Middle-East Journal of Scientific Research 26 (5): 490-502, 2018
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2018.490.502

The Effects of Resources on Biotechnology Inventions Commercialization: A Research-Based View

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Abstract: The purpose of this paper is to explore the effects of resources that reflex to commercialization of biotechnology inventions in Malaysia from Resource-Based View (RBV) perspectives. The resources used in the study had been identified from previous literature review and confirmation with expert opinion. Eleven constructs were utilized namely; technology attributes, technology acquisition, biotech R&D culture, perceived prior biotech experience transferor, access to funding, access to talent, innovative and technological capability. SMARTPLS 3.0 was used to construct the exploratory measurement path model. PLS Algorithm and Bootstrapping were employed to analyze the effect of endogenous latent constructs towards commercialization success. Results indicate that access to talent, innovation capability and technological capability were the significant drivers on biotechnology commercialization. This study gives an added value to the literature by extending the understanding on company's resources and capability that contribute to technology commercialization success.

Key words: Resource-based view (RBV) · Biotechnology · Commercialization

INTRODUCTION

Malaysia government has focusing on biotechnology industries which grows as a national priority to enhance productivity and sustainability, as well economic growth [1]. In Malaysia, biotechnology is considered as a catalyst to promote bio-based economy specifically in three major biotech industries; agricultural, industrial and healthcare. Unfortunately, this promising catalyst needs a start in order to find a way to increase the commercialization rate, especially when dealing with biotech-inventions from universities. Relatively, there are little works that has investigated the factors that may explain why some inventions attracting biotech company's attention and been more successful than others in commercialization. Nevertheless, there is less formal study identifies the necessary conditions that would lead companies to commercialize universities' invention.

The low uptake of academically biotech inventions by private company is the problem which reflected to all companies especially in biotechnological industry in Malaysia. Biotech invention is a technology or products that had been discovered, invent by using biotechnology application and techniques. Due to its nature, biotech invention may ranging from concepts to working prototypes; prototypes showing clinical efficacy and to finalize designs with appropriate approvals [2]. Moreover, in Malaysia the biotech industry constantly being monitor and regulated with special act and regulatory bodies, thus will indirectly affecting them to consider even more before proceeds to plan for commercialization process. Furthermore, biotechnology need a huge investments, high time consuming, with profits that can only be enjoyed after several years [3]. Thus, it takes more initiative and consideration by company to commercialize this technology. Although Malaysia government and its

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agency portray significant role in facilitating process for commercialization, but still there are some critical issues that hinder company in heading towards commercialization process. For them, commercialization of research products is a complex process and no single approach that will guarantee the success [4].

Commercialization mechanism will drain enormous company's resources and capabilities in order to make it true. It is not a simple task by company's management team to decide since it will be affecting the whole company performance. Thus and thus, this study utilized RBV theory in order to identify potential and possible resources that reflex to commercialization success. In this context, Resource-Based View (RBV) theory was applied as a means to explain company resources and capabilities that enable commercialization progress and undoubtedly to gain competitive advantage and superior performance. To promote the success of commercialization, it is therefore important for the company of commercialization and management to understand relevant resources as required.

Indeed, there is one assumption needs to be made, where this study consider Malaysian biotechnology industry as dynamics, as well as backing from university's biotechnology talents and commercial team capabilities, that supports commercialization activity within this industry. The primary competitive advantage of commercialization means to secure necessary resources and the enablement of commercialization activities between company and university. For that reason, the theory of RBV may be used as a method to shed a light to commercialization success.

MATERIAL AND METHODS

Resource-Based View: Resource-Based View suggests the resources and capabilities that can influence the growth and company performance [5, 6]. According to Penrose [6], company can be viewed as a big organization and the productivity is significantly will be affecting by resources and capabilities. Specific, unique and impossible to imitate resources, as well as capability are the standards that would differentiate them as to be unique and superior. Based on resource-based view, resources could be mapped into four different categories namely, human, technological, organizational and financial resource.

