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THE DETERMINANTS OF OPERATIONAL RESEARCH COLLABORATION EFFECTIVENESS BETWEEN INDUSTRY AND ACADEMIA: THE CASE OF THE HARD DISK DRIVE INDUSTRY IN THAILAND

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ABSTRACT

Even though the issue of Inter-organization collaboration has been explored and revealed in various forms, these studies have not covered the different contexts and forms of collaboration specific to operational research collaboration between industry and academia in Thailand. Therefore, it is needed to consider these phenomena in the context of Thailand. The objectives this dissertation intends to explore the key determinants of effective operational research collaboration between industry and academia: The case of the Hard Disk Drive industry in Thailand. A qualitative approach was adopted by the researcher. The sources of data in this study are related documents and in-depth interviews from key informants that have direct experience with operational research collaboration between industry and academia within the case of the Hard Disk Drive industry in Thailand demonstrated at Western Digital (Thailand), BangPa-In factory. The findings of the dissertation suggest that the key determinants affecting the operational research collaboration effectiveness between the HDD Industry and academia are as follows: 1) clear scope, goals and objectives, 2) strong commitment of leadership, 3) trust among stakeholders, 4) communication, 5) win-win situation (mutual benefits), 6) characteristic of key stakeholders, and 7) resources. Understanding the key determinants will further explain the inter-organizational relations theory within different contexts, and contribute to the practical perspectives, for enhancing the collaboration effectiveness between industry and academia, that it's a major trend in the context of Thailand.

Keywords: Research Collaboration, Industry and Academia Collaboration

INTRODUCTION

This dissertation proposes to examine the perspective of engineers, Operational Research collaboration Coordinators/Managers and policymakers (Vice President/Managing Director) that work in the Hard Disk Drive industry, especially Western Digital Company and researchers in universities that have had interaction with Western Digital Company in Thailand in Operational Research Collaboration. This research proposes to determine the key determinants that affect the effectiveness. Considering the electronics industry, especial HDD industry, is being part of hi-technology product was raised in Thailand more than 3 decades. It has long been one of Thailand's most important from the export manufacturing product point of view; in 2011, Thailand supplied around 41 percent of the world's HDDs, which it is a major contribution to exporting. In 2012, Thailand's exports of hard disk drives accounted for 7.3 percent of total exports while output was 7.2 percent of total manufacturing production.

In 2011, many industry estates in the central part of Thailand faced heavy flooding. The world largest HDD maker, Western Digital, receive a serious impact as well because the main factory is located in one of the six industrial estates that was directly impacted by the flooding. However, Thailand's hard disk drive industry bounced back 2 years after the heavy flooding and today remains a world leader in production. It still accounts for about 40% of global HDD production, exporting more than US$12 billion worth annually (BOI Thailand investment review, 2012).

However, investment in this industry in Thailand is likely to reach a diminishing return soon due to various factors, such as the minimum wage/salary policy, the decline

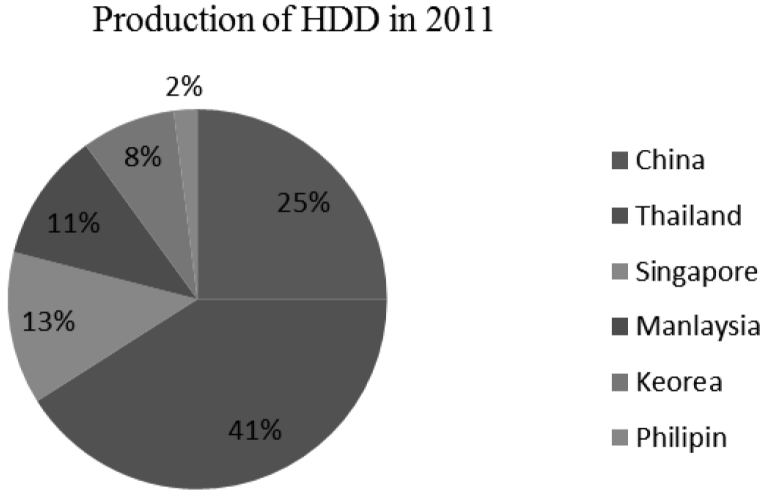

Figure 1 Production of HDD products separated by country

Source: Bank of America Merrill Lynch, 2011. Quoted in Sawangngoenyuang and Subhanij (2012)

