

ISSUES OF COMMERCIALIZATION ACTIVITIES OF BIOTECHNOLOGY RELATED RESEARCHES IN MALAYSIAN RESEARCH UNIVERSITY

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Abstract

This study aims to explore issues of commercialization activities of research results among academic researchers who work in biotechnology related researches in Malaysian Research University. Accordingly, the conceptual framework based on 'Innovation Implementation' model has been assessed for its applicability in describing the phenomenon under study. Through interviews, elements as specified in the 'Innovation Implementation' model were found in this case study. Significant patterns and themes were also identified that suggest local industries, funding for research, development and commercialization as well as leadership, political interference, researcher's attitude, transition management and legal are considered as the contextual factors that affect the commercialization activities of research results. Finally, the revised framework of commercialization activities implementation based on the findings from qualitative analysis was recommended.

Keywords: *Commercialization activities; research results; biotechnology; academic researchers and qualitative analysis.*

Abstrak

Penyelidikan ini bertujuan untuk mengeksplorasi isu-isu dalam aktiviti komersialisasi hasil penyelidikan dalam kalangan penyelidik akademik yang terlibat dalam penyelidikan berkaitan bioteknologi di Universiti Penyelidikan di Malaysia. Justeru, kerangka konseptual berdasarkan model 'Pelaksanaan Inovasi' telah dinilai kesesuaiannya dalam menghuraikan fenomena yang dikaji. Menerusi temubual, elemen-elemen yang dinyatakan dalam model 'Pelaksanaan Inovasi' wujud dalam kajian ini. Pola dan tema penting yang

juga telah dikenal pasti adalah industri tempatan, dana untuk penyelidikan, pembangunan dan pengkomersilan begitu juga dengan kepimpinan, campur tangan politik, sikap penyelidik, pengurusan peralihan dan undang-undang, dianggap sebagai faktor-faktor kontekstual yang mempengaruhi aktiviti komersialisasi hasil penyelidikan. Akhirnya, kerangka semakan pelaksanaan aktiviti komersialisasi berdasarkan dapatan kajian analisis kualitatif disarankan.

Kata kunci: *Aktiviti komersialisasi; hasil penyelidikan; bioteknologi; penyelidik akademik dan analisis kualitatif.*

Introduction

The changing nature of the university's role makes commercialization of university research results more relevant nowadays. Faced with budgetary difficulties, universities now attempt to actively market their discoveries to industry, use their inventions to form new companies and engage in commercial activity related to economic development. These initiatives are described by Slaughter and Leslie (1997) as marking a new era of academic capitalism leading to what Etzkowitz (1983) terms as entrepreneurial universities.

Nelson (2001) contrasts these new initiatives with older norms favoring the open dissemination of research discoveries. Previously, scientists working in university laboratories were, in general, content to pursue their investigations without giving much thought to the practical application of the result. The discovery and development of patentable inventions was not the primary objective of their research efforts. Today, we are witnessing a distinct departure from tradition, where many academic scientists avoided patenting and involvement with industry (Feldman and Desrochers, 2004) and choose to focus on teaching and research. Nevertheless, the changing role of universities from knowledge production to capitalization of knowledge, with the objective of improving regional or national economic performance as well as the university's financial advantage, (Etzkowitz *et al.*, 2000) has led to an increase in the commercial activities among universities in the last two decades.

This evolution of the role of the university in developed countries also imposed new demands and pressures on the developing countries' higher education system (Altbach and Ogawa, 2002; Teichler, 2003). Within this context, in developing countries, research universities are seen as vehicles for technology transfer and a medium through which knowledge exchange is made more effective. This highlights the importance of promoting commercialization activities of research results among academic researchers. In addition, the individual academic researcher is central to the knowledge and technology transfer process in making strategic decisions about how to disseminate their research results in the university. Researchers decide whether or not to collaborate with industry, disclose their inventions to their university and/or start a company based on his/her knowledge. An increase in activity at the level of the individual academic will also accompany the shift from policy to implementation. With the realization that academic researchers are viewed as critical to the process, further understanding is required to identify issues related to commercialization activities of research results.