- *Human resources* indicate characteristics such as knowledge, skills and experience of the company's staff, the commercialization's personnel and also management team in an organization. It is all about technicality and capabilities of the employees. As mentioned by Powers and McDougall [7], human resources is an "access to the persons with talent and expert knowledge for cutting-edge technologies' development.
- *Technological resources* including company specific technology [8] are referred as the company-specific technology, laboratories and equipment, expertise and knowledge, experience in business related to the technology and highly-specialized sets of skill.
- *Financial resources* are referred as the financial support which can be in any kind of amount that company may utilize such as angel investors, venture capitalists, grant making entities and other alternative organizations that provide debt-financing services and banking.
- *Organizational resources* are referred as the routines, the relationships, command structures and systems embedded in the respective company and resist imitation effort by competitor [9].

Biotechnology Invention: Biotechnology is the process of applying "biological knowledge and techniques to develop products and services…[with] any technique that uses living organisms to make [or] modify products, improve plants or animals, or develop microorganisms for a specific use" [10]. According to Oxford Dictionary online [11], invention can be defined as the action of inventing something, typically a process or device. It is noted that according to Smith [12], invention features should include with new ideas, discoveries and breakthrough. In a biotechnology context, it means an invention is based on biotechnology application, or relate to a product, process and biotechnology techniques. For instance, biotechnology industry components are by utilizing and adopting "completely new invention" from academia invention. Hence, biotechnology with the based inventions can be defining as a new technology or products that capitalizing the used of biotechnology specialties, techniques and exploitation of biological processes.

Biotechnology Commercialization on Company Performance: Commercialization can be defined as a series of process commence by industry to acquire technology or invention and converting it into financial value based on market opportunities. For better understanding on technology commercialization, the act of delineation can be done as a conduct or mechanism of

employing a good idea and invention into something marketable and profitable. The process is normally done by specific mechanism in introducing new invention or product and established them through market needs. Every biotech company, they need to engage with commercialization process in order to stay competitive in the market. The performance of the company will highly depending on how they manage the commercialization and the output. Kollmer and Dowling (2004) [13], contend that technology commercialization involving product design and marketing are based on developed technologies or technology transfer through licensing or other cooperative arrangement.

Alternatively, technology commercialization is a capability of the company in "transferring products quickly and efficiently to the market". Furthermore, Zahra and Bogner [14] indicated that the active use of commercialization has positive effects on company performance, including sales growth and return on equity. It was suggested by Chen, [15], that business performance can be supported by the company ability to commercialize the technologies efficiently. Meanwhile, in order to measure company performance, O'Regan and Ghobadian [16] noted by stating that, to get good judgment of effective measurement of company performance, the system must not cover more than just financial measures. Heidt [17] also agreed that some of performance indicator must also emphasis on performance objective such as profitability, sales and asset. As suggested by Frishammar *et al*. [18], technology commercialization can be measured by financial and non-financial dimensions. For non-financial dimension, the performance can be measure by observing the success of business and how this success will contribute or converted into profit. On contrary, for financial dimension, the empirical results in terms of money and bank account usually used as a realistic standard for company. However, in real scenario, both dimensions that discussed above frequently is called as corporate performance or management performance. Non-financial measurement popular to use in study of performance because of certain companies are reluctance to share their financial confidential data. Therefore, to measure biotechnology commercialization in this study, it is suggested to use non-financial dimension for the measurement. "In the context of commercialization, the increased in quantity of successful licensing, patent and quantity of contract research number can be the significant predictors of commercialization adoption performance" [19].

Commercialization Mechanism: There are several commercialization mechanisms based on industry perspective. Initially, before considering the types of mechanism, company envisages resources and capabilities that will give them advantage through the whole process. Thus, these are several mechanisms that usually adapted by industry for commercialization purpose.

Technology Buy Out: It is the classic and the easy way to deal with. The deals will be making to buy out the whole technology, so that everything that relates to the technology would belong to them and company would not have any ties to inventor. Company also will be acquiring the whole intellectual property rights for the related technology. Similarly, company would not have to worry about the royalty or claims made by inventor. Financial resources would be the most resources that will absolute to be utilized for the process.

