construct

	TEC1	TEC2	TEC3	TEC4	TEC5
TEC1	1.000				
TEC2	.692	1.000			
TEC3	.598	.589	1.000		
TEC4	.618	.742	.622	1.000	
TEC5	.630	.674	.574	.661	1.000
$\overline{X}$	4.479	4.773	4.160	4.429	5.025
S.D.	1.383	1.628	1.496	1.730	1.318

The findings of CFA are shown in Figure 4.22 and Table 4.63. In Figure 4.22, a researcher fixes parameter (TEC5) to 1 as a reference indicator of model. It is because TEC5 is the lowest factor loading compared with other observed variables in a model. Covariance of TEC is 1.08. Table 4.63 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 5.07, p=0.41) and RMSEA is 0.010. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.72 (TEC3) to 0.86 (TEC2). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.53 (TEC3) to 0.75 (TEC2). It can be concluded that all observed variables should be included in the further analysis.

Figure 4.22

The Results of CFA of Technological Proficiency Model

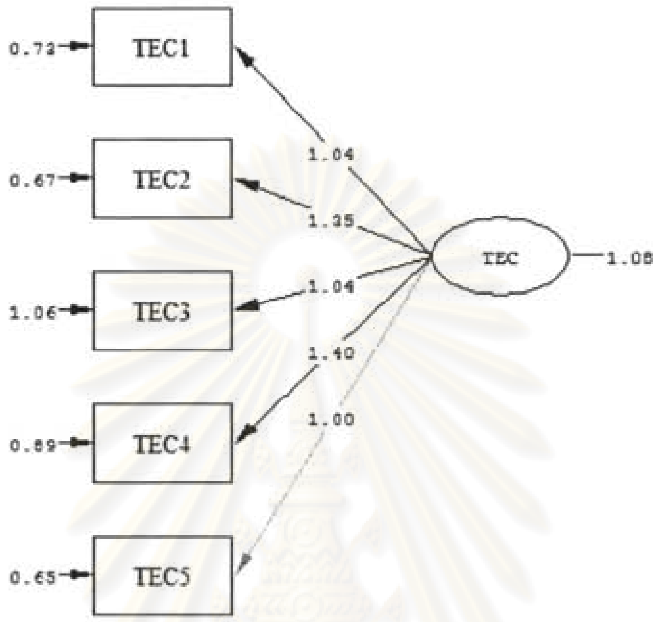


Table 4.63

Standardized Factor Loading, t-Value, and

Composite Reliability of Technological Proficiency Model

Variables	Factor Loading			R^2
	λ	SE.	t	
TEC1	0.78	0.11	9.24	0.62
TEC2	0.86	0.13	10.40	0.75
TEC3	0.72	0.12	8.40	0.53
TEC4	0.84	0.14	10.06	0.71
TEC5	0.79	-	-	0.63
$\chi^2 = 5.07$	df = 5	p = 0.41	RMSEA = 0.010	

- **Development Speed**

Development speed (SPD) construct is measured by three observed variables (SPD1-SPD3). Correlation matrix, means, and standard deviation are shown in Table 4.64. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.705 which is the correlation between SPD1 and SPD3 and the highest correlation is 0.800 which is the correlation between SPD1 and SPD2. Bartlett's test of sphericity Chi-Square is 209.941 at a level of significance 0.05, KMO is 0.738, and all observed variables have MSA between 0.706 and 0.817. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.64

Correlation Matrix, Means, and Standard Deviation of Cross-functional Integration Construct

	SPD1	SPD2	SPD3
SPD1	1.000		
SPD2	.800	1.000	
SPD3	.705	.712	1.000
$\overline{X}$	4.265	3.906	4.026
S.D.	1.539	1.526	1.621

The findings of CFA are shown in Figure 4.23 and Table 4.65. In Figure 4.23, a researcher fixes parameter (SPD3) to 1 as a reference indicator of model. It is because SPD3 is the lowest factor loading compared with other observed variables in a model. Covariance of SPD is 1.66. Table 4.65 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.00, p=0.99) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.79 (SPD3) to 0.90 (SPD2). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.63 (SPD3) to 0.80 (SPD2). It can be concluded that all observed variables should be included in the further analysis.

Figure 4.23

The Results of CFA of Development Speed Model

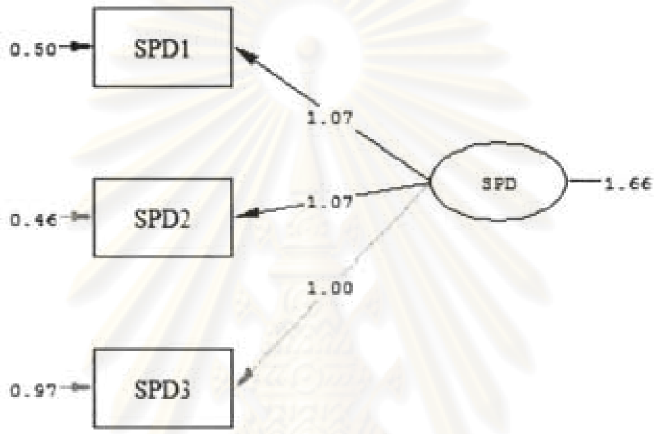


Table 4.65

Standardized Factor Loading, t-Value, and

Composite Reliability of Development Speed Model

Variables	Factor Loading			R^2
	λ	SE.	t	
SPD1	0.89	0.10	11.02	0.79
SPD2	0.90	0.09	11.49	0.80
SPD3	0.79	-	-	0.63
$\chi^2 = 0.00$	df = 2	p = 0.99	RMSEA = 0.000	

- **Launch Proficiency**

Launch proficiency (LAU) construct is measured by six observed variables (LAU1-LAU6). Correlation matrix, means, and standard deviation are shown in Table 4.66. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.475 which is the correlation between LAU1 and LAU4 and the highest correlation is 0.837 which is the correlation between LAU2 and LAU3. Bartlett's test of sphericity Chi-Square is 560.834 at a level of significance 0.05, KMO is 0.894, and all observed variables have MSA between 0.865 and 0.952. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform further the next step of data analysis.

Table 4.66

Correlation Matrix, Means, and Standard Deviation of Launch Proficiency Construct

	LAU1	LAU2	LAU3	LAU4	LAU5	LAU6
LAU1	1.000					
LAU2	.564	1.000				
LAU3	.620	.837	1.000			
LAU4	.475	.645	.719	1.000		
LAU5	.615	.702	.778	.725	1.000	
LAU6	.634	.730	.780	.610	.788	1.000
$\overline{X}$	4.025	4.353	4.160	4.252	4.109	4.126
S.D.	1.447	1.453	1.507	1.433	1.539	1.476

The findings of CFA are shown in Figure 4.24 and Table 4.67. In Figure 4.24, a researcher fixes parameter (LAU1) to 1 as a reference indicator of model. It is because LAU1 is the lowest factor loading compared with other observed variables in a model. Covariance of LAU is 1.00. Table 4.58 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 13.06, p=0.11) and RMSEA is 0.072. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.69 (LAU1) to 0.89 (LAU3 and LAU5). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.48 (LAU1) to 0.80 (LAU5). It can be concluded that all observed variables except

LAU1 should be included in the further analysis because LAU1 has factor loading lower than 0.7.

Figure 4.24

The Results of CFA of Launch Proficiency Model

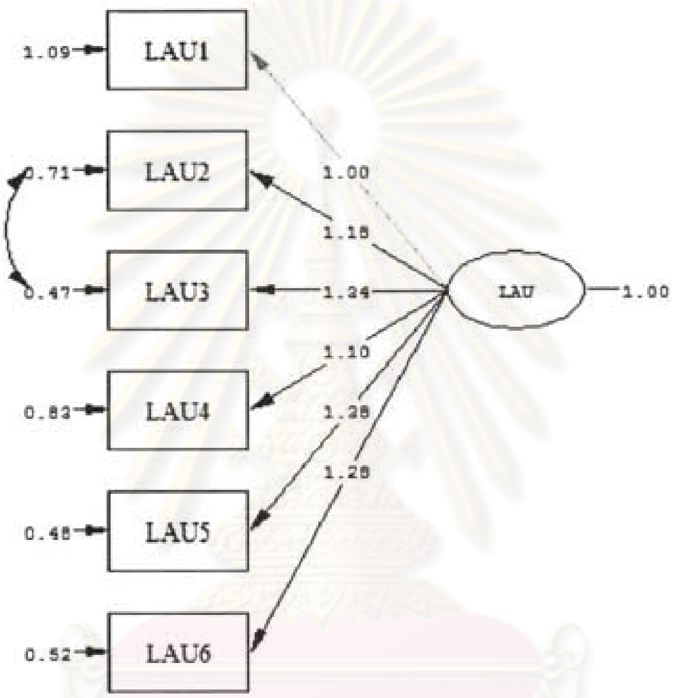


Table 4.67

Standardized Factor Loading, t-Value, and

Composite Reliability of Launch Proficiency Model

Variables	Factor Loading			R^2
	λ	SE.	t	
LAU1	0.69	-	-	0.48
LAU2	0.82	0.14	8.30	0.66
LAU3	0.89	0.15	9.03	0.79
LAU4	0.77	0.14	7.92	0.59
LAU5	0.89	0.15	9.07	0.80
LAU6	0.77	0.15	8.87	0.76
χ^2 = 13.06	df = 8	p = 0.11	RMSEA = 0.072	

- **Demand Uncertainty**

Demand uncertainty (DEM) construct is measured by three observed variables (DEM1-DEM3). Correlation matrix, means, and standard deviation are shown in Table 4.68. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.475 which is the correlation between DEM1 and DEM3 and the highest correlation is 0.615 which is the correlation between DEM2 and DEM3. Bartlett's test of sphericity Chi-Square is 110.352 at a level of significance 0.05, KMO is 0.685, and all observed variables have MSA between 0.640 and 0.725. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.68

Correlation Matrix, Means, and Standard Deviation of Demand Uncertainty Construct

	DEM1	DEM2	DEM3
DEM1	1.000		
DEM2	.595	1.000	
DEM3	.475	.615	1.000
$\overline{X}$	4.667	4.033	4.333
S.D.	1.621	1.511	1.642

The findings of CFA are shown in Figure 4.25 and Table 4.69. In Figure 4.25, a researcher fixes parameter (DEM1) to 1 as a reference indicator of model. It is because DEM1 is the lowest factor loading compared with other observed variables in a model. Covariance of DEM is 1.21. Table 4.69 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.00, p=0.99) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.68 (DEM1) to 0.88 (DEM2). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.46 (DEM1) to 0.77 (DEM2). It can be concluded that all observed variables except DEM1 are included in the further analysis because DEM1 has factor loading lower than 0.7.

Figure 4.25

The Results of CFA of Demand Uncertainty Model

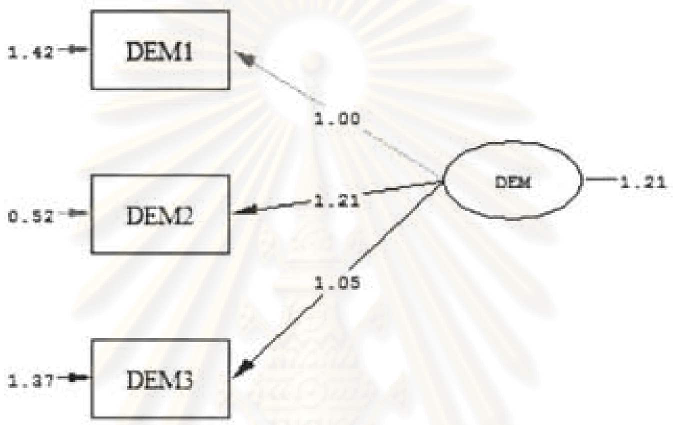


Table 4.69

Standardized Factor Loading, t-Value, and

Composite Reliability of Demand Uncertainty Model

Variables	**Factor Loading**			R^2
	λ	**SE.**	**t**	
DEM1	0.68	-	-	0.46
DEM2	0.88	0.15	8.30	0.77
DEM3	0.70	0.16	6.63	0.49
$\chi^2 = 0.00$	df = 2	p = 0.99	RMSEA = 0.000	

- **Technological Turbulence**

Technological turbulence (TECT) construct is measured by three observed variables (TECT1-TECT3). Correlation matrix, means, and standard deviation are shown in Table 4.70. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.621 which is the correlation between TECT1 and TECT2 and the highest correlation is 0.732 which is the correlation between TECT2 and TECT3. Bartlett's test of sphericity Chi-Square is 179.686 at a level of significance 0.05, KMO is 0.721, and all observed variables have MSA between 0.673 and 0.767. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.70

Correlation Matrix, Means, and Standard Deviation of Technological Turbulence Construct

	TECT1	TECT2	TECT3
TECT1	1.000		
TECT2	.621	1.000	
TECT3	.707	.732	1.000
$\overline{X}$	4.262	4.533	4.107
S.D.	1.498	1.500	1.558

The findings of CFA are shown in Figure 4.26 and Table 4.71. In Figure 4.26, a researcher fixes parameter (TECT1) to 1 as a reference indicator of model. It is because TECT1 is the lowest factor loading compared with other observed variables in a model. Covariance of TECT is 1.35. Table 4.71 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.00, p=0.99) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.77 (TECT1) to 0.93 (TECT3). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.60 (TECT11) to 0.83 (TECT3). It can be concluded that all observed variables should be included in the further analysis.

Figure 4.26

The Results of CFA of Technological Turbulence Model

Table 4.71

Standardized Factor Loading, t-Value, and

Composite Reliability of Technological Turbulence Model

Variables	Factor Loading			R^2
	λ	SE.	t	
TECT1	0.77	-	-	0.60
TECT2	0.80	0.11	9.40	0.64
TECT3	0.93	0.12	10.23	0.83
$\chi^2 = 0.00$	df = 2	p = 0.99	RMSEA = 0.000	

- **Government Agency Support**

Government agency support (GOV) construct is measured by five observed variables (GOV1-GOV5). Correlation matrix, means, and standard deviation are shown in Table 4.72. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.482 which is the correlation between GOV1 and GOV5 and the highest correlation is 0.841 which is the correlation between GOV2 and GOV3.

Bartlett's test of sphericity Chi-Square is 456.424 at a level of significance 0.05, KMO is 0.794, and all observed variables have MSA between 0.742 and 0.856. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.72

Correlation Matrix, Means, and Standard Deviation of Government Agency Support Construct

	GOV1	GOV2	GOV3	GOV4	GOV5
GOV1	1.000				
GOV2	.701	1.000			
GOV3	.763	.841	1.000		
GOV4	.491	.722	.723	1.000	
GOV5	.482	.563	.565	.748	1.000
$\overline{X}$	2.736	2.388	2.554	2.066	2.041
S.D.	1.632	1.416	1.538	1.352	1.306

The findings of CFA are shown in Figure 4.27 and Table 4.73. In Figure 4.27, a researcher fixes parameter (GOV5) to 1 as a reference indicator of model. It is because GOV5 is the lowest factor loading compared with other observed variables in a model. Covariance of GOV is 0.63. Table 4.73 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 1.40, p=0.71) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.61 (GOV5) to 0.94 (GOV3). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.37 (GOV5) to 0.88 (GOV3). It can be concluded that all observed variables except GOV5 are included in the further analysis because GOV5 has factor loading lower than 0.7.

Figure 4.27

The Results of CFA of Government Agency Support Model

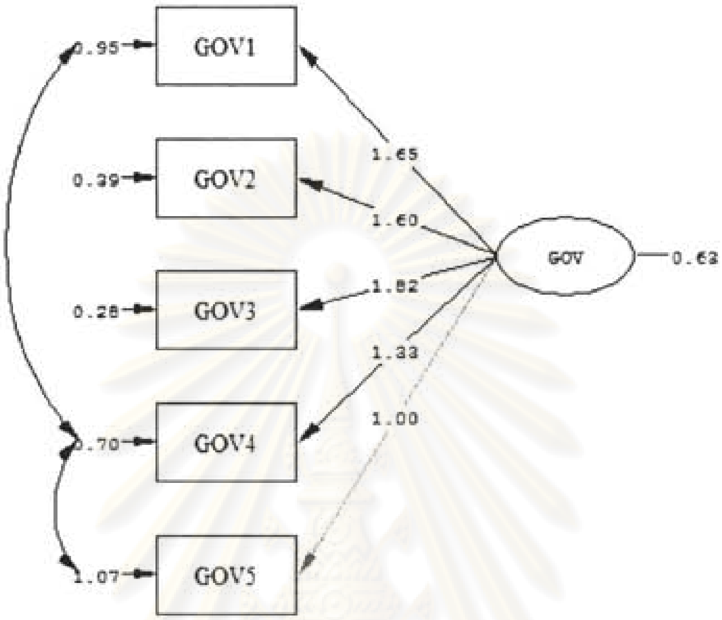


Table 4.73

Standardized Factor Loading, t-Value, and

Composite Reliability of Government Agency Support Model

Variables	Factor Loading			R^2
	λ	SE.	t	
GOV1	0.80	0.23	7.06	0.65
GOV2	0.90	0.21	7.60	0.81
GOV3	0.94	0.23	7.77	0.88
GOV4	0.78	0.14	9.69	0.62
GOV5	0.61	-	-	0.37
$\chi^2 = 1.40$	df = 3	p = 0.71	RMSEA = 0.000	

- **Incremental Product Innovation**

Incremental product innovation (INC) construct is measured by three observed variables (INC1-INC3). Correlation matrix, means, and standard deviation are shown in Table 4.74. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.653 which is the correlation between INC2 and INC3 and the highest correlation is 0.745 which is the correlation between INC1 and INC2. Bartlett's test of sphericity Chi-Square is 162.155 at a level of significance 0.05, KMO is 0.729, and all observed variables have MSA between 0.702 and 0.796. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform should be the next step of data analysis.

Table 4.74

Correlation Matrix, Means, and Standard Deviation of Incremental Product Innovation Construct

	INC1	INC2	INC3
INC1	1.000		
INC2	.745	1.000	
INC3	.657	.653	1.000
$\overline{X}$	3.955	3.955	4.571
S.D.	1.585	1.602	1.505

The findings of CFA are shown in Figure 4.28 and Table 4.75. In Figure 4.28, a researcher fixes parameter (INC3) to 1 as a reference indicator of model. It is because INC3 is the lowest factor loading compared with other observed variables in a model. Covariance of INC is 1.33. Table 4.75 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.00, p=0.99) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.76 (INC3) to 0.87 (INC1). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.58 (INC3) to 0.75 (INC1). It can be concluded that all observed variables should be included in the further analysis.

Figure 4.28

The Results of CFA of Incremental Product Innovation Model

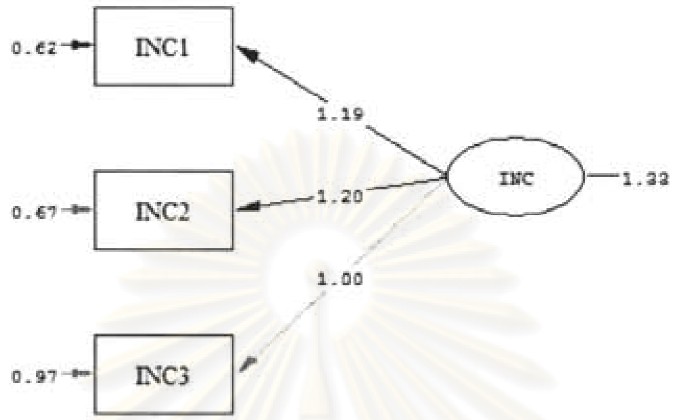


Table 4.75

Standardized Factor Loading, t-Value, and

Composite Reliability of Incremental Product Innovation Model

Variables	Factor Loading			R^2
	λ	SE.	t	
INC1	0.87	0.13	9.55	0.75
INC2	0.86	0.12	9.90	0.74
INC3	0.76	-	-	0.58
$\chi^2 = 0.00$	df = 2	p = 0.99	RMSEA = 0.000	

- **Market Performance**

Market performance (MP) construct is measured by four observed variables (MP1-MP4). Correlation matrix, means, and standard deviation are shown in Table 4.76. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.712 which is the correlation between MP1 and MP3 and the highest correlation is 0.846 which is the correlation between MP1 and MP2. Bartlett's test of sphericity Chi-Square is 395.159 at a level of significance 0.05, KMO is 0.801, and all observed variables have

MSA between 0.795 and 0.808. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.76

Correlation Matrix, Means, and Standard Deviation of Market Performance Construct

	MP1	MP2	MP3	MP4
MP1	1.000			
MP2	.846	1.000		
MP3	.712	.722	1.000	
MP4	.725	.739	.833	1.000
$\overline{X}$	4.050	4.134	3.496	3.580
S.D.	1.472	1.438	1.455	1.482

The findings of CFA are shown in Figure 4.29 and Table 4.77. In Figure 4.1, a researcher fixes parameter (MP3) to 1 as a reference indicator of model. It is because MP3 is the lowest factor loading compared with other observed variables in a model. Covariance of MP is 1.29. Table 4.77 reveals that chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.02, p=0.99) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.78 (MP3) to 0.93 (MP2). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.61 (MP3) to 0.86 (MP2). It can be concluded that all observed variables should be included in the further analysis.

Figure 4.29

The Results of CFA of Market Performance Model

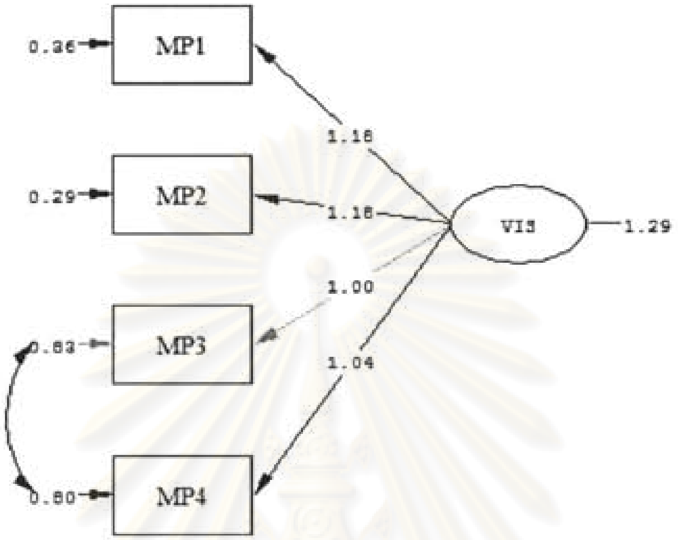


Table 4.77

Standardized Factor Loading, t-Value, and

Composite Reliability of Market Performance Model

Variables	Factor Loading			R^2
	λ	SE.	t	
MP1	0.91	11.26	0.11	0.83
MP2	0.93	11.41	0.10	0.86
MP3	0.78	-	-	0.61
MP4	0.80	14.39	0.07	0.63
$\chi^2 = 0.02$	df = 2	p = 0.99	RMSEA = 0.000	

- **Financial Performance**

Financial performance (FP) construct is measured by three observed variables (FP1-FP3). Correlation matrix, means, and standard deviation are shown in Table 4.78. The results show that correlations of all pairs of observed variables are different from zero at significance level 0.01. The lowest correlation is 0.775 which is the correlation between FP1 and FP2 and the highest correlation is 0.849 which is the correlation between FP2 and FP3. Bartlett's test of sphericity Chi-Square is 288.688 at a level of significance 0.05, KMO is 0.753, and all observed variables have MSA between 0.701 and 0.799. It can be concluded that correlation matrix is considered correlated thus a researcher could proceed to perform the next step of data analysis.

Table 4.78

Correlation Matrix, Means, and Standard Deviation of Financial Performance Construct

	FP1	FP2	FP3
FP1	1.000		
FP2	.775	1.000	
FP3	.829	.847	1.000
$\overline{X}$	3.706	3.765	3.731
S.D.	1.503	1.388	1.460

The findings of CFA are shown in Figure 4.30 and Table 4.79. In Figure 4.30, a researcher fixes parameter (FP2) to 1 as a reference indicator of model. It is because FP2 is the lowest factor loading compared with other observed variables in a model. Covariance of FP is 1.53. Table 4.79 reveals that Chi-square test is not significantly different from zero at a level 0.05 (χ^2 = 0.00, p=0.99) and RMSEA is 0.000. It can be implied that there is a goodness of fit between observed data and the estimated model. Standardized factor loading of each observed variable has ranged from 0.87 (FP1) to 0.95 (FP3). All standardized factor loadings have a significant impact at a level of significance 0.01. R^2 has ranged from 0.76 (FP1) to 0.91 (FP3). It can be concluded that all observed variables should be included in the further analysis.

Figure 4.30

The Results of CFA of Financial Performance Model

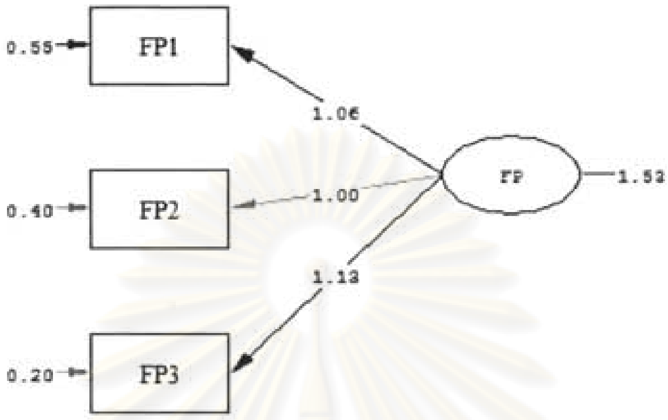


Table 4.79

Standardized Factor Loading, t-Value, and

Composite Reliability of Financial Performance Model

Variables	Factor Loading			R^2
	λ	SE.	t	
FP1	0.87	13.90	13.90	0.76
FP2	0.89	-	-	0.79
FP3	0.95	17.67	17.67	0.91
$\chi^2 = 0.00$	df = 2	p = 0.99	RMSEA = 0.000	

For the preliminary analysis, all fifty nine measurement items except CEN3, FOR3, PRE5, LAU1, DEM1, and GOV5 have standardized factor loading higher than 0.7. The loading that lower than 0.7 is considered to be deleted from the model. Therefore, these six variables are deleted from a measurement model.

