Effect of Quality of Research, Technology Transfer, Intellectual Property, Continue Venture Innovation, and Industrial Partner on New Technology Commercialization

by

MOWAFAQ HADI SALMAN

1543011831

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UNIVERSITI MALAYSIA PERLIS

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Kesan Kualiti Penyelidikan, Pemindahan Teknologi. Harta Intelek, Usaha Inovasi Berterusan dan Rakan Kongsi Industri Terhadap Pengkomersilan Teknologi Baharu.

ABSTRAK

Pengkomersilan produk memerlukan perindustrian memainkan peranan penting dan gelombang inovasi industri baru ini memerlukan integrasi awal sains, teknologi dan pembuatan untuk mencapai produk dan perkhidmatan kelas dunia di Malaysia. Usaha pengkomersilan kebanyakan gagal kerana kurangnya hubungan antara industri dan akademik. Objektif utama kajian ini adalah untuk membangunkan model pengkomersilan yang berkesan yang akan menrangkumi amalan dan garis panduan yang baik untuk pengkomersilan dan fasilitasi teknologi baru ke arah pembangunan yang efektif dalam pemasaran produk di Malaysia. Konsep pengkomersialan di kalangan ahli akademik di universiti awam Malaysia ke arah pengkomersialan produk baru dan pembinaan lain yang terpilih digunakan untuk kajian ini. Beberapa pendekatan penglibatan pengkomersilan di kalangan ahli akademik di universiti awam Malaysia dikenalpasti untuk memberi gambaran yang jelas tentang masalah utama penyelidikan ini. PLS-SEM digunakan untuk penilaian dan pengesahan model yang menjadi rangka kajian yang dicadangkan. Pengesahan dan kesimpulan model yang dibuat dari hasil keputusan empirikal PLS-SEM. Kaedah pensampelan yang digunakan adalah pensampelan rawak mudah dengan mengenalpasti pakar yang terlibat, iaitu, peserta dipilih daripada orang yang pakar dan juara popular serta berpengalaman dalam kedua-dua aspek iaitu penyelidikan dan pengkomersilan teknologi baharu. Responden telah dipilih dan dikenalpasti dengan melihat profil ahli lama dalam bidang pengkomersilan iaitu seramai 1000 ahli akademik tulen dan akademik dengan pengalaman industri di universiti tempatan Malaysia. Kajian pakar yang dipilih dari universiti melalui jumlah penerbitan yang lebih besar dan pembangunan IP dalam teknologi baru berbanding dengan yang lain pakar di Malaysia dan lebih-lebih lagi, para peserta di atas adalah peserta tempatan dan antarabangsa yang dipilih kerana pengetahuan dan pengalaman mereka di lapangan. Penemuan kajian menunjukkan bahawa semua pemboleh ubah seperti kualiti penyelidikan, hak cipta harta intelektual, pemindahan teknologi, rakan industri dan usaha inovasi berterusan mempunyai pengaruh yang kuat dan signifikan kepada pengkomersilan teknologi baharu di universiti awam Malaysia.

Effect of Quality of Research, Technology Transfer. Intellectual Property Continue Venture Innovation and Industrial Partner on New Technology Commercialization.

ABSTRACT

The product commercialization requires industrial to play significant role and this new wave of industrial innovations requires early integration of science, technology, and manufacturing to achieve world-class product and services in Malaysia. Most commercialization efforts have failed due to the lack of connectivity between industry and academia. The main objective of the study is to develop effective commercialization model which will capture good practices and guidelines for the new technology commercialization and facilitation towards effective development of Malaysian research product marketability. The commercialization concept among academician in Malaysia public universities toward new product commercialization and other chosen constructs applicable to this research. Several efforts on commercialization engagement approaches among academician in Malaysia public universities to give a clear understand of the main problem of this research. PLS-SEM was deployed for the evaluation and validation of the proposed user acceptance model. The model validation and conclusions were made from empirical results of the PLS-SEM. The sampling method used was convenient sampling by choosing expertise by profiling form from questionnaire. The participants were chosen from the pool of experts and the popular champions in both new technology production and commercialization were chosen and we identified them by looking at a long-running profile of experts in this field. The academic and industrial experts with long time experience and works were identified from among 1000 pure academic and academic with industrial experience in Malaysian local universities. The study selected expert from universities due to their larger volume of publications and IP development in new technology compared to other experts in Malaysia and moreover, the above participants are both local and international participant were selected due to their vase knowledge in the field. The finding of the study implied that all variables such as quality of research, intellectual property, technology transfer, industrial partner and continue venture innovation have a significant influence on commercialization of new technology in Malaysia public university.