Technology Licensing: This is a regular and common method especially onto commercialization between industry and university. It is a method of attaining permission from owner to exploit the technology. Permission to innovate or manage technology and is basically limits to the deals that have been done. Usual deals will include with expired date and may be limited to some certain levels, such as cannot be sold or shared to other company. Resources such as technology resources and others are needed since the company needs a expert on desire technology to make a deal which is complete with financial package.

Technology Cooperation: At first, company representative will be impressed with certain technology which discovered by university's inventor. Then, the after proof of concept will be validated by company. If there is an interest from company, arrangement will be done to propose for collaboration. Inventor and company are working together on invention and develop it to reach the market value. It is a mutual agreement with both parties agree to spend the amount of money and at the end, the company will have right to have a share of profit when technology is successfully turns into a breakthrough.

Resources: Based on RBV, there are two crucial presumptions in deciding the characteristic of resources; they must heterogeneous and immobile. In sum, heterogeneous can be signified as skills, capabilities or other resources that organization possess which are

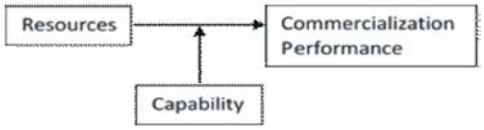

Fig. 1: Concept of this research [21].

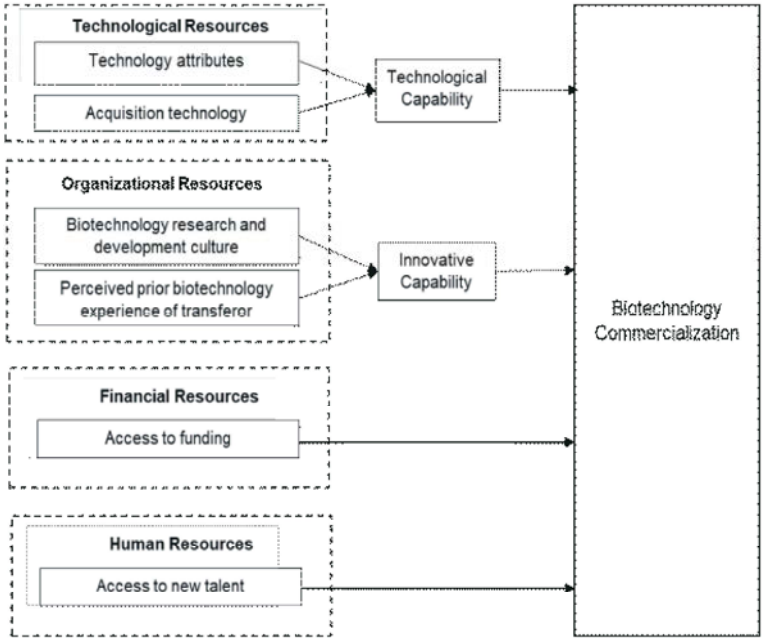

Fig. 2: Theoretical framework from this study.

distinctive from other resources. If company has the same resources, thereupon it will not be able to outperform rival due to the disadvantage that against them. Overall, most company compete on each other in same environment towards same external resources. Heterogeneous resources will make them unique and able to achieve sustainable advantage [20].

Figure 1 shows the concept of this research. The effects of resources to company value can be elucidated in two ways. Firstly, as a direct effect, means resources will have significantly or instant effect on company value. In particular, if company has more valuable resources, then its competitiveness will be increased [21]. Secondly, for indirect effects, it will indirectly affect company competitiveness and efficiency. Indirect effects are a mix with two means of strategies; low cost strategy and different strategy. As suggested by Spanos and Lioukas [22], low cost strategy utilizing productive process with competitive resources, which alternatively acts as different strategy of company ability by product innovation and development.

Research Model and Hypotheses Development: Figure 2; box (outline with dot line) indicates the original RBV theory, with four resources that affecting the company performance. Then capabilities were proposed as mediator, in order to study the direct and indirect effects in the relationship towards commercialization.

Technological Capability – The Mediator: Madanmohan *et al*. [23] claimed that 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, company will acquires new technology from external source such as university and then the adaptation process will begin. The process will includes the subsuming material and facilitate with other process changes. 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, to adapt and to manage technologies" [23]. Most studies have interpreted technological capability as a process of assembling

technical knowledge or a mechanism of company's organizational learning. Indeed, technological capability must empower an organization such biotechnology company to undertake a range of biotechnology application skills, extending from invention adoption to development into product, manufacturing and the introduction of new technologies as they appear. Technological capability is an exercise or activity of the competencies to access, adapt and manage technologies.