4.3 Descriptive Statistics

In this section, a researcher reports descriptive statistics of all variables and constructs for radical and incremental product innovation based performance frameworks. The objective of reporting descriptive statistics is to describe the characteristics of raw data in quantitative terms. In addition, correlation matrices of two frameworks are investigated for testing a relationship among constructs.

4.3.1 Descriptive statistic

Descriptive statistics which are mean ($\overline{X}$), median, standard deviation (S.D.), skewness (Skew), standard error of skewness (S.E. skew), kurtosis and standard error of kurtosis (S.E.kur) of radical and incremental product innovation based performance frameworks are shown in Table 4.80 and 4.81.

Table 4.80

Descriptive Statistic of Radical Product Innovation Based Performance Framework

Construct	Radical innovation						
	$\overline{X}$	Median	S.D.	Skewness	S.E. Skew	Kurtosis	S.E. Kur
Vision (VIS)	5.28	5.5	1.061	-.792**	.171	.774*	.341
• VIS1	5.42	5.00	1.211	-.593**	.170	-.103	.339
• VIS2	5.29	5.00	1.188	-.801**	.170	.605	.339
• VIS3	5.13	5.00	1.213	-.582**	.170	.263	.339
• VIS4	5.29	5.00	1.260	-.933**	.171	.983**	.341
Top management support (TOP)	5.56	5.67	1.039	-.811**	.171	1.092**	.341
• TOP1	5.73	6.00	1.119	-.791**	.171	.624	.341
• TOP2	5.61	6.00	1.154	-.791**	.171	.845*	.341
• TOP3	5.34	6.00	1.212	-.800**	.171	.612	.341
Centralization (CEN)	5.13	5.00	1.058	-.319	.170	.075	.339
• CEN1	5.16	5.00	1.129	-.396*	.170	.053	.339
• CEN2	5.09	5.00	1.167	-.436**	.170	-.017	.339
• CEN3	5.14	5.00	1.158	-.406*	.170	-.090	.339
Formalization (FOR)	4.95	5.00	1.228	-.469**	.171	-.265	.340
• FOR1	5.04	5.00	1.364	-.498**	.171	-.279	.340
• FOR2	5.05	5.00	1.354	-.522**	.171	-.205	.340
• FOR3	4.76	5.00	1.370	-.267	.171	-.450	.340

Table 4.80

Descriptive Statistic of Radical Product Innovation

Based Performance Framework (Cont.)

Construct	Radical innovation						
	$\overline{X}$	Median	S.D.	Skewness	S.E. Skew	Kurtosis	S.E. Kur
Predevelopment task (PRE)	5.18	5.20	.972	-.477**	.171	.115	.341
• PRE1	5.00	5.00	1.294	-.582**	.171	.106	.340
• PRE2	5.27	5.00	1.164	-.571**	.171	.030	.340
• PRE3	4.98	5.00	1.318	-.465**	.171	-.522	.340
• PRE4	5.29	5.00	1.155	-.479**	.171	-.163	.340
• PRE5	5.36	5.00	1.210	-.663**	.171	.181	.341
Cross-functional integration (CRO)	5.20	5.33	1.119	-.562**	.171	.289	.340
• CRO1	5.35	5.00	1.170	-.572**	.171	.195	.340
• CRO2	5.22	5.00	1.252	-.663**	.171	.158	.340
• CRO3	5.02	5.00	1.310	-.566**	.171	.024	.340
Technological proficiency (TEC)	5.36	5.60	1.008	-.751**	.171	.243	.340
• TEC1	5.09	5.00	1.279	-.555**	.171	.117	.340
• TEC2	5.49	6.00	1.287	-.799**	.171	.373	.340
• TEC3	4.95	5.00	1.354	-.420*	.171	-.468	.340
• TEC4	5.43	6.00	1.289	-.642**	.171	-.216	.340
• TEC5	5.86	6.00	1.058	-.861**	.171	.599	.340
Development speed (SPD)	5.08	5.33	1.212	-.592**	.172	.008	.342
• SPD1	5.19	5.00	1.248	-.626**	.171	-.169	.341
• SPD2	5.07	5.00	1.259	-.406*	.171	-.205	.341
• SPD3	4.96	5.00	1.486	-.568**	.172	-.325	.341
Launch proficiency (LAU)	5.03	5.00	1.057	-.438**	.172	-.249	.343
• LAU1	4.76	5.00	1.277	-.491**	.172	.074	.342
• LAU2	5.20	5.00	1.222	-.379*	.172	-.413	.342
• LAU3	5.13	5.00	1.219	-.393*	.172	-.362	.342
• LAU4	5.15	5.00	1.181	-.424*	.172	-.225	.342
• LAU5	5.04	5.00	1.242	-.544**	.172	.035	.342
• LAU6	4.90	5.00	1.250	-.445**	.172	-.098	.343
Demand uncertainty (DEM)	5.01	5.00	.968	-.409*	.172	.979**	.342
• DEM1	5.19	5.00	1.288	-.564**	.172	.297	.342
• DEM2	4.94	5.00	1.321	-.523**	.172	.212	.342
• DEM3	4.91	5.00	1.379	-.603**	.172	.165	.342
Technological turbulence (TECT)	4.96	5.00	1.179	-.203	.172	-.619	.343
• TECT1	4.75	5.00	1.438	-.385*	.172	-.469	.343
• TECT2	5.27	5.00	1.253	-.392*	.172	-.426	.343
• TECT3	4.86	5.00	1.388	-.235	.172	-.671	.343
Government support (GOV)	2.81	2.60	1.413	.607**	.172	-.259	.343
• GOV1	3.17	5.00	1.624	.349*	.172	-.732*	.343
• GOV2	2.95	5.00	1.519	.401*	.172	-.735*	.343
• GOV3	2.99	5.00	1.586	.408*	.172	-.601	.343
• GOV4	2.50	2.00	1.642	.980**	.172	.140	.343
• GOV5	2.43	2.00	1.649	1.047**	.172	.229	.343
Radical innovation (RAD)	5.36	5.33	1.062	-.222	.172	-.821*	.343
• RAD1	5.32	5.00	1.157	-.129	.172	-.870*	.343
• RAD2	5.35	6.00	1.297	-.486**	.172	-.562	.343
• RAD3	5.43	6.00	1.288	-.825**	.172	.402	.343

Table 4.80

Descriptive Statistic of Radical Product Innovation

Based Performance Framework (Cont.)

Construct	Radical innovation						
	$\overline{X}$	Median	S.D.	Skewness	S.E. Skew	Kurtosis	S.E. Kur
Financial performance (FP)	4.96	4.67	1.240	-.339*	.172	-.036	.341
• FP1	4.63	5.00	1.301	-.348*	.172	-.080	.341
• FP2	4.63	5.00	1.328	-.268	.172	-.279	.341
• FP3	4.56	5.00	1.381	-.281	.172	-.288	.341
Market performance (MP)	4.61	5.00	1.036	-.522**	.172	.112	.343
• MP1	5.25	5.00	1.192	-.556**	.172	.335	.341
• MP2	5.37	5.00	1.056	-.768**	.172	.949**	.341
• MP3	4.52	5.00	1.386	-.337	.172	-.366	.341
• MP4	4.66	5.00	1.320	-.521**	.172	.160	.343

** significant level at 0.01.

* significant level at 0.05.

Means of all variables in Table 4.80 range from 2.43 (GOV5) to 5.73 (TOP1) and means of all constructs range from 2.81 (GOV) to 5.56 (TOP). Medians of almost all variables are approximately equaled with their means. However, means and medians of three variables, GOV1, GOV2, and GOV3, are quite different. Medians of these variables are higher than their means. It indicates that these variables are left skew.

To meet the basic assumption of SEMs, a variable should have normal distribution for reliable results of data analysis. Skewness is a measure of the asymmetry of the probability distribution around a mean of a variable. A variable will have normal distribution if it has value of skewness within two times of the standard error. If a variable has value of skewness greater than two times of the standard error, it will have non-normal distribution with a significant degree. The findings in Table 4.84 show that only six variables (FOR3, TECT3, RAD1, FP2, FP3, and MP3) of fifty nine variables have normal distribution. Fifty three variables have skewed around their means which forty five variables have negative or left skewness and eight variables have positive or right skewness. For fifteen constructs, only three constructs (CEN, TECT, and RAD) have normally distributed, one construct (GOV) has positively skewed distribution, and the rest have negatively skewed distribution.

Kurtosis is a measure of relative peakedness or flatness compared with a normal distribution. A variable will have normal distribution if it has value of kurtosis within two times of the standard error. If a variable has value of kurtosis greater than two times of the standard error, it will have non-normal distribution with a significant degree. The results in Table 4.80 show that fifty three variables have normal distribution. Three variables (VIS4, TOP2, and MP2) have positive kurtosis with a significant degree which their distributions are too tall (leptokurtic) compared with normal distribution. On the other hand, three variables (GOV1, GOV2, and RAD1) have negative kurtosis with a significant degree which their distributions are too flat (platykurtic) compared with normal distribution. For fifteen constructs, eleven constructs (CEN, FOR, PRE, CRO, TEC, SPD, LAU, TECT, GOV, MP, and FP) have normally distributed test scores but four constructs have a problem of a significant kurtosis. Three constructs (VIS, TOP, and DEM) have a problem of leptokurtic and one construct (RAD) has a problem of platykurtic.

From the analysis, the data of radical product innovation based performance framework may encounter a problem of non-normal distribution of variables and constructs. Due to large enough of sample size (N>200) in data analysis, the results of radical product innovation based performance, however, are robustness and are not impacted from non-normal distribution. An estimating parameter of in SEM via Maximum likelihood estimation (ML) is convergence and has proper solutions when sample size is large enough (Boomsma and Hoogland, 2001). Therefore, the findings of radical product innovation based performance framework are reliable and valid.

Table 4.81

Descriptive Statistic of Incremental Product Innovation

Based Performance Framework

Construct	Incremental innovation						
	$\overline{X}$	Median	S.D.	Skewness	S.E. Skew	Kurtosis	S.E. Kur
Vision (VIS)	4.16	4.00	1.457	.060	.220	-.832	.437
• VIS1	4.09	4.00	1.683	-.081	.220	-.871*	.437
• VIS2	4.34	4.00	1.584	-.014	.219	-.822	.435
• VIS3	4.07	4.00	1.662	.004	.220	-.832	.437
• VIS4	4.17	4.00	1.588	.016	.220	-.830	.437
Top management support (TOP)	4.55	4.67	1.453	-.412	.220	-.477	.437
• TOP1	4.83	5.00	1.520	-.453**	.220	-.472	.437
• TOP2	4.59	5.00	1.636	-.389	.220	-.730	.437
• TOP3	4.22	4.00	1.635	-.088	.220	-.775	.437
Centralization (CEN)	4.31	4.33	1.169	-.174	.220	-.390	.437
• CEN1	4.45	5.00	1.304	-.254	.220	-.397	.437
• CEN2	4.29	4.00	1.326	-.047	.220	-.497	.437
• CEN3	4.19	4.00	1.344	-.249	.220	-.431	.437
Formalization (FOR)	4.46	4.33	1.311	-.122	.221	-.138	.438
• FOR1	4.59	5.00	1.381	-.243	.221	-.360	.438
• FOR2	4.58	5.00	1.383	-.185	.220	-.573	.437
• FOR3	4.17	4.00	1.647	-.203	.220	-.564	.437
Predevelopment task (PRE)	4.40	4.40	1.311	-.013	.222	-.567	.440
• PRE1	4.26	4.00	1.542	-.066	.221	-.560	.438
• PRE2	4.43	4.00	1.504	-.109	.221	-.618	.438
• PRE3	4.15	4.00	1.532	-.057	.221	-.467	.438
• PRE4	4.53	5.00	1.414	-.142	.221	-.523	.438
• PRE5	4.61	5.00	1.513	-.288	.222	-.840	.440
Cross-functional integration (CRO)	4.43	4.33	1.330	-.172	.220	-.211	.437
• CRO1	4.61	5.00	1.350	-.396	.220	.060	.437
• CRO2	4.49	5.00	1.427	-.263	.220	-.264	.437
• CRO3	4.18	4.00	1.517	-.008	.220	-.613	.437
Technological proficiency (TEC)	4.57	4.80	1.278	-.385	.222	-.171	.440
• TEC1	4.48	5.00	1.378	-.359	.221	.291	.438
• TEC2	4.77	5.00	1.628	-.572**	.222	-.524	.440
• TEC3	4.17	4.00	1.496	-.075	.220	-.547	.437
• TEC4	4.42	5.00	1.736	-.430	.220	-.601	.437
• TEC5	5.02	5.00	1.313	-.518*	.220	-.342	.437
Development speed (SPD)	4.07	4.00	1.419	-.080	.224	-.672	.444
• SPD1	4.28	5.00	1.546	-.209	.221	-.745	.438
• SPD2	3.92	4.00	1.531	.000	.223	-.778	.442
• SPD3	4.02	4.00	1.621	-.125	.222	-.781	.440
Launch proficiency (LAU)	4.17	4.17	1.266	-.160	.222	-.473	.440
• LAU1	4.03	4.00	1.447	.024	.222	-.428	.440
• LAU2	4.37	4.50	1.455	-.330	.221	-.431	.438
• LAU3	4.16	4.00	1.507	-.231	.222	-.691	.440
• LAU4	4.26	4.00	1.429	-.238	.221	-.514	.438
• LAU5	4.13	4.00	1.542	-.115	.221	-.743	.438
• LAU6	4.13	4.00	1.472	.071	.221	-.475	.438

Table 4.81

Descriptive Statistic of Incremental Product Innovation

Based Performance Framework (Cont.)

Construct	Incremental innovation						
	$\overline{X}$	Median	S.D.	Skewness	S.E. Skew	Kurtosis	S.E. Kur
Demand uncertainty (DEM)	4.34	4.33	1.337	-.059	.221	-.620	.438
• DEM1	4.67	5.00	1.621	-.263	.221	-.725	.438
• DEM2	4.03	4.00	1.511	-.028	.221	-.666	.438
• DEM3	4.33	4.00	1.642	-.215	.221	-.751	.438
Technological turbulence (TECT)	4.30	4.33	1.351	-.004	.219	-.504	.435
• TECT1	4.26	4.00	1.498	-.115	.219	-.533	.435
• TECT2	4.53	5.00	1.500	-.101	.219	-.662	.435
• TECT3	4.11	4.00	1.558	.127	.219	-.635	.435
Government support (GOV)	2.36	2.00	1.238	.936**	.220	.748	.437
• GOV1	2.72	2.00	1.633	.842**	.219	.013	.435
• GOV2	2.38	2.00	1.416	.938**	.219	.562	.435
• GOV3	2.54	2.00	1.538	.864**	.219	.100	.435
• GOV4	2.06	1.50	1.350	1.287**	.219	1.215**	.435
• GOV5	2.04	2.00	1.306	1.336**	.220	1.546**	.437
Incremental innovation (INC)	4.16	4.33	1.391	-.317	.228	-.524	.453
• INC1	3.96	4.00	1.581	-.037	.227	-.801	.451
• INC2	3.96	4.00	1.602	-.073	.228	-.829	.453
• INC3	4.59	5.00	1.516	-.376	.227	-.343	.451
Financial performance (FP)	3.73	3.67	1.359	.347	.222	-.400	.440
• FP1	3.71	4.00	1.503	.333	.222	-.348	.440
• FP2	3.76	4.00	1.388	.181	.222	-.469	.440
• FP3	3.73	4.00	1.460	.297	.222	-.505	.440
Market performance (MP)	3.82	3.75	1.325	.289	.222	-.314	.440
• MP1	4.05	4.00	1.472	.122	.222	-.497	.440
• MP2	4.13	4.00	1.438	.004	.222	-.316	.440
• MP3	3.50	3.00	1.455	.445*	.222	-.434	.440
• MP4	3.58	3.00	1.482	.390	.222	-.506	.440

** significant level at 0.01.

* significant level at 0.05.

Means of all variables in Table 4.81 range from 2.04 (GOV5) to 5.02 (TEC5) and means of all constructs range from 2.36 (GOV) to 4.57 (TEC). Medians of almost all variables are approximately equal with their means. It indicates that these variables have normal distributions.

The results in Table 4.81 show that fifty variables have normal distributions. Nine variables have skewed around their means which three variables (TOP1, TEC2, and TEC5) have negative or left skewness and six variables (GOV1, GOV2, GOV3, GOV4, GOV5, and MP3) have positive or right skewness. For sixteen constructs, most constructs have normalities except GOV which has positively skewed distribution.

Fifty six variables have normal distributions. Two variables (GOV4 and GOV5) have positive kurtosis with a significant degree which their distributions are too tall (leptokurtic) compared with normal distribution. Only one variable (VIS1) has negative kurtosis with a significant degree which its distribution is too flat (platykurtic) compared with normal distribution. For sixteen constructs, all constructs have normally distributed test scores.

Hence, the results of data analysis for incremental product innovation based performance framework show reliability because they meet the basic assumption.

4.3.2 Correlation Analysis

Correlation matrices of radical and incremental product innovation based performance frameworks are shown in Tables 4.82 and 4.83. A correlation matrix displays the correlations among fifteen constructs which indicate the relative strength and direction of a linear relationship among constructs in a correlation matrix. Tables 4.82 and 4.83 also show mean ($\overline{X}$) and standard deviation (S.D.) of fifteen constructs in this study.

In Table 4.82, means of twelve exogenous constructs range from 2.808 (GOV) to 5.563 (TOP). Means of three endogenous constructs range from 4.607 (FP) to 5.363 (RAD).

A correlation matrix of constructs of radical product innovation base performance framework is shown in Table 4.82. The findings show that Bartlett's test of sphericity Chi-Square is 9,011.571 at a level of significance 0.05. KMO is 0.909. All observed variables have MSA between 0.653 (GOV5) and 0.954 (LAU4). It can be interpreted that correlations among fifty nine observed variables have some correlations among themselves. Therefore, the analysis for SEM can be proceeded.

Correlations between exogenous constructs except GOV and radical product innovation have positive relationships at a level of significance 0.05. Correlations between a radical product innovation construct and eleven exogenous constructs range from 0.347 (TECT) to 0.585 (TEC). These eleven exogenous constructs have moderate relationship with radical product innovation construct. It can be interpreted that exogenous constructs except government agency support has positive relationship with radical product innovation. For constructs in an organization section, vision has the highest correlation (0.535) with radical product innovation. For constructs in an operational efficiency, technological proficiency has the highest correlation (0.585) with radical product innovation. For constructs in an external environment, demand uncertainty has the highest correlation (0.436) with radical product innovation. Technological proficiency has the highest strength with radical product innovation. Further, radical product innovation construct has statistically positive relationship with financial and market performances constructs at a level of significance 0.05. A radical product innovation construct has higher relationship with market performance (0.506) than with financial performance (0.296).

Correlation matrix, means, and standard deviations of incremental product innovation based performance framework are shown in Table 4.83. Means of twelve exogenous constructs range from 2.357 (GOV) to 4.573 (TEC). Means of three endogenous constructs range from 3.734 (FP) to 4.161 (INC).

A researcher tests an adequacy of correlation among observed variables for the data analysis. The results show that Bartlett's test of sphericity Chi-Square is 6,019.436 at a level of significance 0.05. KMO is 0.883. All observed variables have MSA between 0.587 (GOV5) and 0.951 (TEC4). It can be interpreted that correlations among fifty nine observed variables have some correlations among themselves. Therefore, the analysis for SEM can be proceeded.

Correlations between twelve exogenous constructs and incremental product innovation have positive relationships at a level of significance 0.05. However, correlation between GOV and incremental product innovation has insignificant relationship. Correlations between incremental product innovation construct and eleven exogenous constructs range from 0.261 (TECT) to 0.469 (DEM). For each ten constructs except TECT has moderate relationship with incremental product innovation and GOV has low relationship with incremental product innovation. It can be interpreted that exogenous constructs except government agency support have a positive relationship with incremental product innovation.

For constructs in an organization section, top management support has the highest correlation (0.371) with incremental product innovation. For constructs in an operational efficiency, predevelopment task has the highest correlation (0.410) with incremental product innovation. For constructs in an external environment, demand uncertainty has the highest correlation (0.469) with incremental product innovation. Demand uncertainty has the highest strength with incremental product innovation. Additionally, incremental product innovation has a significant positive relationship with financial (0.263) and market performances (0.346) of firms at a level of significance 0.05. The relationship between incremental product innovation and market performance is higher than between incremental product innovation and financial performance.

Table 4.82

Correlation Matrix of Constructs of Radical Product Innovation Based Performance Framework

	RAD	FP	MP	VIS	TOP	CEN	FOR	PRE	CRO	TEC	SPD	LAU	DEM	TEC	GOV
RAD	1														
FP	.296*	1													
MP	.506*	.759*	1												
VIS	.535*	.392*	.510*	1											
TOP	.427*	.246*	.305*	.622*	1										
CEN	.359*	.243*	.282*	.516*	.627*	1									
FOR	.458*	.276*	.281*	.496*	.469*	.557*	1								
PRE	.473*	.278*	.362*	.610*	.545*	.580*	.678*	1							
CRO	.463*	.301*	.357*	.546*	.652*	.650*	.628*	.675*	1						
TEC	.585*	.316*	.389*	.597*	.496*	.447*	.605*	.804*	.624*	1					
SPD	.511*	.383*	.472*	.674*	.545*	.496*	.499*	.568*	.530*	.614*	1				
LAU	.568*	.479*	.553*	.702*	.541*	.421*	.631*	.686*	.598*	.692*	.646*	1			
DEM	.436*	.372*	.396*	.370*	.393*	.328*	.339*	.387*	.380*	.343*	.395*	.419*	1		
TECT	.347*	.255*	.263*	.262*	.187*	.155*	.316*	.333*	.194*	.267*	.393*	.375*	.432*	1	
GOV	.047	-.046	.018	.080	.050	.060	.090	.080	.085	.076	.081	.068	.129	.215*	1
$\overline{X}$	5.363	4.607	4.959	5.280	5.563	5.127	4.951	5.179	5.199	5.365	5.075	5.025	5.012	4.960	2.808
S.D.	1.062	1.240	1.036	1.061	1.039	1.058	1.228	0.972	1.119	1.008	1.212	1.057	0.968	1.179	1.413

Note: * significant level at 0.05.

153

Table 4.83

Correlation Matrix of Constructs of Incremental Product Innovation Based Performance Framework

	INC	FP	MP	VIS	TOP	CEN	FOR	PRE	CRO	TEC	SPD	LAU	DEM	TEC	GOV
INC	1														
FP	.263*	1													
MP	.346*	.864*	1												
VIS	.319*	.628*	.680*	1											
TOP	.371*	.476*	.516*	.748*	1										
CEN	.339*	.521*	.526*	.637*	.581*	1									
FOR	.344*	.465*	.452*	.527*	.471*	.604*	1								
PRE	.410*	.564*	.588*	.721*	.668*	.527*	.617*	1							
CRO	.337*	.513*	.530*	.614*	.650*	.610*	.645*	.691*	1						
TEC	.374*	.556*	.595*	.707*	.767*	.644*	.615*	.766*	.797*	1					
SPD	.347*	.576*	.637*	.674*	.665*	.559*	.396*	.603*	.488*	.606*	1				
LAU	.369*	.633*	.683*	.731*	.665*	.486*	.545*	.773*	.614*	.766*	.654*	1			
DEM	.469*	.438*	.491*	.519*	.530*	.406*	.297*	.553*	.373*	.573*	.568*	.630*	1		
TECT	.261*	.427*	.468*	.453*	.469*	.490*	.381*	.494*	.490*	.588*	.433*	.479*	.562*	1	
GOV	.107	.218*	.242*	.260*	.265*	.257*	.265*	.301*	.289*	.330*	.256*	.397*	.292*	.324*	1
$\overline{X}$	4.161	3.734	3.815	4.161	4.545	4.311	4.464	4.397	4.427	4.573	4.066	4.171	4.344	4.301	2.357
S.D.	1.391	1.359	1.325	1.457	1.453	1.169	1.311	1.311	1.330	1.278	1.419	1.266	1.337	1.351	1.238

Note: * significant level at 0.05.

154

4.4 Measurement Model Assessment

A researcher tests the reliability and validity of a measurement model of radical and incremental product innovation based performance frameworks. The aim of measurement model assessment is to evaluate the reliability and the validity of observed variables and constructs to increase the quality of input of a structural model.

4.4.1 ***Reliability Test***

Reliability measures the internal consistency of a set of variables of a latent construct. High reliability of a construct demonstrates high opportunity of all variables in a construct to measure the same thing (Hair et al., 2006). Reliability is necessary but is not sufficient condition to verify the validity of construct. Reliability has value between 0 and 1. Reliability of all constructs in this study is tested by using Cronbach's alpha (α) (Cronbach, 1951). The rule of thumb is that Cronbach's alpha should be greater than 0.7 (Nunnally and Bernstein, 1994: 264-265) for sufficient internal consistency.