Why Biotechnology?

A considerable amount of research has been done by scholars on identifying the factors that affect the low rates of university research commercialization in Malaysia. However, the factors which influence and hinder research commercialization are not generalizable to all technology due primarily to the nature of technology itself. Biotechnology is a very good example. Jarret (2007) indicates that achieving regulatory approval is one of the major hurdles to biotechnology commercialization as it involves expensive, long range research and corresponding comprehensive data.

In addition, in the Ninth Malaysia Plan (2006-2010), biotechnology is a highly prioritized sector in Malaysia's national policy because the government has high hopes of achieving international excellence and academic and commercial success in this field. Therefore, it has received strong governmental support and commitment through financial support for its research and development, infrastructure and human resource development. Malaysian research universities with relatively good research and development track records could eventually contribute to the progress of biotechnology. Accordingly, the challenges faced by Malaysian research universities in bringing biotechnology related research to the market will be the focus of this study.

Commercialization Activities of Research Results

Several authors have called attention towards the fact that studies regarding commercialization at universities have hardly been focused on technology transfer i.e. areas related to patenting, licensing and spin off (Litan, Mitchell and Reedy, 2007; Mowery and Sampat, 2005; Meyer-Krahmer and Schmoch, 1998). Less attention has been focused on the other activities that occur before the technology leaves the university setting. In order to have a better understanding of the commercialization among academic researchers in Malaysian research universities, other activities, that occur before the technology leaves the university setting, is needed to look at. Thus, the scope of commercialization used in this study are more comprehensive, not limited to technology transfer activities such as patenting, licensing and spin off, but initial efforts that contribute to the commercialization are also taken into account, including knowledge transfer activities that have value and commercial motives.

Although there have been other studies on technology transfer, particularly, the study which focused on academic researchers, the study had been done mainly in developed countries (refer works by Audretsch and Stephan (1996, 1999); Bercovitz and Feldman (2004); Di Gregoria and Shane (2003); Keck (1993); Louis *et al.* (1989); McFetridge (1993); Thursby and Thursby (2002); Zucker, Darby and Armstrong (2002); Zucker, Darby and Brewer (1998). In Malaysia, for example, the study toward commercialization has been done by Senin (2006) and Sadullah (2002). Sadullah (2002) in his general survey gauged perspectives about university industry collaboration in Malaysia. Interestingly, both studies highlighted that Malaysian academics were not committed to research commercialization at Malaysian Universities. This finding, combined with the researcher's experience, has motivated the researcher to look at this matter in depth.

Theoretical Background

Klein and Sorra (1996) provided a significant theoretical path (Figure 1) addressing an important university research commercialization question: Why does university research commercialization vary among universities? Organizations fall short in successfully exploiting innovation because they are unable to develop new products or services. Klein and Sorra (2006) proposed that ineffective implementation was another cause for unsuccessful attempts by organizations to exploit innovations. The conditions for effective implementation are (1) strong organizational climate for implementation supported by the (2) organizational members' perceptions of the innovation-values fit.

A strong climate encourages the use of innovation by providing resources to develop employability, by establishing a reward system that provides incentives and disincentives and by removing processes and resource obstacles. The perceived fit between the innovation and employee's values influence the level of individual commitment towards implementing the innovation. These circumstances better bridge the organization's ability to shift from adopted policies to demonstrated productivity.

