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The Impact of Technology Characteristics of Selected University Research to NPD Success: Case Studies from Thai SMEs

Rachakrit Klongpayabal¹, Natcha Thawesaengskulthai²

Ph.D student, Technopreneurship and Innovation Management Program, Chulalongkorn University,
Bangkok, Thailand¹

Associate Professor, Department of Industrial Engineering, Chulalongkorn University, Bangkok, Thailand²

Abstract: The limitation of resources, expertise, time and the lack of capabilities to create in-house technology forces firms especially small and medium enterprises (SMEs) to focus on selecting or acquiring new technology from external sources. One of the important external sources that firms can acquire and select is technology or knowledge from science and technology research which developed in university. Due to the need of new knowledge, many researchers and practitioners proposed or presented methods to select or evaluate technology for decision makers can enhance decision making performance in the technology selection process. The characteristics of technology to the firm is one of many factors to recipient firms to make decision in early stage of technology selection process because of the limitation of disclosure information of new technology from researcher in licensing negotiation stage. Firm must make a decision to the uncertainty of technology from technology characteristics of selected university research for NPD success. Therefore, this study aims to present the impact of technology characteristics from selected university research to new product development (NPD) successes from five SMEs firms in Thailand that selected university research to develop new innovative products.

Keywords: Technology selection, Technology characteristics, New product development (NPD), University research, Small and medium enterprise (SME)

I. INTRODUCTION

New technology becomes a main driver for innovation and hence successful innovation leads to sustainable business growth. Therefore the need of new knowledge or new technology acquisition by firms or industries to create the competitive advantages from innovation is vital. The limitation of resources, expertise, time and the lack of capabilities to create in-house technology forces firms especially Thai SMEs to focus on selecting or acquiring new technology from external sources. One of the important external sources that firms can acquire and select is technology or knowledge from science and technology research which developed in university which involve a rich mix of science discovery, beta testing, prototype development, and industry linkage to university-based research are demonstrated to be complementary to firm's R&D [1]. The advantage of university research in Thailand is researchers can create ideas based on their interest without administrative procedure. While the disadvantages are in the research process, inadequate funding, lack of knowledge base, and missing response to the market needs [2]. Most technologies from science and technology research in Thai universities are created from new theory or new science discovery requirement of researchers, and roughly or uncertainty goals for technology commercialization. University researcher do not generally possess the complementary assets necessary to bring the early-stage research results through development into a commercialized product that is marketed and distributed to consumers. The researchers tend to specialize in the creation of knowledge assets, the commercialization of which is typically left to firms [3]. In order to use external technology efficiently for NPD process, firms usually incorporate external technology through projects. Time, cost, and technical performance are three considered components to the effectiveness measurement [4].

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(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 3, March 2014

Thus, this paper reveals the impacts of technology characteristics from selected university research and NPD process successes in the firms. In addition, this study sets out to provide a better understanding of technology characteristic factors in technology selection methodology.

II. LITERATURE REVIEW

A. Technology Selection and Technology Characteristics

Technology selection becomes one of the important tasks in technology management, especially technology that not created inside firm. In technology selection process, firms must evaluate many involved factors before making a final decision to adopt new technology. A right or an appropriate technology may differ depending on the context of each firm. Therefore, one technology that fit for one firm may not be the right technology for the others. Furthermore, selecting a right or an appropriate technology that achieves goals and objectives for new product development (NPD) success is a difficult task. Technology characteristics from candidate or selected university research are critical factors for decision making in the early-stage of the technology selection process because of the uncertainty of technology from the limitation of disclosing information about technology from a researcher in licensing negotiation stage. Firm must make a decision to the uncertainty of technology from technology characteristics of selected university research for NPD success. Therefore, this study aims to present the impact of technology characteristics from selected university research to NPD process and NPD success opportunities. Many researchers have used different criteria and methods for the technology selection framework and methods. The uncertainty of technology from technology characteristics is one of many criteria factors in technology selection and external technology integration process [5-8]. Table I shows the operational definition of these technology characteristics that are used in this study.