of the global economic situation, changes in technology, etc. Joe (2013) pointed out that the landscape of the HDD industry in Thailand is changing, presenting major concerns as follows: 1) there is a flat demand of HDD products resulting from smartphone and tablet expansion, as these devices uses solid state drives (SSDs) for data storage and 2) the structure of operational costs of running manufacturing in Thailand have changed.

Moreover, the population structure of Thailand is changing with the proportion of the workforce decreasing; probably leading to a labor shortage soon. Foreign investors have a choice to invest in any country where the factors support growth and sustainability for maximum benefits. Therefore, Thailand's HDD industry must be developed into a knowledge-intensive economy in order to sustain competitiveness and to attract investors. The HDD industry in Thailand, a manufacturing base of foreign direct investment (FDI), needs both incremental and breakthrough strategies in order to improve in various areas, such as cost reduction, and productivity and quality improvement, so that competitiveness can be sustained and improved. Therefore, in order to sustain this industry in Thailand, productivity improvement is the key activity that needs to be strengthened. According to Porter (1990), the capability of competition depends on the industry's ability to increase its productivity degree. Basically, many strategies and tactics are adopted to drive continual improvement in productivity, both utilizing resources from within and outside the firm. Research collaboration with universities is one of strategies that Western Digital Company, a key maker in the HDD industry in Thailand, has selected to enhance its production base with more capability in terms of driving productivity improvement because the industry itself has a shortage of researchers to perform operational research. Actually, the basic motivation behind university-industry collaboration in research is to develop the research and development capability and innovative potential of the companies, and therefore to increase a country's competitive power (Geisler et al., 1990). Additionally, Sampan (2013), President of the Electronics and Computer Employers Association, has mentioned that collaboration between industry and academia in operational research needs to be enhanced in order to improve productivity by focusing on automation, which can manage the workforce headcount. This statement directly concerns the capability development of company competitiveness. Since research collaboration is important to the HDD industry in Thailand, this study understands that this phenomenon is also important; however, no studies focus on this industry directly especially the HDD industry in Thailand's context.

Currently, the factors or determinants of operational research collaboration effectiveness and a framework of collaboration between the HDD industry and academia that fit the HDD industry of Thailand's context are still not empirically studied or clearly addressed so that practitioners can utilize them.

Moreover, Gulati and colleagues pointed out that there is no clear idea of the factors that would contribute to the effectiveness of the interaction between the alliance partners. Collaborative managers or project managers and researchers have not paid much attention to how alliance partners develop their relationships after a strategic alliance is formed or how they effectively cooperate in contributing to the strategic alliance (Gulati et al., 1994; quoted in Patthareeya, 2009). Therefore, the present author is intent on studying this topic because effective operational research collaboration between the HDD industry and academia requires appropriate factors or determinants to ensure optimal/mutual benefit to the industry for running operations effectively, including academia (university) as well as the country's industry and society generally.

RESEARCH OBJECTIVES

The study objective is to explore the key determinants of effective operational research collaboration between the HDD Industry and academia

SCOPE OF THE STUDY

The scope of this study focuses of the formalized research project collaboration that is 100 percent funded by WD. The frame of sample informants contains the Engineers, Research Collaboration Project Coordinator and Project Managers and Policy-maker of Western Digital, researchers or professors of universities and agencies that have had direct experience in operational research collaboration during years 2012-2014. They are implied to informants, whose projects were completed in 2013 and ongoing projects of operational research collaboration in 2014.

