

A conceptual framework on prioritization factors towards biotechnology inventions commercialization: Malaysia biotechnology industry

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Abstract: Commercialization is an essential strategy for a firm to keep up with the new updated technological change. One of the options for them is to acquire new inventions from external sources such as university. Based on Resource-Based View (RBV) of firm theory, this study proposed the factors that potentially contributed to the success of university-generated inventions commercialization by the potential recipient firm. The RBV theory will be used as a ground theory in identifying those factors. According to RBV, resources can be classified into four domains, organizational resources, technological resources, financial resources, and human resources. Therefore, this paper aims to study the effects of those resources as critical factors that enhancing the success of commercialization academically inventions and to propose a model in order to highlight these critical resources. The effect and strength relationship of various critical factors on the commercialization will be studied by on the biotechnology industries in Malaysia. By reading this paper, readers will be able to obtain clearer picture about conducting future research in order to understand the critical success for commercialization of biotechnological inventions in Malaysia.

Key words: Resource-based view (RBV); Conceptual framework; Technology commercialization and technology transfer

1. Introduction

Commercialization is a process of moving and transfer a technology or innovative inventions from laboratory to market acceptance and use. A number of definitions have been introduced to define commercialization. Generally, commercialization can be defined as the process of transferring and converting knowledge into marketable product (Hassan 2012; Rosa and Rose 2007; Allen Consulting Group; 2004). Technology commercialization will start with the detection of potential or opportunities. Then, the technology will be acquired by interested firm. Later, the process will continue with the application of additional idea and creativity to generate new innovative competitive product. The final stage will be the production of marketable product. Hence, based from firm perspectives new commercialization definition can be derived. Commercialization is a process of acquiring new inventions or technology from university, and converting into marketable product and use. For a company or a firm, the commercialization is one of the options for them to remain competitive in their business (Chen et al., 2011) and is a must for firm survival and advancement (Hung and Tang, 2008). The access to the latest inventions is important for the growth of the firm. Thus, in order to keep up

with the market, it is essential to have a constant inventions and technology update as ongoing basis. With new broad inventions, it is crucial for them to has a specific running strategy in selecting successful inventions. According to Cooper and Edgett (2001), the ability to select inventions with high successful rate is a basic to the business success. Correspondingly, these inventions will undergo product development during the whole process of commercialization and how firm to operationalize the strategy will manifest the business strategy.

Ample evidence shows that continuous research and development on latest invention is crucial for product to penetrate market at the right time. It is clear that firm see the importance to become knowledgeable about potential inventions. Most important, perhaps, is that industry has recognized to certain extent criterion on what they expect for particular inventions, and only choose to engage with it if inventions are highly competitive advantage and in-line with their business. Thus, important technical questions arose: What is the viewpoint in which decisively affects the selection of the invention? What is firm "wish list" or related criterion they look when assessing and selecting new inventions? Both questions have to be answered in order to gains attention from firm and industry and thus increase chance to get commercialized. Only little information that may explain why some firm

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engage more in commercialization with “chosen” inventions and the reasons behind it.

In general, some of the academically inventions from university are very attracting to firm and were commercialized while some of it fails for the breakthrough. A key to understand the problems in commercializing university’s inventions is a fact that university researchers are selling unproven marketable product (Hassan, 2012). Such technologies are not ready to breakthrough into the market, and some of them are too risky due to high investment. This was supported by (Nerkar and Shane, 2007) stated that, the willingness of firm to involve and engage in the commercialization depends on their expectations about the returns of investment that they will capture from successful commercialization.

Thus, a good way to begin is through the selection of potential inventions for commercialization, and then how to operationalize the suitable strategy in order to innovate inventions into marketable product. As suggested by Cooper and Edgett (2010) the identification of commercial potential value for the specific technology is one of necessary precondition element. If they failed to look into the commercial potential at first place or failed to do so, then firm will risk in failing to capture or acquire future technology for their business. In a business world, resource allocation management is a pivotal for firm business survival since technology and marketing resources are simply go to waste on the wrong projects (Cooper and Edgett, 2001). Due to constraint of resources availability and highly competitive markets, firms have focused on specific inventions with commercially viable, purposely to maximize the values or commercial worth. In addition, the strength of inventions based on commercial value is leverage in the marketplace, and these attributes are a key factor for the selection.