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LIST OF ABBREVIATIONS

NTC	New Technology Commercialization
QR	Quality of Research
TT	Technology Transfer
IP	Intellectual Property Development
IPN	Industrial Partner
CVI	Continued Venture Innovation
GDP	Gross Domestic Product
PDI	Power Distance Indicative
PLS SEM	Partial Least Squares Structural Equation Modeling
LVs	Latent Variables
AVE	Average Variance Extracted
CR	Composite Reliability
GOF	Goodness of Fit
SPSS	Statistical Package for the Social Science
V	Sample Size
α	Acceleration (ms-2)
Ω	Resistance (ohm)
Q2	Predictive Relevance
R2	Coefficient of Determination

CHAPTER 1: INTRODUCTION

1.1 Introduction

The commercialization of research products in Malaysia faces a managerial gap that hinders its success. One study highlights the lack of support and awareness regarding the commercialization process in Malaysian universities. Academics often prioritize publishing research papers over commercialization efforts, considering it irrelevant or time-consuming. This perception contributes to the managerial gap in research product commercialization. To address this issue, universities can take proactive steps such as establishing research management centers or technology transfer offices to support and facilitate the commercialization process. Additionally, fostering strong collaboration between universities and industry partners is crucial for successful commercialization. By addressing this managerial gap, Malaysia can unlock the wealth-generating potential of innovative research products (Hamdan, Fathi and Mohamed, 2018).

The commercialization of research products in Malaysian public universities has been a challenge, with a low success rate. Several factors contribute to this issue, including the lack of facilities and support from the universities themselves, the competency of the academic researchers, the need for innovative research products, and the importance of collaboration between universities and industries. Commercialization is still relatively new in Malaysia, and there is a perception that it is less important compared to teaching and research. To improve commercialization, universities can provide support through research contracts, consultations, and joint research. Collaborating with industry partners is crucial, as it increases the rate of commercialization. Producing research products that meet market requirements and considering technological trends in the industry can help bridge the gap between academia and

industry. Strategic approaches, such as industry financial support and academic freedom in research decisions, can also facilitate commercialization. The lack of knowledge regarding the factors that lead to successful commercialization contributes to the problem. Additionally, the commercialization rates of research and development (R&D) products in Malaysian universities have shown a declining trend (Lam *et al.*, 2022).

Today, new technology is often viewed as a crucial tool for boosting a country's economic competitiveness. Around the world, it is widely believed that new technology has a substantial impact on the productivity of nations and sectors. But until the new technology enters the market and becomes widely adopted, these benefits won't be fully felt. Thus, it is essential to comprehend the factors that influence the introduction of new technology items to the market as well as the theoretical models and practical strategies that have emerged about the adoption of new technology in developed countries such as the USA. Therefore, by exploring literature in Malaysia as well as the Association of East Asian Nations (ASEAN) region on the comparison of new technology adoption models between Malaysia and other developed nations, the study intends to fill the gap that exists between Malaysia and other well-developed nations in terms of technology adoption(Ismail, Afzan Abdul Aziz and Hartono, 2021).

Moreover, the decline in global research production can be attributed to several factors, including the impact of the low funding, economic crises in major exporting countries, and structural constraints in research and development (R&D) activities. The research funding has disrupted research activities worldwide, leading to delays, budget cuts, and resource reallocation towards urgent healthcare needs. Additionally, economic crises in countries that generate demand for Malaysian exports have resulted in declines in output, affecting research

production. Moreover, structural constraints in R&D activities, such as limited funding, lack of facilities, and inadequate support from universities, can hinder research productivity . These factors collectively contribute to the declining trend in global research production(Rahim, Mohamed and Amrin, 2021).