CONCEPTUAL FRAMEWORK

The conceptual framework has been developed, taking into account the major factors that determine the effectiveness of inter-organizational collaboration. The variables in the conceptual framework may consist of independent variables that affect the dependent variables. The tentative independent variables are as follows: One are the factors related to the intention or end in mind of collaboration. A shared visions are existing, clear defined of collaborative objectives and purposes, key stakeholders have committed and involved in both organizations. Two are the factors related to the situation in which the participants feel a win-win agreement with clear mutual benefits. The roles, accountability, involvements and interests among stakeholders. Three are the factors related to leadership attributes. Four are the factors related to trust in each other among participants. Five are the factors related to characteristics of participants, skill and knowledge of participants as well as interpersonal skill, etc. Six area the factors related to resources, having enough necessary resources and administration support. Seven are the factors related to communication including open and frequent communication; and formal

and informal communication channels. These categories can be framed into two mechanisms: process and structure factors. The dependent variable is operational research collaboration effectiveness, which can be considered and measured in terms of the operational research collaboration accomplishment within the time frame and achievement of the specific research's objective per planned resources.

Literature Review and Conceptual Framework

Given the theory and literature to cover this dissertation on the determinants of operational research collaboration effectiveness between industry and academia in Thailand, the author has segregated the related literature into 2 main areas that are theory of collaboration and research related to the study as follows:

Theory of Collaboration

Leary et al. (2010) pointed out that the term "collaboration" is widely used in all sectors-public, private, nonprofit-and is especially prevalent in the public administration and public management literature. Collaboration basically means working together to achieve a common purpose (Roberts & O'Connor, 2008). GNU Collaborative International Dictionary of English definitions gives the definition collaboration as the act of cooperation i.e. labor union, In addition, Majumdar (2006) has mentioned that the term of collaborations are shaped in order to enhance the quantity, quality, accessibility, and cost effectiveness. Apart from that it aimed to reduce gaps in services exception and perception. Across the range of definitions there are, however, common characteristics. Essentially, collaborating is looking for ways to work together to achieve greater efficiencies and a scale of outcomes. It allows the facilitation and operation of multi-organizational arrangements to solve problems that cannot be solved or easily solved by single organizations. However, a review of various academic literature shows that there is no unified understanding of the concept. Therefore, this section explores the different aspects of collaboration offered in the literature. While, Longoria (2005) gathered the definition gain from several authors (Mattessich and Monsey (1992); Graham and Barter (1999) that 'collaboration' can be concluded as; a joint activity in the form of a relational system between two or more organizations, an intentional planning and design process results in mutually-defined and shared organizational goals and objectives, the structural properties emerge from the relationship between organizations. Thomson and Perry (2006) defined collaboration as "a process in which autonomous actors interact through formal and informal negotiation, jointly creating rules and structures governing their relationships and ways to act or decide on the issues that brought them together; it is a process involving shared norms and mutually beneficial interactions. In addition, Sanker (2012) proposed that collaboration can be defined as two or more parties who formed and cooperating together. The ends result is to produce something that finally gain more benefit than the each of the individual efforts

and donation. Another various concepts derived during 1980 - 2000 were also appeared in order to clearly define the meaning of collaboration. Those scholars have pointed out at 'the collaboration' included the corporate process, culture, resources and objectives.

Research related to the study

Researcher had searched, collected and found that there were around 133 research studies in topic of collaboration in higher education and business, social science, health, and government agencies. To focus on last 10 years, several academists that update their papers were referred such as Ellen and Perrault (2008), they found six important factors: 1) established informal relationships and communication links, 2) mutual respect, understanding, and trust, 3) flexibility, 4) development of clear roles and policy guidelines, 5) shared leadership, and 6) a learning purpose. Cropper et al., (2008) reported factors describing the nature of the relationships (trust, reciprocity, incentive structures and administrative control); factors relating to contexts (goals, structure, environment, and legal, political, economic); and factors relating to process (trust, leadership, process for innovation, evaluating and intervention). Based on some sample above including another relevant papers, researcher can summarize that there are several key determinants or factors regarding the effectiveness of inter-organizational collaborative arrangements. These are: character and competency among concerned parties, supportive resources, structure and process of operational research collaboration, trust, adequate communication, good relationships, etc. These characteristics could constitute the facets of Inter-organizational Collaborative Effectiveness, etc.