Hence, a good way to begin is to find out the firm strategy when they acquire the needed inventions and technology. There is dearth of study in which looking from the eyes of firm especially in Malaysian biotechnology industry. Additionally, it is not clear based on previous literature on the influence or factor seeks by firm towards the biotechnology inventions; and how these factors will have an impact in the biotechnology industry. The purpose of this paper is to shed light in identifying other various influential factors, and the effect of those on the commercialization of biotechnological inventions based on Resource-based view (RBV) perspectives.

2. Problem statement

The commercialization towards new biotechnological inventions in Malaysia situation is very low compared to global standards. Despite the numerous studies had been done in identifying the factors that affecting the inventions commercialization process in Malaysia situation; however those studies were perceived by academic researcher only (Abu Talib, 2007; Farid et al., 2011;

Frost and Sullivan, 2009; Hussain and Rahman, 2013; Ismail et al., 2012; San et al., 2012) and less study focusing on biotechnology scope. According to Farid et al. (2011), the effective factors that contributed to the success of biotechnology innovation are knowledge, cooperation level received from industry and also amount of fund allocation. However, these studies were viewed based on the perspective of university researchers only with less feedback from firm.

A numerous of research had been published that in result discussed the success of technology commercialization based on firm capabilities and resources such as Chen et al. (2011), Chen (2007), Cho and Yu (2000), Nerkar and Shane (2007). While these previous papers had provided greatly factors that influence commercialization, however less study had been done to discuss the determinants from the technology buyer perspectives. As suggested by Dixon (2009), fewer studies captured the full range of understanding from practitioners in commercialization strategic decision making. Thus, identification of the determinant from different perspectives to ensure the winner inventions not only possess commercial value, but also remain aligns towards firm resources.

In order to derive new conceptual framework, this research will be built upon of Resource-Based View (RBV) of firm theory as ground theory developed by Barney (2001). New additional construct that suitable within the scope of technological, organizational, financial and human resources based on previous literature review will be added.

3. Research objectives

The main study objectives for this conceptual framework will be:

- 1) To identify determinant factors that influence the success of the biotechnological commercialization in Malaysia from the biotechnology industry’s perspectives,
- 2) To establish a hierarchical ranking for determinant factors for the success of the commercialization of biotechnology inventions in Malaysia, reflecting to the level of importance and overall impact,
- 3) To propose a framework for the commercialization determinant for biotechnological invention in Malaysia.

4. Literature review

Numerous studies have been conducted in the area of commercialization especially with academically inventions (Abu Talib, 2007; Farid et al., 2011; Frost and Sullivan, 2009, Hussain and Rahman, 2013; Ismail et al., 2012; San et al., 2012). Following this trend, this paper endeavors to suggest a conceptual framework to identify the several key determinants and influential factors of commercialization. The Resource-Based View (RBV)

theory provides the closest, valuable and potential contributory elements to a firm performance in their commercialization process; although, there is no specific theory enough known to explain the whole phenomenon of commercialization. However, some of the important aspects in RBV are suited within the scope thus; it is very interesting theory to link with. For this framework (refer Appendix), the determinants or factors were grounded and reflected from the RBV theory to identify the success drivers of commercialization.

4.1. The resource-based view (RBV)

In recent years, RBV theory had attracted much attention by scholars especially in technology transfer between firm such as Hung and Tang (2008), Madanmohan et al. (2004), Moller et al. (2003) and Tyler (2001). RBV theory able to highlight necessary resources and shows firm the capabilities it needed to success in technology transfer; subsequently, RBV theory generally focusing on organizational-specific resources; in which to determine essential activities for a firm on how to achieve “sustainable competitive advantage” (Wernerfelt, 1984).