Hypothesis 1: Technological capability relates positively to biotechnology commercialization.

Technological Attributes: For a new discovery and invention, invention attributes of uniqueness, novelty and superiority will attract company to get involve in commercialization by adopting the inventions. The newness, uniqueness and the superiority of technology are the major influential factors to commercialize the academic patents [24]. According to Cooper and Edgett [25], a uniqueness attribute can be a strength for technology in owning an advantage within the competitive market. If the complexity level of technology is high and too sophisticated, the company would face difficulty to acquire which thus will hinder commercialization.

Hypothesis 1a: Technological capability positively mediates technological attributes to biotechnology commercialization.

Technological Acquisition: As mentioned by Hung and Tang [26], "technology acquisition is one way to enable an industry to keep in touch with the latest trends of an accelerated technology". Acquisition can be construed as a "planned and selective process that focusing on new technology transfer in which company has not nor did not master with commercial expectation benefits" [27]. As mentioned before, commonly, mode of acquisition that usually occurs between university and company is through licensing. The outsourcing or licensing agreements enable a company to access several components innovate differentiated product at lower cost [28]. From the acquisition perspectives, the key issue 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 thus will reflect to different path of commercialization mechanism.

Hypothesis 1b: Technological capability positively mediates technological acquisition to biotechnology commercialization.

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 company capabilities, grounded in the processes, systems and organizational structure, which can be applicable to the product or process of innovation activities. This capability will drive company to obtain good performance via product innovations that usually require lower monetary investment [29]; Lo *et al*., [30]; Suk and Jerome, [31]). Strong innovative capabilities will improve commercialization process in terms of the cost, speed, quality and newness attributes of the technologies [28]. Biotechnology sector is generally has a high level of investment for new unproven technology. With innovative capability and already existing technology, company could benefit easily from the innovation process.

Hypothesis 2: Technological capability relates positively to biotechnology commercialization.

Biotechnology Research and Development (R&D) Culture: Biotechnology and development culture can be inferred as the professionalism, productive, operational personnel of R&D experts in biotechnology application. It is involving with the well-defined plan and roadmap to innovate new technology in biotechnology application. As suggested by Somsuk *et al*., [32], employees that has a good record of commercialization will potentially broader the commercialization success. This shown that company has its own expectation about the outcome from the commercialization process. Thus, it can conjugates 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 university-company for future success.

Hypothesis 2a: Innovative capability positively mediates biotechnology research and development culture towards biotechnology commercialization.

Perceived Prior Biotechnology Experience of Transferor: Previous experience of transferor among the important factors has given a great influence towards the technology commercialization. Moreover, there is the possibility dispute due to technical problems that might arouse during the commercialization process. The lessons gained from previous acquisition will more likely to reduce the commercialization cost (Hung and Tang, 2008) [26]. For the successful of technology commercialization, the availability of technical personnel is a significant contributor to the degree of which personnel expert involved during the process. It was supported by Zahra and Nielsen (2002) [28] which indicated that knowledge, expertise and skills of personnel do put company into advantage in gaining relatedness technology and making technology commercialization at easy.

Hypothesis 2b: Innovative capability positively mediates perceived prior biotechnology experience of transferor towards biotechnology commercialization.

Access to Funding: According to San *et al*. [33], the factors that hinder for commercialization to take places are due to the limited amount of fund allocated and restricted investment. Scholars such as Bakar *et al*., [34] also stated that 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 biotechnology industry situation, a study conducted by Ahn and York [1] 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 in order to "enable biotechnology company to efficiently obtain international investment and alliances to ensure sustainability" [1].

Hypothesis 3: Access to funding relates positively to biotechnology commercialization.

Access to New Talent: This is the need of more talented personnel involved in future research especially in biotechnology expertise [1]. As extension to RBV, 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 asset. In this context, the new talent will give new advantage for both parties which are company 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 of considerations and providing new ideas.

