EVALUATION OF RESEARCH COLLABORATION BETWEEN UNIVERSITY AND INDUSTRY

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To my parents

Syed Muhammad Iqbal Yousuf, Jahan Zaiba

and my beloved husband Dr. Adnan Shahid Khan

"Only the Almighty Allah will reward them"

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ABSTRAK

Kerjasama penyelidikan yang melibatkan kedua-dua universiti dan industri adalah faktor penting, berkesan dan dinamik bukan sahaja untuk pembangunan masyarakat sosial tetapi juga untuk pembangunan negara. Walaupun berkepentingan besar, terdapat masalah tertentu dalam menjayakan kerjasamaini sebagai contoh isu yang berkaitan dengan masa, latihan, perbezaan persepsi, orientasi dan matlamat, isu-isu hak harta intelek, beberapa kompetensi teknologi dan perkara-perkara berhubung dengan dana kewangan menjadi kekangan utama yang sedikit sebanyak memberikesan terhadap kerjasama ini. Oleh itu, untuk menangani masalah-masalah ini dan untuk menganalisis kekuatan serta kelemahan teknologi ini yang berhubung kait, penilaian kerjasama itu adalah sangat dituntut. Sebagai fakta, penilaian kerjasama ini telah menarik perhatian yang besar di kalangan ahli sains kerana keboleh gunaannya, ketentuannya dan nilai teknologinya. Kajian ini ditumpukan terutamanya kepada pembangunan model penilaian, yang tidak hanya bertanggungjawab untuk penilaian metrik generasi yang berdasarkan pembolehubah seperti kekangan, kriteria kejayaan, parameter penilaian dan hasil yang ketara tetapi juga menekankan pembolehubah yang sangat berpengaruh. Untuk pembangunan model ini, kaedah pengumpulan data gabungan yang dipilih iaitu kuantitatif dan kualitatif. Model yang dihasilkan mampu menilai kekuaton dan kelemohan kerjasama penyelidikan di sampling mempunyai nilai yang menguntungkan untuk masyarakat berasaskan pengetahuan serta untuk pembuat dasar. keberkesan model ini boleh menguatkan hubungan berimpak tinggi di kalangan penyelidikan sektor awam dan swasta negara. Lebih-lebih lagi untuk penilaian, model ini adalah sangat mudah dan sangat berkesan. Oleh itu, untuk meningkatkan keupayaan model penilaian ia adalah sangat disyorkan untuk melibatkan sektor kerajaan untuk pengumpulan data dan juga disebabkan oleh fakta bahawa beberapa dasar awam secara langsung dan tidak langsung memberi kesan kepada kedua-dua entiti.

ABSTRACT

University-industry research collaboration is an essential, effective and dynamic factor not only for development of social community but also for the development of a nation. Despite the enormous importance of this collaboration, there have been problems with successful collaborations such as time, training, different perceptions, orientations, goals, intellectual property right issues, technological competency, fund and financial matters. These are the key constraints that may affect this collaboration. Thus to tackle the cause of these problems and to analyse the strength and weaknesses of this collaboration viewed as technological linkage, evaluations of these research collaborations are very important. Evaluations of research collaboration have generated attention amongst scientists due to its feasibility, determination and technological value. This research focussed on the development of an evaluation model, that is not only responsible for the generation of a robust set of evaluation metrics but also highlights the influential constraints, success criteria and tangible outcomes. To develop this model, mixed methods research methodology using quantitative and qualitative methods were applied to collect data. The model is simple, efficient and has an auspicious value for the evaluation of research collaboration between a university and the industry. It is capable of evaluating the strength or weakness of a collaboration as well as demonstrating how successful collaboration can be achieved. Successful research collaboration between a university and the industry would have high impact on the nation and economy of the nation. Moreover, this research has a significant value, not only for the scientists and business analysts but also for policy makers. To enhance the capability and efficiency of this model, it is highly recommended that government sectors be included in the surveys and interviews due to the fact that public policies may directly and indirectly affect universities and industries that are involved in research collaborations.

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CHAPTER 1

INTRODUCTION

1.1 Research Background

Recently university-industry collaboration and their evaluation in terms of research have been developed and gain the level of interest widely. The process of evaluation of university-industry (U-I) research collaboration has generated the greatest attention among the scientist or the researchers of university and industry due to its feasibility, determination and technological value (Mitive, 2009). Many authors indeed focused on evaluation of research contribution between public (universities) and private (industries) sectors in the shape of give and take outcomes (Spyros, 2005). Luik believes that most of the research publications and their related works depend on the evaluation of importance of research being held at university level (Luik, 2005).