RESEARCH METHODOLOGY

Overview of Research Approach

In this study the main focus was on the phenomenon of the operational research collaboration between Industry and Academia, the case of the Hard Disk Drive Industry in Thailand, with particular reference to Western Digital Company. A Qualitative Approach was adopted by the researcher. For the period of time that this research was undertaken, the research was conducted during April 2014-Oct 2014 (6 months).

Research Paradigm

This study intends to understand the social phenomenon of the "operational research collaboration between industry and academia. It is a subjective approach where the researcher believes the reality to consist of people's subjective experiences of the external world; thus, this study has adopted an inter-subjective epistemology and the ontological belief that reality is socially constructed. Walsham (1993) suggested that in the analytical paper, there are no 'right' or 'wrong' principle.

Methods of the Data Collection and source of data

In order to identify a group of key informants, such as researchers, engineers, and key informants that would be most likely

to have experience with operational research collaboration between the HDD industry (Western Digital Company) and academia, purposeful sampling (Creswell, 2003) was utilized. Creswell noted that in qualitative research, "the intent is not to generalize to a population, but it is to develop an in-depth exploration of a central phenomenon," which is best achieved by using purposeful sampling strategies (2005) to select the key informants.

The source of data in the study are related documents and in-depth interview 16 key informants that consist of 2 Policymakers (VP/MD), 2 Project Managers/Coordinators and 6 Engineers of Western Digital Company that had direct experience in Operational Research Collaboration with 6 Professors or Researchers from various academia. These 16 informants are acquired from the stratified random sampling technique, which 3 types of group across the inter-organization collaboration; policy makers, project managers/coordinators, engineers and professors are collected related to the demographic or proportion of each group. Moreover, the researcher select the representatives of each group with non-discrimination. The group of key informants are working relate directly or direct experience to research collaboration program with Western Digital Company that demonstrated an accomplished research project per intended outcomes in the previous 3 years. The interview process will be completed as long as data/ information are fully adequate according to the research objectives.

Data Analysis

This study applied hermeneutics or interpretive analysis. Miles, Huberman, and Saldana (1994) characterized qualitative data analysis in terms of three concurrent flows of activity: 1) data condensation, 2) data display, and 3) conclusion drawing/verification. This study also adopted the three flows of activity to analyze the data of all sources based on the data collection method. Therefore, for adopting the data analysis theory as a framework, the researcher will take up for: 1) listening to voice recordings along with note reviewing; 2) transcription to paper to display the data; 3) condensing the key words and sentences; and 4) grouping content and writing contents.

Results of the study

The researcher reviewed and used various sources of data and information such as documented information in the form of working procedures, and a presentation package and memorandum of understanding (MOU). Additionally, in-depth interviews with key informants, policymakers, researchers, engineers and research collaboration project managers and coordinators were carried out as planned as well as prolonged observations made in the real setting of the research collaboration context.

The key determinants of effective operational research collaboration between the HDD Industry and Academia

The research collaboration between Western Digital and university itself is an interaction between professionals, researchers

and engineers, to achieve intended goals and objectives (goal attainment) under the direction and policy of the two organizations. The keys determinants of effective operational researcher collaboration can be described based on the viewpoint of the key informants, policymakers, RC Manager, Researchers and Engineers, according to the following details.

1. Clear Scope, Goals, and Objectives

Goals and objectives are like a compass to determine the direction of each research collaboration project as to what was intended to achieve. A specific or clear scope and goals and objectives in each research collaboration project are defined in the project proposal and agreement by mutual agreement between the project owner and researcher. The good scope of work must be clear and measurable.

2. Win-win situation (mutual benefit) among stakeholders

The win-win phenomenon is a situation where mutual benefits, both official and unofficial, exist among stakeholders of research collaboration projects at organizational and individual levels through defining a clear contract, roles, responsibility, and involvement and interests that could be described as follows:

2.1 Organizational Level

2.1.1 Western Digital Company

2.1.2 Close the Gap of theoretical Limitation and Workforce Shortage

The research collaboration with academia enables the organization's performance development by acquiring external knowledge and transferring this to engineers and also allows the organization to utilize an externally-competent workforce, lecturer or researcher, to close the gap and overcome the competent workforce shortage as well.