Hypothesis 4: Access to new talent relates positively to biotechnology commercialization.

Research Method

Data: This study was conducted through online survey, phone call and semi-conducted interview in order to collect the data. Two main criteria must be considering; a company must able to possess biotechnology techniques applications in product/technology innovation and commercialization process. Then, data screening was done, with 42 companies' data were finally retained for study. Hair *et al*. [35] suggested that the minimum effective sample size is ten times of the largest number of formative indicators or the highest number of structural paths directed at a particular latent construct. The highest number for this research model is four, so the minimum sample size needed for PLS-SEM analysis is 40. Thus, the sample size of this study is sufficient for the analysis. Detailed descriptive statistics for the company's demographic characteristics are presented in Table 1. The samples' demographic characteristics resemble the biotechnology company in Malaysia between March - May 2018, in which divided into three main sector; Agricultural (42% of the sample), Industrial (26%) and Healthcare (30%). Each of the sectors was classified into the type of biotech application that utilized and exploit by each company.

Instrument Development: All measurement items in this study were developed based on prior studies and checked for reliability and validity. In total, 27 measurement items describe eight latent constructs: access to funding, access to new talent biotech R&D culture, innovative capability, perceive prior biotech exp. transferor, technology acquisition, technology attributes, technological capability and one dependent variable (biotechnology commercialization).

Data Analysis and Results

Measurement Model: This study employed partial least squares (PLS) methodology with Smart PLS 3.0 to test the suggested model and interrelated hypotheses. PLS-SEM analysis is applicable on the given sample size (n=42), the focus on each path coefficient and the focus on variance

Table 1: Company Characteristic in Malaysian Biotech.

Profile		Biotech Application	f	%
Biotech Sector	Agricultural biotech (n=18)	Planting Materials (Plant Tissue Culture)	9	21
		Crop Nutrition Or Enhancer (Bio-fertilizer or soil enhancer)	5	12
		Crop Protection (Bio-Pesticides or Bio-herbicide)	3	7
		Genetically modified organism (GMO)	1	2
	Industrial biotech (n=11)	Bioremediation (Bacteria and Fungi)	5	12
		Fine chemicals and specialty chemicals	3	7
		Biomaterials and Oleo-chemicals	2	5
		Biofuel and compost	1	2
	Healthcare biotech (n=13)	Stem-cell	1	2
		Medical drugs	7	18
		Medical devices	4	10
		Contract Research	1	2

Table 2: Loading of Indicator and Reliability Value.

Construct	*Original Sample (O) (>0.7)*	*t-value*	*Composite reliability (>0.6)*	*AVE (>0.5)*
Technology Attributes	0.563	1.465		
	0.824	2.619*		
	0.772	2.637*	0.768	0.530
Technology Acquisitions	0.800	5.808*		
	0.817	6.030*		
	0.812	5.590*	0.851	0.656
Biotechnology R&D culture	0.801	7.196*		
	0.832	6.332*		
	0.832	11.983*	0.862	0.676
Perceived Prior Biotech Exp. of Transferor	0.645	3.567*		
	0.841	7.822*		
	0.703	3.942*	0.776	0.539
Access to Funding	0.662	2.344**		
	0.793	2.993*		
	0.675	2.328**	0.754	0.6508
Access to New Talent	0.880	3.318*		
	0.937	3.630*		
	0.807	2.930*	0.908	0.768
Technological Capability	0.881	9.090*		
	0.849	8.190*		
	0.859	7.196*	0.898	0.745
Innovative Capability	0.891	25.523*		
	0.814	7.539*		
	0.763	6.158*	0.863	0.679
Biotechnology commercialization	NIL	NIL		
	0.817	4.366*		
	0.830	4.026*	0.820	0.695

Notes: *p<0.001; **p<0.05; ***p<0.01 (two-tailed)

explained rather than overall model fit [36]. Confirmatory factor analysis was conducted to examine the convergent validity of each construct. Table 2 shows the cross-loadings of all items and demonstrates the highest loading on their respective construct and the summary of construct statistics. Composite reliability value may lead to higher estimates of true reliability [37]. Values which are greater than 0.708 indicate an acceptable internal consistency, however value that equal or greater than 0.6 is accepted for exploratory study [38]. The convergent validity of the scale items was assessed using three criteria. First, the factor loadings should be greater than 0.40 as proposed by Hair *et al*. [35]. All composite reliability in construct is more than 0.70. Lastly, the average variance extracted (AVE) for each construct should be greater than 0.50 [39]. AVE is the sum of the squared loadings (indicator loadings) divided by the number of indicators. When examining discriminant

