

# Developing Determinant Factors for Product Commercialization and Innovation in Malaysia

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Although many inventions and innovations have been done in Malaysian universities, the innovations' marketing is still low compared to the research output. A statement by the Malaysian Ministry of Education claimed that, out of RM1.152 billion research grants disbursed, only 20 completed research projects were successfully commercialized, while income is only 3.2 percent, with only RM7.6 million revenues generated. The objective of the study is to develop commercialization guidelines that can be implemented at the Malaysian University. Several problems have been identified from studies such as lack of entrepreneurship skills among researchers; no cooperation between universities, industry, and government; the weak IP awareness; and no uniformity on commercialization policy. A sample of 300 researchers from various disciplines was taken as respondents from 20 public universities. From the result, the researcher's attitude, technology transfer office, rules and policy, university's role, three-way relationship, a spin-off company, government's role, intellectual properties, and center of excellence role showed the significant relationship towards commercialization's successfulness. However, when innovation acts as a moderator, some elements are not significant. This situation must receive attention from all parties involved to increase the number of successfully commercialized products.

**Keywords:** *Product Inventions, Product Innovation, Commercialization, Research Projects, Success factors, Malaysian Universities*



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## Introduction

The commercialization of university research has drawn attention from various parties in recent years because of its contribution to local economic growth (Heng et.al. 2011). The researchers' ability to create innovation and start-up companies has given a new perspective to the commercialization activities (Aziz, Haris & Norhashim, 2011). Due to this situation, R & D has also undergone a transition process with increased commercialization activities (Djokovic and Souitaris, 2008). Candell and Jaffe (1999); Ndonzuau et.al. (2002) suggest that widespread recognition has been given to the importance of university research and development, including commercialization activities. These activities are often categorized as "third mission" in which innovations resulting from the research was commercially exploited (Collier & Gray, 2010) as the final activity.

However, commercialization activities are not on the same par compared to the number of researches that has been conducted despite the booming rate in product design and innovation in Malaysia. According to the Malaysian National Survey of R&D 2016 by the Ministry of Science, Technology and Innovation find an overall increase in the expenditures and headcounts but decreases in research output. Gross Expenditures on Research and Development (GERD) has been increasing gradually from RM6, 071 million in 2008 to RM15,058 million in 2015. This can be translated into an average annual growth of 13.85% per year. In terms of percentage of GDP, GERD also records a gradual increment from 0.79% in 2008 to 1.30% in 2015. Berita Harian (2014) reported that from the RM1.152 billion in grants disbursed in the last five years, only 20 completed research projects were successfully commercialized. The outcome from R & D activities by Public institutions stated that only 3.2 percent with the revenue of RM7.6 million was successfully generated (Bernama, 2011). Whereas a report from Berita Harian (2014) showed less than two percent or 494 out of 27,449 from R & D has been successfully commercialized for the next five to 10 years. It is evident that, based on the statistic, 1.5 percent came from research universities, and another 0.3 percent was contributed by non-research universities (Berita Harian, 2014), as shown in Table 1. below.

Based on the above discussions, the research question of this study can be narrowed down to the challenges to commercialize research product commercialization in the public university and the recommendations for the success of a research product commercialization.

**Table 1.** Research R&D Statistics and Grant Received by Malaysian Universities.

University	R & D	Award	Commercialize	Paten	Grant (RM)
Uni.Malaya	10,000	732	39	109	N/I
Uni.Putra Malaysia	5,700	557	85	1,066	100m/year
Uni.Sains Malaysia	406	505	58	290	578million
Uni.Teknologi Malaysia	3,894	791	239	1,221	307 million
Uni.Tun Hussein Onn	161	300	9	149	44.4 million
Uni.Teknikal M'sia Melaka	400	381	3	48	10m / year
Uni.Malaysia Perlis	1,500	741	7	89	84 million
Uni.Malaysia Kelantan	58	52	3	22	17 million
Uni.Utara Malaysia	1,806	473	10	0	T/M
Uni.Malaysia Sabah	718	40	10	70	50 million
Uni.Pendidikan Sultan Idris	930	84	13	47	N/I
Uni.Malaysia Terengganu	405	350	13	10	N/I
Uni.Malaysia Pahang	534	295	4	193	N/I
Uni.Sultan Zainal Abidin	801	40	1	5	228 grant
Uni.Pertahanan Nasional	13	85	0	10	15.8 million
	27,449	5,426*	494	3,329	