An Economic Benefit

In addition to the company gaining effectiveness in problem solving and improving in specific areas as well as relieving manpower limitations, as mentioned above, based on empirical data the company has also gained in terms of the financial perspective more than 800 million baht as of 2015 that reflected a contribution from the research collaboration project in the form of return of investment.

Faculty or University Point of view

University's Mission Aligning "An academic service to society"

The research collaboration program is an opportunity to fulfill the university's mission, and one of the generic missions of an academic organization, especially of the public university, is to provide an "academic service" to society. This mission also cascades to lecturers or researchers in the university as well. The interaction between both of them is able to demonstrate as an "academic service" objectively from the university's point of view because the lecturer or researcher is directly able to deliver his or her academic capability to contribute to research collaboration success

Financial Benefits

Besides the benefits mentioned above, Faculty or University that made a research collaboration agreement or contract, their lecture

or researcher must be involved the research collaboration program with Western Digital Company, they also gain a financial benefit as well. The earnings that are contributed from the research collaboration program also will be paid back to the university.

Opportunity for graduated student admission

The setting of research collaboration is a chance for the interaction between researchers from the university and experienced engineers. The university has an opportunity to promote the curricula in their faculties to those engineers. Simultaneously, Western Digital Company also has implemented the scholarship program to acquire any engineering and science fields that match with the company's core business as well as to enhance the student's skill and knowledge. Many universities take advantage of this to invite experienced engineers to enroll and study in their various faculties (both master and Ph.D. levels) that match the interest of engineers

Opportunity to train students in the real case study in the field

In the contract of research collaboration, there are open opportunities for researchers or lecturers to have students from their university join the program as researcher assistants. The researcher utilizes the researcher assistant to engage in the research setting and to provide feedback information to the researcher when any changes or deviations are found in the setting. This supports the university in developing the skills and knowledge of their students in the right manner and is also related to the quality of the students.

Source of input for curriculum development

In normal practice, any curriculum of any field in any faculty of the university needs to be reviewed and revised periodically. There are needed various sources of data and information as an input for any curriculums development. The input from the real world of the practitioner in the industry is very important information besides other sources for curriculum development. Lecturers as researchers are able to receive data and information directly on what is the movement of knowledge in the current and future applicable to the industrial world in their field and to take it back to their faculties. Then, they are able to review the curriculum so that it is aligned with those movements. This means that university is able to utilize or take advantage of the research collaboration program with industry as one of the feedback mechanisms or systems for their curriculum development.

1. Individual Level
2. Researchers
3. Proper Financial Incentive

Basically, Lecturers or Researchers that have participated in a research collaboration project will earn compensation in a financial incentive form as well. In the contract agreement, the amount of financial benefit is clearly identified concerning how much the company will pay for any particular research collaboration projects.

Acquiring new knowledge and empirical experience

Besides gaining of financial benefit, the lecturer as researcher also is able to acquire or harvest new knowledge on the research topic. In the research execution process, researchers are permitted to review the data and information related to the research topic-both primary and secondary data. The activities that allow researchers to acquire this new knowledge and experience might happen in various forms; for example, the researcher has to visit the production line for HDD or HDD components to get an understanding of the real situation and to gain direct experience, to discuss with the engineer and technician on the shop floor, have formal meetings with the engineer and manager, etc.

Opportunity for Paper Publishing

The lecturer has pointed out that the academic paper publishing is one of the tasks to demonstrate the performance of the lecturer toward in his/her career. Joining a research collaboration program with an industry is a chance for the lecturer as a researcher gaining an academic issue that is related to the research project. Researchers are able to pick up some issues of the research topic to write a paper and publish, but it must not violate the intellectual property agreement with the company. Generally, the content of a research collaboration project is confidential. Paper publishing that is related to a research topic shall be permitted by the company.