The results of testing reliability of constructs both radical and incremental product innovation based performance frameworks are shown in Table 4.84. For radical product innovation based performance framework, all constructs except demand uncertainty have reliability indices range from 0.808 to 0.928. For incremental product innovation, all constructs have reliability range from 0.791 to 0.930. The results show high reliabilities of both constructs.

In conclusion, the results of reliability testing show that all sixteen constructs except demand uncertainty in radical product innovation based performance framework have high reliabilities. For demand uncertainty in radical product innovation based performance framework, a researcher will investigate further about the appropriateness of this construct included in radical product innovation based performance framework with confirmatory factor analysis technique in the next section.

Table 4.84

Cronbach's Alpha of All Sixteen Constructs

Construct	Number of variables	Radical innovation	Incremental innovation
Exogenous			
• Vision	4	0.893	0.917
• Top management support	3	0.874	0.895
• Centralization	3	0.907	0.858
• Formalization	3	0.884	0.877
• Predevelopment task	5	0.850	0.920
• Cross-functional integration	3	0.881	0.920
• Technological proficiency	5	0.861	0.897
• Development speed	3	0.890	0.894
• Launch proficiency	6	0.928	0.928
• Demand uncertainty	3	0.557	0.791
• Technological turbulence	3	0.833	0.868
• Government agency support	5	0.928	0.905
Endogenous			
• Radical product innovation	3	0.808	
• Incremental product innovation	3		0.867
• Financial performance	3	0.919	0.930
• Market performance	4	0.855	0.928

4.4.2 ***<u>Validity Test</u>***

To test the validity of a measurement model, confirmatory factor analysis is used. For CFA, the purpose of applying CFA is to test how well the indicators are grouped into some specific constructs that a researcher specifies or hypothesizes (Jöreskog and Sorbom, 1996; McDonald and Ho, 2002). Another objective of CFA is to assess a measurement model. This assessment is to test the reliability and the validity of constructs.

- *Radical Product Innovation Based Performance Framework*

For testing the reliability of each variable, composite reliability (R^2) is used to test the reliability of each variable. This measure demonstrates how well variables serve as measurement items for constructs, whereas R^2 has value between 0 and 1. A large value reveals a good measurement item for constructs. In Table 4.85, all variables except TEC1, TEC3, DEM1, DEM2, DEM3, TECT1, GOV5, RAD2, RAD3, and MP2 have R^2 lower than 0.5. Thus, they demonstrate bad measurement items. However, Hair et al. (2006) suggest that a researcher should consider factor loading between variables and constructs more than composite reliability for deleting variables.

Factor loadings (λ) of a measurement model of a radical product innovation based performance framework are shown in Table 4.85. Loading that lower than 0.7 is considered to be deleted from the model. The findings show that PRE1, DEM1, DEM3, TECT1, GOV5, RAD3, and MP2 have factor loading lower than 0.7. Therefore, PRE1, DEM1, DEM3, TECT1, GOV5, RAD3, and MP2 will be deleted from the model.

Table 4.85

Factor Loading, Standard Error, t-value, and Composite Reliability of Measurement Model of Radical Product Innovation Based Performance Framework

Variables	Factor loading			R^2
	λ	SE.	t	
VIS				
• VIS1	0.84	0.07	14.34	0.70
• VIS2	0.83	0.07	14.09	0.68
• VIS3	0.78	0.07	12.94	0.61
• VIS4	0.84	0.07	14.56	0.71
TOP				
• TOP1	0.88	0.06	15.49	0.78
• TOP2	0.90	0.07	16.06	0.81
• TOP3	0.75	0.08	12.18	0.56
CEN				
• CEN1	0.93	0.06	17.03	0.86
• CEN2	0.93	0.06	17.30	0.87
• CEN3	0.78	0.07	13.09	0.61
FOR				
• FOR1	0.91	0.08	16.41	0.82
• FOR2	0.95	0.07	17.82	0.91
• FOR3	0.70	0.09	11.31	0.50
PRE				
• PRE1	0.66	0.08	10.37	0.44
• PRE2	0.72	0.07	11.58	0.52
• PRE3	0.72	0.08	11.56	0.51
• PRE4	0.76	0.07	12.57	0.58
• PRE5	0.75	0.07	12.31	0.56
CRO				
• CRO1	0.85	0.07	14.59	0.72
• CRO2	0.86	0.07	15.03	0.75
• CRO3	0.82	0.08	13.94	0.68
TEC				
• TEC1	0.71	0.08	11.27	0.50
• TEC2	0.81	0.08	13.72	0.66
• TEC3	0.71	0.08	11.44	0.51
• TEC4	0.77	0.08	12.84	0.60
• TEC5	0.72	0.07	11.63	0.52

Table 4.85

Factor Loading, Standard Error, t-value, and Composite Reliability of Measurement Model of Radical Product Innovation Based Performance Framework (Cont.)

Variables	Factor loading			R^2
	λ	SE.	t	
SPD				
• SPD1	0.86	0.07	14.79	0.73
• SPD2	0.88	0.07	15.49	0.78
• SPD3	0.84	0.09	14.46	0.71
LAU				
• LAU1	0.73	0.08	11.98	0.54
• LAU2	0.86	0.07	15.15	0.74
• LAU3	0.90	0.07	16.51	0.82
• LAU4	0.86	0.07	15.09	0.73
• LAU5	0.82	0.07	14.05	0.67
• LAU6	0.79	0.07	13.37	0.63
DEM				
• DEM1	0.44	0.10	5.73	0.20
• DEM2	0.69	0.10	9.10	0.48
• DEM3	0.54	0.11	7.13	0.29
TECT				
• TECT1	0.68	0.09	10.33	0.46
• TECT2	0.87	0.08	14.48	0.76
• TECT3	0.84	0.08	13.90	0.71
GOV				
• GOV1	0.91	0.09	16.67	0.82
• GOV2	0.96	0.08	18.33	0.92
• GOV3	0.93	0.09	17.26	0.86
• GOV4	0.77	0.10	12.82	0.59
• GOV5	0.65	0.10	10.34	0.43
RAD				
• RAD1	0.90	0.07	15.53	0.81
• RAD2	0.78	0.08	12.62	0.61
• RAD3	0.66	0.08	10.08	0.44
FP				
• FP1	0.88	0.07	15.82	0.78
• FP2	0.85	0.08	14.74	0.71
• FP3	0.95	0.07	17.74	0.89

Table 4.85

Factor Loading, Standard Error, t-value, and Composite Reliability of Measurement Model of Radical Product Innovation Based Performance Framework (Cont.)

Variables	Factor loading			R^2
	λ	SE.	t	
MP				
• MP1	0.75	0.07	12.15	0.56
• MP2	0.69	0.07	10.85	0.48
• MP3	0.83	0.08	14.09	0.69
• MP4	0.81	0.08	13.50	0.65

For construct validity, fit indices are criterion to determine how well the fit of association among indicators and latent variables of a researcher's estimated model and observed data (Weston and Gore Jr., 2006). Several indices to evaluate the fit of the model are suggested, for example, Chi-square test (χ^2), root mean square error of approximation (RMSEA), comparative fit index (CFI), normed fit index (NFI), incremental fit index (IFI), and relative fit index (RFI).

Carmines and Mclver (1981) suggest that Chi-square to degree of freedom ratio (χ^2/d.f.) lower than 3 to 1 reveals a good fit between the estimated model and observed data. Bentler and Bonnet (1980) suggest a cutoff value for NFI should be higher than 0.9 for a good fit between observed and estimated data. This criterion is also applied to other fit indices such as CFI, IFI, and RFI (Marsh, Balla, and Hau, 1996: 318). Furthermore, Browne and Cudeck (1993) recommend a cutoff value of RMSEA is lower than 0.1 for an acceptance fit of estimated model with observed data.

Table 4.86

Fit Indices for Testing Measurement Model of

Radical Product Innovation Based Performance Framework

Parameter	Value
χ^2	2553.96
d.f.	1379
p-Value	0.000
RMSEA	0.065
NFI	0.934
CFI	0.965
IFI	0.965
RFI	0.926

In Table 4.86, a measurement model of a radical product innovation based performance framework has Chi-square to degree of freedom ratio equal 1.85:1 (2553.96/1379) which is lower than 3:1. So, this ratio demonstrates a very good fit between the estimated model and observed data. But, p-value is lower than 0.05 which it demonstrates a bad fit model. It is because Chi-square value is sensitive to sample size. A large sample size increases Chi-square value and decrease p-value. From this reason, Fornell and Larcker (1981) suggest that a researcher should consider other fit indices (such as RMSEA, NFI, CFI, IFI, and RFI) rather than p-value to evaluate a goodness of fit between the observed and estimated model when sample size is large. RMSEA of a measurement model is 0.065 which is lower than 0.1. It shows a good fit between the estimated model and observed data. In addition, NFI (0.934), CFI (0.965), IFI (0.965), and RFI (0.926) are above a cut off value (0.9). Thus, these fit indices demonstrate a good fit between the estimated model and observed data.

Based from the analysis, a researcher concludes that a measurement model of a radical product innovation based performance framework has a reasonable fit with the data.

- *Incremental Product Innovation Based Performance Framework*

Reliability of each variable in the incremental product innovation based performance framework is examined. In Table 4.87, all variables except CEN3 (0.47), FOR3 (0.49), LAU1 (0.49), DEM1 (0.41), and GOV5 (0.42) have composite reliability (R^2) lower than 0.5 which demonstrate bad items. However, a researcher focuses on factor loading more than composite reliability for deleting variables from a model.

Factor loadings (λ) of a measurement model of an incremental product innovation based performance framework are shown in Table 4.87. Factor loading that lower than 0.7 is considered to be deleted from a model. The results show that CEN3, DEM1, and GOV5 have factor loading lower than 0.7. Therefore, CEN3, DEM1, and GOV5 are deleted from the model.

Table 4.87

Factor Loading, Standard Error, t-value, and Composite Reliability of Measurement Model of Incremental Product Innovation Based Performance Framework

Variables	Factor loading			R^2
	λ	SE.	t	
VIS				
• VIS1	0.83	0.13	11.06	0.69
• VIS2	0.81	0.12	10.67	0.66
• VIS3	0.88	0.12	12.07	0.77
• VIS4	0.92	0.11	13.20	0.85
TOP				
• TOP1	0.91	0.11	12.82	0.83
• TOP2	0.92	0.12	12.95	0.84
• TOP3	0.77	0.13	9.83	0.59
CEN				
• CEN1	0.90	0.10	12.38	0.81
• CEN2	0.91	0.10	12.50	0.82
• CEN3	0.68	0.11	8.29	0.47

Table 4.87

Factor Loading, Standard Error, t-value, and Composite Reliability of Measurement Model of Incremental Product Innovation Based Performance Framework (Cont.)

Variables	Factor loading			R^2
	λ	SE.	t	
FOR				
• FOR1	0.92	0.10	13.07	0.85
• FOR2	0.95	0.10	13.77	0.91
• FOR3	0.70	0.13	8.71	0.49
PRE				
• PRE1	0.86	0.11	11.71	0.74
• PRE2	0.88	0.11	12.12	0.77
• PRE3	0.83	0.12	11.04	0.68
• PRE4	0.84	0.11	11.31	0.71
• PRE5	0.78	0.12	10.17	0.61
CRO				
• CRO1	0.85	0.10	11.46	0.72
• CRO2	0.92	0.10	13.11	0.85
• CRO3	0.90	0.11	12.72	0.82
TEC				
• TEC1	0.80	0.11	10.46	0.64
• TEC2	0.88	0.12	12.07	0.77
• TEC3	0.71	0.12	8.77	0.50
• TEC4	0.83	0.13	11.09	0.69
• TEC5	0.78	0.10	10.08	0.61
SPD				
• SPD1	0.90	0.11	12.45	0.81
• SPD2	0.88	0.11	11.94	0.77
• SPD3	0.80	0.13	10.40	0.64
LAU				
• LAU1	0.70	0.12	8.74	0.49
• LAU2	0.86	0.11	11.74	0.74
• LAU3	0.92	0.11	13.25	0.85
• LAU4	0.78	0.11	10.17	0.61
• LAU5	0.87	0.11	11.90	0.75
• LAU6	0.85	0.11	11.49	0.72
DEM				
• DEM1	0.64	0.14	7.48	0.41
• DEM2	0.89	0.11	11.74	0.78
• DEM3	0.72	0.13	8.84	0.52

Table 4.87

Factor Loading, Standard Error, t-value, and Composite Reliability of Measurement Model of Incremental Product Innovation Based Performance Framework (Cont.)

Variables	Factor loading			R^2
	λ	SE.	t	
TECT				
• TECT1	0.76	0.12	9.50	0.58
• TECT2	0.82	0.12	10.68	0.68
• TECT3	0.90	0.12	12.23	0.81
GOV				
• GOV1	0.78	0.13	10.12	0.61
• GOV2	0.91	0.10	12.70	0.82
• GOV3	0.93	0.11	13.35	0.87
• GOV4	0.78	0.10	10.14	0.62
• GOV5	0.65	0.11	7.83	0.42
INC				
• INC1	0.82	0.13	10.33	0.67
• INC2	0.83	0.13	10.66	0.70
• INC3	0.83	0.12	10.60	0.69
FP				
• FP1	0.89	0.11	12.37	0.79
• FP2	0.91	0.10	12.84	0.82
• FP3	0.92	0.10	1.317	0.85
MP				
• MP1	0.85	0.11	11.56	0.72
• MP2	0.86	0.11	11.71	0.74
• MP3	0.89	0.10	12.42	0.79
• MP4	0.89	0.11	12.48	0.79

The criteria for determining fit indices are the same as in testing fit indices in a radical product innovation based performance framework. The results are shown in Table 4.88. A measurement model of an incremental product innovation based performance framework has Chi-square to degree of freedom ratio equal 1.68:1 (2320.11/1379) which is lower than 3:1. The finding presents a good fit between the estimated model and the observed data. But, p-value is lower than 0.05 which it demonstrates a bad fit model. It is because Chi-square value is sensitive to sample size. A large sample size increases Chi-square value and decrease p-value. From this reason, Fornell and Larcker (1981) suggest that a researcher should consider other fit indices (such as RMSEA, NFI, CFI, IFI, and RFI) rather than p-value to evaluate a goodness of fit between the observed and estimated model when sample size is large. RMSEA of a measurement model is 0.075 which is lower than 0.1. It indicates a good fit between the estimated model and the observed data. Additionally, NFI (0.927), CFI (0.962), IFI (0.9652), and RFI (0.918) are above a cut off value (0.9). Thus, these fit indices demonstrate a good fit.

Based from the analysis, a researcher concludes that a measurement model of an incremental product innovation based performance framework has a reasonable fit with the data.

Table 4.88

Fit Indices for Testing Measurement Model of

Incremental Product Innovation Based Performance Framework

Parameter	Value
χ^2	2320.11
d.f.	1379
p-Value	0.000
RMSEA	0.075
NFI	0.927
CFI	0.962
IFI	0.962
RFI	0.918

4.5 Structural Model Assessment

After the results of testing reliability and validity of the measures and model fit assessment of measurement models for both radical and incremental innovation are satisfied, assessing fit of structural model is performed. The criteria for assessing fit indices presenting a goodness of fit of model are Chi-square test, CFI, IFI, NFI, RFI, and RMSEA. P-value of Chi-square should be more than 0.05 to not reject the null hypothesis. This can be interpreted that the observed and estimated covariance matrix are not different. Further, other indices, such as NFI, CFI, IFI, and RFI, should have values higher than a cutoff values 0.9. In addition, RMSEA should have value lower than 0.1.

The results of model fit assessment of a radical product innovation based performance framework are summarized in Table 4.89. The results show that the null hypothesis that observed and estimated covariance matrix are equal is rejected at a level of significance 0.05. The result demonstrates a bad fit model. A bad fit model shows the unequal of observed and estimated covariance matrix that a model does not fit with the data. It is because Chi-square value is sensitive to sample size. A large sample size will increase Chi-square value while p-value will decrease. Because of this reason, Fornell and Larcker (1981) suggest that a researcher should consider other fit indices (such as RMSEA, NFI, CFI, IFI, and RFI) rather than p-value to evaluate a goodness of fit between the observed and estimated model when sample size is large. Other fit indices indicate that a radical product innovation based performance framework has a good fit. The ratio of Chi-square value to degree of freedom is lower than 3 to 1 (2,656.48:1,130 = 2.35:1) which demonstrates an adequate fit of a model with the observed data. Moreover, fit indices, NFI (0.925), CFI (0.954), IFI (0.954), and RFI (0.919), are above the cutoff criteria (0.9) and RMSEA (0.082) is lower than recommended value (0.1). Thus, these indicators demonstrate a good fit.

Based from the analysis, a researcher concludes that a structural model of the radical product innovation based performance framework reasonably fits to the data.

Table 4.89

Fit Indices for Testing Structural Model of

Radical Product Innovation Based Performance Framework

Parameter	Value
χ^2	2,656.48
d.f.	1130
p-value	0.000
RMSEA	0.082
NFI	0.925
CFI	0.954
IFI	0.954
RFI	0.919

In Table 4.90, the findings of model fit assessment of an incremental product innovation based performance framework are concluded. The findings demonstrate a bad fit model because the null hypothesis that the observed and estimated covariance matrix is equal is rejected at a level of significance 0.05. It means that a framework is not equal to the sample data. It is because Chi-square value is sensitive to sample size. A large sample size increases Chi-square value and decreases p-value. For this reason, Fornell and Larcker (1981) suggest that a researcher should consider other fit indices (such as RMSEA, NFI, CFI, IFI, and RFI) rather than p-value to evaluate a goodness of fit between the observed and estimated model when sample size is large. Other fit indices demonstrate a good fit of an incremental product innovation based performance framework. The ratio of Chi-square value to degree of freedom is lower than 3 to 1 (2,813.17:1,275 = 2.21:1). Moreover, other fit indices, such as NFI (0.918), CFI (0.952), IFI (0.952), and RFI (0.911) are above the cutoff criteria (0.9). Additionally, RMSEA (0.093) is equal the ideal value (0.1).

Based from the analysis, a researcher concluded that a structural model of the incremental product innovation based performance framework reasonably fits to the data.

Table 4.90

Fit Indices for Testing Structural Model of

Incremental Product Innovation Based Performance Framework

Parameter	**Value**
χ^2	2,813.17
d.f.	1275
p-value	0.000
RMSEA	0.010
NFI	0.918
CFI	0.952
IFI	0.952
RFI	0.911

4.6 Hypothesis testing

In this section, hypotheses of the proposed frameworks for both a radical and an incremental product innovation based performance frameworks are tested. Coefficient of determinations and total effect of endogenous variables are revealed. Additionally, nested models within both frameworks are investigated. To check the validity and the robustness of the results of the data analysis, a researcher separates each radical and incremental product innovation based performance framework into three submodels. These submodels are separated based on three groups of antecedents of radical and incremental product innovation based performance framework which are organization, operational efficiency, and external environment.

4.6.1 Radical Product Innovation Based Performance Framework

The hypotheses of radical product innovation based performance framework are shown in Table 4.91.

Table 4.91

Hypotheses of Radical Product Innovation Based Performance Framework

Hypotheses
Organization (Antecedents)
H1a: Vision has a positive impact on radical product innovation H2a: Top management support has a positive impact on radical product innovation H3a: Centralization has a negative impact on radical product innovation H4a: Formalization has a negative impact on radical product innovation
Operational Efficiency (Antecedents)
H5a: Predevelopment task has a positive impact on radical product innovation H6a: Cross-functional integration has a positive impact on radical product innovation H7a: Technological proficiency has a positive impact on radical product innovation H8a: Development speed has a negative impact on radical product innovation H9a: Launch proficiency has a positive impact on radical product innovation
External Environment (Antecedents)
H10a: Demand uncertainty has a negative impact on radical product innovation H11a: Technological turbulence has a negative impact on radical product innovation H12a: Government agencies support has a positive impact on radical product innovation
Consequences
H13a: Radical product innovation has a positive impact on market performance H14a: Market performance has a positive impact on financial performance

Antecedents: In order to consider the effects of twelve antecedents of a radical product innovation, a researcher tests H_{1a} to H_{12a} proposed in Chapter 2. The findings are shown in Figure 4.31 and Table 4.92.

Antecedents can be classified into three parts: organization, operational efficiency, and external environment. For organization, H_{1a} to H_{4a} are tested. The results show that vision (H_{1a}) has a significant positive impact on a radical product at a level of significance 0.05. However, top management support (H_{2a}), centralization (H_{3a}), and formalization (H_{4a}) have insignificant impact on a radical product. Therefore, H_{1a} is fully supported but H_{2a}, H_{3a}, and H_{4a} are not supported.

For operational efficiency, H_{5a} to H_{9a} are examined. The results demonstrate that technological proficiency (H_{7a}) has a significant positive impact on a radical product at a level of significance 0.01. Additionally, launch proficiency (H_{9a}) also has a significant positive impact on a radical product at a level of significance 0.01. But, predevelopment task (H_{5a}), cross-functional integration (H_{6a}), and development speed (H_{8a}) do not have significant impact on a radical product. Therefore, H_{7a} and H_{9a} are fully supported but H_{5a}, H_{6a}, and H_{8a} are not supported.

For external environment, H_{10a} to H_{12a} are tested. The results show that demand uncertainty (H_{10a}) has a significant positive impact on a radical product at a level of significance 0.01. But, this finding is contradicted with the proposed hypothesis. A researcher proposes that demand uncertainty has negative impact on a radical product. Technological turbulence (H_{11a}) has a partial significant impact on a radical product at a level of significance 0.1, which also contradicts with the proposed hypothesis. The negative impact on technological turbulence on a radical product is hypothesized. Government agency support (H_{12a}), however, has insignificant impact on a radical product. Consequently, H_{10a}, H_{11a}, and H_{12a} are not supported.

Consequences: The impacts of a radical product innovation on market and financial performance are tested. The results are shown in Figure 4.31 and Table 4.92.

For H_{13a}, the impact of radical product innovation on market performance is tested. The result shows that radical product innovation (H_{13a}) has a positive significant impact on market performance at a level of significance 0.01. Thus, H_{13a} is fully supported.

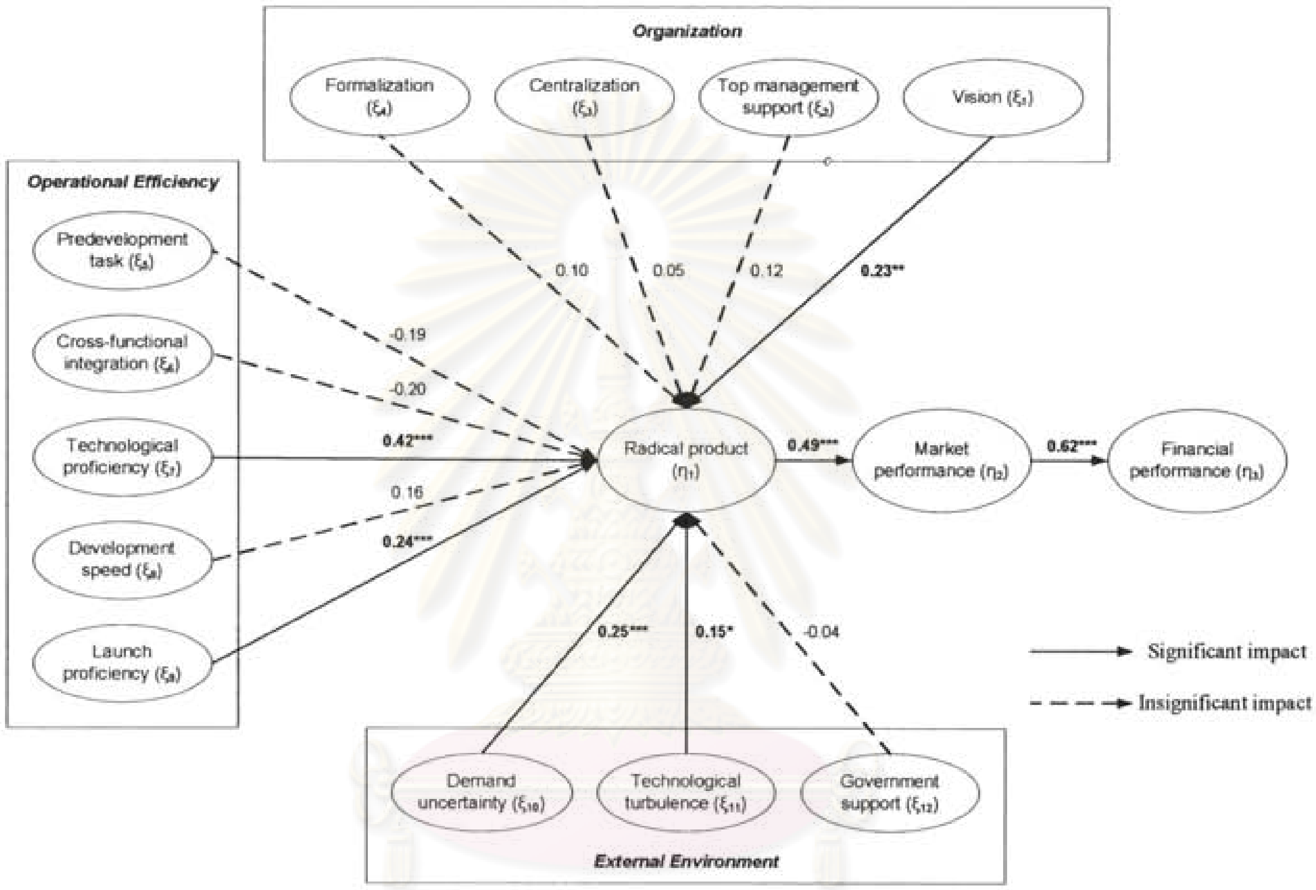
For H_{14a}, the impact of market performance on financial performance is investigated. The result shows that market performance (H_{14a}) has a significantly positive impact on financial performance at a level of significance 0.01. Hence, H_{14a} is fully supported.