\* Local and Abroad, N/I – No Info. Source: Berita Harian (2014)

## Literature Review

### *Challenges and problems in the commercialization of research product*

According to the Schumpeter (1947) trilogy of invention, innovation, and diffusion, it is the most common approach in economics and researchers, whereas Cantwell (2001) described the three stages shortly as, the first stage is the invention stage; the second stage is the innovation process stage, and the third stage is the diffusion stage. However, according to Ismail et.al (2011), the main issue is the viability of commercialization in research universities. Various types of research grants have been awarded to universities in developed countries such as Malaysia (Govindaraju et.al. 2009), which is valued at RM1.152 billion, but it is still unable to cope in terms of research capacity and is new to the commercialization “game” as mentioned by Aziz et.al. (2011). In fact, Malaysia has just entered the commercialization games recently. Previous researches have listed several problems in commercializing university products; as such, there is a difference between R & D universities, which is publication oriented and R & D industries are focused on commercialization, which has been kept confidential and geared to earn a profit (Zaini, 2007). This has led to R & D academia is seen lagging in terms of commercialization. However, Heng et.al. (2011) found that academic researchers who are conscious of their commercialization activities were more inclined to commercialize their innovative products. A study conducted by Aziz et.al. (2011) also listed three factors, namely the failure of commercialization, lack of marketing skills, not in the scope of the study, as well as the absence of a special fund for the commercialization activities in Malaysian universities. According to Zaini (2007), Chu and Andreassi (2011), researchers were unable to do R & D activities due to the absence of sufficient funds that will interfere with the commercialization at the initial process is quite critical. In Malaysia, academics and industry players lack collaboration to improve the advancement of the industry involving commercialization and innovation. It also creates a gap between local researchers

and industry on the product's status that is ready for commercialization, while local researchers are still unfamiliar about the products that can be brought to market (Zaini, 2007).

### ***Commercialization of research activities***

Commercialization of university technology has become an important topic of discussion today in which research universities' results are expected to create opportunities for new products and processes. Some concepts, theories, and frameworks that focus on the commercialization of an institution can be seen in the study by Data et.al (2013), Ranga et.al (2013), Aziz et.al. (2011), Govindaraju et.al. (2009) and many others. Govindaraju et.al. (2009) stated that although there are many studies about the practice of science and technology commercialization in Malaysia, the ideographic study is limited. Meanwhile, studies by Hii (2003), the Ministry of Science, Technology and Environment (2003); Danabalan (1996); Soong (1996); and Thiruchelvam (1995) solely focuses on the adoption of innovation and commercialization of technology.

The background theory adopted by this study is based on Prospect theory, which explains decision making involving uncertainty in the context of psychology and economics (Kahneman & Tversky, 1979), provides a useful means of assessing the effect of this micro-level variable on the selection of the form of governance for commercialization. The theory offers insights into why managers make non-optimizing decisions rather than strictly choosing those that are profit-maximizing.

Based on the findings of previous studies which include Data et.al (2013), Ranga et.al (2013), Aziz et.al. (2011), Govindaraju et.al. (2009), Kamariah et.al. (2011), and Zaini (2007), this study highlighted ten determinant factors for the successfulness of product commercialization and innovation in Malaysian public universities.

### ***Researcher's attitude***

Until today, two views dictate the discussion related to the researcher's perception and behavior (Wang and Sun, 2008). The first assumes that the two constructs as compatible and equal both conceptually and operationally; and are thus used interchangeably (Mehta, 2000). The second, which is a more popular view amongst scholars, contends that one's perception precedes attitude (Wang and Sun, 2008). Standish-Kuon (2007) utilizes Azjen's 1991 Theory of Planned Behavior (TPB) to show a positive link between the perception of feasibility towards commercialization and the actual display of the behavior. According to Zaini (2007), researchers are also less committed to the product commercialization process due to problems such as time management and lack of communication skills that have caused the industry to face problems due to the unfamiliarity of the product commercialized. Besides that, Kamariah et.al. (2011) stated that researchers are more motivated to commercialize their products through an established company than downstream companies due to the lack of entrepreneurial skills and attributes. In view of this, this study hypothesized a relationship between the researcher's attitude with the success of product commercialization and innovation.