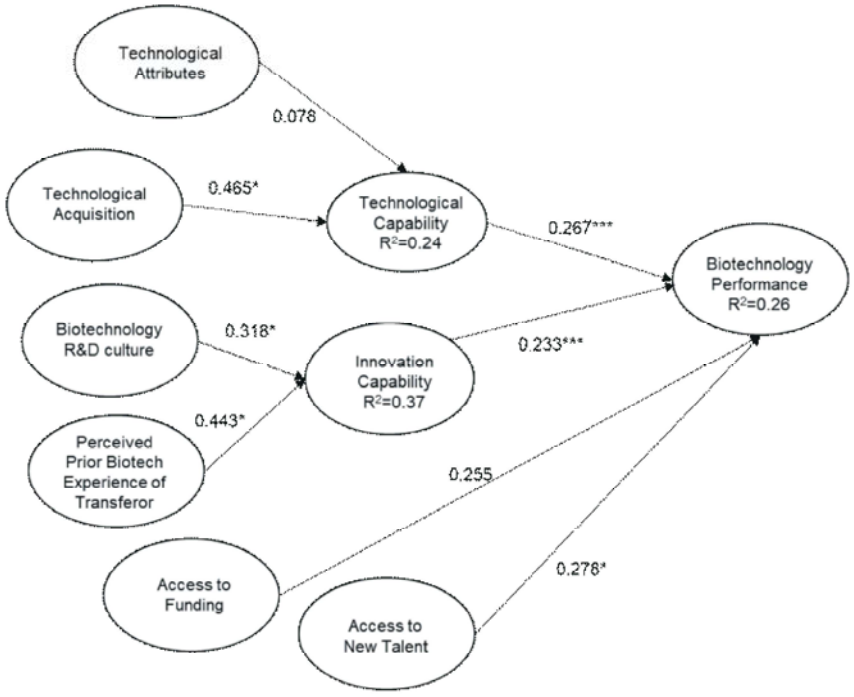

Fig. 3: PLS Analysis Result.

validity, the square root of the AVE for each construct should be greater than the correlation values between any two constructs. The inter-construct correlation matrix demonstrates that all values meet these recommendations for discriminant validity.

Common Method Variance (CMV): CMV should be considered when a study uses self-reported data from a survey. CMV refers to a "variance that is attributable to the measurement method rather than to the constructs that the measures represent" [40]. Rigorous research design and data collection can avoid CMV problems. However, rigor in research design and data collection is complex and most studies would apply several statistical methods to test CMV during the data analysis procedure. According to Podsakoff *et al*. [40], Harman's single-factor test and a discriminant validity table are the examples of such statistical methods. According to the results of the single-factor test, nine factors were found and the first factor's variance was lower than 27 percent. Analysis shows that negative correlations among constructs are observed; therefore, the data of this study are not subjected to a CMV problem. Typically, a PLS study does not require model fit. Henseler and Sarstedt [41] introduced the Standardized Root Mean Square Residual (SRMR) as a goodness of fit measure for PLS-SEM. The SRMR is the difference between the observed correlation and the predicted correlation. It allows assessing the average magnitude of the discrepancies between observed and expected correlations, which act as an absolute measure of (model) fit criterion. A value less than 0.10 and 0.08 (in conservative sense) are considered a good fit [42]. Result indicated that SRMR values are more than 0.08; which hence placing the model as not meeting the goodness of the fit criteria.