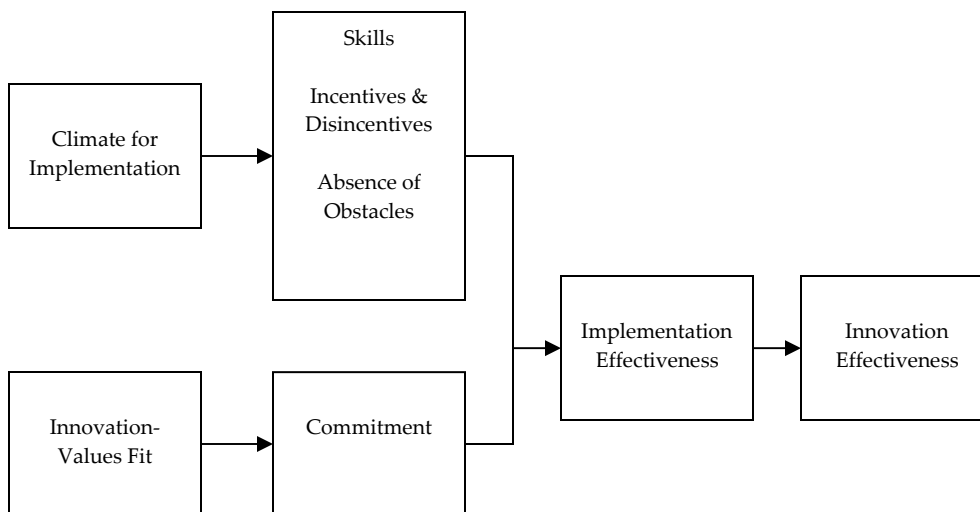


Figure 1. Determinant and consequences of implementation effectiveness (Klein and Sorra, 1996)

Conceptual Framework

Klein and Sorra (1996) model presented a wide range of variables and environmental factors that can have an impact on implementation effectiveness. However, only limited research has been done on their models within a higher educational institution setting using the academician as a unit of analysis. Drawing on aspects of innovation implementation theory (Figure 1) as related to innovative activity, these dimensions are positively related to the commercialization of research. Commercialization of research could also be considered as innovation since innovation is defined as the adoption of an idea or behavior that is new to the organization (Damanpour 1988, 1991; Daft and Becker 1978; Hage 1980; Hage and Aiken 1970; Oerlemans, Meeus and Boekema, 1998;

Wood 1998; Zaltman, Duncan and Holbek, 1973; Zammuto and O'Connor 1992). However, this theoretical framework needs to be elaborated to address the complexity of the study by the development of the conceptual framework.

Based on Figure 2, the conceptual framework (pre-testing) is conveyed representing institutional influences and individual attitude on commercialization activities of research results. The foundation of the conceptual framework is that university climate for commercialization and innovation-values fit are recognized as the critical factors which lead to commercialization activities of research results. As theoretically conceived by Klein and Sorra (1996), the innovation-values fit construct is important to consider when evaluating innovation implementation effectiveness within an organization. The influence of university climate on commercialization of research conveys that it is not about finding which one factor contributes the most towards promoting commercialization of research, but rather it is the perception of all factors collectively that is most important. Commercialization Activities of Research Results response to implementation effectiveness as implementation behavior are defined as an individual's consistent and committed use of a particular innovation (Klein and Sorra, 1996).