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### ***Technology transfer office (TTO)***

According to Freeman (2011), a successful TTO manages IP assets through knowledge of IP, licensing, and contract law, an understanding of business management and practicalities, and connections to outside industrial and investment communities. In addition, there was a wide range of technology transfer offices (TTO) at universities and research institutes with different names and different management models that lead to confusion, thus failed to establish confidence in the industry (Zaini, 2007). Furthermore, the emergence in technology breakthroughs that were successfully transferred to the industry was interrupted with management's incompetence in ensuring the research findings were efficiently and effectively applied in the commercialization process to create innovative products. Therefore, this study hypothesized that the existence of TTO has a relationship with the success of product commercialization and innovation.

### ***Rules and policy***

In addition, Malaysian policies in science and technology have been restructured to encourage commercialization (Malaysian Ministry of Science, Technology and Environment (MOSTE), 2003). The establishment of a new business development unit in the MOSTE reflects the government's responsibility to accelerate the commercialization of technology. In fact, the provision of adequate funding by the government has enabled technology entrepreneurs to fund more research and commercialization of research results, especially in encouraging venture capital investors and other forms of financiers equity that require continuous investments, whether at the initial state or later than new business development (Kamariah et al., 2011). Public universities and several agencies such as the MOSTE, Multimedia Development Corporation (MDC), Standard and Industrial Research Institute of Malaysia (SIRIM), Malaysia's National Applied Research and Development Centre (MIMOS) have been working together in creating a research culture that is related to commercialization as well as innovation to both researchers and students alike. Through the agencies, the government has assisted nearly 500 companies in commercializing their R & D with funding's more than RM700 million. A study conducted by Chu and Andreassi (2011) listed factors that contributed to the failure of the innovation process, such as financial patterns; laws that guarantee the rights of intellectual property; laws or regulations relating to risks to health and the environment, and the actions of regulatory agencies; and partnerships. However, Zaini (2007) sees the success of innovation and commercialization must involve research institutions, the community, and the local community. Based on these discussions, this study hypothesized that there is a relationship between the existence of rules and policy with the success of product commercialization and innovation.

### ***Research funds***

Commercialization activity is a long and complex process. It involves initial investment before success. Initial investments are normally for intellectual property filing, company registration, hiring qualified entrepreneurs, and marketing the R&D outcomes. Chandran (2010) argued that current weaknesses of funding channels in Malaysia include the lack of pre-seed and seed funding, market

funding, prototype funding, and the lack of funding and incentives to support private-sector research commercialization. Furthermore, the funding problems of commercialization include the gap between producing research findings and getting commercial partners. The lack of pre-seed finance beyond the “proof of concept” stage that precludes the smooth translation of potential research findings into tangible commercial outputs is also identified as a funding factor against successful commercialization, Kusmi (2007). Thus, this study hypothesized that there is a relationship between the existence of research funds with the success of product commercialization and innovation.

### ***University's role***

University makes a significant contribution to the economic development of the country. Technologies generated in universities have been known as engines of growth. However, the university's research ideas and decision-making processes failed to align with the firm's business strategy. Technology transfer is a risky process because there is no guarantee that the project on the development of technologies can determine the success of product launches as well as investments that would generate sufficient return. Kamariah and Khademi (2013) examine the factors of critical success in universities' commercialization processes, such as researchers' perceptions, time, entrepreneurial team, network, level of technology, financing, market research, and convergence. As time is seen as essential as commercialization is a time-consuming process. Therefore, time management in innovation will generate competitive advantages, but commercialization requires commitment, and more proactive efforts should be established to support a range of approachable policies for scientists and innovation-friendly (Zaini, 2007). Due to this reason, this study hypothesized that there is a relationship between the university's role with the success of product commercialization and innovation.