A standardized structural parameter estimate demonstrates size and direction of the effect between two constructs. A standardized estimate is used to compare a relative strength or the importance of antecedents in the model. A standardized structural parameter estimates of all paths are included in Figure 4.31 and Table 4.92. In Figure 4.31, it shows that technological proficiency (0.42) is the most influential factor affecting on radical product innovation. Other factors which have some impacts on a radical product innovation are demand uncertainty (0.25), launch proficiency (0.24), vision (0.23), and technological turbulence (0.15), respectively.

In conclusion, technological proficiency is considered to be the most important factor for the development of a radical product innovation.

Figure 4.31

Structural Model of Radical Product Innovation Based Performance Framework with Standardized Parameter Estimates and Statistical Significance



Note: *** significant level at 0.01.

* significant level at 0.1.

Table 4.92

Standardized Structural Equation Parameter Estimates and t-Value of Radical Product Innovation Based Performance Framework

	Endogenous constructs					
	Radical product innovation (RAD)		Market performance (MP)		Financial performance (FP)	
	γ	t-Value	β	t-Value	β	t-Value
Exogenous Construct						
VIS	0.23**	2.03				
TOP	0.12	1.33				
CEN	0.05	0.55				
FOR	0.10	1.00				
PRE	-0.19	-1.56				
CRO	-0.20	-1.61				
TEC	0.42***	3.74				
SPD	0.16	1.29				
LAU	0.24***	2.74				
DEM	0.25***	3.56				
TECT	0.15*	1.77				
GOV	-0.04	-0.55				
Endogenous Construct						
RAD			0.49***	5.82		
MP					0.62***	5.82

Note: *** significant level at 0.01.

** significant level at 0.05.

* significant level at 0.1.

γ is a standardized parameter estimate from exogenous to endogenous construct

β is a standardized parameter estimate from endogenous to endogenous construct

Coefficient of determination (R^2) is the measure of variance of endogenous construct explained by exogenous constructs. For coefficient of determinations of a radical product innovation, 35.1 percent of a radical product innovation is explained by twelve antecedents. Further, 24.0 percent of market performance is explained by a radical product innovation. Additionally, 80.3 percent of financial performance is explained by market performance. The results are shown in Table 4.93.

Table 4.93

Coefficient of Determinations of Endogenous Constructs of Radical Product Innovation Based Performance Framework

Construct	R^2
RAD	0.351
MP	0.240
FP	0.803

The standardized total effects are the sum of direct effect and indirect effect between two constructs. Direct effect is the direct effect between two constructs with a single path. Indirect effect is the impact which the link between two constructs is intervened by other constructs. In Table 4.94, the total effects of radical product to market performance and financial performance are 0.490 and 0.303, respectively. It can be concluded that a radical product innovation has impacted on the market performance more than on the financial performance. The total effect of market performance to financial performance is 0.618.

Table 4.94

Standardized Total Effects of Endogenous Variables of Radical Product Innovation Based Performance Framework

	RAD	MP
MP	0.490	
FP	0.303	0.618

A propose of testing nested model is to increase the validity and the robustness of the results of hypothesis testing. A researcher divides radical product innovation based performance framework into 3 submodels: organization, operational efficiency, and external environment.

A researcher tests an organization model which is a nested model within a radical product innovation based performance framework. The organization model has four exogenous constructs: vision, top management support, centralization, and formalization. The organization model is shown in Figure 4.32 and the results are shown in Table 4.95.

Figure 4.32

Organization Model

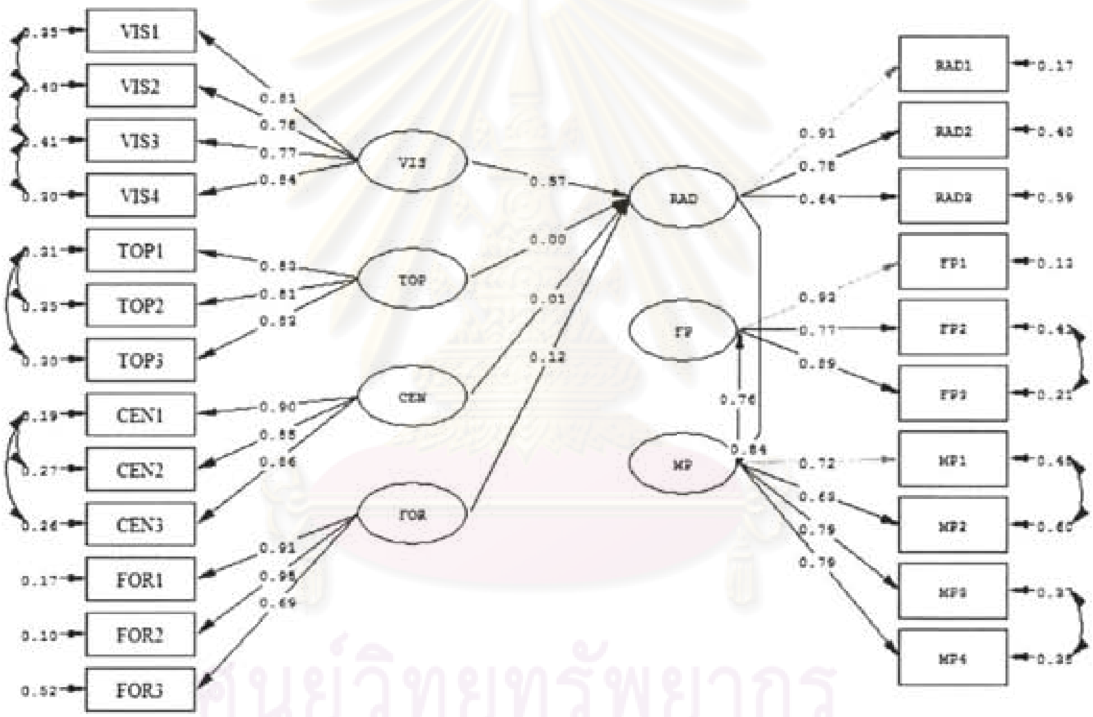


Table 4.95

Standardized Structural Equation Parameter Estimates

and t-Value of Organization Model

	Endogenous constructs					
	RAD		MP		FP	
	γ	t	β	t	β	t
<u>Exogenous Construct</u>						
VIS	0.57^{***}	4.88				
TOP	0.00	0.01				
CEN	0.01	0.08				
FOR	0.12	1.48				
<u>Endogenous Construct</u>						
RAD			0.84	6.54^{***}		
MP					0.76	7.76^{***}
Chi-square = 298.48, d.f. = 205, p = 0.000, RMSEA = 0.047						

*** significant level at 0.01.

γ is a standardized parameter estimate from exogenous to endogenous construct

β is a standardized parameter estimate from endogenous to endogenous construct

In Table 4.95, the findings show that an organization model has a reasonable fit between the estimated model and the observed data ($p < 0.05$, χ^2:d.f. < 3:1, RMSEA<0.1). Vision has a significant positive impact on a radical product innovation at a level of significance 0.01. Further, a radical product innovation has a positive impact on the market performance and the market performance has a positive impact on the financial performance. The results are congruent with a radical product innovation based performance model which vision has a positive impact on a radical product innovation.

Next, a researcher also examines an operational efficiency model which is a nested model within a radical product innovation based performance model. The operational efficiency model has five exogenous constructs: predevelopment task, cross-functional integration, technological proficiency, development speed, and launch proficiency. The operational efficiency model is shown in Figure 4.33 and the results are shown in Table 4.96.

Figure 4.33

Operational Efficiency Model

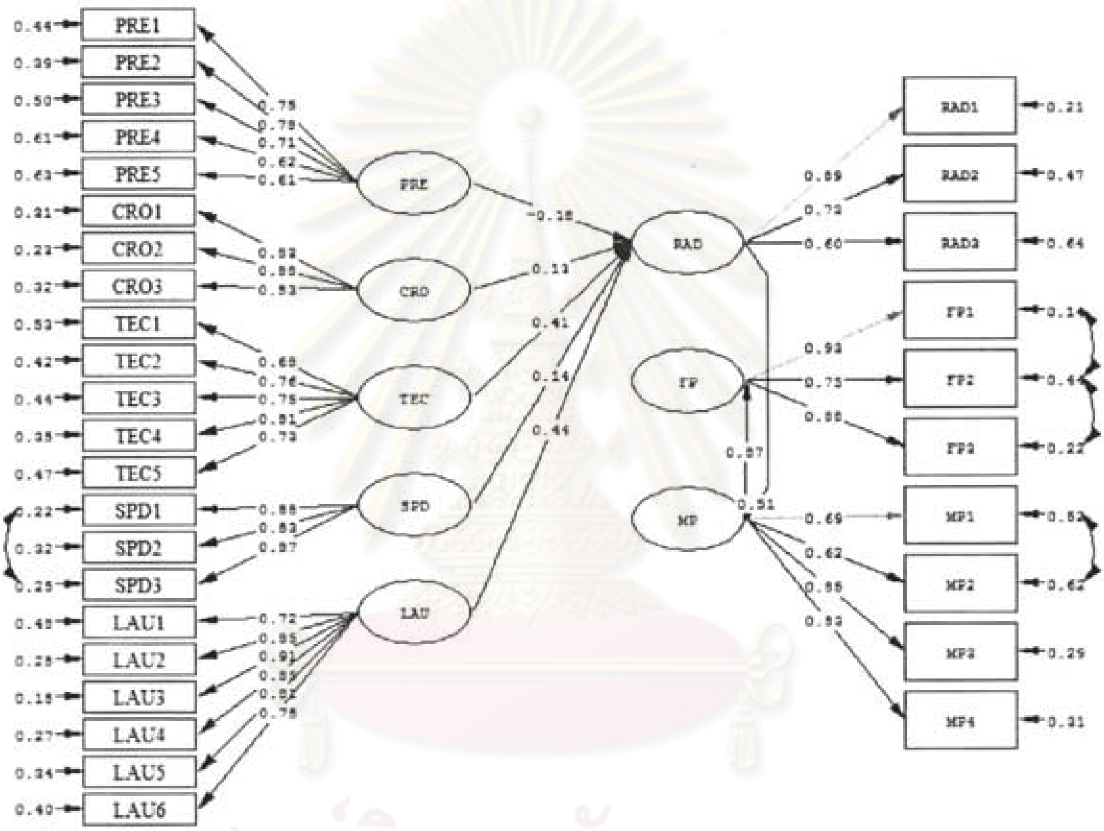


Table 4.96

Standardized Structural Equation Parameter Estimates and t-Value of Operational Efficiency Model

	Endogenous constructs					
	RAD		MP		FP	
	γ	t	β	t	β	t
Exogenous Construct						
PRE	-0.18	-1.57				
CRO	0.13	1.29				
TEC	0.41***	4.42				
SPD	0.14	1.41				
LAU	0.44***	4.52				
Endogenous Construct						
RAD			0.51***	5.94		
MP					0.87***	10.33
Chi-square = 1263.31, d.f. = 448, p = 0.000, RMSEA = 0.095						

*** significant level at 0.01.

γ is a standardized parameter estimate from exogenous to endogenous construct

β is a standardized parameter estimate from endogenous to endogenous construct

In Table 4.96, the findings show that an organization model has a reasonable fit between the estimated model and the observed data ($p < 0.05$, χ^2:d.f. < 3:1, RMSEA<0.1). Technological proficiency and launch proficiency have significant positive impacts on a radical product innovation at a level of significance 0.01. Further, a radical product innovation has a positive impact on the market performance and the market performance has a positive impact on the financial performance. The results are congruent with a radical product innovation based performance model which technological proficiency and launch proficiency have positive impacts on a radical product innovation.

Finally, a researcher examines an external environment model which is a nested model within a radical product innovation based performance model. The external environment model has three exogenous constructs: demand uncertainty, technological turbulence, and government agency support. The external environment model is shown in Figure 4.34 and the results are shown in Table 4.97.

Figure 4.34

External Environment Model

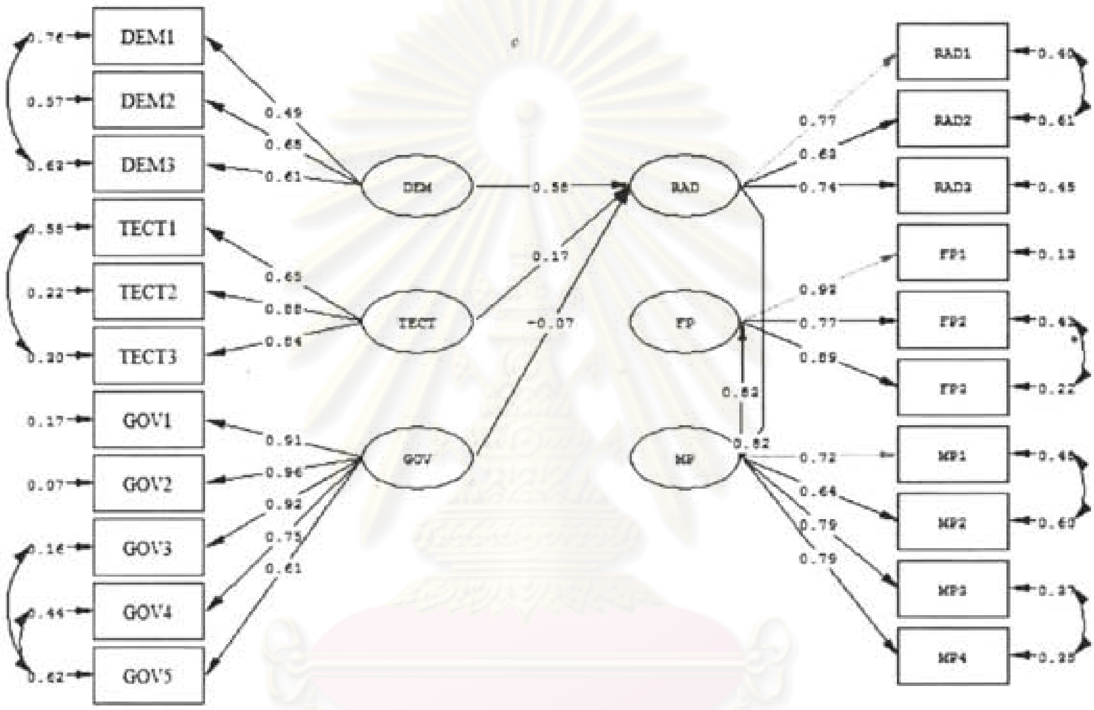


Table 4.97

Standardized Structural Equation Parameter Estimates

and t-Value of External Environment Model

	Endogenous constructs					
	RAD		MP		FP	
	γ	t	β	t	β	t
Exogenous Construct						
DEM	0.58***	4.98				
TECT	0.17*	1.76				
GOV	-0.07	-1.03				
Endogenous Construct						
RAD			0.82***	5.80		
MP					0.83***	7.68
Chi-square = 257.74, d.f. = 170, p = 0.000, RMSEA = 0.050						

*** significant level at 0.01.

* significant level at 0.1.

γ is a standardized parameter estimate from exogenous to endogenous construct

β is a standardized parameter estimate from endogenous to endogenous construct

In Table 4.97, the results show that an external environment has a reasonable fit between the estimated model and the observed data ($p < 0.05$, χ^2:d.f. < 3:1, RMSEA<0.1). Demand uncertainty and technological turbulence have significant positive impacts on a radical product innovation at a level of significance 0.01 and 0.1, respectively. Further, a radical product innovation has a positive impact on the market performance and the market performance has a positive impact on the financial performance. The results are congruent with a radical product innovation based performance model which demand uncertainty and technological turbulence have positive impacts on a radical product innovation.

4.6.2 Incremental Product Innovation Based Performance Framework

The hypotheses of incremental product innovation based performance framework are shown in Table 4.98.

Table 4.98

Hypotheses of Incremental Product Innovation Based Performance Framework

Hypotheses
Organization (Antecedents)
H1b: Vision has a positive impact on incremental product innovation
H2b: Top management support has a positive impact on incremental product innovation
H3b: Centralization has a positive impact on incremental product innovation
H4b: Formalization has a positive impact on incremental product innovation
Operational Efficiency (Antecedents)
H5b: Predevelopment task has a positive impact on incremental product innovation
H6b: Cross-functional integration has a positive impact on incremental product innovation
H7b: Technological proficiency has no impact on incremental product innovation
H8b: Development speed has a positive impact on incremental product innovation
H9b: Launch proficiency has a positive impact on incremental product innovation
External Environment (Antecedents)
H10b: Demand uncertainty has no impact on incremental product innovation
H11b: Technological turbulence has no impact on incremental product innovation
H12b: Government agencies support has a impact on incremental product innovation
Consequences
H13b: Incremental product innovation has a positive impact market performance
H14b: Market performance has a positive impact on financial performance

Antecedents: twelve hypotheses (H_{1b}-H_{12b}) in an incremental product innovation based performance framework proposed in Chapter 2 are investigated. The results are shown in Figure 4.35 and Table 4.99. Similarly with a radical product innovation based performance framework, antecedents in an incremental product innovation based performance framework are classified into three parts.

For organization, the H_{1b} to H_{4b} are examined. The findings show that centralization (H_{3b}) and formalization (H_{4b}) have significant positive impacts on an incremental product innovation at a level of significance 0.1. However, vision (H_{1b}) and top management support (H_{2b}) do not have significant impact on an incremental product innovation. Hence, H_{3b} and H_{4b} are partial supported, but H_{1b} and H_{2b} are not supported.

For operational efficiency, H_{5b} to H_{9b} are investigated. The results show that cross-functional integration (H_{6b}) has a significant positive impact on an incremental product innovation at a level of significance 0.1. Although technological proficiency (H_{7b}) does not have a significant impact on an incremental product innovation, this result is congruent to proposed hypothesis that technological does not have an impact on an incremental product innovation. Further, predevelopment task (H_{5b}), development speed (H_{8b}), and launch proficiency (H_{9b}), these factors have insignificant impact on an incremental product innovation. H_{6b} and H_{7b}, therefore, are supported but H_{5b}, H_{8b}, and H_{9b} are not supported.

For external environment, H_{10b} to H_{12b} are tested. The findings show that demand uncertainty (H_{10b}) has a positive impact on an incremental product innovation at a level of significance 0.01. However, the result is contradicted with proposed the hypothesis. A researcher proposes that demand uncertainty does not have impact on an incremental product innovation. The contradicted finding is discussed in Chapter 5. Technological turbulence (H_{11b}) has insignificant impact on an incremental product innovation. This result is congruent with the proposed hypothesis that technological turbulence does not have impact on an incremental product innovation. H_{12b} (government agency support) fails to reject the null hypothesis that government agency support do not have an impact on an incremental product innovation. Therefore, H_{11b} is supported but H_{10b} and H_{12b} are not supported.

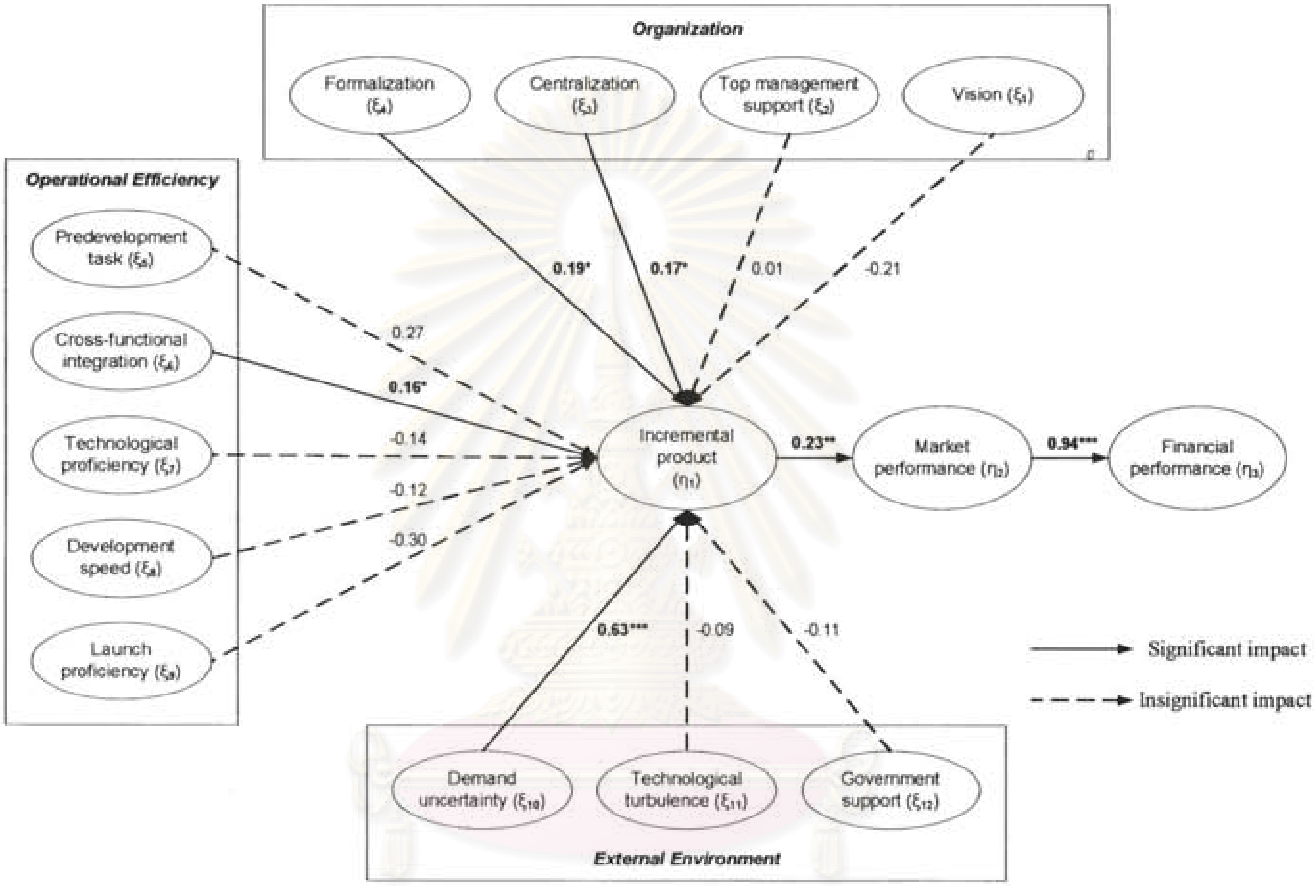
<u>Consequences:</u> an incremental product innovation based performance framework in Figure 4.35 has two consequences: market performance and financial performance. For H_{13b}, an incremental product innovation has a positive impact on market performance at a level of significance 0.01. For H_{14b}, market performance has a positive impact on financial performance at a level of significance 0.01. Therefore, H_{13b} and H_{14b} are fully supported.

A standardized parameter estimates of an incremental product innovation based performance framework are shown in Figure 4.35 and Table 4.99. In Figure 4.35 and Table 4.99, demand uncertainty is the highest standardized parameter estimate value (0.63). So, demand uncertainty is the most influential factor affecting on an incremental product innovation. Centralization is the second highest standardized parameter estimate value (0.19), followed by formalization (0.17) and cross-functional integration (0.16).

Therefore, demand uncertainty is considered to be the most important factor for the development of incremental product innovation.

Figure 4.35

Structural Model of Incremental Product Innovation Based Performance Framework with Standardized Parameter Estimates and Statistical Significance



Note: *** significant level at 0.01.

** significant level at 0.05 .

* significant level at 0.1.

Table 4.99

Standardized Structural Equation Parameter Estimates and t-Value of Radical Product Innovation Based Performance Framework

	Endogenous constructs					
	Incremental product innovation (INC)		Market performance (MP)		Financial performance (FP)	
	γ	t-Value	β	t-Value	β	t-Value
Exogenous Construct						
VIS	-0.21	-1.33				
TOP	0.01	0.07				
CEN	0.17*	1.87				
FOR	0.19*	1.79				
PRE	0.27	1.35				
CRO	0.16*	1.66				
TEC	-0.14	-0.75				
SPD	-0.12	-0.78				
LAU	-0.30	-1.54				
DEM	0.63***	3.28				
TECT	-0.09	-0.80				
GOV	-0.11	-1.24				
Endogenous Construct						
INC			0.23**	2.51		
MP					0.94***	11.39

Note: *** significant level at 0.01.

** significant level at 0.05.

* significant level at 0.1.

γ is a standardized parameter estimate from exogenous to endogenous construct

β is a standardized parameter estimate from endogenous to endogenous construct

For coefficient of determinations (R^2) of an incremental product innovation based performance framework, 38.6 percent of an incremental product innovation is explained by twelve antecedents. Moreover, 5.5 percent of an incremental product innovation is explained by the market performance. In addition, 88.2 percent of the market performance is explained by the financial performance. The results are shown in Table 4.100.

Table 4.100

Coefficient of Determinations of Endogenous Variables of Incremental Product Innovation Based Performance Framework

Construct	R^2
INC	0.386
MP	0.055
FP	0.882

The standardized total effects of an incremental product innovation based performance framework is shown in Table 4.101. The total effect of an incremental product innovation on the market performance is 0.235 and the total effect of an incremental product innovation on the financial performance is 0.220. It can be concluded that an incremental product has impacted on the market performance more than on the financial performance. The total effect of the market performance on the financial performance is 0.939.