At the end of 50s, the developing countries had almost no industrial capacity. Industrialization deals with the strengthening up of national capacity to utilize raw materials and product development for domestic consumption (Todaro, 2006). The term "industrialization" is the organization of production in business enterprises. The social and physical infrastructures of many of them were not enough therefore the building of such capacity was seen to be tricky. Industrialization was seen as an essential feature for continuing or promoting national growth and improving the standard of living in a country. It was regarded as an instrument that could transform

agriculture, construction, transport, and other service industries into highly productive sectors (David, 2006). Thus they do not have any doubt for this research collaboration to get maximum out of it from adoption to commercialization stage. For this purpose, research collaboration between university and industry is very important. The mere presence of conventional economics inputs like land, labors or capitals are no longer enough to ensure economic growth in a nation. What is now important is the rationale application of these resources to productive purposes by means of technology. Both the industrialized and developing nations recognize the fact that technology plays a significant role in economic growth and the improvement of living standards of their countries. It is widely recognized that transfer of technology has played a vital role at industrial progress and overall economy of the nation. And it is possible only from university-industry research collaboration.

University research centers and center of excellence are no doubt an essential back bone of technology for research and development cells of industries. Thus, in well developed nations, there exists a powerful research bond within U-I to carry out innovations in a smooth and healthy way.

Despite the enormous importance of university-industry research collaborations there have been some general problems in the process of successful collaborations. These problems that include mainly the research agreements, conflict of intellectual properties, freedom of publication, different objectives, financials barriers and culture difference have led to unsuccessful collaboration between universities and industries (Bonaccorsi, 2007). Therefore, it is necessary for the developing countries to promote and to evaluate the relationship between university and industry. For this purpose, important techniques should be adapted to evaluate the research collaboration that can identify those elements in which they are weak.

1.2 Problem Statement

Cooperative relationship between university and industry can be justified by the manifestation of industries related to subject development, the usage of scientific research to generate fruitful environment at firm's level and the economical globalization and technology internationalization (Ahn, 1995).

National economies somehow depend on the research application, that's why most of the nations reserve big amount of their annual budget for their education especially on research activities. In Malaysia, there are five different public research universities and seventeenth other public universities (Web search, 2011). Within all universities, post graduation is either fully research or mixed mode based. Malaysian education system focused more on research in their post graduate studies and producing a very huge number of research activities every year, but all the researches are not commercialized thus leaving some weaknesses within these activities (GCR, 2011).

As the matter of fact, the first generation of any commercialized product in infancy stage is always incubated in research center and the final place just before commercialization is R&D of industries. University research is normally education based but industry demands commercial based research, thus most of the research seems to be useless and only shelved in the library for the references leading towards the wastage of resources every year (MyIPO, 2010, GCR, 2011).

To achieve the maximum output within these two researches, there should be a strong compatibility and collaboration within these two entities especially in their goals (Simon, 2008). There are certain problems that limit the efficiency of university-industry research collaboration. Especially research agreement, which is one of the major risk factor between university- industry collaboration. University and industry are entirely different societies which results not only different natures and perspectives but also different objectives. These differences generate friction within these research entities which limits their successful collaborations. One of the

key problems within these two entities is unavoidable culture differences (Barnes, 2002, Cyert, 1997, Siegel, 2003, Decter et al., 2007). Cultural barriers are insidious in U-I collaborations that's leads the stakeholders to work under dissimilar organizational environment which have entirely different not only norms and standards but also values (Siegel, 2003). Industries normally hesitate to publicize their researches and results amongst colleagues and even outsides the organizations. They believed technology to be kept proprietary and only be utilized for their profits. On the other hand, university considered researches and knowledge need to shares amongst all public and they consider it public property. By these contradictions, it seems to be more astonishing dilemma about publication freedom versus privacy of research activities (Peter, 2007**)**.

In U-I research collaboration, fund and finance is no doubt a powerful barrier for the technology development that is the reason for the government to supply additional funding to research centers or public sectors (Veugelers and Cassiman, 2005). Matters related to intellectual property rights are also one of the concerns in this relationship (Gomes, 2005). The researchers may want protection of propriety rights of their innovations even before this collaboration. On the other hand, industry may also claim the ownership due to their investments. Hall elaborates that intellectual property right issues are insoluble and limit the sought-after research collaborations (Hall et al., 2000).

According to Siegel, industry normally professed that university are much more insistent about intellectual property rights (Siegel et al., 2003). This leads to a tough environment on negotiations. Time period is another critical constraint for both entities. Industry always talks in months and days, while university researchers provide themselves with years to accomplish their innovations (Peter, 2007). Moreover, lack of periodical evaluation is also a big constraint between university-industry collaboration (Richard k, 1980), so the periodical evaluation is the best practice to measure the efficiency and deficiency of any linkage. For this purpose, the evaluation metrics has been generated in this research to give the clear picture of strength and weaknesses of research the collaboration. For the accomplishment of this research, research questions have been developed in the following section.