### ***Three-way relationship***

Collaboration between University and Industry (UI) has long been studied by researchers around the world (Chu & Andreassi, 2011; Kondo, 2011). Researchers in Brazil, such as Plonski & Vedovello (1990), & Moraes & Stal (1994), Plonski (1995, 1999), Marcovitch (1999), Segatto-Mendes and Sbragia (2002) states technology research through partnerships between companies and universities; research institutions is a worldwide trend. In Japan, the UI is progressing rapidly in various fields. According to Kondo (2011), the UI frame exists in the triple helix relationship between university - industry - governments as shown by Etzkowitz and Leydesdorff (1997). This partnership embodies the transformation of the university's role from building science to the science center and innovation, and it was known as the second academic revolution (Etzkowitz, 2003b in the study of Kondo, 2011). According to Kamariah et.al (2011), even though the researchers fully understand their products, it is impossible for them to commercialize their products by themselves. Instead, the researchers who have good ties with the industry are more likely to exploit their creations and speed up the process of getting ownership and the commercialization of product to be marketed (Markman et.al., (2005); Kamariah et. al. (2011). In their study, Arora & Gambardella (1994) believe that most industry players lack innovation. Hence, Govindaraju (2009) recommended the industry put trust and confidence in

academicians' ability to transform their research findings to fulfill industry needs. Thus, the relationship between industry players and researchers can assist in establishing partnerships and learn new things as in the commercialization process, creating new marketing segments, forming research, innovation capacity based on the manufacturer and full use of university resources to the industry (Govindaraju et.al. 2009). Heng et.al. (2012) suggested that the established framework for generating interaction and clear communication between these two entities (entrepreneurs and researchers) involved in facilitating the process of commercialization should be created. A study conducted by Marwan (2013) found that UTM's commercialization activities were influenced by good rapport developed between universities and industry as well as financial support given to ensure the success of this activity. Based on the above discussion, this study hypothesized that there is a relationship between the existence of the three-way relationship with the success of product commercialization and innovation.

### ***Spin-off company***

According to Steffensen et al. (1999), a spin-off company is a new venture established by a parent organization (the university). Kamariah et.al (2011) found that despite significant government funds given to motivate researchers to commercialize their patents, the need for a venture in capital financing for downstream companies (spin-off) is seen as essential as funding support and development. Besides that, encouraging the participation of venture capitalists to support research and development in universities is crucial. In fact, the perplexing question arises in the study conducted by Govindaraju et.al (2009), whereby the government today assumes that universities have a role in supporting innovation and commercialization of technology without knowing how to help enhance their ability to reform. Meanwhile, Rasmussen (2008) proposed developing a better and more relevant measurement style to access government initiatives' performance. The involvement of various parties viewed that innovation and commercialization activities are very important. Therefore, this study hypothesized that there is a relationship between a spin-off company's existence with the success of product commercialization and innovation.

### ***Government's role***

In Malaysia, the commercialization process starts with government support in creating policies, programs, and funding research and development (R & D). Assistance in the early stages of new products or prototypes is critical, especially in providing grants and sufficient funding. Kamariah and Khademi (2013) stressed that the government should help the founders search for new ways of commercializing their research-based technology. For that matter, the government has allocated RM1.6 billion for R & D and technology commercialization in the Eighth Malaysia Plan compared to RM1 billion in the Seventh Malaysia Plan to fulfill the needs for innovation (Malaysia 2001). Government cooperation in the procurement of licenses and patents is very important in supporting and assisting universities and industry in protecting their copyright. According to Li-Hua (2010), the Prime Minister's Initiative 2 Project (MI2) in the United Kingdom can be regarded as a catalyst for the internationalization of innovation activities that provide guidelines in implementing the

innovation process. Thus, this study hypothesized that there is a relationship between the government's role and the success of product commercialization and innovation.