Hypotheses Testing: This study employed a bootstrapping technique within Smart PLS that used randomly selected subsamples to generate t-statistics to indicate the significance of model paths. The structural path model results are summarized in Figure 3. There are eight proposed hypotheses, from six latent constructs with 2 as mediator and one dependent variable. Among the antecedents, technological acquisition shows a significant positive (H1b, β=0.465, t-value=3.232 $p<0.001$) of impact on technological capability while technological attributes show insignificant effect (H1a, β=-0.078, t-value=0.471). On contrary, technological capability shows the significant effect towards biotechnology commercialization (H1, β=0.267, t-value=1.691, $p<0.01$). Conversely, biotechnology R&D culture and perceived prior biotech experience of transferor show a significant positive (H2a, β=0.318, t-value=3.116, $p<0.001$; H2b,

β=0.443, t-value=4.575, p<0.001) of impact on innovation capability. Differently, innovation capability shows significant effect towards biotechnology commercialization (H2, β=0.233, t-value=1.754, p<0.01). Again, there are significant effects of access to new talents towards biotechnology commercialization, (H4, β=0.278, t-value=2.711, p<0.01) whereas access to funding shows the insignificant effects towards biotechnology commercialization (H3, β=0.255, t-value=1.522). The R^2 of biotechnology commercialization is 26 percent and the other mediators are 24 percent (technological capability) and 37 percent (innovation capability) respectively.

There was a strong effect of technological acquisition on technological capability in this study. It can be understood that, company employees within organization will tend to be more competent if they choose the suitable type of technology acquisition mechanism that fits to their skills. This will makes them more effective if working with previous mechanism rather than new and unknown mechanism to them. Furthermore, the skills and knowledge must require and they must take an appropriate measure before able to brings the technology to the market in timely manner. Next, according to the result, technological capability and innovation capability has positive effects towards biotechnology commercialization. This outcome also was supported by Madanmohan *et al*. [23], in which the researcher urged technological capability as to be essential since it will "increase the productivity of both capital and labor employees during development process". Technological capability also covers the mastering of technology, which includes the acts of handling, maintaining, repairing, modification and increasing invention quality. It must adequately being developed by employees through the guidance of creating an understanding of well knowledge on the technology, either to adapt, improve, or further develop it. For this study, technological capability is defined as the knowledge and skills required for company to choose, install, operate, maintain, adapt, improve and develop the technologies. This capability usually will be developing with specific training and practice which need to be acquired by company. The most important part is the employee able to assimilate, adapt to new technology and also able to modify and maintain such technologies. Indeed, technological capability is undoubtedly crucial for commercialization success.

Intangible assets such as perceived prior biotechnology experience of transferor, biotechnology research and development culture show the important effect towards innovation capability. Based on the path coefficient number, there are strong connections between them which act as a key factor that contributes to innovative capability. It was suggested that innovative capability within organization can be increased by encouraging employees to learn on an ongoing basic towards biotechnology R&D culture. In fact, employees who make an effective use of their accumulated experience on previous technology transfer will contribute to the superior innovative organization.

Innovative capability also shows compelling effects toward commercialization. Innovative capabilities specify to company's capabilities, acquaint in the processes, arrangement, scheme and organizational structure, which can be pertinent to the mechanism of innovation activities. The resource-based view submits that a company with strong capabilities, especially innovative capabilities, can lead to preferable competence, such as biotechnology competence over their rivals. "Innovative capabilities tend to be imperfectly imitable because they are born of organizational skill and accumulative corporate learning" [15]. As supported by Zahra and Nielsen, [28], technology commercialization requires varied innovative capabilities in terms of cost, speed, quality and newness attributes of the technologies. Company can bring them together and expand their innovative capabilities to innovate new inventions and introduce them to the market in a correct time [15].

On contrary, based on empirical data, results show that access to funding is not significant. On contrary, the result gained from the study was not expected. Again, a study related to Malaysia biotechnology as conducted by Ahn and York [1] in 2009 has indicated that the most critical resource which needed at that time were access to funding and followed by access to talent. The survey was conducted between September and November 2008, which was 3 years after the National Biotechnology Policy was launched in order to spur sector growth. At the same time, Malaysia Biotech Corporation (Biotechcorp) was established by the government to nurture industry in terms of monetary and non-monetary incentives, coordinate all biotechnology industry activity, as well as to enhance alliances between domestic and foreign companies. Admittedly, this data actually been 10 years gaps and many drastic change occurred in biotech industry environment. Adequate financing and huge investment from Biotechcorp are appear in research and pre-commercialization activities for biotechnology cluster. One of the incentives is a shape of grant in helping them to secure the long term capital for their business. Due to

this, most of the companies are still competent in allocating and utilizing and channeling money to commercialization mechanism.