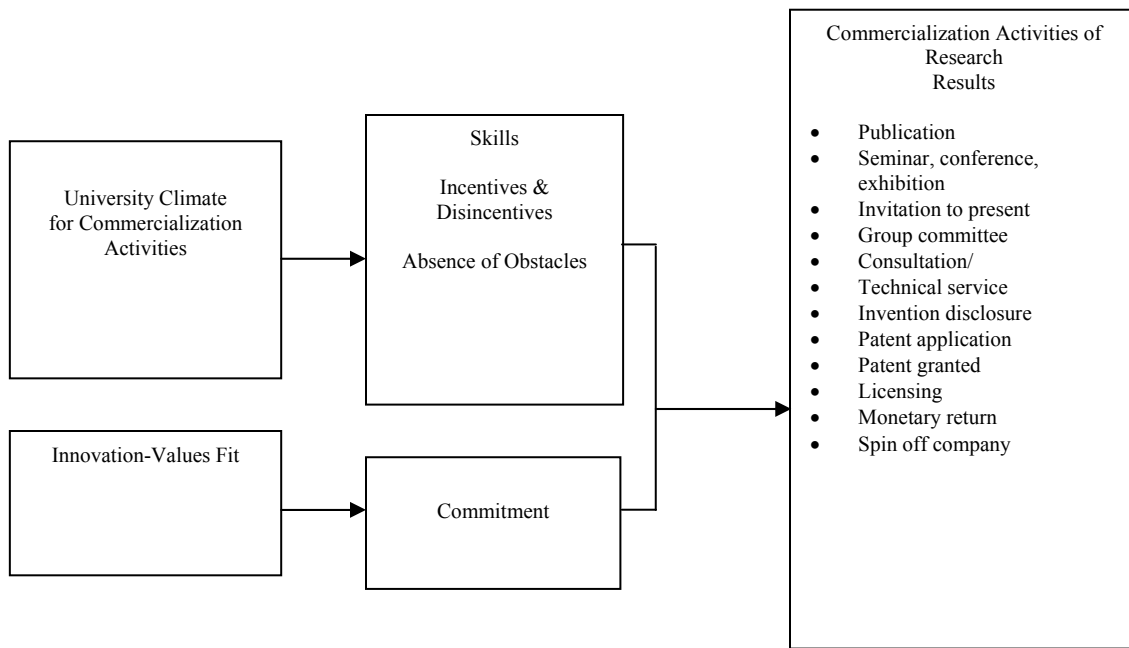


Figure 2. Conceptual framework (Pre-Testing)

The framework also showed that University Climate for Commercialization Activities and Innovation-Values Fit will affect the 11 items of Commercialization Activities of Research Results among academic researchers. It pointed out that the vision of Research University will be to encourage researchers to consider their knowledge transfer activities as knowledge assets that can be transferred outside the scholarly community (Landry, Amara and Ouimet, 2007). As the 11 items used by Jusoh (2008) will be used in this study. In addition, Jusoh's study was also conducted on Research University with focus on Total Quality Management.

The 11 items are (1) publishing academic writing, (2) communication with other users outside the academic environment/priority parties such as private firms or government agencies through

seminar, conference, exhibition, report in printed or electronic media, (3) presentation of research to group and organizations who could make direct use of them, (4) involvement in committees which are interested in using and exploiting new knowledge based on the research, (5) given consultation/technical services (based on technology field/ research result) to private firms, government agencies or others, (6) disclose the invention based on research, (7) applied patent based on research, (8) got patent based on research, (9) gave the licence to other party or organization to produce or market the product from research (10) the licenses that have been given to other party, would be resulted in monetary return and (11) research result could create spin off company that specifically produce and commercialize the research product.

Methodology

The methodological approach used in this study is framed within qualitative research. The single case study is an appropriate design under several circumstances. The single case can be used to determine whether a theory's propositions are correct or whether some alternative set of explanations might be more relevant (Yin, 2003). Single case research design also serves the purpose of theory testing particularly well, if they are most or least likely or crucial cases. Single case studies can also reject variables as being necessary or sufficient conditions (Dion, 1998). For purpose of this study, a research university which has proven track record leading towards spin off of biotechnology related research has been selected as a single case. This research university's uniqueness qualify its selection as the single case as Yin (1994) recommendation.

As in any qualitative case study, 'the crucial factor is not the number of respondents but rather the potential of each person to contribute to the development of insights and understanding of the phenomenon' (Merriam, 1988: 77). As such, by using purposive sampling and snowball sampling, eleven academic researchers who work on biotechnology related research were selected and participated in the interview.

Semi structured interviews were the principal research instrument used in the case study. The interviews for this study began at the end of July 2009 and ran until October 2009. E-mail requesting interviews were sent to potential academic researchers prior to fieldwork. Interviews were conducted according to the respondents' schedule and availability and at their preferred location.