### ***Intellectual properties***

According to Ashiqin and Norliah (2013), the commercialization problems are unparalleled with intellectual property policy, and the different approaches among universities have led to various legal implications. The emphasizing and understanding of intellectual property rights ownership, creation disclosure, confidentiality, the submission of commercialization rights, and distribution of income were not given much attention (Zaini, 2007). Govindaraju et.al. (2009) states that the incompetent management of national intellectual properties has led the researchers to pay less attention or focus on the innovation process that involves commercialization. Meanwhile, Heng et.al. (2011) found that the commercialization process was delayed by bureaucratic inefficiencies, such as universities and government agencies becoming an obstacle to the industry in order to protect their intellectual property due to the process of patenting products are expensive and time-consuming. Yaakub et.al (2011) further suggested that royalties were paid to the faculty's inventor to see a positive impact on the number of licenses applied. According to Ashiqin and Norliah (2013), it is fundamental for the university to have a complete intellectual property policy so that good practices in the management of commercialization can be implemented. In addition, important issues in universities' intellectual property policy need to be emphasized and understood, namely ownership of intellectual property rights, creation disclosure, confidentiality, commercialization rights, and income distribution. According to a study by Fiedler & Welpé (2010), which found that there was a significant relationship between intellectual property protection and cooperation as the exploitation strategy and real predominant strategy for the holders of intellectual property rights is not in cooperation/partnership but market entry product, either by building their own resources or by obtaining it from other companies. Based on these discussions, this study hypothesized that there is a relationship between intellectual properties and the success of product commercialization and innovation.

### ***Centre of Excellence (CoE) role***

According to Hellstrom (2018), CoEs can be described as organizational environments that strive for and succeed in developing high standards of conduct in a field of research, innovation, or learning. They are often highly attractive to research and development (R&D) investments and talent in their field, and two common pillars of excellence in this regard tend to recur, namely prioritization and concentration in terms of focus and resources (Kitagawa 2010). Therefore, they possess the ability to absorb and generate new knowledge. Ideally, they would distribute and utilize this new knowledge in the form of new capacity in their field, be it research results, innovations, or talent. Centres of Excellence (CoEs) have become an important part of the policy mix for realizing higher education and research (HER) sector goals, all over the world. Beerkens (2009) even speak of an emerging 'global model' for CoEs; that is a convergence on research topics, processes, and funding systems for

this type of instrument. Therefore, this study hypothesized that there is a relationship between CoE's role with the success of product commercialization and innovation.

### **Commercialization and Innovation Model**

According to Rahman et.al. (2010), the innovation management model (IMM) is the best platform for innovation entrepreneurs to manage innovation more effectively and assist in promoting, sharing, and reuse of innovation between a university with university and a university with related organizations. He suggests a practical model that consists of four (4) main activities, innovation development, innovation storage, distribution, innovation and commercialization of innovations. Dirk Libaers (2013) proposed a Status Characteristics Theory that can be used in the study of (product) innovation management with the powerful behavior, where the status of researchers can play an important role in determining the advantages or disadvantages of interaction with new product development (NPD) team (Bstieler & Hemmert, 2010; Edmondson & Nembhard, 2009; Hienerth & Lettl, 2011). Aziz et.al. (2011) also provide guidelines (blueprint) for the successful commercialization of university products:

1. Strategic Orientation for Research, Development and Commercialization (R, D & C)
2. Drive Research and Development Structure
3. Drive Commercialization Structure
4. To ensure the effectiveness of Commercialization

Mintzberg (1979), in the study conducted by Chu and Andreassi (2011), states "the existence of new strategy" is a feature of an innovative organization. The findings derived from Chu and Andreassi (2011) have produced a model for the effective innovation strategy that will contribute to commercialization activities. In the analysis carried out by Coutinho et.al. (2003), taking into account the biotechnology sector, the authors found two strategic postures adopted: Offensive Strategy and Defence Strategy. Ranga and Etzkowitz (2013) introduced the concept of the Triple Helix as a construct of analysis which synthesizes the main characteristics of the interaction cooperation of university-industry-government (Triple Helix) into the 'innovation system' format, which is defined according to the systems theory as a set of components, relationships and functions. According to Ranga and Etzkowitz (2013), the concept of the Triple Helix relationship started in the 1990s by Etzkowitz (1993) and Etzkowitz and Leydesdorff (1995).