1.3 Research Questions

1) What are the constraints commonly associated with research collaboration between university and industry?

2) What are the evaluation metrics that may exists between university and industry to evaluate the strength of the research collaboration?

3) What are the success criteria for each evaluation metrics to evaluate the research collaboration?

4) What are the expected tangible outcomes from these research collaborations?

5) What is the relationship of evaluation parameters with constraints, success criteria and tangible outcomes?

The first research question aimed to explore the constraints and impeding factors that are commonly associated with research collaboration. The second research question seeks to identify the evaluation metrics that can show the strength and weakness of the research collaboration. From the third research question researcher intended to discover those criteria that can help out to evaluate the evaluation parameters, the purpose of fourth research question was to identify the outcomes that university-industry severely required from their collaboration which also show the strength of the collaboration while the last research question were developed to recognize the relationship of evaluation metrics with constraints, success criteria and tangible outcomes to generate comprehensive and robust set of evaluation metrics. From this question, all the related parameters are find out to remove the redundancy and to generate the evaluation metrics.

1.4 Objective

1) To investigate the highly influential constraints, evaluation parameters, success criteria and tangible outcomes that associated with university-industry research collaboration.

2) To develop an evaluation model for the evaluation of university-industry research collaboration.

3) To generate evaluation metrics that will be responsible for the successful evaluation of university-industry research collaboration.

1.5 Scope of the Study

In this research, a performance evaluation model for university-industry collaborative research has been developed. This study carried out from the perspective of university as well as from the industry. The target population of this research is the top management of the research centers in Faculty of Electrical Engineering in their collaborated industries. This Faculty has seven research centers and has high portion of industry-university research collaboration activities in Universiti Teknologi Malaysia.

1.6 Importance of Research

The proposed evaluation model has the capability to generate evaluation metrics for any research collaboration between university and industry. Moreover, it also categories high influence constraints, success criteria and tangible outcomes to

strengthen the collaboration with more focused manner. In addition, an evaluation metrics has been generated through this model is highly cost and time efficient. This evaluation can be applicable to evaluate the linkage of any university industry research collaboration. The model can be seen in Figure 5.2.

1.7 Thesis Contribution:

The research has developed an evaluation model and generated a robust set of evaluation metrics with the recognition of high impact constraints, evaluation parameters, success criteria and tangible outcomes. Significant contributions include:

1) **Recognition of Highly Influential Constraints, Evaluation parameters, Success criteria and Tangible outcome:**

The first contribution of this research is the recognition of high impact constraints, success criteria and tangible outcomes. These high impact variables are responsible to develop an evaluation model for the evaluation of university-industry research collaboration. The method of generation highly influential variables can be used in any research collaboration to analyze the initial level of collaborative strength.

2) **Development of Evaluation Model:**

The proposed evaluation model is cost, time and energy efficient model. This developed evaluation model is responsible to generate a robust and concrete set of evaluation metrics for evaluating any research collaboration between university and industry. However, by adopting the given strategy to develop the evaluation model any university and industry can create their own evaluation model to generate their own specific set of evaluation metrics.

3) Generation of Evaluation Metrics:

The generated evaluation metrics is the final version of our evaluation model that is responsible for evaluating any research collaboration between university and industry. It is comprised of joint venture, knowledge sharing, cooperative R&D agreement cultural development, financial support, communication, patent and licenses and masters and doctorate thesis. This evaluation metrics can be utilized in term of checklist or in the shape of forum discussions or in any means by simply following the set of generated evaluation metrics to check the strength and weaknesses of the collaboration.

1.8 Organization of the Thesis

This research contains five chapters. Chapter one discusses the background of the research and a basic concept of evaluation of University-Industry research collaboration. It also outlines the problem statements, objectives, research questions, and the scope of the research.

Chapter two address the literature review of university-industry research collaboration, process of university-industry interaction, reasons for creating this collaboration, importance of research centers in universities, importance of R&D in industries, innovation process by university to firms, constraints between university-industry and the key evaluation parameters with their corresponding success criteria for university-industry research collaboration. The conceptual framework which has been applied for this study is also discussed in this chapter.

Chapter three discusses the research methodology used, and the research design such as questionnaire design, unit of study and key respondents as well as data collection procedure. This chapter provides the data analysis techniques and research construct measurement.

Chapter four conducts the analysis of the research questions and addresses the empirical result of data collection from the sampling. In this chapter data has been analyzed with help of mix method (quantitative and qualitative).

Finally chapter five presents the summary and conclusion of the significant findings and provides valuable recommendations for future research.

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