Interview protocol representing lists of questions to be asked to each respondent was also created prior to fieldwork. Three questions from the interview have been asked in order to get perception of the participants regarding the university climate factors and the eleven commercialization activities of their research results. The questions are: 1) How did your university help academic lecturers in that particular commercialization activity? 2) How did your university deal with lecturers who commit or do not commit to that particular commercialization activity and 3) How did your university help you to reduce the difficulties in that particular commercialization activity? Those particular commercialization activities refer to the eleven commercialization activities as the questions were asked pertaining to one commercialization activity at a time. In order to examine innovation-values fit factors, the following two questions were asked: 1) As a lecturer/senior lecturer/associate professor/professor, how does this commercialization activity benefit you? and 2) Have you

involved in this commercialization activity? If yes, what were the difficulties that you often encountered in this commercialization activity? If you have not involved in this commercialization activity, what are the reasons?

While having a predetermined list of questions, during the interviews the question wording was not necessarily the same and the order of the questions were often modified based on the participant's responses. Additional questions were often asked. All interviews were conducted in English. However, the participants were allowed to answer in Malay or English, whichever language they were most comfortable with. On average, the interviews lasted approximately one hour and fifteen minutes.

To ensure confidentiality, develop trust and encourage the respondents to provide full information, names were coded. A refers to the first academic researcher interviewed while B refers to the second academic researcher interviewed. Interviews were recorded on tape with the respondents' permission. Taping the interview allows the researcher to concentrate on the discussion and listen to the interview as often as needed. Repeatedly listening to a taped interview enables the researcher to capture the essence and meanings of words, which facilitates quality analysis of data. Follow up inquiries were often made by telephone or e-mail.

Validity and Reliability

According to Breakwell (2000), 'the interview approach relies upon respondents being able and willing to give accurate and complete answers to questions posed, no matter what their format. Yet respondents may be motivated to lie. They may dislike or distrust the researcher. They may wish to sabotage the research. They may be too embarrassed to tell the truth. Even if they wish to cooperate, they may be unable to answer accurately because they cannot remember the details requested or because they do not understand the questions.'

The above factors allowed the researcher to set several strategies to ensure internal validity. In this study multiple sources of data or triangulation was used which include document investigation, participant observation, and interviews (Denzin, 1988). For this qualitative case study, strategies such as triangulation (the use of more than one method and data collection technique) and checking interpretations with the individuals interviewed or observed were used to establish validity. However, Guba and Lincoln (1985: 288) felt that the triangulation of data collection methods strengthen the 'dependability' and 'consistency' of the results obtained from the data. Guba and Lincoln (1985) believed that the two terms better describe the term 'reliability' and are linked with internal validity since it is impossible to have internal validity without reliability, a demonstration of internal validity amounts to a simultaneous demonstration of reliability' (Guba and Lincoln, 1981: 120).

The interview protocol developed at the outset of the case study research were not only helpful in guiding the researcher during the fieldwork but also helped to ensure that the study could be repeated with similar results, therefore reinforcing its reliability (Yin, 2003:37).

Results

The case study revealed a detailed pattern as to what extent the Innovation Implementation Model can be applied to describe and explain the commercialization activities of biotechnology related research among academic researchers in the context of Malaysian Research University.

It can be concluded that university climate as well as innovation value-fit factors are important in promoting commercialization activities of biotechnology related research in the conducted case study. Based on the interview of eleven academic researchers, for university climate, it is apparent that most academic researchers perceived commercialization of their research geared up the publication activities because of the institutional policy that gives most incentive to publication activity. Problems and issues related to the eleven commercialization activities, that faced by participants, were lack of experience of patenting, Technology Transfer Office (TTO) staffs lack of experience in patenting process, negotiating agreements with industry, TTO not aggressive enough to push companies to pay for consultation and licensing fees that have been agreed, very limited workshop and training regarding spin offs and time constraint to create spin off. It is interesting to note that there are two groups of academic researchers involved in biotechnology related research, the lecturer and the medical lecturer, who hold different perspectives due to different responsibilities and research approaches. The different issues raised by medical lecturers were about conflict of interest, and costly medical product to produce.