Engineers

Support Engineer's objective achievement

One of the key roles and responsibilities of the engineer in the company is to solve and fix any problems and improve the situation in order to achieve the objective and target in their responsible area with high expectation. In the situation where the engineers respond in various roles, the research collaboration project is able to close that gap by helping the engineer to solve the problem as well as improve in a specific area per his/her primary role and responsibility, which means that the research collaboration project helps him or her to achieve key performance indicators (KPIs) as well.

Obtaining further knowledge

Regarding the research collaboration setting, engineers and researchers have always interacted and socialized both formally and informally in various channels. The key topic of discussion among them is related to academic viewpoint and practical surrounding research topic. By this phenomenon, the engineer is able to obtain and absorb tacit knowledge from the researcher while the researcher is also able to absorb and gain tacit knowledge from the engineer as well. Moreover, the official project charter and agreement of any research collaboration project also mentioned deliverable items with reference to final report and knowledge transfer through training activities.

Recognition from Management

Engineers that work in big organizations like Western Digital do not have much opportunity to be recognized by senior management. Many engineers work in the function or area where there is less chance to meet with senior management due to the span of control and the constraint of the work location. Almost 100 percent of the engineers work in other buildings that are far away from the management's office. Therefore, engineers as Research Collaboration Project owners have more opportunity to meet with Management to present their achievement to the Researcher to let the Management know that their performance is beyond routine roles and responsibilities.

Opportunity of high education study

Regarding the circumstance of the Research Collaboration Project, Engineers and Researchers have worked and interacted closely and this accelerates the opportunity to exchange information that is beyond the research topic. For example, the researcher informs engineer the information that related to graduate study of their university or faculty in various fields to let them know and understand for consideration to apply and enroll. Moreover, the engineer as a research collaboration project owner is able to utilize some part of that topic to fulfill further study at the master or PhD. degree level.

1. Strong commitment of leadership

The leader of Western Digital Company was defined as an active leader due to the research collaboration program, at the policy and direction level, was initiated and activated by Western Digital Company leader. They need to overcome the paradigm of quick-fix solutions and have enough open-mindedness to move on to basic sciences and fundamental research. Leaders also tend to emphasize long-term results rather than the short-term perspective.

2. Trust

The research collaboration program between universities and Western Digital Company is a phenomenon in which data and information related to the research project are normally and routinely exchanged and transferred among engineers and researchers. Traditional and official practice, the Non-Disclosure Agreement (NDA) will be issued and signed by all researchers that are participating in the research collaboration program. However, the NDA is just an official bond from the legal standpoint. It does not guarantee the open-mindedness for sharing information among the stakeholders if there is no trust among them.

3. Characteristic of key stakeholders

The good characteristic of key stakeholders is also the key determinant for driving the effectiveness of the research collaboration project as well. The sub-characteristics could be described in terms of the behavior, skills, and intensive knowledge surrounding the research topic.

Engineer

Based on the findings from the in-depth interviews, the characteristics of the engineer as a research collaboration project owner in

the context of Western Digital Company can be described as follows.

Sense of Ownership and Accountability

Engineers should have a sense of ownership and accountability from the beginning to the end of the project because research collaboration is not a traditional turnkey project where engineers cannot anticipate the results or excellence of the outcomes without commitment and consecration.

Strong Background of Knowledge

The background knowledge is the experience and knowledge of the engineer related to the research collaboration project. The engineer also as an area or function owner is a person that activates the research topic in his/her area. Therefore, he or she needs to have enough background knowledge surrounding the research topic because he/she is a primary source of data and information for the research topic.

Fast Learner

The research collaboration project for each topic in the context of Western Digital Company needs to utilize various disciplines of knowledge. Engineers that are assigned to work on research collaboration projects in an effective manner should be a person able to be a fast learner and to be able to absorb complicated information from the research setting and from the researcher.