As claimed by Acedo et al. (2006) and Barney (1991), by using RBV theory the successful strategy for organization to achieve sustainable competitive advantage can be formulated. Within this context, Barney (1991) stated that every organization owns their specific individual resources in order to compete and become competitor in a certain environment. RBV theory underlies two assumptions in which resources are heterogeneous, organization own different bundles of resources. Next, the resources immobile, and different resources can be sustainable (Patas et al., 2012). Collectively, whether these resources able to create and drive organization towards sustainable competitive or competitive advantage, it will rely on the peculiarity of its attributes, rare, imitable, valuable and not substitutable (Patas et al., 2012). By referring to Somsuk et al. (2010) and Philbin (2012) resources might be both tangible (such as infrastructure, physical technology or equipment and materials) and intangible (such as intellectual property, information, process knowledge, and learning). According to RBV there are four resources, namely technological, organizational, and financial and human resources that predicted directly towards the sustainable competitive advantage. RBV framework also suggests that these sets of resources and capabilities cannot easily transfer between organizations without incurring cost (Asheim and Isaksen, 2005).

In addition, there is another concept within the RBV that need to enlighten on, in which is the capabilities. Firstly, introduced by Barney in 1986, the concept concerns on how the firm skills able to organize and managing the concept. To be precise, capabilities can be defined as “the process of an organization undertakes in order to utilize its

resources” (Philbin, 2012), or skills to deploy resources to reach desired objectives (Carraresi et al., 2012). It also can be defined as a firm ability to “develop a set of activities through resource deployment in order to reach a desired end (Helfat and Peteraf, 2003). Applying to this concept, there are two capabilities that had been included in this framework. It was represented by technologies and innovative capability in which firm can exploit to achieve successful commercialization.

4.2. Viewing Commercialization through the Lens of RBV

Since RBV perspectives had been used in technology transfer such as Chen et al., (2011), Chen (2007), Cho and Yu (2000), Nerkar and Shane (2007) and Somsuk (2010), it seems to be suitable to discuss to the level of technology commercialization scope. Firm considered new inventions and technology as vital strategic sources for new business and value creations. However, these inventions do not contribute to any value towards firm unless this inventions being commercialize (Fars, 2012). Therefore, decision on the acquisition and commercialization of the new inventions is considered as a strategic selection. Usually, because of the state of new inventions specifically on biotechnology, commercialization process is not simple as the purchase of capital good (Hung and Tang, 2008); firm need to obligate to their substantial resources to adapt, assimilate in order to improve the technology (Hung and Tang, 2008). In respond to this, the firms are truly sensitive in dealing with inventions in which to ensure only a suitable technology invention with potential commercial value were selected.

Due to specific resource required for firm to achieve sustainable competitive advantage (Chen et al., 2011; Fars, 2012; Zhao et al., 2005), it is a tricky business when to select potential winners from a wide range of inventions in order to bring it to market and meet consumer demands (Nerkar and Shane, 2007). From the firm perspectives and view from Resource based-view (RBV) theory, the internal and external resources can be derived from assets, firm capabilities, attributes, organizational process, information, technology and knowledge (Somsuk, 2010). These resources were controlled by a firm and enable them to implement the strategies to improve firm efficiency and give them the capabilities they need to be successful in commercialization.

4.3. Technological resources

4.3.1. Technology attributes

For new and latest technology, the uniqueness and the superiority of technology strengthen firm motivation to get involve in commercialization. Study by Wang et al., (2012) towards technology

licensing and patenting in Taiwan's universities indicated that, the newness, uniqueness and the superiority of technology is a major influential factors to commercialize the academic patents. According to Cooper and Edgett (2010), a uniqueness attribute can be strength for technology, thus will have an advantage within the competitive market. Additionally, firm knowledge in seeking, identifying, assessing and valuing technology also will guarantee the commercialization success. If the complexity level of technology is high and too sophisticated, it will be difficult for a firm to acquire it. The current experts on the specific technology might not in the same par. Thus, the technology might fail to breakthrough in the market. Even though there will be an advantage due to newness of the technology, the experts are needed to operationalized it during commercialization process.