Table 4.101

Standardized Total Effects of Endogenous Variables of Incremental Product Innovation Based Performance Framework

	INC	MP
MP	0.235	
FP	0.220	0.939

An objective of testing a nested model is to increase the validity and the robustness of the results of hypothesis testing. A researcher divides an incremental product innovation based performance framework into 3 submodels: organization, operational efficiency, and external environment.

A researcher tests an organization model which is a nested model within an incremental product innovation based performance framework. The organization model has four exogenous constructs: vision, top management support, centralization, and formalization. The organization model is shown in Figure 4.36 and the results are shown in Table 4.102.

Figure 4.36

Organization Model

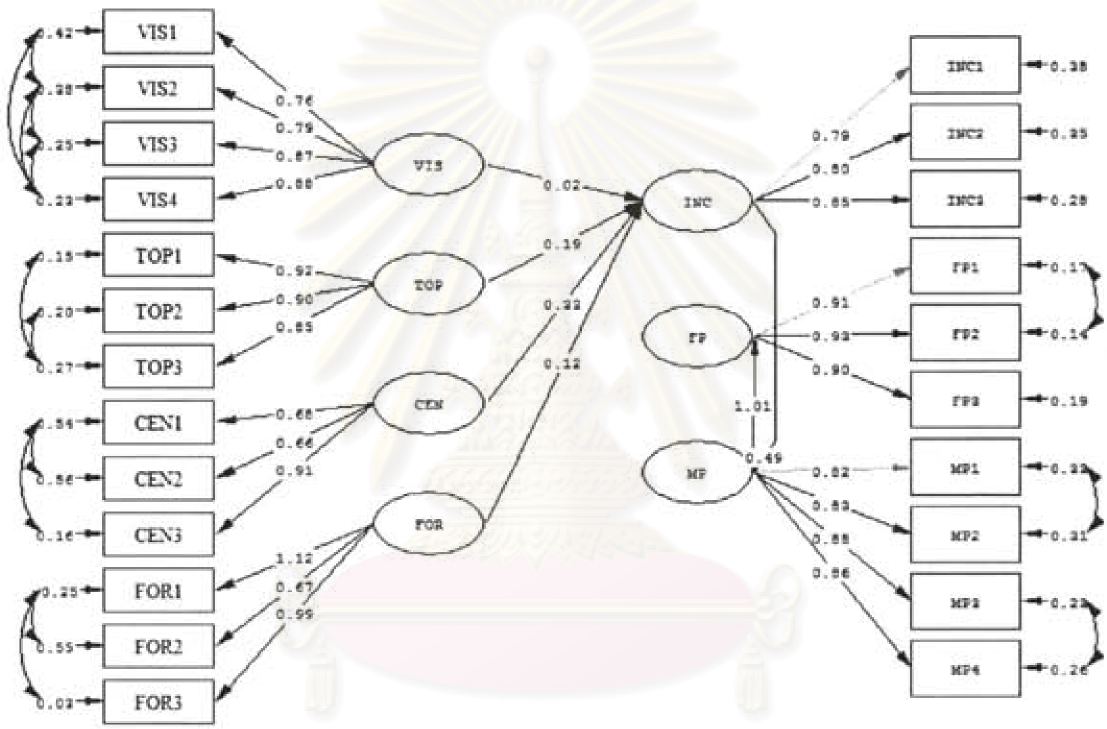


Table 4.102

Standardized Structural Equation Parameter Estimates

and t-Value of Organization Model

	Endogenous constructs					
	INC		MP		FP	
	γ	t	β	t	β	t
Exogenous Construct						
VIS	0.01	0.13				
TOP	0.19	1.18				
CEN	0.33^{**}	2.24				
FOR	0.12^{*}	1.64				
Endogenous Construct						
INC			0.49^{***}	4.78		
MP					1.01^{***}	10.84
Chi-square = 426.14, d.f. = 204, p = 0.000, RMSEA = 0.095						

*** significant level at 0.01.

** significant level at 0.05.

* significant level at 0.1.

γ is a standardized parameter estimate from exogenous to endogenous construct

β is a standardized parameter estimate from endogenous to endogenous construct

In Table 4.102, the results show that an organization model has a reasonable fit between the estimated model and the observed data ($p < 0.05$, χ^2:d.f. < 3:1, RMSEA<0.1). Centralization and formalization have significant positive impacts on an incremental product innovation at a level of significance 0.05 and 0.01, respectively. Further, an incremental product innovation has a positive impact on the market performance and the market performance has a positive impact on the financial performance. The results are congruent with an incremental product innovation based performance framework which centralization and formalization have a positive impact on an incremental product innovation.

Next, a researcher also examines an operational efficiency model which is a nested model within an incremental product innovation based performance framework. The operational efficiency model has five exogenous constructs: predevelopment task, cross-functional integration, technological proficiency, development speed, and launch proficiency. The operational efficiency model is shown in Figure 4.37 and the results are shown in Table 4.103.

Figure 4.37
Operational Efficiency Model

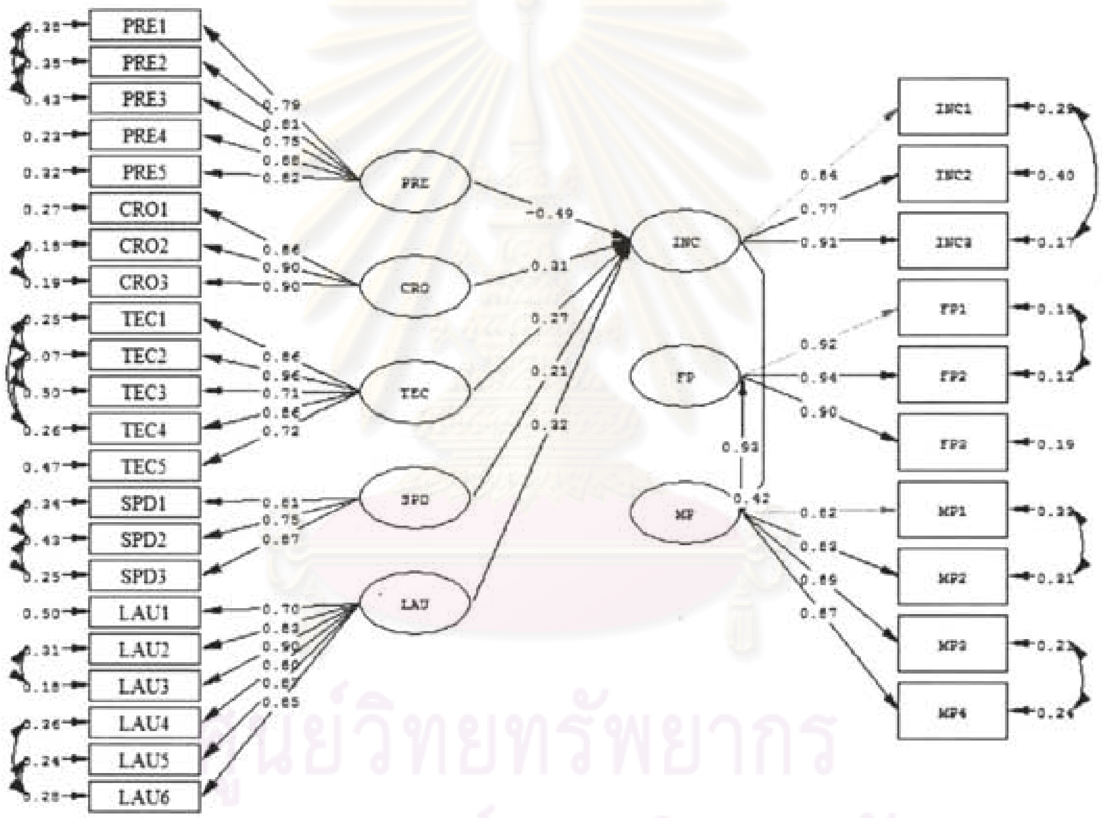


Table 4.103

Standardized Structural Equation Parameter Estimates

and t-Value of Operational Efficiency Model

	Endogenous constructs					
	INC		MP		FP	
	γ	t	β	t	β	t
Exogenous Construct						
PRE	-0.48	-0.86				
CRO	0.30	1.14				
TEC	0.26	1.12				
SPD	0.20	1.28				
LAU	0.32	1.20				
Endogenous Construct						
INC			0.42***	3.98		
MP					0.93***	11.40
Chi-square = 832.80, d.f. = 431, p = 0.000, RMSEA = 0.088						

*** significant level at 0.01.

γ is a standardized parameter estimate from exogenous to endogenous construct

β is a standardized parameter estimate from endogenous to endogenous construct

In Table 4.103, the findings show that an operational efficiency model has a reasonable fit between the estimated model and the observed data ($p < 0.05$, χ^2:d.f. < 3:1, RMSEA<0.1). No factor has an impact on an incremental product innovation. An incremental product innovation has a positive impact on the market performance and the market performance has a positive impact on the financial performance. The results are not congruent with an incremental product innovation based performance model. For organizational efficiency model, cross-functional integration do not have an impact on an incremental product innovation. But, for an incremental product innovation based performance model, cross-functional integration has a positive impact on an incremental product innovation. Therefore, a majority of the results of hypothesis testing of a full model and a nested model are the same.

Finally, a researcher examines an external environment model which is a nested model within an incremental product innovation based performance model. The external environment model has three exogenous constructs: demand uncertainty, technological turbulence, and government agency support. The external environment model is shown in Figure 4.38 and the results are shown in Table 4.104.

Figure 4.38

External Environment Model

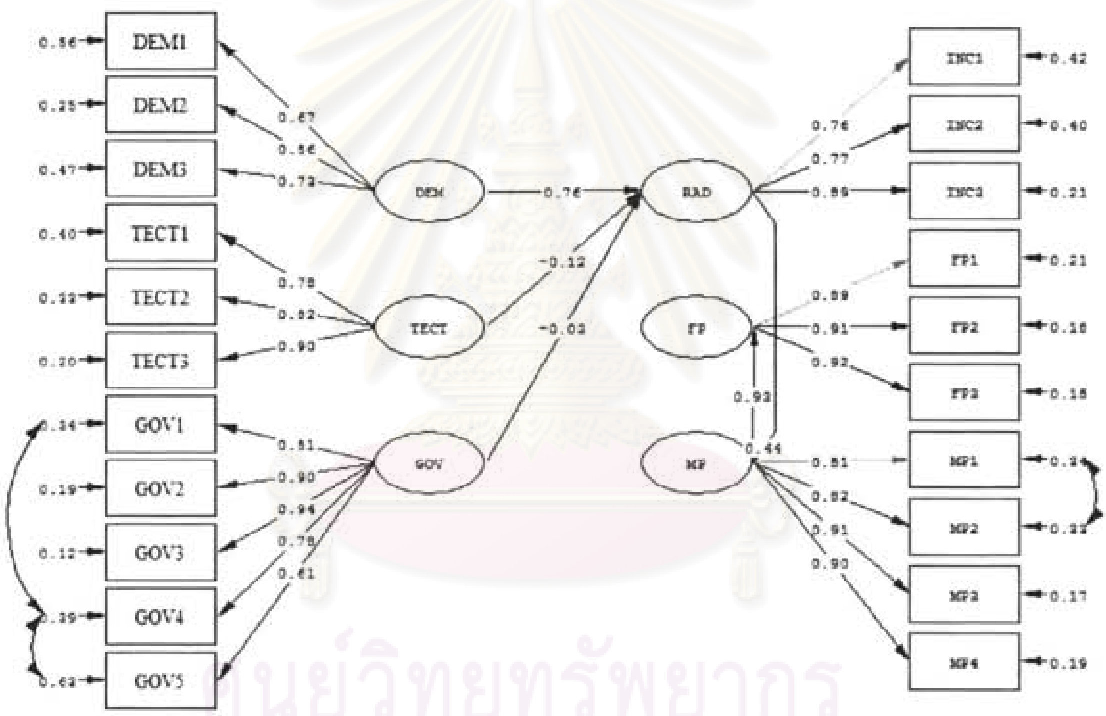


Table 4.104

Standardized Structural Equation Parameter Estimates

and t-Value of External Environment Model

	Endogenous constructs					
	INC		MP		FP	
	γ	t	β	t	β	t
Exogenous Construct						
DEM	0.76***	4.89				
TECT	-0.12	-0.88				
GOV	-0.03	-0.28				
Endogenous Construct						
INC			0.44***	4.31		
MP					0.93***	10.74
Chi-square = 308.67, d.f. = 178, p = 0.000, RMSEA = 0.078						

*** significant level at 0.01.

* significant level at 0.1.

γ is a standardized parameter estimate from exogenous to endogenous construct

β is a standardized parameter estimate from endogenous to endogenous construct

In Table 4.104, the results show that an external environment has a reasonable fit between the estimated model and the observed data ($p < 0.05$, χ^2:d.f. < 3:1, RMSEA<0.1). Demand uncertainty has a positive impact on an incremental product innovation at a level of significance 0.01. Further, an incremental product innovation has a positive impact on the market performance and the market performance has a positive impact on the financial performance. The results are congruent with an incremental product innovation based performance model which demand uncertainty has a positive impact on an incremental product innovation.

Finally, a researcher summarizes the hypothesis testing of this study in Table 4.105 and 4.106. These tables compare the proposed hypotheses and the results of hypothesis testing.

Table 4.105

Summary of Hypothesis Testing of

Radical Product Innovation Based Performance Framework

Hypotheses	Proposed	Results
H1: Vision has a positive impact on radical product innovation	+	+
H2: Top management support has a positive impact on radical product innovation	+	NS.
H3: Centralization has a negative impact on radical product innovation	–	NS.
H4: Formalization has a negative impact on radical product innovation	–	NS.
H5: Predevelopment task has a positive impact on radical product innovation	+	NS.
H6: Cross-functional integration has a positive impact on radical product innovation	+	NS.
H7: Technological proficiency has a positive impact on radical product innovation	+	+
H8: Development speed has a negative impact on radical product innovation	–	NS.
H9: Launch proficiency has a positive impact on radical product innovation	+	+
H10: Demand uncertainty has a negative impact on radical product innovation	–	+
H11: Technological turbulence has a negative impact on radical product innovation	–	+
H12: Government agencies support has a positive impact on radical product innovation	+	NS.
H13: Radical product innovation has a positive impact on market performance	+	+
H14: Market performance has a positive impact on financial performance	+	+

Note: NS is not significant impact

+ is positive impact

- is negative impact

Table 4.06

Summary of Hypothesis Testing of

Incremental Product Innovation Based Performance Framework

Hypotheses	Proposd	Results
H1: Vision has a positive impact on incremental product innovation	+	NS.
H2: Top management support has a positive impact on incremental product innovation	+	NS.
H3: Centralization has a positive impact on incremental product innovation	+	+
H4: Formalization has a positive impact on incremental product innovation	+	+
H5: Predevelopment task has a positive impact on incremental product innovation	+	NS.
H6: Cross-functional integration has a positive impact on incremental product innovation	+	+
H7: Technological proficiency has no impact on incremental product innovation	NS.	NS.
H8: Development speed has a positive impact on incremental product innovation	+	NS.
H9: Launch proficiency has a positive impact on incremental product innovation	+	NS.
H10: Demand uncertainty has no impact on incremental product innovation	NS.	+
H11: Technological turbulence has no impact on incremental product innovation	NS.	NS.
H12: Government agencies support has a impact on incremental product innovation	+	NS.
H13: Incremental product innovation has a positive impact market performance	+	+
H14: Market performance has a positive impact on financial performance	+	+

Note: NS is not significant impact

+ is positive impact

- is negative impact

4.7 Summary

This chapter presents the results of data analysis of radical and incremental product innovation based performance framework. Preliminary data analysis is performed to test the validity of the observed variables. The reliability of measurement items and the validity of measurement and structural models are examined. Both two frameworks are reliable and valid. Further, the findings of hypothesis testing for radical and incremental product innovation based performance framework are revealed. To check the validity of the results of hypothesis testing, a researcher compares the results between the full models and the nested models. The findings show that the results of full and nested model are harmonizing.

CHAPTER V

CONCLUSIONS, DISCUSSIONS, AND RECOMMENDATIONS

The dissertation topic "The Empirical Study of the Impact of Product Innovation Factors on Performance of New Product: Radical and Incremental Product Innovation" aims to investigate the effect of internal and external factors on radical and incremental product innovation. This study demonstrates the cause effect relationship between product innovation and firms' both market and financial performances. The radical and incremental product innovation based performance frameworks reveal the antecedents, mediators (radical and incremental product innovation), and consequences (market and financial performances). A researcher collects the data from firms that have their own product innovation in five industries. The results of the study confirm the theory and concepts described in literature review. The radical and incremental product innovation based performance frameworks are shown in Figures 5.1 and 5.2.

Figure 5.1

Radical Product Innovation Based Performance Framework

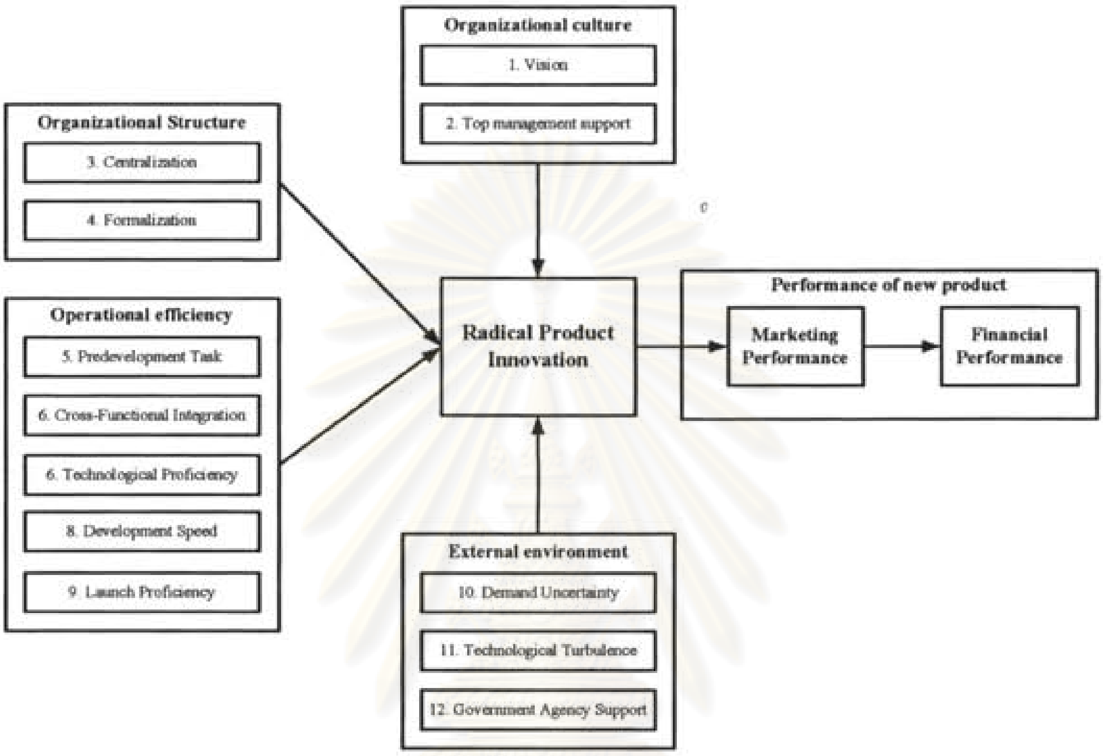
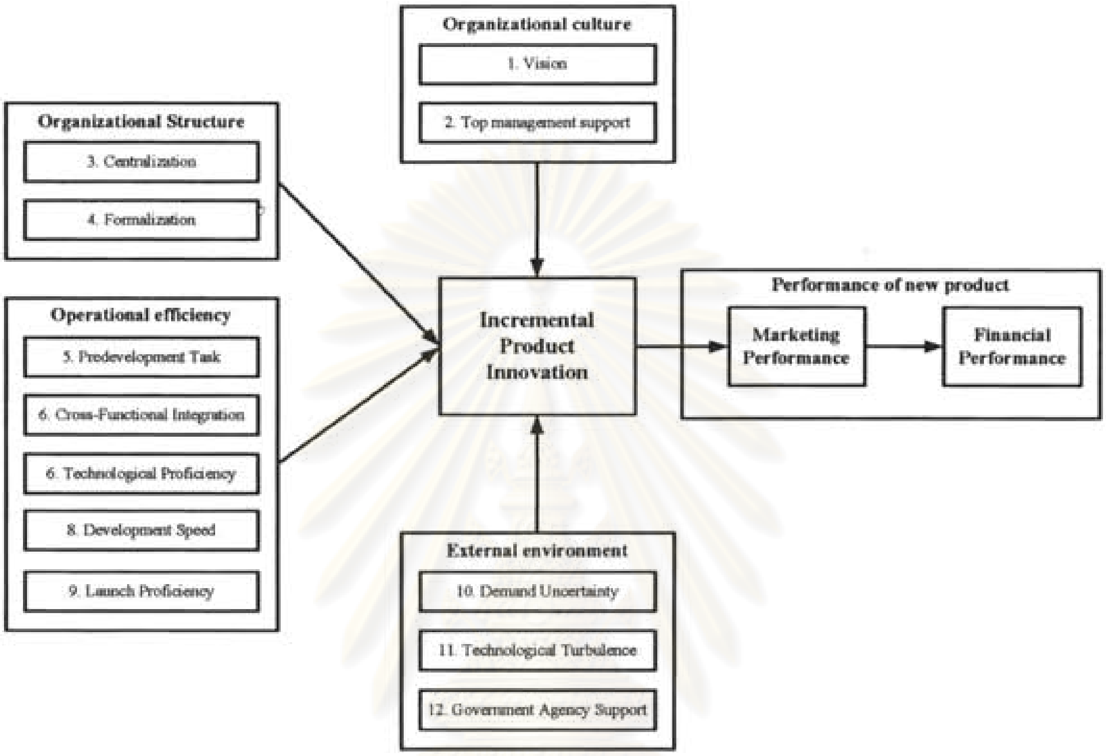


Figure 5.2

Incremental Product Innovation Based Performance Framework



This chapter provides conclusions and discussions of the research findings. Recommendations for academicians and practitioners which are theoretical and managerial contributions are described. Finally, limitations of the study and future research are suggested.

5.1 Conclusions

The first objective of this study is to examine the impacts of twelve product innovation factors on radical and incremental product innovation from the customer's perspective. These twelve factors are classified into three categories which are organization, operation efficiency, and external environment. Organization includes vision, top management support, centralization, and formalization. Operational efficiency are predevelopment task, cross-functional integration, technological proficiency, development speed, and launch proficiency. External environment are demand uncertainty, technological proficiency, and government agency support.

The other objective of the study is to develop systematic frameworks for radical and incremental product innovation from the customer's perspective. Both frameworks contain antecedents, mediator, and consequences. Antecedents are twelve product innovation factors. Mediator is product innovation, and consequences are market and financial performances.

Product innovation can be viewed from three perspectives: customer, technology, and a combination of customer and technology perspective. This study focuses on product innovation from the customer's perspective because the success of new product depends heavily on customer not on technology (Brown and Eisenhardt, 1995; Voss and Voss, 2000; Ziamou and Ratneshwar, 2003).

Radical and incremental product innovation based performance frameworks are developed based on the resource-based view theory, the contingency theory, the social capital theory, and the concept of competitive advantage.

The population in this study are manufacturers that have their new products in agriculture, biotechnological, energy, food, and pharmaceutical industrial sectors. BIOTEC, DBD, FTI, NFI, NIA, and Siamlist database are used as a sampling frame. A researcher selects 2,000 firms by simple random sampling from those database. Mail questionnaires were sent to 2,000 firms in Thailand. A questionnaire is reviewed by a dissertation advisor and six practitioners who are managers. A total returned questionnaires are 392 and the response rate equals 19.6%. The analytical tool to simultaneously investigate the impacts among constructs on radical and incremental product innovation based performance framework is LISREL 8.52.

SPSS 13.0 is used for testing descriptive statistic and reliability of measurement items. LISREL 8.52 is performed for the preliminary analysis, validity of measurement, and the structural model. After all the analyzes are done, hypotheses testing are performed and the results of hypothesis testing are organized into two parts: radical and incremental product innovation based performance frameworks.

For radical product innovation based performance framework, the findings reveal that vision (γ_{11} = 0.23, t-value = 2.03), technological proficiency (γ_{71} = 0.42, t-value = 3.74), launch proficiency (γ_{91} = 0.24, t-value = 2.74), and demand uncertainty (γ_{101} = 0.25, t-value = 3.56) have significant positive impacts on radical product innovation at a level of significance 0.05. Technological turbulence (γ_{111} = 0.15, t-value = 1.77) has positive impact on radical product innovation at a level of significance 0.1. Radical product innovation (β_{21} = 0.49, t-value = 5.82) has significant positive impact on market performance at a level of significance 0.01 and market performance (β_{32} = 0.62, t-value = 5.82) has a significant positive impact on financial performance at a level of significance 0.01.

For incremental product innovation based performance framework, the results show that demand uncertainty (γ_{101} = 0.63, t-value = 3.28) has positive impact on incremental product innovation at a level of significance 0.01. Centralization (γ_{31} = 0.17, t-value = 1.87), formalization (γ_{41} = 0.19, t-value = 1.79), and cross-functional integration (γ_{61} = 0.16, t-value = 1.66) have significant positive impacts on incremental product innovation at a level of significance 0.1. Incremental product innovation (β_{21} = 0.23, t-value = 2.51) has significant positive impact on market performance at a level of significance 0.05 and market performance (β_{32} = 0.94, t-value = 11.39) has significant positive impact on financial performance at a level of significance 0.01.

5.2 Discussions

This study presents the systematic framework of the impacts of product innovation factors on the performance of new products both in radical and incremental product innovation. The results from hypothesis testing demonstrate many interesting points which can be discussed in details as follows.