This paper aims to present the determinants for the successful commercialization of technology innovation among Malaysia's academic researchers. Specifically, this paper discusses ten determiners, which include researcher's attitude, technology transfer office (TTO), rules and policy, research funds, university's role, three-way relationship, spin-offcompany, government's role, intellectual properties and centre of excellence (COE) role that contribute to successful commercialisation of technology innovation. The ten (10) important elements in the university's commercialization are the independent variables and matched with the dependent variables, which is the level of success. Besides that, the level of innovation was also asked. The relationship of ten

elements with the level of success was tested to know which factor contributes to commercialization success.

## Methodology

The respondents who participated in this study are lecturers from public universities, and the number of respondents involved is 20 universities. In this study, a total of 300 respondents were selected to answer the questionnaire. Interview and visitation methods are used to ensure that respondents answer all questions. Questionnaires were built based on the number of sections and the Likert-scale will be used to benchmark alternative answers by the respondents. Open-ended and close-ended questions, which enable respondents' freedom to provide their own answers are provided and it will be analysed using the SPSS Software version 21. 0. For the purpose of data analysis and hypothesis testing, a number of statistical tests will be conducted, such as the reliability test, validity test, factor analysis, descriptive analysis and regression test.

The list of public universities involved in gathering the information process is as follows;

1. Universiti Kebangsaan Malaysia
2. Universiti Putra Malaysia
3. Universiti Sains Malaysia
4. Universiti Sultan Zainal Abidin
5. Universiti Tun Hussien Onn
6. Universiti Teknologi MARA
7. Universiti Malaysia Pahang
8. Universiti Malaysia Terengganu
9. Universiti Malaysia Kelantan.
10. Universiti Islam Antarabangsa
11. Universiti Utara Malaysia
12. Uni.Teknikal Malaysia Melaka
13. Universiti Teknologi Malaysia
14. Universiti Malaya
15. Universiti Malaysia Perlis
16. Universiti Sains Islam Malaysia
17. Universiti Malaysia Sarawak
18. Uni. Pendidikan Sultan Idris
19. Universiti Malaysia Sabah
20. Universiti Pertahanan Nasional

## Results and Discussion

In this research, most of the respondents with 57.3 percent or 172 out of 300 respondents have attended entrepreneur courses either conducted by their university or an outsource consultant. Besides that, 128 respondents (42.7 percent) have never attended any entrepreneur course at all. It shows that not all the respondent has the interest to be involved in entrepreneurship. Meanwhile, 195 respondents or 65 percent of respondents stated that they were never involved in commercialization. Only 35 percent or 105 respondents were involved in the commercialization process.

Table 2 shows the ten (10) important elements in the university's commercialization, wherein respondents were asked to answer questions based on a five-point (5) Likert-scale from the questionnaire. The elements in commercialization are; researcher's attitude, technology transfer office (TTO), rules and policy, research funds, university's role, three-way relationship, spin-off company, government's role, intellectual properties and centre of excellence (COE) role. Besides

that, the level of innovation was also asked. The relationship of ten elements with the level of success was tested to know which factor contributes to commercialization success. As a result, all the elements showed significant relationship with level of success, that are researcher's attitude ( $\beta = 0.53$ ,  $p < 0.05$ ), TTO ( $\beta = 0.14$ ,  $p < 0.05$ ), rules and policy ( $\beta = 0.135$ ,  $p < 0.05$ ), research funds ( $\beta = 0.156$ ,  $p < 0.05$ ), university's role ( $\beta = 0.226$ ,  $p < 0.05$ ), three-way relationship ( $\beta = 0.186$ ,  $p < 0.05$ ), spin-off company ( $\beta = 0.155$ ,  $p < 0.05$ ), government's role ( $\beta = 0.183$ ,  $p < 0.05$ ), intellectual property ( $\beta = 0.145$ ,  $p < 0.05$ ) and centre of excellence ( $\beta = 0.165$ ,  $p < 0.05$ ). Overall, all ten (10) elements contributed about 40 percent ( $r = 0.60$ ) of variants changes in the level of success of commercialization.