TABLE I
TECHNOLOGY CHARACTERISTICS OF SELECTED UNIVERSITY RESEARCH

Technology Characteristics	Operational Definition
Technology Novelty	The degree of newness of technology to firm's context in terms of knowledge, familiarity, technical capabilities
Technology Complexity	The degree of complexity of technology to firm's context in terms of completion of technology, tacit knowledge in technology
Technology Feasibility	The degree of new technology feasibility to develop new product to firm's context in terms of technology proofing, tested technical features, manufacturing assessment
Technology interrelationship	The degree of interrelationship between new technology and existing technology in terms of technological resources and technical knowledge sharing

B. New Product Development (NPD)

New product development (NPD) has received a great deal of study in strategic literature, and serves as a means as a key factor to success in an increasingly competitive advantage of the firms. Many researchers have studied and proposed NPD model or NPD stage on knowledge and creativity management, communication and information transfer in any NPD process. Most of the studies related to industrial products and focused towards NPD success studies. There is a gap between NPD research and NPD practice by investigating thoroughly whether the proposed practices deserve recognition for all kinds of industries and their implications for different organizations [9]. Furthermore, many researchers have studied and proposed success factors of NPD process in many dimensions [10-11]. In this study Market success, financial success, technical success, and performance success are major dimensions in terms of NPD process success. Table II shows the operational definition of seven NPD process stages that are used in this study. The measurement of NPD process successes is shown in Table III.

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TABLE II
NEW PRODUCT DEVELOPMENT PROCESS STAGES

NPD Process Stages	Operational Definition
Planning stage	The stage of planning on time, cost, resources, and product performance of new developed product
Integration stage	The stage of integrating new external technology and existing technology for NPD process
Engineering design stage	The stage to develop engineering prototype, identifying materials, engineering processes, conduct engineering test, and develop manufacturing methods
Pre-production prototype stage	The stage of developing pre-production prototype or final prototype of new products which product design, physical features and usage features of new product for commercial prototype, packaging design, selecting manufacturing equipment
Marketing Stage	The stage of assessing the market's need for new product, competitive analysis, market opportunities analysis, distribution networks analysis, and identifying customers' needs to create a strategic marketing plan
Production Stage	The stage of production of new products for industrial scale
Commercialization stage	The stage to introduce new products to market and provide access to distribution networks and identifying resources in commercialization of new products

TABLE III
THE MEASUREMENT OF NPD PROCESS SUCCESSES

NPD Process Success	Operational Definition
Market success	The measurement of market success in terms of sale unit, market share, customer satisfaction
Financial success	The measurement of financial success from profitability from sales
Technical success	The measurement of technical success is measured and analysed for cost of product, time to develop, skills and capabilities
Performance success	The measurement of performance success is measured and analysed for performance of product, competitive advantage

A conceptual framework to study is proposed to consider the impacts of technology characteristics to NPD process success. The proposed framework is inspired from technology selection frameworks in the literature and aims to develop a simple and efficient framework which is easy to understand, covers all areas regarding to technology characteristics of university research and real-world activities of NPD process in Thai SMEs. This framework takes into account not only the views of the experts or managers of the firm but also gives due consideration to the university's stakeholders involved to university knowledge transfer. This helps in understanding the dynamics of the NPD process as shown in the figure I.

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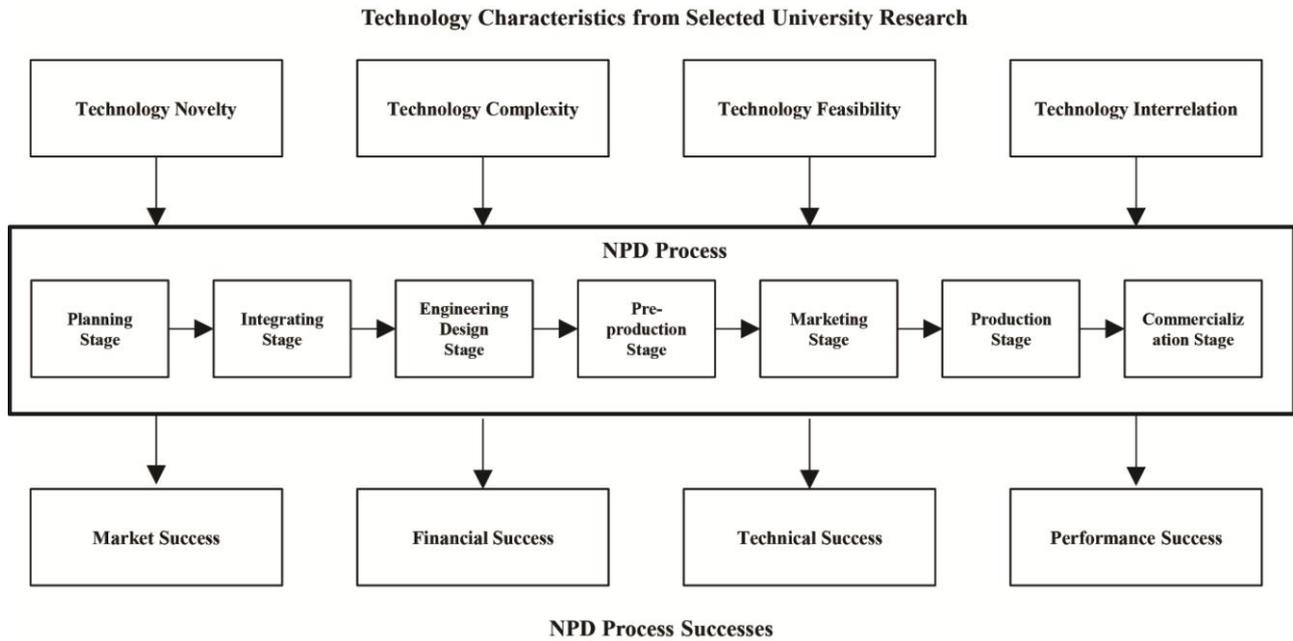