5.2.1 ***Radical Product Innovation Based Performance Framework***

The results from the hypothesis testing reveal that vision (H_1), technological proficiency (H_7), and launch proficiency (H_9) have positive impacts on radical product innovation according to the proposed hypotheses. For consequences, radical product innovation (H_{13}) has a positive impact upon market performance and market performance (H_{14}) has a positive impact upon financial performance. These findings confirm the proposed hypotheses.

Academicians or managers who have responsibility to develop radical product innovation should focus on both internal and external factors. For internal factors, operational efficiency should be focused more than organization because two factors (technological proficiency and launch proficiency) in operational efficiency have an impact upon the development of radical product innovation, but only one factor in organization (vision) has an impact on the development of radical product innovation. In addition, technological proficiency has the highest impact on the development of radical product innovation. For external environment, demand uncertainty and technological turbulence should receive more attention on the development of radical product innovation. Discussions of the findings are as follows.

- **Organization**

Vision plays an important role for developing radical product innovation. Firms that have clear vision will help R&D and manufacturing teams to know the way to apply technology and know-how within firms to develop radical product. Vision provides the guideline for staffs who are involved with the development of radical product innovation. Vision that demonstrates the support of resources for the development of radical product innovation is required because a large investment is needed in technology and production process such as equipment and know-how for developing radical product innovation.

However, it is found that top management support (H_2) does not have an impact on radical product innovation. The explanation is that top managers may only suggest an opinion or strategy for new product development, but they may not support other resources for developing new products (Brentani and Kleinschmidt, 2004). Moreover, developing radical product innovation, new and various ideas from several departments and management levels may generate some conflicts between top management and development staffs. Manager may avoid these problems by postponing or canceling the development of radical product deviated from current product.

For centralization (H_3), this factor does not have an impact on radical product innovation. The plausible explanation could be that new ideas for developing new product to meet customer needs may come from development teams who are closer with customers than top management. Valuable information for developing radical new products always comes from the market (Schreier and Prugl, 2008). So, top management may accept the ideas and information from a development team to be the way for the development of radical product rather than top management assigns the working process to the development team for developing radical product.

The finding shows that formalization (H_4) does not have an impact on the development of radical product innovation. In the past, formalization was believed that it decreased the success of development of radical product innovation (Damanpour, 1991; Jaworski and Kohli, 1993). It was because formalization might limit the new ideas of a development team. However, well designed rules and regulations may make staffs to feel unity and cooperation among departments. Well designed regulations encourage staffs to work together and support and sacrifice to other staffs. These may be a positive attitude for bureaucratic and contribute of formalization (Alder and Borys, 1996). Besides, codification efforts of new ideas from internal organization (staffs) and external stimuli (customers, competitors, technological changes, etc.) in written rules and regulations might help firm to disseminate these new ideas to develop radical product innovation.

- **Operational Efficiency**

Technological proficiency is an important factor for developing radical product innovation. New product attributes, functions, and benefits that meet customer needed require proficiencies in technology such as R&D, know-how, engineering, and manufacturing in development process. So, the development of radical product innovation that offers superior benefits than existing products in the market needs technological proficiency.

Launch proficiency is also a key factor for developing radical product innovation because products that cannot commercialize do not count as "innovation" (Garcia and Calantone, 2002). Proficiency in launch strategy (segmentation, target, and positioning) and launch tactic (marketing mix) helps firm's new products superior than current products. These firms that have proficiency in launching new product can select appropriate marketing strategy and marketing mix to fit with the radical product innovation. Therefore, launch proficiency has essential for successful of radical product innovation.

It is found that predevelopment task (H_5) does not have impact on radical product innovation. The plausible explanation for contradicting result from proposed hypothesis may due that a long time period of developing radical product. The project planning may be adjusted, changed, and intervened, such as changing product concept or product screening process because of changing customer preferences during the development of a new product. Firms must adjust tasks to match with current situation rather than to match with past situation. These changes make the difference between predevelopment tasks and actual tasks for the development of radical product innovation (Salomo, Weise, and Gemünden, 2007). Therefore, predevelopment task may not influence the successful rate of radical product innovation if predevelopment tasks are different from actual tasks.

For an insignificant impact of cross-functional integration (H_6) on radical product innovation, the explanation is the extent to which varieties of perspectives and opinion on the customer needed of staffs from several departments in a developing team may mismatch. Each department has own objectives and perspectives which can shape different opinions, ideas, and perspective of staffs within department. As such, mismatch or disagreement of opinions and ideas among staffs, such as new product attributes, will lead to unsuccessful of developing radical products. In addition, frequent discussion among staffs in developing team may lead to unsuccessful development of radical products because developing teams can not conclude what new product attributes they should develop (Troy, Hirunyawipada, and Paswan, 2008).

Development speed (H_8) does not have a significant impact on radical product innovation. The plausible explanation for disagreement between proposed hypothesis and the finding is that too fast and too slow development speed can detriment new product innovation (Nohria and Gulati, 1996). Firms that define too short the development time for developing radical product can generate pressure to the development staffs. These staffs must increase their speed in developing new product which it can make error and misspecification of new products. On the contrary, too long the development time can harm new product of firms. New products of firms will encounter a problem of product obsolete from replacing new products from competitors which these new products of firms may be the same with or inferior than competitor's products in the eye of customers.

- **<u>External Environment</u>**

The results show that demand uncertainty and technological turbulence have a positive impact on the radical product innovation. These results are contradiction with the proposed hypotheses. Proposed hypotheses state that demand uncertainty and technological turbulence have a negative impact on radical product innovation. The explanations of these results are as follows.

Demand uncertainty (H_{10}) is found to have a positive impact on radical product innovation, but this finding opposes with proposed hypothesis. The alternative explanation of this contradicted result is the extent to which firms are stimulated or pressured to develop new products for their survival in the market. Rapid change in customer needs is the major factor that pressure and stimulate firms to develop new product to serve the customer needed. So, firms will develop radical products to serve the changing need of customers that benefits or attributes of radical product are not found from current products.

For technological turbulence (H_{11}), it is also found to have a positive impact on radical product innovation. This finding is opposed a proposed hypothesis. Although the success of radical products must offer superior benefit serving the needs of customers rather than offer the advantage of technology within products to customers. Latest technology may offer new benefits to customers that they do not know or see these benefits before if firms can apply these new technologies to be the features or attribute within radical product.

For government agency support (H_{12}), it is not found an impact on radical product innovation. This result is contrary with proposed hypothesis. The plausible explanation might be that firms rarely receive support from government agency. This argument was supported by report of International Institute for Management Development (IMD) in year 2008. The results revealed that scientific and technological infrastructure ranking of Thailand are ranked to 37^{th} and 43^{rd} in scientific and technological infrastructure, respectively (IMD, 2008). Besides, in Table 4.80, respondents rate mean of four measurement items of government agency support lower than 3 (disagree). For example, respondents rate the degree of government agency to give technological support to the company for use in new product development equal 2.95. The results in Table 4.80 are congruent with the study of IMD.

- **Consequences: Market and Financial Performances**

The results show the effect of radical product innovation on market performance. New product attributes and benefits from a customer perspective can gain the advantage of differentiation over competitors. Product advantages that have superior in benefits, attributes, quality, and functions than current products will increase market performance of firms. Moreover, increasing of market performance will increase financial performance of firms such as revenue, profit, and ROI. This result will stimulate firms to innovate radical product innovation so that firms can sustain their business in the long run.

5.2.2 Incremental Product Innovation Based Performance Framework

The findings of hypothesis testing of twelve antecedents demonstrate that centralization (H_3), formalization (H_4), and cross-functional integration (H_6) have a positive impact on incremental product innovation, which these findings support proposed hypotheses. For technological proficiency (H_7) and technological turbulence (H_{11}), the results show that technological proficiency and technological turbulence do not have an impact on incremental product innovation. These results consist with proposed hypothesis.

In addition, incremental product innovation (H_{13}) has a positively significant impact on market performance and market performance (H_{14}) has a positively significant impact on financial performance. These results confirm proposed hypotheses.

Academicians or managers who have responsibility to develop incremental product innovation should focus on both internal and external factors. For internal factors, organization should be focused more than operational efficiency because two factors (centralization and formalization) in organization have an impact on the development of incremental product innovation, but only one factor in operational efficiency (cross-functional integration) has an impact on the development of incrémental product innovation. For external environment, demand uncertainty should be focused on the development of incremental product innovation. Discussions of the findings are as follows.

- **<u>Organization</u>**

Centralization and formalization have a positive impact on incremental product innovation. For centralization, this factor affects to incremental product innovation. Incremental product innovation is developed from existing product. Small changes in attributes and the improvements from current product are the characteristics of developing incremental product innovation. Successful of incremental product innovation is depended on quick response to the market before new products of firms are obsolete by competitors' products (Jansen, Van Den Bosch, and Volberda, 2006). Decision-making from management level will increase the effectiveness of developing incremental product innovation because it increases the speed of decision-making and assigns a complete guideline for developing new products.

For formalization, developing incremental product innovation involves with the use of existing routing job because it involves with improving attributes from current products. Formalization can increase the efficiency of developing incremental product innovation by regulating the rules and procedures. Rules and procedures reduce variation of working process which staffs can follow these rules and procedures.

Nevertheless, opposing with hypothesis, vision (H_1) does not have an impact on incremental product innovation. The explanation is that incremental product is modified from current products, as it already has a clear vision how to modify. Resources for developing incremental product, such as production process, material, or staffs, may be the same with current job. So, vision that demonstrates supporting resources for the development of incremental product may not need.

Top management support (H_2) does not have an impact on incremental product innovation. The explanation could be that improving or developing existing product may not require supporting from top management because extra resources may not be required for developing incremental product. Also, the development of incremental product may use existing resources. Suggestions or stimulations from top management may not essential as development teams already know how to improve existing product. Confirmed with the empirical study of Lynn and Akgün (2001), they reveal that support within team members is the major factor for the development of incremental product not support from top management.

- **Operational Efficiency**

Cross-functional integration has impacted on incremental product innovation. The benefit of cooperation within development team from various departments (such as R&D, manufacturing, marketing, finance, and other departments) is sharing information, ideas, and problem-solving for best practice in developing new product. Information and opinion that are exchanged within development staffs for developing incremental product innovation are based on current products. Within development staffs, they have low conflicts or disagreement because ideas and opinion are not much deviated from existing product. Therefore, exchanging information and skills that are useful for developing incremental product innovation can reduce redesign of new product, decrease development time, shrink of cost of development and increase the opportunity to develop new product to meet the customer needed.

Technological proficiency does not have an impact on incremental product innovation. This finding is congruence with the proposed hypothesis. The reason is the extent to which incremental product innovation has minor changes in product benefits or attributes. Technological proficiency in the product process such as R&D and manufacturing process may not be required for developing such products.

For, predevelopment task (H_5), it is not found an impact on incremental product innovation. The plausible explanation is the extent to which incremental product innovation is continuously developed from existing products. Firms may not require predevelopment task because processes of improving existing products may not change present processes or change patterns of current products. For example, including new benefits attributes for existing products may not need to test a product concept or not need to do product screening.

Development speed (H_8) does not have an impact on incremental product innovation. The explanation could be that development speed is a major factor for a success of the development of incremental product innovation. Firms try to develop incremental product as fast as possible to evade from a problem of product obsolete. Because information of market is necessary for developing new product, firms will exchange information with their distributors rather than firms' customers to increase speed of the development. Speed of developing new products increase because firms and distributors collaborate to identify and resolve problems of developing new product (Fang, 2008). However, increasing speed of developing new product can reduce a successful rate of new products. Information sharing between firms and their customers is scarcity if firms pay too much attention to increase development speed. Firms may lack useful information to improve existing products. Hence, the combination of positive and negative effects of development speed may generate an insignificant impact of development speed on the development of incremental product.

For launch proficiency (H_9), it is not found an impact on incremental product innovation. The explanation for the opposed finding could be that launch proficiency, such as ability to define appropriate target market and advertising, may not required for an incremental product innovation. Incremental product is developed from existing products, so customers can perceive additional benefits of new products without advertising or other information from firms. Further, the objective of developing incremental product innovation is to server the needs of current market (Banbury and Mitchell, 1995). Firms may not take an effort with launching activities for incremental product innovation in the current market because customer can perceive benefits of new products that based on existing products.

- **External Environment**

Technological turbulence does not have an impact on incremental product innovation which this finding is consistent with proposed hypothesis. The objective of firms to introduce incremental product innovation is to maintain customers in existing market. Customers in stable market do not change their preferences from existing product to much (Olshavsky and Spreng, 1996). Adding some benefits or attributes derived from late technologies within new product may not match with customer preferences or may not be accepted from customers in current market.

However, the impact of demand uncertainty (H_{10}) on incremental product innovation is contrary with proposed hypothesis. The explanation deviated from proposed hypothesis might be that the main market of incremental product is stable market or existing market which has little bit changes in customer preferences. Nevertheless, firms should consider these changes so that firms use these changes to be a guideline to develop new products to meet a new demand of customers in stable market. The benefits of firms that have continuously improved their existing products are: taking advantage over competitors in the market, increasing their market and financial performances, and increasing their survival rate in the current market.

Government agency support (H_{12}) does not have an impact on incremental product innovation. The explanation is similar with the result in radical product innovation based performance framework. Another explanation is a lack of incentive to receive a major support of firms that do not have new creations (Stuart, Hoang, and Hybels, 1999). In the eye of government agency, firms that developing incremental product lack motivation to support necessary resources because these firms do not have newly creative products introducing to the market. Further, the results in Table 4.81 show that low government agency support in the eyes of respondents who develop incremental product comparing with respondents who develop radical product innovation. For example, respondents, who develop radical product, average rate financial support for the firms developing new product from government agency (GOV4) equal 2.50. But respondents, who develop incremental product, average rate financial support for the firms developing new product from government agency equal 2.06.

- **Consequences: Market and Financial Performances**

The findings show that incremental product innovation increases market performance of firms. Although incremental product innovation has minor changes in benefits and attributes from existing products, it still has product advantage. Therefore, incremental product innovation will improve market performance because products that have advantage over competitors increase firms' performance. Moreover, increasing market performance will increase financial performance of firms. This result will encourage firms to innovate incremental product innovation so that firms can survive in the long run.

The effect of type of industry is minimal in this study. A result of testing mean differences among type of industry for each construct is shown in Chapter 4. From Table 4.7, there are six constructs (VIS, TOP, PRE, TECT, GOV, and RAD) from sixteen construct that have mean differences among industries. A researcher investigates the effect of type of industry in more detail for each type of product innovation. For radical product innovation, there is only one construct (GOV) that have a mean difference among industries. In the same way, for incremental product innovation, there is only one construct (INC) that have a mean difference among industries.

Other variables (firm's income, firm size, and firm age) do not have impact on a radical and incremental product innovation. The results are shown in Table 4.10 up to Table 4.18. For radical product innovation, all constructs have an equality of means among groups of firm age. One construct (MP) has mean difference among groups of firm's income. One construct (CRO) has mean difference among groups of firm size. Likewise, for incremental product innovation, all constructs have an equality of means among groups of firm's income. Only one construct (INC) has a mean difference among groups of firm size. Five constructs (VIS, PRE, SPD, DEM, and INC) have mean difference among groups of firm age. In summary, a majority of constructs in this study do not have an impact on these three variables. So, these variables are not included as control variables into radical and incremental product innovation based performance framework to reduce a complexity of structural model.

Structural equation modeling is used to analyze the impact of each construct in the proposed framework requiring large sample size for stable solution (Hair et al., 2006), generalization (MacCallum and Austin, 2000) and explanatory power (MacCallum, Browne, and Sugawara, 1996). Weston and Gore Jr. (2006) suggest that a minimum sample size for SEM should be 200. Hence, sample size of radical product innovation based performance framework (204 samples) is considered adequately enough.

However, low sample size of incremental product innovation based performance framework (122 samples) may provide unstable solution and low statistical power to test hypotheses in this model. Boomsma and Hoogland (2001) suggest that a number of sample size lower than 200 generate problems of nonconvergence and improper solution. However, incremental product innovation based performance framework has not been affected by these problems. The reasons are that the results of estimated parameters of incremental product innovation based performance framework are convergence. Also, variances of all observed variables of incremental product innovation based performance framework are positive. Further, problems of nonconvergence and improper solution are not occurred in this model because of reliability and validity of measurement model (Boomsma and Hoogland, 2001). In addition, Boomsma (1987) reveals that maximum likelihood estimation with LISREL is robust if sample size is greater than 100. Therefore, the results of incremental product innovation based performance framework are reliable and valid. Nevertheless, interpreting the results must be done with caution.

5.3 Theoretical Contributions

The empirical results of this study increase the understanding how the product innovation factors impact on a product innovation and the impact of a product innovation on the performance of firms on the context of radical and incremental product innovation from the customer perspective. The major contributions for marketing literature are discussed.

The systematic frameworks for each type of product innovation from the customer perspective can be obtained. In the past, many studies proposed models and frameworks to explain the impact of product innovation factors on a radical product innovation (Cooper and Kleinschmidt, 1987; Song and Parry, 1997; Zhou, Yim, and David, 2005), but a systematic framework for an incremental product innovation from the customer perspective was scarcity (Bhaskaran, 2006; Wind and Mahajan, 1997). Hence, this study creates the frameworks to simultaneously explain the impact of antecedents, mediator, and consequences both radical and incremental from the customer perspective. Further, this study fills a gap of shortage literature of incremental product innovation. The empirical findings reveal that antecedents of radical product innovation based performance framework are vision, technological proficiency, launch proficiency, demand uncertainty, and technological turbulence. Centralization, formalization, cross-functional integration, and demand uncertainty are antecedents of incremental product innovation based performance framework. For consequences, market and financial performance are consequences of both radical an incremental product innovation based performance framework.

Past studies concentrated on specific product innovations factors that impacted on product innovation. For example, Lynn and Akgün (2001) investigated the effect of vision on product innovation. Relationships between centralization and product innovation and between formalization and product innovation were explored by Jansen, Van Den Bosch, and Volberda (2006). Olson et al. (2001) examined the relationship between cross-functional integration among departments and product innovation. This study, therefore, combines product innovation factors for developing new product from the customer perspective as much as possible in radical and incremental product innovation based performance frameworks. These factors were expected to be potential factors of developing new products from previous literature. Consequently, these frameworks provide insights into the antecedents of radical and incremental product innovation from the customer perspective better than previous product innovation literature in the past.

The impact of product innovation factors on product innovation from the customer perspective that had not been empirically tested before in the past would be understood. In knowledge of a researcher, for radical product innovation, predevelopment task, launch proficiency, and government agency support were not investigated previously. In contrast, predevelopment task, technological proficiency, launch proficiency, demand uncertainty, technological turbulence, and government agency support were not studied earlier for incremental product innovation. The empirical results of this study uncover the impact of these factors on radical and incremental product innovation.

The enhancement of the frontier of knowledge in the resource-based view theory, contingency theory, social capital theory, and concept of competitive advantage can be expected. With resource-based view theory, firms must evaluate resources within firms because resources required for developing new product are depended on what type of product innovation. The findings of this study provide a strong support RBV theory that internal resources are required for developing new products. Necessary resources for developing radical product innovation are vision, technological proficiency, and launch proficiency, but centralization, formalization, and cross-functional integration are resources required for developing incremental product innovation. The different resources for developing radical and incremental product innovation were congruent noted by Veryzer (1998). This study indicates that RBV can be applied in emerging market such as Thailand and China (Atuahene-Gima, 2005). Previous product innovation literature suggested that RBV could be applied in developed countries especially in US (Li and Calantone, 1998) and Europe (Kleinschmidt, de Brentani, and Salomo, 2007). In addition, RBV was also applied in developed countries in Asia (Lee, Lee, and Pennings, 2001). Thus, the findings demonstrate consistency of application of RBV across emerging markets and developed countries.

Contingency theory explains the effects of external environment on the success of the development of new product (Zeithaml, Varadarajan, and Zeithaml, 1988). The results confirm contingency theory. External environment has an impact on product innovation especially in radical product innovation. Understanding the impact of external environment helps firms to define appropriate firms' strategies to cope with turbulences from outside firms (Dess, Lumpkin, and Covin, 1997). These turbulences can either damage or increase the success of firms in developing new product.

The results, however, do not support social capital theory. A possible explanation for the deviation from theory may be that, firms located in Thailand lack of government agency support for the development of new product. This argument is supported by several indicators. For instance, scientific infrastructure in Thailand was ranked to 37th from 55 countries in 2008 (IMD, 2008). Similarly, Thailand was ranked to 43rd in technological infrastructure (IMD, 2008). Although government agency support does not have an impact on the development of new products of firms located in Thailand, cooperation between private and public sectors make a success to the development of new product in developed countries. For example, Kleyn, Kitney, and Atun (2007) revealed that partnership between firm and university could increase the successful rate of developing new product. Therefore, social capital theory might be supported if these frameworks are investigated in developed countries or in industrial sectors that government agency have fully supported for the development of new products.

The concept of competitive advantage is strongly supported in this study. The results show that new products, which sending superior benefits to firms' customers, increase market and financial performance of firms. Porter (1985) suggested that product differentiation was one of the sources of competitive advantage. Firms, which had competitive advantage over competitors, could enjoy benefits from their advantage, such as market and financial performances (Day and Wensley, 1988). Moreover, they could sustain and survive their businesses in the long run by continuously investment (Bharadwaj, Varadarajan, and Fahy, 1993) to maintain their competitive advantage.

Lastly, the measures of radical and incremental product innovation have been developed to fit with the constructs. In order to differentiate characteristics of radical and incremental product innovation, this study overcomes the problems of poorly defined constructs which deteriorate reliability and validity of results (MacKenzie, 2003). A researcher designs the measurement items to fit with characteristics of each type of product innovation. The results of this study, consequently, are more reliable and valid.

5.4 Managerial Contributions

Managers who are involved with the development of new product can achieve benefits from the results of this study as follows.

Due to the fact that firms have limited resources, firms can utilize these limited resources to success in developing new products if firms can identify factors in developing new products for each type of product innovation from the customer perspective. Additionally, firms can reduce using resources in unnecessary factors for developing new product which it has effect on performance of new product, such as revenue and profit. Radical and incremental product innovation based performance frameworks provide managers how to utilize resources within firms according to firms' strategies.

Further, managers can define the appropriate strategy to fit with resources within firms. For example, it may be hard for small and medium firms or new firms to develop radical product innovation because it requires large and superior resources which these firms lack of these resources. Developing incremental product may be suitable strategy for these firms, as firms concentrate to invest resources only in centralization, formalization, and cross-functional integration. On the other hand, firms desired to develop radical product must focus on the investment in vision, technological proficiency, and launch proficiency. In addition, managers must concern external environment such as demand uncertainty and technological proficiency. Demand uncertainty has an impact on both radical and incremental product innovation, but technological turbulence has an impact only on radical product innovation.

Managers can identify the effect of product innovation on the performance of firms. Increasing of performances motivates firms to develop new products. This study shows that radical and incremental product innovation increase both market and financial performance because firms increase their competitive advantage by differentiating firms' new products from firms' competitors. Moreover, firms should sustain their competitive advantage in the long run by reinvesting in firms' resources. Specially, small and medium firms or new firms, which desire to survive in the market, must continuously reinvest their resources so that they can develop new product to differentiate from competitors for improving their performances in the long run.

5.5 Limitations

Although there are a number of important findings, this study has a few limitations which are described as follows:

Firstly, the data collection in this study has been conducted in only five industrial sectors (agriculture, biotechnological, energy, food, and pharmaceutical sectors). Consequently, generalizability the results beyond the scope of this study cannot be made.

Secondly, this study encounters a low response rate (approximately 20%). Even though, a researcher had tried to increase the response rate as much as possible for reliability and validlidity of the findings. Various methods for increasing response rate are made by using telephone and personal contract of a researcher.

Thirdly, in practice, firms have a variety of products. It is hard to find firms which have only one product in this study. So, a researcher focuses on a product of firms that have the highest innovation. The finding may be limited for radical product innovation because samples in this framework are combined with firms developing either radical product or radical and incremental product.

5.6 Future Research

Future research should investigate the meaning of radical and incremental product innovation using the opinion of customers (Tellis, Prabhu, and Chandy, 2009). Firms and researchers will better understand a product innovation in the eyes of customer. The literature defined product innovation from the researchers' perspective (Booz, Allen, Hamilton, 1982) or from the firms' perspective (Govindarajan and Kopalle, 2006) but did not define product innovation from the customers' perspective.

The survey is conducted with firms located in Thailand in five industries sectors: agriculture, biotechnological, energy, food, and pharmaceutical. Therefore, the generalizability of radical and incremental product innovation based performance framework may be limited. So, survey in different industrial sectors for future research is required to expand the usefulness of these findings.

Most previous innovation literature took place in developed countries, but this study is done in a developing country. Can radical and incremental product innovation based performance framework developed in a developing country be applied in developed countries? Future research may examine the application of radical and incremental product innovation based performance framework in a developed country so that the study can increase generalizability of the findings.

To measure the impact of product innovations on market and financial performance, it takes a long time to capture these impacts (Chandy and Tellis, 1998). A longitudinal study may be done to capture these impacts in future study to increase the explanatory power. The longitudinal research also helps to understand the dynamic changes of the impact of new product on performances over time.

Which one performs better performances between radical and incremental product innovation? This question should be investigated in future research because firms can decide what type of new product they should develop for the highest performance of firms. Classifying type of performances (market and financial performance) for analysis enhances the understanding the effect of radical and incremental product innovation on performances of firms.