Interpersonal Skill

Besides working with the researcher and researcher's assistant, engineers that "own" the research collaboration project also need to work closely with other stakeholders such as peer departments, suppliers, supervisors, and so on. They need to interact with others in the right manner so that the project can move forward effectively. Therefore, interpersonal skills are a key characteristic that engineers need to have in order to work effectively with stakeholders.

Willing to Learn

In the research collaboration project work, engineers always face challenges in learning new things related to the research project from the researcher and the project itself. Therefore, willing to always learn new things allows the engineer to be able to acquire new knowledge that is beneficial in terms of driving the research project effectively as a research project owner. The mentioned knowledge might be generated in the process of the research project or transferred from researcher to engineer. Engineers have to internally motivate themselves to learn new things enthusiastically

Researcher

Given the key determinants related to the characteristics of the researcher that affect the research collaboration effectiveness, the findings from the in-depth interviews from the key informants are as follows

Specialty

When taking into account research work, the expertise or deep knowledge of the researcher is very important and must be matched with the research topic. The matching between research topics with the specialty of the researcher is a critical job of the RC Manager

to find out when the research topic is raised by the engineer. If the specialty of the researcher is not agreeable, then there is risk of failure.

Emphatic Listening

Throughout the research collaboration process, researchers need to understand all of the details and get information surrounding the research topic from engineers and relevant staff as much as possible. At the project forming and planning stage, dialogue and discussion between the researcher and engineer is carried out frequently through face-to-face meetings in order to understand the context of the research. Emphatic listening skills are a vehicle to bring the researcher out from the academic viewpoint into the practical world of Western Digital Company. Emphatic listening practice allows the researcher to be able to diagnose effectively the research problem before execution.

Fast Learner

Researchers need to learn new things related to the HDD Hi-Technology manufacturing process and surroundings research topic, especially at the beginning. They should be able to capture, digest and learn the complicated data of the research project from various sources related to the know-how of HDD manufacturing within a short period of time. Being a fast learner is one of the characteristics of researchers that allow them to be able to drive research projects forward effectively.

Willing to Teach

The researcher, as an expert that has a specialty in his or her field, ought to deliver some theoretical perspectives that are interrelated with the research topic to the engineer. By doing this, they are able to accelerate knowledge spillover from the researcher to the engineer smoothly. However, knowledge transfer or spillover cannot effectively happen if the researcher is not willing to teach.

Open-mindedness

The rank of lecturer in Thai society and university is quite high. Generally, lecturers are respected by students and others, which can provide the academic viewpoints. Once the lecturer works in the industry sector as a researcher, the rank and status of the researcher might not be equivalent to the status of working in university. The relationship between researchers and engineers is a partnership that is not similar to the relationship between pupils and teachers in university. Therefore, researchers should be open-minded enough to accept the feeling of losing some rankings.

1. Resources

The effectiveness of researcher collaboration projects requires the availability, accessibility, flexibility and adequacy of needed resources. Given the needed resources, research collaboration projects require various resources for support which depends on the requirements of each specific research topic. Besides financial resources, the tools and equipment that need to be used in each project are also important for researchers and engineers. The needed resources should be accessible, flexible, and adequate and suit the requirements of each research collaboration project.

2. Communication

For communication among stakeholders, the channels and forms are expanded in many ways in both formal and informal such as face-to-face meeting, e-mail, SMS (Short Message Service) and phone call, etc. The key matter of communication is to make each other understand the message that is intended to be delivered to all relevant stakeholders of each research collaboration project.

CONCLUSIONS AND DISCUSSIONS

The Research Collaboration Program between Western Digital and universities raises the mutual benefit for both and at both organizational and individual levels. In view of organizational level, the company utilizes the research collaboration program to close the gap of know-how as well as workforce shortages to gain the economic benefits and improve in theoretical aspect. It could be proved that this program has existed under the frame of resource dependency theory in which Galaskiewicz (1985) identified three fields of inter-organizational relations: resource procurement and allocation, political advocacy, and legitimation. Resource procurement, allocation, and legitimation fields involve resource dependency issues in their explanatory framework.