Fig.1 Conceptual framework of technology characteristics to NPD process success

III. RESEARCH METHODOLOGY

The study has been conducted five manufacturing SMEs firms in Thailand that selected new technology from university research to develop commercialize product as case studies. In this qualitative study, purposive sampling technique is used to select case study firms because of the requirement for long period data collection. Action research (AR) which suitable for researcher role as business consultant is used as research methodologies. Data collection is conducted from June 2011 to August 2013. Five managers who selected new technology or decision makers are in-depth interviewed by semi-structure questionnaires about objectives, criteria, and methods of technology selection. Technology characteristics from selected university research; technology novelty, technology complexity, technology feasibility, and technology interrelation that implied by firms were the critical factors to observe and analysed by observation and thematic content analysis. Furthermore NPD process to develop new product and is observed and analysed by researcher to measure the success of NPD process of firms. Overview of case studies is shown in Table IV.

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TABLE IV
OVERVIEW OF CASE STUDIES

Firm No.	Firm Overview	New Product	Technology Overview
1	Manufacturer of solar-dried banana products which is the first innovation of dried banana production process in Thailand by manufacturing system in standardized Parabola. Parabola Dome can control temperature, moisture and drying period resulting in spotless, smooth color, tasty and bigger size of dried banana.	Banana Syrup	The process to manufacturing banana syrup by amylase enzyme from solar-dried banana that has high nutrition benefit
2	Manufacturer of natural cosmetic products which is the first innovation product in Thailand that mixed longan seed extraction substance.	Analgesic cream from longan seed extract	The process to extract substance from longan seed. This extracted substance is used to develop an analgesic cream product that have properties for arthrosis or osteoarthritis treatment
3	Manufacturer of sensor and analyser devices. Firm has a competency in automation, analyser, and chemical & biosensor field.	Spicy detector	The process to measure food spicy level for food manufacturing industry from capsaicinoid and dihydrocapsaicin Scoville heat unit (SHU) by biosensor through electrochemical process.
4	Start-up manufacturer of high nutrition organic rice product	GABA organic jasmin rice	The process to manufacturing organic rice from Thai jasmin rice which high nutrition and high gamma-aminobutyric acid (GABA)
5	Manufacturer of essential oil, fragrances, and flavours which extract from natural plants	Anti-aging and wrinkle reduction cream from Thai jasmin rice	The process to manufacturing fermented Thai jasmin rice liquid. This fermented liquid is used to develop cosmetic products that have properties for anti-aging and wrinkle reduction

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IV. RESULTS

A. Technology Characteristics of Selected Research to Firms

Technology characteristics of selected university research to firm context are shown in Table V. The degree of relation between characteristics to firm context is divided to five levels from very high, high, moderate, low, and very low.

TABLE V
TECHNOLOGY CHARACTERISTICS OF SELECTED RESEARCH TO FIRMS

Firm No.	Technology Characteristics of Selected Research to Firms			
	Technology Novelty	Technology Complexity	Technology Feasibility	Technology Interrelationship
1	Very High	High	Moderate	Moderate
2	Moderate	Moderate	Very High	Very High
3	High	High	Moderate	Low
4	Very High	Very High	Low	Low
5	Moderate	High	High	High

B. The Impacts of Technology Characteristics to NPD Process

The impacts of technology characteristics to NPD process from the study are shown in Table VI. The degree of impacts is divided to three levels from positive impact, moderate impact, and negative impact.