5.7 Summary

This Chapter describes the conclusions, discussions, theoretical and managerial contributions, limitations, and future research. The results of the study both radical and incremental product innovation based performance framework are discussed. Theoretical and managerial contributions for academics and practitioners are revealed. Finally, a researcher recognizes the limitations of the study and suggests different issues in product innovation for future research.

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APPENDICES

APPENDIX A

LETTER OF REQUESTING INFORMATION

LETTER OF REQUESTING INFORMATION

วันที่

เรื่อง ขอความอนุเคราะห์ในการตอบแบบสอบถาม

เรียน

สิ่งที่ส่งมาด้วย แบบสอบถามและซองจดหมาย

ด้วย ***นายดนุพล หุ่นโสภณ*** นิสิตหลักสูตรปริญญาเอกร่วมสาขาบริหารธุรกิจ ซึ่งเป็นโครงการความร่วมมือผลิตบัณฑิตระดับปริญญาเอกระหว่างจุฬาลงกรณ์มหาวิทยาลัย มหาวิทยาลัยธรรมศาสตร์ และสถาบันบัณฑิต พัฒนบริหารศาสตร์ (NIDA) กำลังดำเนินการทำวิทยานิพนธ์ระดับปริญญาเอกในหัวข้อ ***"The Empirical Study of the Impacts of Product Innovation Factors on Performance of New Products: Radical and Incremental Product Innovation"*** โดยมีวัตถุประสงค์เพื่อศึกษาอิทธิพลของการจัดการนวัตกรรมที่มีผลต่อการประกอบธุรกิจของบริษัทฯ

ในฐานะอาจารย์ที่ปรึกษาของนิสิต ดิฉันจึงใคร่ขอความอนุเคราะห์จากท่าน/ผู้บริหารที่เกี่ยวข้องกับการพัฒนาสินค้าใหม่ในบริษัทของท่าน เพื่อโปรดให้ความอนุเคราะห์ในการตอบแบบสอบถามฉบับนี้ และขอความกรุณาท่านส่งแบบสอบถามคืนโดยใช้ซองจดหมายตามที่ผู้วิจัยได้จัดเตรียมไว้ให้ท่านแล้วภายใน**วันที่ 20 มีนาคม 2552** ทั้งนี้ ข้อมูลที่ท่านได้ให้ความอนุเคราะห์ในแบบสอบถาม ผู้วิจัยจะใช้เพื่อการศึกษาในเรื่องนี้เท่านั้น และทางผู้วิจัยจะจัดเก็บรักษาข้อมูลของบริษัทของท่านไว้เป็นความลับอย่างยิ่ง ***และเพื่อเป็นการขอบคุณที่ท่านกรุณาสละเวลาในการตอบแบบสอบถาม ผู้วิจัยจะจัดส่งผลสรุปสำหรับผู้บริหารมายังท่านเมื่องานวิจัยชิ้นนี้แล้วเสร็จสมบูรณ์***

อนึ่ง หากท่านมีข้อสงสัยประการใดในแบบสอบถามชุดนี้ ขอความกรุณาสอบถามได้ที่ ***นายดนุพล หุ่นโสภณ*** ที่เบอร์โทรศัพท์ หรือ E-mail: ดิฉันหวังเป็นอย่างยิ่งว่าท่านจะกรุณาให้ความอนุเคราะห์แก่นิสิตในการตอบแบบสอบถามชุดนี้และขอขอบพระคุณท่านเป็นอย่างสูงมา ณ โอกาสนี้

ขอแสดงความนับถือ

(รองศาสตราจารย์ ดร. กุณฑลี รื่นรมย์)
หัวหน้าภาควิชาการตลาด
คณะพาณิชยศาสตร์และการบัญชี จุฬาลงกรณ์มหาวิทยาลัย
อาจารย์ที่ปรึกษาวิทยานิพนธ์

APPENDIX B

QUESTIONNAIRE (THAI VERSION)

QUESTIONNAIRE (THAI VERSION)

แบบสอบถาม

การศึกษาเชิงประจักษ์ของผลกระทบของปัจจัยที่ก่อให้เกิดนวัตกรรมซึ่งมีผลต่อการดำเนินงานของผลิตภัณฑ์ใหม่: นวัตกรรมแบบสมบูรณ์และนวัตกรรมแบบค่อยเป็นค่อยไป

ส่วนที่ 1 ข้อมูลทั่วไปของบริษัท

1. ชื่อผู้กรอกแบบสอบถาม________________________________

2. บริษัท________________________________

3. ตำแหน่ง________________________________

4. จำนวนพนักงานประจำของบริษัทท่านโดยประมาณ____________ คน

5. บริษัทก่อตั้งในปี พ.ศ.________________________________

6. รายได้ของบริษัทในปี 2550 ประมาณ____________________ บาท

7. บริษัทของท่านมีการพัฒนาสินค้าใหม่ อาทิเช่น ***ผลิตสินค้าใหม่ที่บริษัทไม่เคยผลิตขึ้นมาก่อนเลยหรือเป็นสินค้าที่พัฒนาปรับปรุงจากสินค้าเดิม***ภายในบริษัท ออกสู่ตลาด***ในช่วง 2 ปีที่ผ่านมา หรือไม่***

❒ มี ❒ ไม่มี

8. ถ้าท่านตอบว่า***มี***ในข้อที่ 7 จำนวนหรือประเภทสินค้าใหม่ที่ท่านวางจำหน่ายในตลาดมีจำนวน ______________ ชิ้น/ประเภท

9. สินค้าที่มีการพัฒนาหรือปรับปรุงใหม่ที่ท่านคิดว่า***เด่นที่สุด***ในบริษัทได้แก่ (ให้ระบุชื่อสินค้าหรือประเภทของสินค้าเพียง "1" ชนิด/ประเภท)________________________________

10. ท่านคิดว่าลูกค้าของท่านมองว่า***สินค้าใหม่หรือสินค้าที่ได้มีการพัฒนาปรับปรุงของบริษัทในข้อที่ 9. มีความแตกต่างจากสินค้าอื่นที่มีอยู่ในตลาด***แค่ไหน กรุณาทำเครื่องหมาย ✓ เพื่อแสดงความคิดเห็นของท่านลงในสเกลข้างล่างนี้ซึ่งมีอยู่ 6 ช่วง ได้แก่ ***"1=แตกต่าง น้อยที่สุด และ 6= แตกต่างมากที่สุด"***

1	2	3	4	5	6

ถ้าท่านทำเครื่องหมายในช่องที่ *<u>"1 หรือ 2 หรือ 3"</u>* กรุณาตอบคำถามในส่วนที่ *<u>"2 และ 3"</u>* เท่านั้น
ถ้าท่านทำเครื่องหมายในช่องที่ *<u>"4 หรือ 5 หรือ 6"</u>* กรุณาตอบคำถามในส่วนที่ *<u>"2 และ 4"</u>* เท่านั้น

ส่วนที่ 2 ทัศนคติของท่านในด้านต่างๆ

2.1 ท่านเห็นว่าสินค้าใหม่ของท่านบรรลุวัตถุประสงค์ในด้านเหล่านี้เพียงไร	เห็นด้วยน้อยที่สุด → เห็นด้วยมากที่สุด
1. ปริมาณสินค้าใหม่ที่ขายได้เป็นไปตามเป้าหมายของบริษัท	1 2 3 4 5 6 7
2. กำไรที่ได้รับจากการขายสินค้าใหม่เป็นไปตามเป้าหมายของบริษัท	1 2 3 4 5 6 7
3. รายได้ที่ได้รับจากการขายสินค้าใหม่เป็นไปตามเป้าหมายของบริษัท	1 2 3 4 5 6 7
4. การยอมรับจากลูกค้าต่อสินค้าใหม่เป็นไปตามเป้าหมายของบริษัท	1 2 3 4 5 6 7
5. ความพึงพอใจของลูกค้าต่อสินค้าใหม่เป็นไปตามเป้าหมายของบริษัท	1 2 3 4 5 6 7
6. ความสามารถสร้างส่วนแบ่งตลาดของสินค้าใหม่เป็นไปตามเป้าหมายของบริษัท	1 2 3 4 5 6 7
7. จำนวนลูกค้าที่เพิ่มขึ้นหลังจากทำการขายสินค้าใหม่เป็นไปตามเป้าหมายของบริษัท	1 2 3 4 5 6 7

2.2 ท่านเห็นว่าวิสัยทัศน์ของบริษัทท่านมีลักษณะอย่างไร	เห็นด้วยน้อยที่สุด → เห็นด้วยมากที่สุด
1. มีวิสัยทัศน์ที่ชัดเจนเกี่ยวกับลักษณะสินค้าใหม่ที่ต้องการผลิต	1 2 3 4 5 6 7
2. มีความเข้าใจที่ชัดเจนถึงความต้องการของลูกค้ากลุ่มเป้าหมาย	1 2 3 4 5 6 7
3. มีวัตถุประสงค์ร่วมกันในทุกแผนกที่เกี่ยวข้องกับการผลิตสินค้าใหม่	1 2 3 4 5 6 7
4. มีนโยบายที่ชัดเจนและมั่นคงเกี่ยวกับเป้าหมายของสินค้าใหม่ตั้งแต่แนวคิดของสินค้าจนกระทั่งวางจำหน่าย	1 2 3 4 5 6 7

2.3 ท่านเห็นว่าการสนับสนุนจากผู้บริหารตั้งแต่ระดับผู้จัดการขึ้นไปในการผลิตสินค้าใหม่เป็นอย่างไร	เห็นด้วยน้อยที่สุด → เห็นด้วยมากที่สุด
1. ให้การสนับสนุนทรัพยากรที่ใช้ในการพัฒนาสินค้าใหม่อย่างเต็มที่	1 2 3 4 5 6 7
2. ให้คำแนะนำเกี่ยวกับแนวทางในการพัฒนาสินค้าใหม่	1 2 3 4 5 6 7
3. กระตุ้นให้พนักงานเสนอความคิดเห็นที่สร้างสรรค์เกี่ยวกับการพัฒนาสินค้าใหม่ภายในบริษัทอย่างต่อเนื่อง	1 2 3 4 5 6 7

2.4 ท่านเห็นว่าการกระจายอำนาจภายในบริษัทท่านเป็นอย่างไร	เห็นด้วยน้อยที่สุด → เห็นด้วยมากที่สุด
1. ผู้จัดการระดับกลางและล่างมีอิสระในการทำงานภายในขอบเขตที่เหมาะสม	1 2 3 4 5 6 7
2. ผู้จัดการระดับกลางและล่างมีอิสระในการตัดสินใจภายในขอบเขตที่เหมาะสม	1 2 3 4 5 6 7
3. ปัญหาที่เกิดขึ้นระหว่างการพัฒนาสินค้าได้รับการแก้ไขตามลำดับขั้นการบังคับบัญชาภายในขอบเขตที่เหมาะสม	1 2 3 4 5 6 7

2.5 ท่านเห็นว่ารูปแบบการบริหารงานภายในบริษัทท่านเป็นอย่างไร	เห็นด้วยน้อยที่สุด → เห็นด้วยมากที่สุด
1. ความรับผิดชอบของพนักงานแต่ละคนถูกกำหนดไว้อย่างชัดเจน	1 2 3 4 5 6 7
2. บริษัทกำหนดแนวทางการทำงานของพนักงานไว้อย่างชัดเจน	1 2 3 4 5 6 7
3. มีเอกสารเป็นลายลักษณ์อักษรเมื่อต้องการติดต่อสื่อสารระหว่างแผนกต่างๆ	1 2 3 4 5 6 7

2.6 ก่อนที่จะเริ่มการพัฒนาสินค้าใหม่บริษัทของท่านได้มีการดำเนินงานในประเด็นต่อไปนี้	เห็นด้วยน้อยที่สุด → เห็นด้วยมากที่สุด
1. มีการประเมินเบื้องต้นเกี่ยวกับความต้องการของสินค้าในตลาด	1 2 3 4 5 6 7
2. มีการประเมินเบื้องต้นว่าแนวความคิดของสินค้าใหม่สอดคล้องกับนโยบายของบริษัท	1 2 3 4 5 6 7
3. มีการนำแนวคิดสินค้า (product concept) ที่ผ่านการประเมินมาแล้วมาบรรจุเป็นแผนธุรกิจของบริษัท	1 2 3 4 5 6 7
4. มีการประเมินเบื้องต้นเกี่ยวกับความพร้อมในด้านเครื่องมือและเทคโนโลยีภายในบริษัท	1 2 3 4 5 6 7
5. มีการกำหนดหน้าที่และความรับผิดชอบแก่ผู้บริหารและพนักงานที่จะพัฒนาสินค้าใหม่นั้น	1 2 3 4 5 6 7
6. มีการสนับสนุนงบประมาณที่จะใช้ในการพัฒนาสินค้าใหม่หรือปรับปรุงสินค้าให้ดีขึ้น	1 2 3 4 5 6 7
7. มีการพิจารณาการออกแบบและคุณลักษณะของสินค้าใหม่ก่อนการผลิตจริง	1 2 3 4 5 6 7

2.7 ท่านเห็นว่าการประสานงานระหว่างแผนกหรือหน่วยงานต่างๆภายในบริษัทท่านเป็นอย่างไร	เห็นด้วยน้อยที่สุด → เห็นด้วยมากที่สุด
1. ทุกแผนกให้ความร่วมมือเป็นอย่างดีในการพัฒนาสินค้าใหม่	1 2 3 4 5 6 7
2. มีการปรึกษาปัญหาที่เกิดขึ้นระหว่างแผนกอย่างสม่ำเสมอในช่วงของการพัฒนาสินค้าใหม่	1 2 3 4 5 6 7
3. การตัดสินใจในเรื่องต่างๆระหว่างการพัฒนาสินค้าใหม่เกิดจากความเห็นร่วมกันระหว่างแผนกต่างๆ	1 2 3 4 5 6 7

2.8 ท่านเห็นว่าความเชี่ยวชาญด้านเทคโนโลยีในการผลิตสินค้าใหม่ของบริษัทเป็นอย่างไร	เห็นด้วยน้อยที่สุด → เห็นด้วยมากที่สุด
1. มีการใช้เทคโนโลยีที่ทันสมัยในการพัฒนาสินค้า	1 2 3 4 5 6 7
2. มีการสร้างต้นแบบหรือตัวอย่างของสินค้าเพื่อการทดสอบก่อนผลิตสู่ตลาด	1 2 3 4 5 6 7
3. มีการควบคุมคุณภาพของสินค้าในกระบวนการผลิตเป็นอย่างดี	1 2 3 4 5 6 7

2.9 ท่านเห็นว่าระยะเวลาการพัฒนาสินค้าใหม่ของบริษัทท่านเป็นอย่างไร	เห็นด้วยน้อยที่สุด → เห็นด้วยมากที่สุด
1. สามารถใช้เวลาในการพัฒนาสินค้าใหม่ได้เร็วขึ้นเมื่อเทียบกับระยะเวลาการพัฒนาสินค้าของบริษัทใน อดีต	1 2 3 4 5 6 7
2. สามารถใช้เวลาในการพัฒนาสินค้าใหม่ได้เร็วขึ้นเมื่อเปรียบเทียบกับระยะเวลาการพัฒนาสินค้าของคู่แข่งที่มีลักษณะใกล้เคียงกัน	1 2 3 4 5 6 7
3. ท่านมีความพึงพอใจต่อระยะเวลาการพัฒนาสินค้าใหม่ในปัจจุบัน	1 2 3 4 5 6 7

2.10 ท่านเห็นว่าบริษัทมีความสามารถด้านการนำสินค้าใหม่ออกจำหน่ายในท้องตลาดเป็นอย่างไร	เห็นด้วยน้อยที่สุด → เห็นด้วยมากที่สุด
1. มีการจัดสรรงบประมาณสำหรับการนำสินค้าใหม่สู่ตลาด	1 2 3 4 5 6 7
2. สามารถเลือกกลุ่มลูกค้าเป้าหมายสำหรับสินค้าใหม่ได้อย่างเหมาะสม	1 2 3 4 5 6 7
3. สามารถเลือกการวางตำแหน่งของสินค้าใหม่ได้อย่างเหมาะสม	1 2 3 4 5 6 7
4. สามารถเลือกกลยุทธ์ในการตั้งราคาสินค้าใหม่ได้อย่างเหมาะสม	1 2 3 4 5 6 7
5. สามารถเลือกกลยุทธ์ด้านช่องทางการจัดจำหน่ายสำหรับสินค้าใหม่ได้อย่างเหมาะสม	1 2 3 4 5 6 7
6. สามารถเลือกกลยุทธ์ด้านการส่งเสริมการตลาดสำหรับสินค้าใหม่ได้อย่างเหมาะสม	1 2 3 4 5 6 7

2.11 ท่านเห็นว่าการเปลี่ยนแปลงความต้องการของลูกค้าในตลาดเป็นอย่างไร	เห็นด้วยน้อยที่สุด → เห็นด้วยมากที่สุด
1. ลูกค้าของบริษัทมองหาสินค้าใหม่ๆเพื่อตอบสนองความต้องการของพวกเขาตลอดเวลา	1 2 3 4 5 6 7
2. สินค้าใหม่ของบริษัทเป็นที่ต้องการของกลุ่มลูกค้าที่ไม่เคยซื้อสินค้าของบริษัทมาก่อน	1 2 3 4 5 6 7
3. กลุ่มลูกค้าใหม่และกลุ่มลูกค้าเก่าของบริษัทมีความต้องการสินค้าใหม่ที่แตกต่างกัน	1 2 3 4 5 6 7

2.12 ท่านเห็นว่าการเปลี่ยนแปลงของเทคโนโลยีในปัจจุบันเป็นอย่างไร	เห็นด้วยน้อยที่สุด → เห็นด้วยมากที่สุด
1. เทคโนโลยีของอุตสาหกรรมที่บริษัทดำเนินการอยู่มีการเปลี่ยนแปลงอย่างรวดเร็ว	1 2 3 4 5 6 7
2. เทคโนโลยีที่เปลี่ยนแปลงสามารถสร้างโอกาสกับบริษัท	1 2 3 4 5 6 7
3. เกิดแนวความคิดของสินค้าใหม่เป็นจำนวนมากภายในบริษัทเนื่องจากการเปลี่ยนแปลงเทคโนโลยีในอุตสาหกรรม	1 2 3 4 5 6 7

2.13 ท่านเห็นว่าความช่วยเหลือที่ท่านได้รับจากหน่วยงานของรัฐเป็นอย่างไร	เห็นด้วยน้อยที่สุด → เห็นด้วยมากที่สุด
1. ภาครัฐสนับสนุนข้อมูลที่เป็นประโยชน์ในการพัฒนาสินค้าใหม่ให้กับบริษัท	1 2 3 4 5 6 7
2. ภาครัฐสนับสนุนเทคโนโลยีที่ใช้ในการพัฒนาสินค้าใหม่ให้กับบริษัท	1 2 3 4 5 6 7
3. ภาครัฐสนับสนุนความรู้ด้านการบริหารจัดการที่ใช้ในการพัฒนาสินค้าใหม่ให้กับบริษัท	1 2 3 4 5 6 7
4. ภาครัฐสนับสนุนเงินทุนหรือแหล่งเงินทุนในการพัฒนาสินค้าใหม่ให้กับบริษัท	1 2 3 4 5 6 7
5. ภาครัฐให้ความช่วยเหลือด้านภาษีในการพัฒนาสินค้าใหม่ของบริษัท	1 2 3 4 5 6 7

ส่วนที่ 3 สำหรับผู้ที่ตอบคำถามข้อที่ 10 ในช่องที่ 1 หรือ 2 หรือ 3

ท่านเห็นว่าสินค้าใหม่ของบริษัทท่านเป็นอย่างไร	เห็นด้วยน้อยที่สุด			→			เห็นด้วยมากที่สุด
1. สินค้าใหม่มีการปรับปรุงเพียงเล็กน้อยเมื่อเทียบกับสินค้าของคู่แข่งที่มีอยู่ในท้องตลาดในทัศนะของลูกค้า	1	2	3	4	5	6	7
2. ประโยชน์ที่ได้รับจากสินค้าใหม่มีการเปลี่ยนแปลงเพียงเล็กน้อยในทัศนะของลูกค้า	1	2	3	4	5	6	7
3. เป็นการพัฒนาปรับปรุงสินค้าที่มีอยู่ในปัจจุบันให้ตรงกับความต้องการของลูกค้าเพิ่มมากขึ้น	1	2	3	4	5	6	7

ส่วนที่ 4 สำหรับผู้ที่ตอบคำถามข้อที่ 10 ในช่องที่ 4 หรือ 5 หรือ 6

ท่านเห็นว่าสินค้าใหม่ของบริษัทท่านเป็นอย่างไร	เห็นด้วยน้อยที่สุด			→			เห็นด้วยมากที่สุด
1. มีการปรับปรุงเป็นอย่างมากเมื่อเทียบกับสินค้าของคู่แข่งในทัศนะของลูกค้า	1	2	3	4	5	6	7
2. ให้ประโยชน์เป็นพิเศษกับลูกค้าซึ่งไม่สามารถพบได้ในสินค้าคู่แข่งในทัศนะของลูกค้า	1	2	3	4	5	6	7
3. สามารถทดแทนสินค้าประเภทเดียวกันในทัศนะของลูกค้า	1	2	3	4	5	6	7

จบแบบสอบถาม

ขอขอบคุณอย่างยิ่งในความร่วมมือของท่าน

นาย ดนุพล หุ่นโสภณ

นักศึกษาโครงการปริญญาเอกร่วมสาขาบริหารธุรกิจ สังกัดจุฬาลงกรณ์มหาวิทยาลัย

โทรศัพท์ โทรสาร

อีเมล์

APPENDIX C

QUESTIONNAIRE (ENGLISH VERSION)

QUESTIONNAIRE (ENGLISH VERSION)

The Empirical Study of the Impact of Product Innovation Factors on the Performance of New Products: Radical and Incremental Product Innovation

Part 1 General information

1. Name of the person filling in the questionnaire ______________________________

2. Company ____

3. Position ____

4. Estimated number of employees ____________ persons

5. Year of establishment of the company (Buddhist Era): ______________________

6. Approximately your company revenue in 2009 ______________________ Million bath

7. Your company has developed a new product, for example, ***a novel product for the company or an improved product from the existing product line*** over the past 2 years

☐ Yes ☐ No

8. If your answer **"yes"** in question 7, the quantity(s) or the type(s) of new products available for sales in the market is _________ piece(s)/ type(s)

9. The new product that is developed or improved that you think is the company's most outstanding product is: (Please specify only 1 piece/type) _________________

10. How do you perceive *"**New product or new product developed from existing product of firm in question 8 differs from available products in the market**"*. Please mark your opinion in the scale given below. The scale is divided into 6 intervals from "1 = least different and 6 = most different"

1	2	3	4	5	6

If you mark in scale "1 or 2 or 3" Please only answer the question in part "2 and 3"

If you mark in scale "4 or 5 or 6" Please only answer the question in part "2 and 4"

Part 2: Attitude

2.1 How much do you think the new product has achieved the following purposes?	Least Agree → Extremely Agree
1. Sales quantity of the new product meets the company's target.	1 2 3 4 5 6 7
2. Profit of the new product meets the company's target.	1 2 3 4 5 6 7
3. Revenue of the new product meets the company's target.	1 2 3 4 5 6 7
4. Customers' acceptance of the new product meets the company's target.	1 2 3 4 5 6 7
5. Customers' satisfaction with the new product meets the company's target.	1 2 3 4 5 6 7
6. New product's ability to gain market share meets the company's target.	1 2 3 4 5 6 7
7. Increased number of customers after the launch of the new product meets the company's target.	1 2 3 4 5 6 7

2.2 How do you perceive the visions of your company?	Least Agree → Extremely Agree
1. Clear vision about the characteristics of the new product to be manufactured.	1 2 3 4 5 6 7
2. Clear understanding of the needs of the targeted customers.	1 2 3 4 5 6 7
3. All related departments shared the same objectives for the new product to be manufactured.	1 2 3 4 5 6 7
4. Clear and consistent policies towards the goals of the new product from inception of the idea to the distribution of the product in the market.	1 2 3 4 5 6 7

2.3 How much support do you perceive from the top management level for developing new product?	Least Agree → Extremely Agree
1. Full support in the resources needed for new product development.	1 2 3 4 5 6 7
2. Guidance for the new product development approach.	1 2 3 4 5 6 7
3. Consistent encouragement of employees to present constructive idea about new product development	1 2 3 4 5 6 7

2.4 How do you perceive distribution of power within the company?	Least Agree → Extremely Agree
1. Middle and lower-level managers have freedom within their boundary of responsibility.	1 2 3 4 5 6 7
2. Middle and lower-level managers have freedom in their decisions within their boundary of responsibility.	1 2 3 4 5 6 7
3. Problems occurring during product development are fixed according to supervisory steps within the boundary of responsibility.	1 2 3 4 5 6 7

2.5 How do you perceive management within you company?	Least Agree → Extremely Agree						
1. Responsibilities of each employee have been clearly assigned.	1	2	3	4	5	6	7
2. Company has clearly assigned the line of work for employees.	1	2	3	4	5	6	7
3. Documents are made in writing for communications between departments.	1	2	3	4	5	6	7

2.6 Prior to new product development, have your company preceded with the following tasks?	Least Agree → Extremely Agree						
1. Initial assessment of the demand in the market.	1	2	3	4	5	6	7
2. Initial assessment about whether new product development is consistent with the company's policies.	1	2	3	4	5	6	7
3. Evaluated product concept is used in the company's business plan.	1	2	3	4	5	6	7
4. Initial assessment of machinery and technology of the company.	1	2	3	4	5	6	7
5. Duties and responsibilities for new product development have been assigned to certain executives and employees.	1	2	3	4	5	6	7
6. Budget is allocated for new product development/ product improvement.	1	2	3	4	5	6	7
7. Consideration is given towards the design and characteristics prior to actual production.	1	2	3	4	5	6	7