At the first glance, firms seem to generally prefer a relevance technology suits for their main core business since firm human resources are equipped with previous "know-how" capabilities related to the main focus technology (Madanmohan et al., 2004). A relevancy of the technology will influence the rates at whether transfer succeeds or fail (Yasuda, 2005) since the risk during acquisition is diminished and smoother process (Dyer, 1997). Firm then turn to the choice in which technology requires the lowest resources commitment but highest in term of the value of creations. But, in biotechnology industry the technology is not always be cheaper since to acquire the technology is already expensive and future R&D is needed for the development of the product. Due to several constrains, firm might not afford to support future R&D and then it is the matter to focus on the readiness of the technology. They prefer to buy readable technology and later can be manufactured into marketable product. Product that ready in the final stage for mass production with less improvement changes also matter in commercialization success.

H1: Technology attributes will have a significant positive effect on technology commercialization performance.

4.3.2. Acquisition technology

Acquisition can be defined as a planned and selective process that focusing on new technology transfer in which firm has not nor did not master with commercial expectation benefits (Cho and Yu, 2000); firm gaining new inventions or technology from university that have commercial potential value. Generally, there are several mechanisms in the commercialization that frequently being observed between university and firm, famously licensing or cooperative R&D or a joint R&D and joint venture. Licensing is a method of securing permission, creating legal relationships by which to use certain technologies and access to the related secret know-how (Yoshikawa, 2003; Hung and Tang, 2008; Somsuk, 2010). According to Rahal and Rabelo (2006) licensing is the rights to innovate for industry

for further commercial development. The main purpose for technology licensing is to transfer the rights which are the intellectual property rights to the transferee. Thus, in the firm-university context, it will "leads to royalties and licensing income back to the inventor, which is university in the form of social and economic benefits" (Rogers et al., 2000).

Cooperative Research and Development (R&D) or a joint R&D is another popular technology transfer mechanism and attracted enormous attention between firm and university (Yoshikawa, 2003). This mechanism is a joint cooperation arrangement between both parties to developing new technologies or inventions under mutually agreed specification goal (Yasuda, 2005); from RBV perspectives, cooperative R&D as the amalgamated of resources such as technological resources and for better access to external business resources. Hence, the problems will be reduced, allowing partner to share risk and developing cost for technology innovation. Partners will be beneficial in controlling financial resources into unified management and also increase the market position (Hung and Tang, 2008).

Lastly, a joint venture is an organization takes the form in short time cooperation or partnership, in which ownership shared between both parties (Yasuda, 2005). Both parties will contribute and combine respective resources, assets, capital, technology and human resources. In order to achieve mutually agreed business goal, both parties will form new entity under shared control (Hung and Tang, 2008) to manage manufacturing resources and distribution resource thus, reducing risks (Yasuda, 2005).

Commonly, mode of acquisition that usually occurs between university and firm is licensing. The outsourcing or licensing agreements enable firm to access several components and enable firm to innovate differentiated product at lower cost (Zahra and Nielsen, 2002). From licensing, important issues such as Intellectual Property (IP) can be easily manageable and with good sharing strategies. Firm will simply administer resources through licensing agreements, user agreement and also patents (Moorsel, 2005). From the acquisition perspectives, the key issues will be on to decide or regulate to what extent for both parties to obtain the profit benefits. Different type of inventions will have different enforcement mechanism protection toward intellectual property rights. In this case, university researchers which known as inventor and investor from firm must detect infringement in order to enforce the patent (Steven, 2009).

With weak enforcement mechanism, the IP values on those inventions will correspondingly diminish. As conclusion, acquisition technology will have a significant positive effect on technology commercialization performance.

H2: Acquisition technology will have a significant positive effect on technology commercialization performance.

4.3.3. Facilitating condition

One of the important elements based on RBV theory is the physical attributes. For the commercialization between firm and university, there can be a numbers of collaboration in terms of sharing physical resources. In this theory, resources that had been discussed are an infrastructure such as laboratory, equipment and facilities provided by university for future involvement and cooperation (Suk and Jerome, 2004). Collaboration with university will provide firm with stable platform to develop new technology related to business and will lead to future commercial projects. Considering the range of interactions that can take place as part of the collaborations, there can be a number of instruments available that can be coordinated in order to give benefits between university and firm. The strategic collaboration programs such as laboratory and equipment sharing can be administered for further cooperation. In order to gain specific access to application of specific technologies, high technology laboratory equipment must be shared and also with assisting experience lab assistant. Collectively, these resources need to be harnessed in an efficient manner to underpin the collaborative process with these two parties (Philbin, 2012).