TABLE VI
THE IMPACTS OF TECHNOLOGY CHARACTERISTICS TO NPD PROCESS

Firm No.	Technology Characteristics	NPD Process Stages						
		Planning	Integration	Engineering Design	Pre-production	Marketing	Production	Commercialization
1	Novelty	Negative	Negative	Negative	Negative	Positive	Moderate	Positive
	Complexity	Negative	Negative	Negative	Negative	Positive	Moderate	Positive
	Feasibility	Negative	Negative	Negative	Negative	Moderate	Positive	Positive
	Interrelation	Positive	Negative	Negative	Negative	Moderate	Positive	Positive
2	Novelty	Positive	Positive	Positive	Positive	Positive	Positive	Positive
	Complexity	Positive	Positive	Positive	Positive	Positive	Positive	Positive
	Feasibility	Positive	Positive	Positive	Positive	Positive	Positive	Positive
	Interrelation	Positive	Positive	Positive	Positive	Positive	Positive	Positive
3	Novelty	Negative	Moderate	Moderate	Moderate	Positive	Moderate	Moderate
	Complexity	Negative	Moderate	Moderate	Moderate	Positive	Moderate	Moderate
	Feasibility	Moderate	Moderate	Moderate	Positive	Moderate	Moderate	Moderate
	Interrelation	Moderate	Moderate	Moderate	Positive	Moderate	Positive	Positive
4	Novelty	Moderate	Negative	Negative	Negative	Positive	Negative	Negative
	Complexity	Moderate	Negative	Negative	Negative	Moderate	Negative	Negative
	Feasibility	Moderate	Negative	Negative	Negative	Moderate	Negative	Moderate
	Interrelation	Negative	Negative	Negative	Negative	Moderate	Negative	Moderate
5	Novelty	Negative	Moderate	Moderate	Moderate	Positive	Moderate	Moderate
	Complexity	Negative	Moderate	Moderate	Moderate	Positive	Moderate	Moderate
	Feasibility	Moderate	Moderate	Positive	Positive	Positive	Positive	Moderate
	Interrelation	Positive	Positive	Positive	Positive	Moderate	Positive	Moderate

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C. The Success of NPD Process

The success of NPD process from case studies is shown in Table VII. The degree of success is divided to five levels from very high, high, moderate, low, and very low.

TABLE VII
THE SUCCESS OF NPD PROCESS

Firm No.	Product	Success of NPD Process			
		Market	Financial	Technical	Performance
1	Banana Syrup	High	High	Moderate	Moderate
2	Analgesic cream from longan seed extract	Very High	Very High	High	Very High
3	Spicy detector	Low	Low	High	High
4	GABA organic jasmin rice	Low	Very Low	Low	Moderate
5	Anti-aging and wrinkle reduction cream from Thai jasmin rice	Very Low	Low	Moderate	Moderate

V. FINDINGS

- Technology novelty and technology complexity are two factors which have negative impacts to early-stage of NPD process whilst technology feasibility and technology interrelationship are two factors which have positive impacts to early-stage of NPD process.
- The negative impacts have significant affects to time, cost, resources, and product performance of new products in NPD process whilst the positive impacts have significant affects for controlling time, cost, resources, and product performance according to NPD process
- Technology characteristics have no significant impacts to NPD process success especially in market and financial success but have impacts to technical and performance success.

VI. CONCLUSION

Through the exploratory study, we draw the conclusions: firstly, to select a right or appropriate technology from university research firms must aware and consider the fit or match between technological characteristics to firm’s context. Secondly, the fit or match between their technological characteristics and stage of NPD will help firm implementing NPD process efficiently that reduce the risks of time and cost investment to develop their new products. Thirdly, the success of new commercialize products or NPD successes do not only depend to the right or appropriate technology that selected by firms but depended to the way firms market and distribute new products to customers. In addition, this study sets out to provide a better understanding of technology characteristic factors in technology selection methodology for early-stage or incomplete technology to commercialize.

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BIOGRAPHY

Ratchakrit Klongpayabal is a Ph.D candidate from Technopreneurship and Innovation Management Program (TIP), Chulalongkorn University, Thailand. At present, Mr. Ratchakrit is the business planning consultant for SMEs. He is one of the expertise committees of the Innovation Business Plan Grant program by the Thailand Research Fund (TRF).