Meanwhile, since commercialization unit assisting the commercialization process, any early product development that had been initiated by academician inventor thus will save the financial resources. In addition, commercialization mechanism such as cooperation or joint R&D also contributes to company to allocate less money during the process. Government has successfully building the right ecosystem into funneling investor's capital towards technology sector rather than property financing [43]. Government guarantee is an act of securing long term capital for a company by providing grants which would be used by banks to support technology ventures. Here, it can be concluded that the financial is not a problem anymore due to various channels and incentives. Conversely, most of the biotech company is no longer in nurture stage, which can be seen through the present commercialization ecosystem by focusing on niche markets stage, as projected by MOSTI [44].

As per mentioned before, latent variable such as technological attribute is not a major concern that contributes to commercialization success. This can be explained by the existence of the commercialization unit in Malaysian local university. Generally, an invention that been produce by academician is classified as technology push, which appears when research and development in new technology drive the development of new products and usually does not involve market research. So, the main functions of this unit is to provide an assistance to inventor to make more inventions with commerciality characteristic by encouraging the innovation process (Aziz *et al*., 2011) [45]. Several steps also being done in screening the inventions, in which one of them is through the complex scoring system for the evaluation of commercial value. Thus and thus, this screening process will eliminate unproven scientific concepts, invention with less unproven commercial value, together with high and risky investment before industry commercialization mechanism takes place. The invention will be evaluating over the flip of three hundred and sixty degrees and certainly covering the technological attributes. At last, commercialization unit would able to identify possible technological acquisition that will be introduced to company interest. Finally, it is up to company to proceed to the downstream process in commercialization, since the early stage had been done by commercialization unit. Based on result, it shows that technological acquisition is significant because company still has the power in deciding the preferable way to commercialize the academically invention. The decision is based on company, as they are the parties who decide for commercialization to happen.

CONCLUSION

Contribution and Implications: This section describes a study undertaken to enhance efforts of building a global competitive biotechnology industry sector in Malaysia. The survey of biotechnology industry experts has first identified on national priorities and unique national capabilities within the Malaysian biotechnology industry context, as well as the gaps that exist between those capabilities and the key success factors that are competitive within various biotechnology industry segments. Drawing on the literature review on various resources of technology commercialization, a set of hypotheses was developed and tested using a sample of 42 biotech companies in Malaysia.

First perspective shows that the access to new talent, the technological and the innovation capability have significant effects towards biotechnology commercialization. This indicates that the biotech company should look closer to this indicator to which it will enhance the mechanism of commercialization in their company. To increase the organizational capability especially in technological and innovation capability, the company management team should take appropriate measures such as retraining their employees, or adding more training to sharpen the skills and also introducing attractive incentives. Such effort may enable the biotech company to gain more superiority in capabilities compare to their competitor. Thus, the ability to successfully commercialize their technology will lead to superior business performance (Park and Ryu, 2015) [19]. Finally, this result shows an important practical implementation towards the biotech company on how they should react or formulate the crucial strategies in promoting biotechnology commercialization.

Limitations and Suggestion for Future Research: This study has some limitations. First, the sample size of 42 companies is relatively small if compare to all biotech company in Malaysia industry, which thus potentially weakening the stability of statistical estimation. Future study must employ the larger sample in order to minimize statistical errors. Second, only two types of capability were proposed in this study namely; technological and

innovation capabilities. In real time, there should be more capabilities or intangible assets that require during the commercialization mechanism process. Third, other resources should be considered such as environmental of the biotech company in Malaysia such as government policy, regulatory body or drug act that regulated biotech product especially in pharmaceutical and industrial biotech. Future research also should consider variable control such as company age and size of the company, in order to put on guard onto any generalization of the results to other industries.

ACKNOWLEDGMENT

This study was supported financially by the Institute of Graduates Studies of Universiti Teknologi MARA (UiTM) and Ministry of Education of Malaysia.

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