The finding for innovation-values fit (the perceived fit between the commercialization activities and employee's values), most participants of the case study, viewed job satisfaction as the most important benefit of their commercialization activities. According to Klein and Sorra (2006), this innovation-values fit will influence the level of individual commitment towards implementing the innovation (commercialization activities). Thus, job satisfaction is interrelated with commitment. The job satisfaction normally depends on what the employees can get or receive from the job. As humans, academic researchers are also subject to problems of dissatisfaction at workplace. If they are not satisfied, they may not be committed to deliver the best. Many studies have shown that committed workers are more likely to become high performing workers who benefit their organization in terms of productivity and profit (Narimawati, 2007; Tella *et al.*, 2007). In the context of this study, most participants perceived job satisfaction in term of intangible benefit as they felt that there is no compromise in any commercialization activities as it supposed to be their obligation as an academician. Some of them perceived job satisfaction in term of tangible benefits like promotion and monetary return. This finding is consistent with previous research done by Jaafar *et al.*, (2006) who found that responsibility and opportunity for promotions ranked as the important motivating factors that affect job satisfaction.

From the interviews there are several factors other than university climate and innovation-values fit factors that influence commercialization activities of research results among academic researchers. Other factors are viewed as consisting of local industries, funding for research and development and commercialization (R&D&C), leadership, political interference, researcher's attitude toward commercialization, transition management and legal.

Lack of industry related in biotechnology is the barrier for researcher to bring out their research result to committee. They perceived that the reality is that most of Biotechnology Companies are Small Medium Enterprises (SMEs) which hardly involve in commercialization activities. More

over the available industry is not serious in commercialization activities of research results because of funding and some conflict of interest. G commented that local companies do not seem to support the commercialization process for the right reason. When money becomes the main objective, the company interest does not match with researchers' interest anymore.

In this study, academic researchers involved in biotechnology related research find themselves in a different position from their peers at institutions in developed countries. They tend to be underfunded and unable to purchase and apply the latest research equipment. H remarked that funding the research itself is a problem. Finding the right facilities is very tedious and has caused disheartened among researchers. When even the process of buying the equipment is difficult, researchers would be demotivated to move forward.

Commercialization funding also reported as a problem. C complained that finding funding for commercialization projects is a huge problem even for public sector bodies. C explained that, due to lack of local regulation guideline, enforcement and certification such as CE for medical devices, researchers in medical field need to take it upon themselves to get proper certification for their product in order to be able to market the products for use. Acquiring such certification means researchers bearing additional cost for the whole tedious process, doing it on their own accord. Apart from difficult funding opportunities, organizations like public sector bodies could only help to supply only a fraction of the required funding amount.

The behavior of leaders plays a fundamental role in facilitating, nurturing and supporting commercialization activities within university. Participants in this study claim that university-level leadership act as the catalyst that stimulates commercialization activities. They perceived vice chancellor and deputy vice chancellor were good at planning strategy and vision. A commented that the current Vice Chancellor (VC) is very supportive and helpful towards their commercialization activities. C also commented that this is even more when the current Deputy Vice Chancellor (DVC) of research and innovation is coming from the same research background. His experience helps him to makes the process easier for his researchers.

Political interference also influences participants in commercialization activities. F viewed politics as a barrier as the intention to create spin offs cannot be achieved because of the current political climate. Speaking from personal experience, the participant had been invited to present the research result with one company, but because of the politics, the management change, the arrangement was cancelled. This discouraged the researcher from commercializing her research result. While C faced with this difficulty in getting the funding for commercialization of his product. C explained how repeated rejection from one of the funding agency, who claimed that his product was not good enough to be commercialize, he has resorted to help from political figure in order to realize his commercialization process.