H3: Facilitating condition will have a significant positive effect on technology commercialization performance.

4.3.4. Technological capability – the mediator

According to Madanmohan et al. (2003), the technological capability process involves three comprehensive stages. First step is “learning by acquisition”, next is “learning by doing” and lastly “learning by learning”. Usually, firm will acquire new technology from external source such as university, and then adaptation process will begin. The process will include the subsuming material and facilitate with other process changes. Based on previous experts in acquisition, new knowledge can be obtained from further study of technology. New expert level will be gained on the improvement. It will extend their learning to develop new product and processes. It is “a function of the ability to access, adapts, and manages technologies” (Madanmohan et al., 2003). The outcome of the technological capability process is likely depending on the variety of internal and external factors. In addition, RBV also suggested that the diversity of resources will suggest different performances of the firm (Barney, 1991). Therefore, firms that is able to gradually gather or acquire appropriate resources and capabilities resulting to a better technological capability over competitors.

H1a: The effect of technology attributes on technology commercialization performance will be moderated by technological capabilities.

H2a: The effect of acquisition technology on technology commercialization performance will be moderated by technology capabilities.

H3a: The effect of facilitating condition on technology commercialization performance will be moderated by technology capabilities.

4.4. Organization resources

4.4.1. Biotechnology research and development culture

In order for firm to derive a necessary benefit from interrelations with university, there are needs of appropriate interactions and culture that fits the mechanism of commercialization. Regarding this, Somsuk (2012) found that certain firm often able to establish links with university that have a good research development culture. This culture will build up the capabilities as their organizational routines and thus easy to work with. As an extension, the study of the effect of biotechnology culture yet to be discovered. Biotechnology and development culture can be defined as the professionalism, productive, operational personnel of R&D experts in biotechnology application, well defined plan/roadmap to improve or develop new technology in biotechnology application. As mentioned before, Somsuk (2012) also found that researcher that has a good record of commercialization will potentially broader the commercialization success. This shown that, both university and firm have their own expectation about the outcome from the process. Thus, it can conjugate into a good culture when embarking on a new collaboration due to the realistic expectation that had been drawn before. Finally, the mechanism process will establish a complementary fit between two parties for future success.

H4: Biotechnology and development culture will have a significant positive effect on technology commercialization performance.

4.4.2. Perceived prior biotechnology experience of transferor

Previous experience of transferor among the important factors that influence the technology acquisition due to technical might arouse during the commercialization process. The lessons gained from previous acquisition will more likely reduce the commercialization cost (Hung and Tang, 2008). For the successful of technology commercialization, the availability of technical personnel is a significant contributor to the degree to which personnel expert involved during the process. It was supported by Zahra and Nielsen, (2002) indicated that knowledge, expertise, and skills of personnel put firm into advantage in gaining relatedness technology and making technology commercialization is easy.

These expert personnel also improve commercialization success by facilitating the

developments of product. Whether firm can acquire the information and knowledge of the inventions, it is technically depending on the support provided inventor. Since the most likely researchers invented and innovated those inventions, they are the ones that most familiar with the technology to play role in the technology transfer (Thursby and Thursby, 2003). Furthermore, this pivotal role of university's researcher to follow-up further with firm is necessary because most of biotechnology inventions likely need specific expertise during commercialization process. The willingness of researcher to get involve within the commercialization process is essential for a firm to improve the inventions (Thursby and Thursby, 2003).

Subsequently, the commitment of inventor to continuously involve in technology transfer also has become a major concern. A study by Thursby and Thursby (2003) on the issues between industry and university licensing, the involvement and commitment by inventor is one of the important factors that motivated firm to engage in commercialization. The demands of cooperation from inventor by acquirer also include skills, expertise and experience (Hung and Tang, 2008). Another consideration is the credibility and the reputation of the inventor. For a firm to establish a relationship, those qualities are important in order to make firm confident, hence will strengthen the relationship and communication between both parties (Wang et al., 2012). Clearly, the role of experience of transferor, in this case is experience in biotechnology field will have a significant contribution in commercialization.