**Table 2.** The relationship of University's Commercialization elements with Success Factor

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.487	.281		5.291	.000
Researcher's attitude	.530	.068	.481	7.770	.000
Tech Transfer Office	-.141	.065	-.147	-2.191	.029
Rules and policy	-.135	.065	-.139	-2.077	.039
Research funds	-.156	.079	-.136	-1.983	.048
University's role	.226	.070	.229	3.249	.001
Three-way relationship	.186	.088	.159	2.107	.036
Spin-off Company	.155	.072	.137	2.162	.031
Government Role	-.183	.093	-.145	-1.975	.049
Intellect property	-.145	.070	-.156	-2.064	.040
Centre of Excellence	.165	.066	.167	2.494	.013

a. Dependent Variable: Success

The relationship of ten elements with level of success when level of innovation act as a moderator was also tested. Results showed that not all element have significant relationship with level of success such as TTO ( $\beta = 0.073$ ,  $p > 0.05$ ), rules and policy ( $\beta = 0.068$ ,  $p > 0.05$ ), university's roles ( $\beta = 0.064$ ,  $p > 0.05$ ), three-way relationship ( $\beta = 0.144$ ,  $p > 0.05$ ), spin-off company ( $\beta = 0.083$ ,  $p > 0.05$ ) and COE's role ( $\beta = 0.052$ ,  $p > 0.05$ ). However, four (4) elements showed significant relationship when level of innovation acts as a moderator. Researcher's attitude ( $\beta = 0.395$ ,  $p < 0.05$ ), research funds ( $\beta = 0.175$ ,  $p < 0.05$ ), government's role ( $\beta = 0.216$ ,  $p < 0.05$ ), intellectual property ( $\beta = 0.160$ ,  $p < 0.05$ ) and level of innovation have positive significant influence ( $\beta = 0.524$ ,  $p < 0.05$ ) on the relationship of ten (10) elements with level of success. The elements of commercialization contributed more than 50 percent ( $r = 0.69$ ) when level of innovations acted as moderators.

In general, the results showed that all significant elements are critical for the commercialization process. Moreover, the element that is not significant when innovation acts as a moderator is still important and must be given attention by all parties (university, government and researcher), especially the three-way relationship. The aforementioned relationship involves industrial players who are adept about marketing and customers' needs in comparison to the universities or the government. Universities also need to increase their responsibility toward innovation and



commercialization and not only to focus on traditional methods (learning and teaching). Rules and policies must also be reviewed. All parties that are responsible for the rules and policies should review them again in order to give comfort to all parties that are involved in innovation and commercialization. If rules and policy at every university is eased to accept, the commercialization process is more efficient and effective. According to the regression analysis above, the experience of researchers in the commercialization process gives the greatest impact to the percentage of contribution on the level of success ( $\beta = 0.53, p < 0.05$ ), and with the level of innovation as moderator ( $\beta = 0.395, p < 0.05$ ).

## **Conclusion**

Debates and criticism in terms of the commercialization of university products and innovation in Malaysia are widely prevalent. It was proven by the headlines in local newspapers and electronic media suggesting that research in Malaysian universities is a waste of time and does not bring benefit to the government, industry, and society at large. Criticism and suggestions from various parties from industries, the leadership of the Malaysian Ministry of Education, and private individuals, as well as based on previous studies, lead to the main objective of this study, which is to establish a specific model that determines the future direction of commercialization and innovation activities. The outcome of this study will act as guidelines to the industry, government agencies, universities and researchers in the future. The results must also gain attention from all parties involved in innovation and commercialization to increase contribution either to the government or society. The action taken by responsible parties is hoped to gain confidence from the industry regarding our university researchers' ability to meet the needs and quality level of technology required in the industry when problems of this study can be overcome. This will eventually build opportunities for academicians to participate in the industry either at the national or international level directly. Further results from this study are expected to assist the government in developing policies, programs, and business development, public management systems, which involves a partnership that will enhance the development of universities, industry and researchers. In addition, the resulting model will be the basis and guidelines for future research to improve the commercialization method further and promote the collections of literature and knowledge in this particular subject matter.

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