2.7 How do you perceive coordination between departments or business units within the company?	Least Agree → Extremely Agree						
1. All departments cooperated well with new product development.	1	2	3	4	5	6	7
2. Problems occurring during new product development are frequently discussed between departments.	1	2	3	4	5	6	7
3. Decisions during new product development programme are jointly made between all departments.	1	2	3	4	5	6	7

2.8 How do you perceive the company's expertise in new product development technology?	Least Agree → Extremely Agree						
1. Modern technology is used in new product development.	1	2	3	4	5	6	7
2. Model or sample of the product is created for testing purposes prior to product launch into the market.	1	2	3	4	5	6	7
3. Good quality control in the production process.	1	2	3	4	5	6	7

2.9 How do you perceive your company's speed of new product development?	Least Agree → Extremely Agree						
1. The company is able to develop new product in shorter period of time compared with product development in the past.	1	2	3	4	5	6	7
2. The company is able to develop new product in shorter period of time compared with product development from similar competitors.	1	2	3	4	5	6	7
3. The company is satisfied with the present speed of new product development.	1	2	3	4	5	6	7

2.10 How do you perceive your company's capability to launch new product into the market?	Least Agree → Extremely Agree						
1. Budget is allocated for new product launch.	1	2	3	4	5	6	7
2. Target customers are appropriate for the new product.	1	2	3	4	5	6	7
3. New product is appropriately positioned in the market.	1	2	3	4	5	6	7
4. Pricing strategy is appropriate for the new product.	1	2	3	4	5	6	7
5. Distribution strategy is appropriate for the new product.	1	2	3	4	5	6	7
6. Promotion strategy is appropriate for the new product.	1	2	3	4	5	6	7

2.11 How do you perceive the changes in demand of the customers?	Least Agree → Extremely Agree						
1. Customers always look for new products that satisfy their needs.	1	2	3	4	5	6	7
2. The new product meets the demand of new customers who did not buy the company's products before	1	2	3	4	5	6	7
3. New customers and existing customers have different requirements for the new product.	1	2	3	4	5	6	7

2.12 How do you perceive the changes in present-day technology?	Least Agree → Extremely Agree						
1. Technology within the industry the company operates in changes rapidly.	1	2	3	4	5	6	7
2. Changing technology creates opportunity for the company.	1	2	3	4	5	6	7
3. Changing technology in the industry has created a vast number of innovative ideas for new products within the company.	1	2	3	4	5	6	7

2.13 How do you perceive the support from the government agency to your company?	Least Agree	→					Extremely Agree
1. Government agencies provide the company with useful information for new product development.	1	2	3	4	5	6	7
2. Government agencies give technological support to the company for use in new product development.	1	2	3	4	5	6	7
3. Government agencies give the company management counseling for new product development.	1	2	3	4	5	6	7
4. Government agencies support the company financially or they find sources of financial support for the company for new product development.	1	2	3	4	5	6	7
5. Government agencies give tax incentives to the company for new product development.	1	2	3	4	5	6	7

Part 3: for respondent who answer question 10 in scale 1 or 2 or 3

How do you perceive your company's new product?	Least Agree	→					Extremely Agree
1. New product is slightly improved compared with the competitors' in the eyes of the customers.	1	2	3	4	5	6	7
2. Benefits gained from new product changes only slightly in the eyes of the customers.	1	2	3	4	5	6	7
3. New product is an improved version that matches the requirements of the customers better than the existing product.	1	2	3	4	5	6	7

Part 4: for respondent who answer question 10 in scale 4 or 5 or 6

How do you perceive your company's new product?	Least Agree	→					Extremely Agree
1. A significant improvement compared with competitors' in the eyes of the customers.	1	2	3	4	5	6	7
2. Special benefits for customers that is not found in the competitors' products	1	2	3	4	5	6	7
3. Can substitute for similar products in the eyes of the customers.	1	2	3	4	5	6	7

End of questions

Thank you for your cooperation

Mr. Danupol Hoonsopon

JDBA student, Chulalongkorn University

Tel. Fax. E-mail:

APPENDIX D

LISREL'S SOURCE CODE OF RADICAL PRODUCT INNOVATION BASED PERFORMANCE FRAMEWORK

LISREL 'S SOURCE CODE OF RADICAL PRODUCT INNOVATION BASED PERFORMANCE FRAMEWORK

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TI
DA NI=50 NO=204 NG=1 MA=CM
LA
RAD1 RAD2 FP1 FP2 FP3 MP1 MP3 MP4
VIS1 VIS2 VIS3 VIS4 TOP1 TOP2 TOP3 CEN1 CEN2 CEN3 FOR1 FOR2 FOR3
PRE2 PRE3 PRE4 PRE5 CRO1 CRO2 CRO3 TEC1 TEC2 TEC3 TEC4 TEC5
SPD1 SPD2 SPD3 LAU1 LAU2 LAU3 LAU4 LAU5 LAU6
DEM2 DEM3 TECT2 TECT3 GOV1 GOV2 GOV3 GOV4
KM
1
.721   1
.305   .192   1
.287   .186   .722   1
.292   .189   .827   .821   1
.378   .218   .634   .521   .615   1
.404   .284   .698   .575   .662   .576   1
.417   .359   .693   .532   .654   .538   .722   1
.526   .442   .250   .297   .316   .362   .335   .328   1
.507   .396   .316   .282   .314   .433   .413   .387   .747   1
.453   .360   .333   .326   .363   .307   .338   .353   .598   .634   1
.424   .371   .326   .315   .327   .321   .368   .370   .689   .654   .733   1
.449   .358   .220   .151   .207   .294   .165   .222   .520   .502   .473   .467
       1
.433   .381   .211   .184   .213   .241   .175   .251   .493   .540   .437   .458
       .813   1
.348   .277   .207   .231   .207   .185   .160   .238   .445   .483   .499   .487
       .614   .674   1
.345   .263   .263   .265   .258   .272   .180   .224   .399   .384   .442   .420
       .551   .533   .556   1
.320   .210   .204   .236   .202   .240   .163   .207   .354   .351   .465   .435
       .507   .466   .509   .872   1
.400   .197   .151   .158   .126   .229   .173   .147   .370   .372   .500   .456
       .491   .472   .544   .695   .731   1
.403   .323   .217   .235   .255   .171   .223   .215   .442   .328   .448   .545
       .425   .377   .388   .506   .507   .488   1
.432   .351   .246   .259   .288   .200   .262   .263   .420   .322   .477   .579
       .401   .348   .419   .488   .503   .494   .867   1
.338   .253   .168   .194   .209   .113   .212   .201   .278   .232   .262   .340
       .368   .333   .345   .414   .378   .376   .625   .664   1
.372   .354   .120   .133   .169   .207   .224   .238   .468   .422   .473   .525
       .396   .430   .391   .370   .368   .403   .452   .493   .323   1
.365   .334   .190   .164   .185   .252   .245   .213   .332   .339   .453   .494
       .281   .281   .322   .421   .409   .462   .510   .550   .515   .634   1
.386   .325   .202   .215   .210   .210   .200   .245   .373   .316   .446   .367
       .485   .381   .389   .495   .483   .541   .568   .541   .519   .433   .499
       1
.433   .299   .243   .183   .286   .183   .209   .353   .399   .340   .405   .426
       .574   .473   .447   .464   .430   .472   .485   .480   .489   .426   .460
       .656   1
```

.424	.314	.227	.222	.271	.218	.206	.285	.453	.394	.532	.430
	.555	.517	.568	.544	.501	.578	.519	.525	.440	.567	.365
	.569	.603	1								
.399	.397	.242	.206	.261	.198	.250	.332	.387	.362	.466	.375
	.498	.508	.591	.514	.477	.591	.494	.528	.484	.450	.396
	.498	.509	.738	1							
.336	.336	.277	.258	.286	.285	.249	.308	.383	.382	.517	.446
	.475	.453	.542	.521	.528	.584	.506	.585	.497	.466	.493
	.512	.473	.663	.739	1						
.370	.352	.226	.210	.231	.187	.226	.297	.423	.321	.397	.424
	.351	.304	.246	.370	.336	.326	.500	.509	.411	.480	.568
	.583	.533	.406	.340	.332	1					
.398	.374	.248	.189	.263	.185	.210	.311	.416	.334	.450	.431
	.496	.430	.384	.419	.405	.463	.477	.504	.410	.593	.538
	.667	.725	.593	.551	.550	.620	1				
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	.345	.237	.189	.225	.184	.244	.382	.423	.366	.424	.457
	.482	.510	.393	.372	.411	.569	.529	1			
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	.424	.392	.323	.312	.250	.349	.415	.514	.390	.530	.484
	.508	.544	.485	.438	.433	.472	.607	.603	1		
.477	.431	.255	.255	.334	.332	.295	.315	.412	.410	.452	.446
	.493	.480	.345	.378	.314	.423	.426	.461	.390	.488	.399
	.506	.526	.580	.482	.452	.437	.555	.520	.650	1	
.516	.333	.406	.377	.387	.409	.397	.363	.548	.501	.478	.578
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	.462	.509	.454	.419	.399	.485	.477	.495	.555	.482	1
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	.365	.420	.419	.400	.412	.332	.356	.488	.474	.452	.752
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	.409	.487	.486	.471	.426	.352	.418	.434	.507	.433	.701
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	.484	.570	.539	.457	.454	.422	.496	.460	.571	.603	.578
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	.176	.241	.208	.280	.197	.166	.203	.058	.114	.160	.188
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	.177	.180	.203	.127	.145	.235	.212	.268	.283	.227	.352
	.287	.271	.163	.173	.142	.238	.208	.237	.279	.217	.370
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	.127	.088	.110	.077	.094	.161	.207	.266	.310	.138	.292
	.199	.188	.077	.186	.164	.144	.122	.208	.205	.158	.301
	.373	.229	.306	.227	.248	.274	.205	.274	.171	.260	.741
	1										
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	.104	.056	.201	.014	.038	.090	.082	.181	.099	.110	.089
	.081	.125	.074	.127	.119	.113	.089	.115	.130	.032	.136
	.146	.143	.202	.130	.058	.129	.154	.191	.044	.098	.226
	.246	1									
.071	.038	.078	.038	.094	.052	.126	.122	.112	.077	.153	.128
	.030	-.018	.093	.022	.053	.110	.071	.133	.089	.078	.129
	.059	.075	.039	.065	.162	.120	.069	.103	.064	-.003	.108
	.166	.083	.155	.081	.033	.046	.097	.152	.062	.124	.210
	.269	.882	1								
.035	-.007	.043	.008	.049	.020	.091	.083	.081	.050	.095	.072
	.082	.011	.110	.012	.030	.097	.047	.125	.023	.053	.068
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	.112	.061	.101	.030	-.007	.012	.064	.094	.055	.111	.181
	.209	.840	.881	1							
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.003	-.042	-.076	-.035	-.042	.013	.104	-.019	.011	.036	.008	.092
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SE
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50/
MO NX=42 NY=8 NK=12 NE=3 LY=FU,FI LX=FU,FI BE=FU,FI GA=FU,FI PH=SY,FI PS=SY,FI
TE=SY,FI TD=SY,FI
LE
RAD FP MP
LK
VIS TOP CEN FOR PRE CRO TEC SPD LAU DEM TECT GOV
FR LY(1,1) LY(2,1) LY(3,2) LY(4,2) LY(5,2) LY(6,3) LY(7,3) LY(8,3)
FR LX(1,1) LX(2,1) LX(3,1) LX(4,1) LX(5,2) LX(6,2) LX(7,2) LX(8,3) LX(9,3) LX(10,3) LX(11,4)
LX(12,4) LX(13,4)
FR LX(14,5) LX(15,5) LX(16,5) LX(17,5) LX(18,6) LX(19,6) LX(20,6) LX(21,7) LX(22,7) LX(23,7)
LX(24,7) LX(25,7)
FR LX(26,8) LX(27,8) LX(28,8) LX(29,9) LX(30,9) LX(31,9) LX(32,9) LX(33,9) LX(34,9)
LX(35,10)
FR LX(36,10) LX(37,11) LX(38,11) LX(39,12) LX(40,12) LX(41,12) LX(42,12)
FR BE(3,1) BE(2,3)
FR GA(1,1) GA(1,2) GA(1,3) GA(1,4) GA(1,5) GA(1,6) GA(1,7) GA(1,8) GA(1,9) GA(1,10)
GA(1,11) GA(1,12)
FR PH(1,1) PH(2,2) PH(3,3) PH(4,4) PH(5,5) PH(6,6) PH(7,7) PH(8,8) PH(9,9) PH(10,10)
FR PH(11,11) PH(12,12)
FR TE(2,2) TE(3,3) TE(4,4) TE(5,5) TE(6,6) TE(7,7) TE(8,8)

FR TD(1,1) TD(2,2) TD(3,3) TD(4,4) TD(5,5) TD(6,6) TD(7,7) TD(8,8) TD(9,9) TD(10,10)
TD(11,11) TD(12,12) TD(13,13)
FR TD(14,14) TD(15,15) TD(16,16)TD(17,17) TD(18,18) TD(19,19) TD(20,20) TD(21,21) TD(22,22)
TD(23,23)
FR TD(24,24) TD(25,25) TD(26,26) TD(27,27) TD(28,28) TD(29,29) TD(30,30) TD(31,31)
TD(32,32) TD(33,33) TD(34,34)
FR TD(36,36) TD(37,37)TD(38,38) TD(39,39) TD(40,40) TD(41,41) TD(42,42)
ST 0.1 TE(1,1) TD(35,35)
FR PS(1,1) PS(2,2) PS(3,3) PS(2,3)
FR PH(2,5) PH(3,7) PH(4,9) PH(5,11) PH(6,7) PH(1,5) PH(5,8) PH(2,3) PH(8,11) PH(4,11) PH(5,12)
PH(3,5) PH(4,5) PH(1,8)
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FR TE(4,5) TE(7,8)
FR TD(1,3) TD(3,4) TD(14,15) TD(30,31) TD(31,32) TD(15,16) TD(15,17) TD(18,20) TD(19,20)
TD(21,23)
PD
OU PC RS EF FS SS SC PT MI ND=3

APPENDIX E

LISREL'S SOURCE CODE OF INCREMENTAL PRODUCT INNOVATION BASED PERFORMANCE FRAMEWORK

LISREL 'S SOURCE CODE OF INCREMENTAL PRODUCT INNOVATION BASED PERFORMANCE FRAMEWORK

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TI
DA NI=53 NO=122 NG=1 MA=CM
LA
INC1 INC2 INC3 FP1 FP2 FP3 MP1 MP2 MP3 MP4
VIS1 VIS2 VIS3 VIS4 TOP1 TOP2 TOP3 CEN1 CEN2 FOR1 FOR2 FOR3
PRE1 PRE2 PRE3 PRE4 PRE5 CRO1 CRO2 CRO3 TEC1 TEC2 TEC3 TEC4 TEC5
SPD1 SPD2 SPD3 LAU1 LAU2 LAU3 LAU4 LAU5 LAU6
DEM2 DEM3 TECT1 TECT2 TECT3 GOV1 GOV2 GOV3 GOV4
KM
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.745    1
.657    .653    1
.172    .127    .356    1
.208    .183    .373    .775    1
.159    .148    .280    .829    .847    1
.208    .235    .475    .727    .703    .693    1
.245    .285    .508    .689    .738    .672    .846    1
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.148    .220    .367    .743    .763    .751    .725    .739    .833    1
.136    .122    .409    .501    .561    .484    .492    .531    .545    .528    1
.177    .274    .399    .535    .644    .595    .570    .609    .554    .607    .676    1
.229    .275    .472    .480    .552    .458    .554    .561    .500    .544    .683    .741
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.098    .140    .428    .536    .564    .484    .597    .582    .553    .587    .802    .696
        .820    1
.193    .231    .444    .466    .466    .399    .467    .540    .384    .407    .563    .595
        .682    .687    1
.224    .252    .506    .409    .398    .337    .426    .505    .357    .410    .541    .571
        .683    .650    .838    1
.214    .246    .438    .406    .441    .341    .380    .500    .364    .378    .572    .551
        .600    .610    .673    .714    1
.208    .244    .260    .339    .372    .366    .445    .409    .332    .346    .519    .411
        .438    .566    .452    .444    .405    1
.187    .198    .300    .343    .456    .443    .465    .433    .362    .426    .453    .462
        .451    .581    .393    .401    .454    .830    1
.217    .251    .284    .309    .384    .396    .300    .320    .336    .336    .493    .484
        .395    .430    .349    .309    .520    .442    .499    1
.191    .245    .289    .352    .386    .422    .354    .381    .403    .402    .485    .446
        .362    .411    .324    .348    .502    .484    .539    .882    1
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        .609    .611    .600    .541    .549    .403    .430    .538    .496    .500    .803
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	.796	1									
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	.662	.597	.710	.628	.775	.837	1				
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	.434	.576	.579	.570	.465	.493	.490	.485	.449	.471	.646
	.644	.615	.669	.624	.618	.690	.588	1			
.268	.300	.482	.498	.520	.469	.492	.534	.427	.494	.555	.526
	.557	.550	.625	.631	.577	.532	.532	.535	.577	.602	.633
	.681	.618	.782	.759	.662	.726	.663	.692	1		
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	.497	.475	.550	.564	.482	.389	.400	.295	.276	.293	.417
	.450	.519	.452	.467	.502	.493	.504	.598	.589	1	
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	.504	.572	.593	.550	.465	.408	.456	.230	.336	.302	.427
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	.514	.555	.520	.568	.587	.318	.362	.405	.428	.397	.643
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	.608	.460	.388	.480	.564	1					
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	.578	.592	.549	.606	.603	.296	.395	.364	.369	.423	.663

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	.614	.639	.494	.535	.368	.454	.419	.462	.478	.406	.409
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	.557	.577	.471	.520	.533	.337	.446	.404	.500	.454	.656
	.624	.595	.594	.588	.482	.501	.512	.521	.574	.454	.570
	.496	.517	.531	.551	.615	.706	.778	.725	1		
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	.538	.531	.464	.512	.522	.250	.344	.420	.428	.355	.582
	.592	.551	.539	.564	.464	.438	.487	.456	.504	.449	.510
	.476	.401	.425	.488	.634	.730	.780	.611	.788	1	
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	.519	.538	.378	.482	.326	.372	.374	.407	.452	.514	.482
	.455	.571	.525	.555	.459	.560	.633	.580	.524	.598	1
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	.502	.442	.435	.446	.385	.279	.354	.170	.177	.215	.425
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	.495	.396	.334	.351	.361	.487	.474	.356	.324	.395	.481
	.399	.621	1								
.123	.159	.292	.369	.416	.356	.463	.421	.410	.475	.424	.387
	.350	.436	.388	.421	.431	.506	.480	.280	.301	.371	.398
	.369	.536	.396	.468	.433	.495	.396	.487	.458	.456	.425
	.442	.400	.333	.458	.373	.425	.461	.362	.341	.368	.490
	.362	.707	.732	1							
.135	.150	.315	.242	.302	.198	.258	.285	.238	.316	.288	.315
	.249	.250	.249	.359	.387	.148	.209	.174	.161	.206	.337
	.314	.388	.294	.300	.320	.263	.306	.229	.296	.376	.440
	.271	.278	.237	.281	.389	.354	.418	.252	.333	.396	.399
	.314	.341	.392	.372	1						
.074	.155	.181	.170	.267	.170	.156	.165	.179	.224	.184	.247
	.152	.153	.112	.204	.261	.144	.224	.168	.201	.221	.214
	.208	.328	.273	.279	.190	.204	.153	.222	.252	.264	.272
	.165	.190	.203	.148	.338	.279	.366	.310	.400	.353	.288
	.235	.261	.340	.326	.704	1					
.026	.098	.225	.140	.211	.119	.211	.214	.170	.228	.212	.218
	.158	.208	.126	.235	.305	.112	.183	.201	.240	.218	.221
	.204	.285	.252	.211	.277	.233	.232	.181	.182	.235	.293
	.212	.225	.230	.173	.302	.297	.366	.311	.349	.297	.303
	.214	.207	.261	.241	.765	.843	1				
-.073	.022	.015	.147	.148	.142	.164	.173	.129	.115	.129	.145
	.091	.166	.042	.125	.227	.167	.189	.187	.242	.201	.188
	.137	.254	.194	.152	.215	.208	.205	.183	.162	.098	.162

.126	.082	.184	.154	.280	.203	.221	.207	.281	.180	.155
.042	.066	.111	.182	.495	.723	.725	1			

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SE

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31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53/
MO NX=43 NY=10 NK=12 NE=3 LY=FU,FI LX=FU,FI BE=FU,FI GA=FU,FI PH=SY,FI PS=SY,FI
TE=SY,FI TD=SY,FI
LE
INC FP MP
LK
VIS TOP CEN FOR PRE CRO TEC SPD LAU DEM TECT GOV
FR LY(1,1) LY(2,1) LY(3,1) LY(4,2) LY(5,2) LY(6,2) LY(7,3) LY(8,3) LY(9,3) LY(10,3)
FR LX(1,1) LX(2,1) LX(3,1) LX(4,1) LX(5,2) LX(6,2) LX(7,2) LX(8,3) LX(9,3) LX(10,4) LX(11,4)
LX(12,4) LX(13,5)
FR LX(14,5) LX(15,5) LX(16,5) LX(17,5) LX(18,6) LX(19,6) LX(20,6) LX(21,7) LX(22,7) LX(23,7)
LX(24,7) LX(25,7)
FR LX(26,8) LX(27,8) LX(28,8) LX(29,9) LX(30,9) LX(31,9) LX(32,9) LX(33,9) LX(34,9)
LX(35,10)
FR LX(36,10) LX(37,11) LX(38,11) LX(39,11) LX(40,12) LX(41,12) LX(42,12) LX(43,12)
FR BE(3,1) BE(2,3)
FR GA(1,1) GA(1,2) GA(1,3) GA(1,4) GA(1,5) GA(1,6) GA(1,7) GA(1,8) GA(1,9) GA(1,10)
GA(1,11) GA(1,12)
FR TE(2,2)TE(3,3) TE(4,4) TE(5,5) TE(6,6) TE(7,7) TE(8,8) TE(9,9) TE(10,10)
FR TD(1,1) TD(2,2) TD(3,3) TD(4,4) TD(5,5) TD(6,6) TD(7,7) TD(8,8) TD(9,9) TD(10,10)TD(11,11)
TD(12,12) TD(13,13)
FR TD(14,14) TD(15,15) TD(16,16) TD(17,17) TD(18,18) TD(19,19) TD(20,20) TD(21,21)
TD(21,21) TD(22,22) TD(23,23)
FR TD(24,24) TD(25,25) TD(26,26) TD(27,27) TD(28,28) TD(29,29) TD(30,30) TD(31,31)
TD(32,32) TD(33,33) TD(34,34)
FR TD(35,35) TD(36,36) TD(37,37) TD(38,38) TD(39,39) TD(40,40) TD(41,41) TD(42,42)
TD(43,43)
FR PS(1,1) PS(2,2) PS(3,3)
FR PH(1,1) PH(2,2) PH(3,3) PH(4,4) PH(5,5) PH(6,6) PH(7,7) PH(8,8) PH(9,9) PH(10,10) PH(11,11)
PH(12,12)
ST 0.05 TD(9,9)
ST 0.05 TE(1,1)
FR PH(5,9) PH(1,5) PH(1,9) PH(2,3)PH(2,8) PH(2,12) PH(7,8) PH(7,11) PH(3,8) PH(5,8) PH(1,10)
FR PH(1,11) PH(1,12) PH(2,4) PH(2,10) PH(2,7) PH(1,7) PH(7,10) PH(5,7) PH(2,6) PH(1,8)
FR PH(4,9) PH(10,12) PH(9,10) PH(8,10)
FR TE(7,8) TE(4,5) TE(2,3) TE(9,10)
FR TD(10,11) TD(16,17) TD(30,31) TD(32,34) TD(40,43) TD(2,3) TD(3,4) TD(10,11) TD(1,2)
PD
OU PC RS EF FS SS SC PT MI ND=3
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VITA

Danupol Hoonsopon was born in Bangkok, Thailand, on 9 May 1977. In 1994, he entered The King Mongkut's Institute of Technology Ladkrabang, receiving the degree of Bachelor of Telecommunication Engineering in May, 1998. He entered The Master of Arts in Business and Managerial Economics at Chulalongkorn University in 2001, earning a Master's of Arts degree in 2004. At present, he has studied at The Joint Doctoral of Business Administration, collaborating with Chulalongkorn University, Thammasat University, and The National Institute of Development Administration, in major of marketing since 2005.

He worked at UCOM (World Radio) for 2 years (1998-2000) in position of engineering. He spent one year (2001) at Ministry of Finance in economist and junior consultant position. He had also worked for Thai-German Institute (TGI) for 3 years (2002-2005) in Industrial Technology and Development Researcher. During his stay at the University, he has been a visiting lecturer at Graduate School of Management and Innovation, King Mongkut's University of Technology Thonburi. He was a part time independent researcher at TGI.

For his publications, he was a one of research team to write "The Master Plan of Mould and Die" and "The Implementing Advance Technology on the Production Process". Additionally, his and his advisor's researcher topic, The Empirical Study of the Impact of Product Innovation Factors on the Performance of New Product: Radical and Incremental Product Innovation, was published in The Business Review in 2009.