H5: Perceived prior biotechnology experience of transferor will have a significant positive effect on technology commercialization performance.

4.4.3. Innovative capability – the mediator

One of the capabilities that can be exploited in order to achieve good performance in commercialization is innovative capability. As mentioned by Chen (2009) innovative capabilities refer to firm capabilities, grounded in the processes, systems, and organizational structure, which can be applicable to the product or process innovation activities. This capability will drive firm to obtain good performance via product innovations that usually require lower monetary investment (Carraresi et al., 2010; Suk et al., 2010; Wei and Wang, 2011); coherently, this capability imperfectly transferable, and also not easily replicated and substituted. It can be gained based on experience, organizational skills and learning. RBV suggest, firm with strong innovative capabilities can lead to become superior to rivals. Strong innovative capabilities will improve commercialization process in terms of the cost, speed, quality, and newness attributes of the technologies (Zahra and Nielsen, 2002). Through biotechnology sector, it generally has a high level of investment for new unproven

technology. With innovative capability and already existing technology, firm could benefit easily from innovation process; firm able to innovate in their creative ways, such as unique innovations like adaptation of new methodologies for prolonging the technology, new packaging and supplemental procedure and so on. This imperfectly transferable constitutes a capability according to the RBV requirement (Carraresi et al., 2012). Firm can exploit their innovative capabilities to acquire technology, innovate new product and introduce them to the market in a timely accurate (Chen, 2009).

H4a: The effect of biotechnology and development culture on technology commercialization performance will be moderated by innovative capabilities.

H5a: Perceived prior biotechnology experience of transferor on technology commercialization performance will be moderated by innovative capabilities.

4.5. Financial resources

4.5.1. Access to funding

According to San et al. (2012), the factor that hinder for commercialization to take places due to the limited amount of fund allocated and restricted investment. Scholars such as Bakar et al. (2013) also stated, the access to financial capital has a significantly impact towards the success of Malaysian biotechnology companies. The ability to access to funding is a vital factor during strategic decision for high technology ventures. In Malaysia situation, study by Ahn and York (2009) claims that the need of sustained government institutions investment towards the biotechnology companies is crucial to the success of commercialization. The capital flows are needed as central role to “enable biotechnology firm to efficiently obtain international investment and alliances to ensure sustainability” (Ahn and York, 2009).

H6: Access to funding will have a significant positive effect on technology commercialization performance.

4.6. Human resources

4.6.1. Access to new talent

The needs of more talented personnel are involved in future research especially in biotechnology expertise (Ahn and York, 2009). As extension to RBV, the human resources is applicable to manage the technological situation since the prowess personnel in handling technology is salient. It is the major determinant and most valuable strategic assets. In this context, the new talent will give new advantage for both parties which are firm or university for its ability to deploy new knowledge; idea and expertness since new talent also come with unique manner. More talented workers will not just

add up the sum of hands, but also added new detailed considerations and providing new ideas. Thus, the commercialization process can be improved.

H7: Access to new talent will have a significant positive effect on technology commercialization performance.

5. Significance of the research

In Malaysia, the uptake of biotechnology inventions by industry purposely for commercialization is still in low frequency. Due to that, outcome from the research will also provide guidelines to researcher upon controlling inventions purpose and screen their research with expectation from industry needs. This study contributes to the stream of research in commercialization field specifically in biotechnology. Apart from that, this study will be able to test the ability of RBV as a grounded theory to analyze the prominent resources and factors for firm dealing with new outside inventions as external resources. Integration of new resources and capability into RBV modified framework also provides a useful conceptualize idea of the external and internal resources and the linkage to the success of commercialization.

To the researcher, understanding the degree of determinant factors will influence the acceptance of industry towards their inventions and essential to its success for commercialization. It is imperative to know that biotechnology industry is varying in financial, technological, human and organization resources. Understanding these capabilities factors in the biotechnology inventions will assist researcher to obtain accurate estimation for better inventions and attract the trust from industry to further commercialize it.