Researchers' attitude toward commercialization activities also influences their engagement in commercialization activity: H emphasized that he remained convinced that the main reason for conducting research is not for commercialization.

Other factor is management transition. As to improve the process of commercialization activities, university introduced new system or institution to facilitate academic researchers. However, H explained how due to TTO being a new establishment, sometime caused overlapping with the university company.

From legal perspective, J complained about Non Disclosure Agreement (NDA) that university had implemented has frightened outside parties away from inviting academic researchers to present their research results. Besides that, participants also complained about civil service system in Malaysia that restricts them to create spin off and compare with other countries. For H, the restriction which disallowed civil servants from operating and running a company is a serious disadvantage. He cited Harvard which is declared as a profit organization (in contrast with local universities as nonprofit organizations), having their own staffs running companies while still functioning as an active academic staffs. Here is an illustrative comment from H:

“...in the US, every university is a company. Harvard University has two components: Harvard University, the university and Harvard in cooperated. So you declare university as a non-profit organization, but Harvard in cooperated is a profit organization...and a lot of company put under this...And of course because everything is own within Harvard incorporated, the flexibility of you running a company and becoming a professor is not an issue. And that’s how Walter Gilbert runs a company that’s now called M-gene and at the same time become professor of Harvard. Here we are not allowed to. Any government servant is not allowed to become executive...plays as an executive role.”

Based on the findings, a revised innovation implementation framework is derived accordingly (Figure 3). The revised commercialization activities implementation framework incorporates the qualitative findings as contextual factors into the conceptual framework (pre-testing) in this study that affect the degree of relationship between University Climate for Commercialization and Innovation-Values Fit and Commercialization Activities of Research Results throughout the project life cycle.