Furthermore, the research collaboration program is employed to serve a condition of BOI's requirement and for Foreign Direct Investment (FDI) as for income tax exception. From academia's or the university's point of view, working with the HDD industry, in this case Western Digital Company, through research collaboration programs allows them to serve the university's mission, especially regarding the academic service to society. Additionally, they also gain financial benefit, opportunity for master and PhD. student admission, opportunity to train students in real case study in the industrial sectors, sources of input for curriculum development, etc. At the individual level, working together between engineers and researchers to execute research collaboration projects accelerates knowledge transfer among them. Engineers gain theoretical knowledge from the researcher while the researcher gains practical knowledge of the HDD industry from engineers. From an individual standpoint, engineers utilize research collaboration projects to fix problems as well as to deal with their work smoothly. Moreover, as project owners, engineers are also able to take a credit for the project achievement. The company pays remuneration to the researcher in financial form at the amount agreed in each project. They also gain more knowledge from a practical perspective in the HDD industry manufacturing context that are able to bring to share their students in the class in University.

Contribution to the theoretical perspective

The findings that were illustrated from this qualitative study revealed the key determinants at the sub-level that affected the operational research collaboration effectiveness between the industry and academia in the context of Western Digital Company. It

contributed to inter-organizational collaboration effectiveness theories in the field of industry and academia collaboration For instance, the results of this study could help to explain further "leadership commitment" behavior explained in previous study by many scholars. For an additional example, this study also revealed and explained further sub-determinants such as emphatic listening, being a fast learner, being willing to teach and learn, and having a sense of ownership related to the characteristics of the participants besides skills, knowledge, and interpersonal skills. Therefore, it can be concluded that this study explained further detailed to inter-organization organization relations theory.

Contribution to practical perspective

From the practical perspective, understanding the key determinates of operational research collaboration effectiveness between industry and academia could be beneficial to practitioners or management in both the industry sector and the university.

From the academic institution viewpoint, given the higher educational policy of Thailand, the theory of the new public service paradigm, World University Rankings and higher education institution standards announced by the Ministry of Education, there are encouraged higher education institutions to work with the private sector in various channels. However, the direction that just guided on what is higher education institution should do? Therefore, the outcomes of this dissertation would be beneficial to academic institutions in terms of applying the understanding key determinants in the right manner for enhancing the effectiveness of working with the private sector that align with their mission.

From the industry viewpoint, they are able to initiate or create the guideline or procedure to manage collaboration programs between organizations effectively by covering all of the key determinants that might help to enhance operational research collaboration effectiveness with academia in their context. For instance, in February 2015, the Thai government with the cabinet has approved "Talent Mobility Policy" proposed by the Ministry of Science and Technology to promote researchers' working collaboration in the industrial sector. This initiate encourages researchers from government and university agencies work full-time in the private sector and get the official-services ages or working ages from their originated agencies. This policy also explains what government agencies and university should do, to work collaboration with the private sector. Therefore, understanding the key determinants could support this initiative in the right manner to accelerate project achievement per the desired results and outcomes. Furthermore, it can help industrial development in value creation through inter-organization collaboration that meets both sides of academia and industry mission.

SUGGESTIONS AND RECOMMENDATION

Regarding future study related to this field, it might be applied to other theoretical

viewpoints besides the resource-based view or resource dependency theory. For instance, it might be focused on the effectiveness of policy implementation through the policy evaluation process. Further, in this study only covered the case studied and focused on one organization in the HDD industry in Thailand. Therefore, there is an opportunity in other industries that have a collaboration program with the university as well. Additionally, this study only applied the qualitative method and it would be better if all of the key determinants could be proved using the qualitative method with a wide range of study in this area. Furthermore, during the interviewing, some findings beyond the scope of this study were found, for instance, when a company is going to merge with another company. Therefore, future study might focus on the key success factors of the merging of two successful companies. Moreover, in Thailand's context, the government has initiated various programs to promote collaboration between the public and private sectors as mentioned. Therefore, the study in this area could be beneficial to fill out the practical and theoretical perspectives in this field.

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