6. Research methodology

As mentioned earlier, this conceptual framework will be built based on RBV theory, developed by Barney, (1991), combined with new additional constructs from Somsuk et al. (2010), Chen et al. (2011), Hung and Tang (2008), Cho and Lee (2011), Zahra and Nielsen (2002), Suk and Jerome (2004), Ahn and York (2009) and Chen (2009). Researcher also added new mediating factors to investigate the strength of relationships among technology and innovative capability, government and venture capital supports dependent variables. New additional constructs and mediator is entailing because RBV model alone does not address the whole commercialization manifestations between firm and university especially in biotechnology field. Therefore, by expanding the model towards the commercialization and incorporates biotechnology characteristic, an extensive research framework will be developed. Through this research will depict the influence factors as a determinant of commercialization performance.

Based on the RBV theory and construct items based on previous literature, a research framework, shown in Appendix 1.0 was developed to illustrate the relationship among the factors, mediator and technology commercialization performance. Appendix 1.0 indicates the proposed research model in this study. The dashed rectangle indicating the items added to the RBV model. Technology and innovative capability, and government and venture capital supports were added to the model as mediator.

7. Data collection and sample

A quantitative method will be carried out to test the thirteen hypotheses that were developed based on seminal literature. The companies during this study will be selected from biotechnology companies in Malaysia based on Ministry of Science, Technology and Innovation (MOSTI) Biotechnology Cluster. The informants will be chosen respectively from three sectors, which are from agriculture, healthcare, and industrial sector because these sectors are high in numbers on commercialized biotechnology inventions in Malaysia. The empirical study employs a questionnaire approach to collect data for testing research hypotheses and constructing model. Variables in the questionnaire include background information, four resources, namely technological, organizational, and financial and human resources. The mediators are innovative capability, technological capability, government and venture capital supports. All variables, except moderating variables and control variables, require seven-point Likert-style responses ranging from "strongly disagree" to "strongly agree" in multiple items. The questionnaire will include two parts and requests the commercialization executive to complete the first part – dependent variables and control variables and the other executive to complete the second part – independent variables and mediator variables, respectively.

8. Data analysis

The conceptual framework and hypotheses will be tested using The Statistical Package for Social Sciences (SPSS) Windows version 20.0 from survey data. A series of statistical analysis will be applied to analyze the data gain from survey. Descriptive statistics will be used to summarize and describe the data collected. The data will be gained from this study then will be interpreted using the descriptive statistic such as mean, median, mode, range, percentage for demographic variables analysis (Tharenou et al., 2007).

Inferential statistics will be performed in order to analyze the relationships between variables. The relationships between variables, the commercialization activity and the number of possible determinant factors will be explored by using correlation and regression analysis as suggested by Kothari (2004). Correlation analysis

will be employed in order to examine the relationship between all measurement items and regression analysis will be used to measure linear relationships between two or more variables (Hair et al., 2003).

9. Conclusion

This study explored on firm-university technology commercialization from the lens of RBV perspectives. The potential resources that relatively related to firm-university commercialization can be identified. This study will contribute to the RBV literature in two important ways. First, the use of RBV perspective as ground theory prior to firm-university technology commercialization. The integration of RBV theory on this study cast a light about how commercialization between firm-university can be achieved with respect to pooling sourcing resources. Unlike many other studies on commercialization, this study looks through the eye of transferee firm. Through ongoing, study reinforces on identification of formidable resources related to commercialization. These prominent resources are highly considered by transferee before to move forward on the commercialization. Coherently, to make commercialization happen, there are external resources required by firm. Rather than exploiting their own existing resources, firm seeking to obtain those external resources to gain more advantage in commercialization process.

Secondly, from this paper, new theoretical perspectives can be drawn upon based on the identification of new formidable resources. The application of new derived theoretical perspectives may help to study the importance of each resources. In other words, which one of these resources will be seen as the highest priority and thrive commercialization process. Importantly, with respect to prioritization of those resources, the linkage of new theoretical resources must be empirically investigated and can be tested. The RBV theory is used to ensure sustainable competitive advantage can be achieved, as well as to improve commercialization frequency between both parties.

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