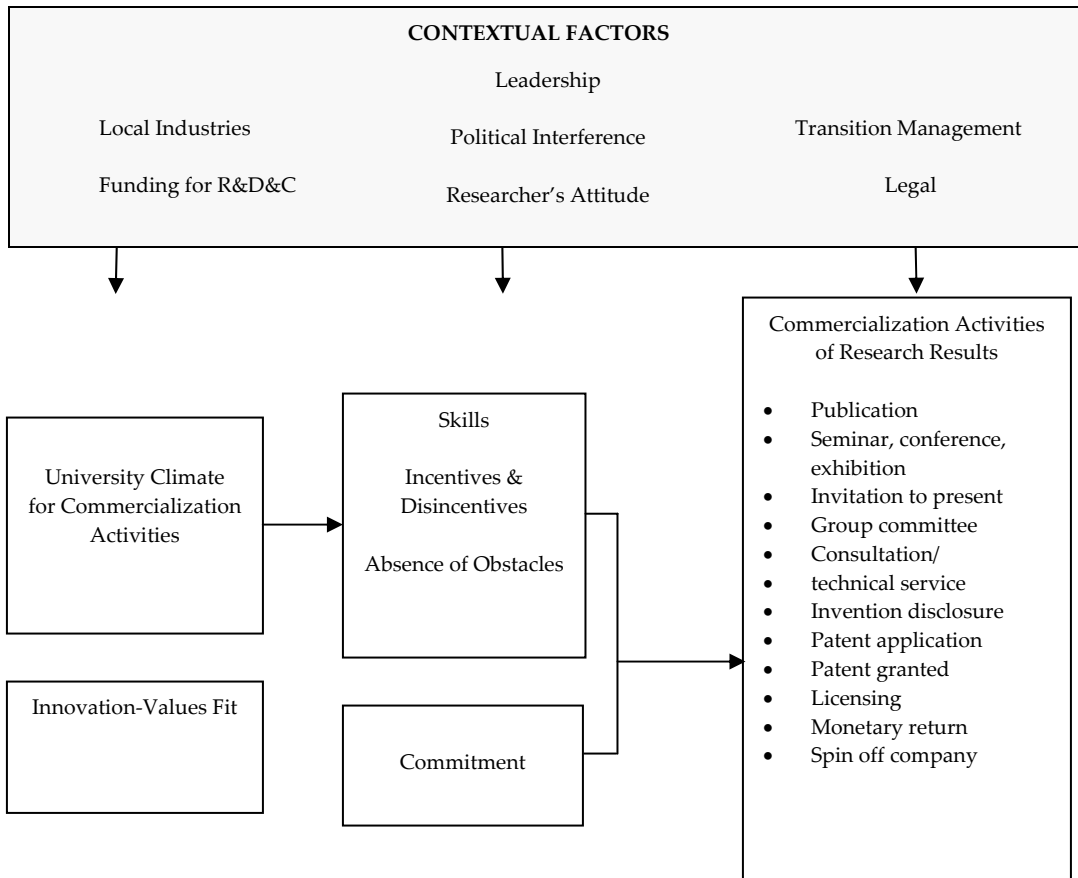


Figure 3. Revised commercialization activities implementation framework

Discussion

University climate for commercialization activities are critical in stimulating, enabling, facilitating and nurturing commercialization of research, behaviour and mind set among academic researchers. When the university climate is perceived to be accommodative and conducive for commercialization activities, a higher level of academic commercialization activities can be witnessed in university. Hence, there is a strong need to understand the university climate for commercialization activities that contribute toward commercialization of research among lecturers so that steps can be taken by the management to create conducive commercialization activities environment that is in line with their expectations.

The findings of this study indicates that university climate for commercialization factors should be given due consideration as they significantly affect the consistency of commercialization of their research compare to innovation-values fit factors. For example in this study, incentives are more than disincentives in most commercialization of research that will make academic researcher satisfied with whatever their achievement. Furthermore the incentives also lack at certain level of commercialization activities. For example in patenting, licensing and spin off. This will bring academic researcher to prone in certain types of commercialization activities which involve less work and more incentive.

This study also revealed that there are deficiencies in university Technology Transfer Office (TTO) itself. Most participants complained about TTO not having experienced staff in helping their product patenting process, not aggressive in collecting repayments from industries on behalf of the researchers and lack of spin off activities exposure. Obviously, policies should address issues that are critical to the success of commercialization of research such as royalty-income distribution, assignment of responsibility for seeking patent protection, researcher and institutional conflict of interest, management of licensees' contractual performance and training in spin off companies. Given that this initiative is relatively new, university officials and policymakers need to seek guidance on "best practice".

The higher education systems in Malaysia during this study period consisted only of four research universities with limited autonomy which were tightly controlled by the government. This limits the ability of the academics to engage in collaborative activities with industries. For instance, academic staff employed by these universities were considered civil servants, subject to strict public service regulations imposed by the Malaysian Public Service Department, including restrictions not only on the number of working hours with industry but also on the amount of money that could be received from activities such as consultant fees. Universities and their academic staff were not allowed to engage in commercial activities, including exploitation of academic research results. Commercialization activities of research results therefore were minimal during this study period as indicated by the findings of the survey of commercialization activities of research result among academic researchers. Thus, the Intellectual Property Commercialization Policy for R&D projects, introduced in June 2009, can be used as a platform to further evaluate the impact of this policy towards commercialization of research among Malaysian academic researchers.

Conclusion

Conclusively, this research suggests that university climate for commercialization activities and innovation-values fit do affect the choice of method used for commercializing the research result. However there is one limitation to the evidence obtained. The primary evidence is derived from a single case study and from a small number of participants due to lack of number of academic researchers who have experience in all commercialization activities that have been studied. There is a need for evidence from additional studies from other universities. Nevertheless, this suggests the opportunity for further research in this topic.

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