Research and innovation profiles of Cambodia, Malaysia, Thailand and Vietnam These four countries are all developing economies located in an economically dynamic region. They form part of the Association of Southeast Asian Nations (ASEAN), which also includes Brunei, Indonesia, Lao PDR, Myanmar, the Philippines and Singapore. Each is experiencing long-term and reasonably sustained economic growth; each is at a slightly different stage of economic development; and each aspires to develop a stronger capacity in R&I (Hamdan, Fathi and Mohamed, 2018).

Table 1.1. Selected indicators for Cambodia, Malaysia, Thailand and Vietnam

Indicators	Countries (year)			
	Cambodia	**Malaysia**	**Thailand**	**Vietnam**
GNI per capita	USD 820 (2011)	USD 8 770 (2011)	USD 4 440 (2011)	USD 1 070 (2011)
Researchers per million inhabitants (full-time equivalent)	17 (2002)	365 (2006)	316 (2007)	116 (2002)
Percentage employed by business enterprises	15.7% (2002)	36.4% (2006)	23.3% (2007)	10.4% (2002)
Percentage employed in higher education	12.5% (2002)	52.6% (2006)	60.5% (2007)	32.4% (2002)
Percentage employed by government	50.7% (2002)	11.0% (2006)		56.5% (2002)
Gross domestic expenditure on R&D (GERD) as a % of GDP	0.05% (2002)	0.63%[1] (2006)	0.21% (2007)	0.19% (2002)
Population (millions)	14.3 (2011)	29 (2011)	69.5 (2011)	87.8 (2011)

Source: UNESCO Institute of Statistics and World Bank

Malaysia is the leader in many of the indicators shown in Table 1. As well as having the highest level of GNI per capita, it also has the highest level of gross domestic expenditure on research and development (GERD) as a proportion of gross domestic product (GDP). This measure is a standard indicator of an economy's willingness and capacity to invest in research

and development. "*In terms of overall global competitiveness, the Global Competitiveness Report for 2012-13 ranked Malaysia 25th, Thailand 38th, Vietnam 75th and Cambodia 85th out of 144 countries (World Economic Forum, 2011). Malaysia's economy is described as "being in transition from being "efficiency-driven" to being "innovation-driven", that is, its national economic prosperity relies less on simply improving the efficiency of production and more on being able to utilise new technologies and more sophisticated production processes and business models. In contrast, Thailand's economy is said to remain "efficiency-driven" and the economies of Vietnam and Cambodia are described as being "factor-driven", that is, they continue to rely significantly on the availability of low-skilled labour and natural resources"*(Bakar, 2016).

1.2 Problem statement

Commercialisation of the research product has now become a critical issue and has been recognised as a source of wealth creation especially relevant for university in Malaysia. Although many initiatives and efforts have been put forward for commercialisation activities, however the rate of success is still less encouraging. The purpose of the study is identifying determinant factors for commercialising research products in the Malaysian public universities. For the purpose of the study, survey was conducted with academic researchers and industries who have interest in commercialising their research products successfully. Drawn from their insights and experiences, this study identified the most impactful factors that determine the successfully commercialization of the research product(Sarujee *et al.*, 2022).

Commercialisation of the research product has now become one of the critical agenda in the university. Commercialisation involves transferring knowledge from the research laboratory into the market place to a new and improved products and services. Although,

traditionally teaching, learning and researching have been the main focus in the university, nevertheless the role and function of the university are gradually changed towards achieving a commercial entity. The emergence of new and improved products from the university have pave the way for university to enjoy a more commercialised status, and some may refer as entrepreneurial university. Thus, inevitably, university has to be independent to generate their own income. Academics need to be creative to transform their scientific and technological research in an entrepreneurial way. The utmost important motivation behind the creation from the university is that it should give impactful benefits to the nation. However, it is interesting to note that commercialisation of research product is still new in Malaysia, especially in the university(Ramli *et al.*, 2021).

Moreover, there are also little findings to support for commercialisation activities. The reason is that that commercialisation involves risky, long and complex processes. Furthermore, since teaching, learning and researching are considered the main mission in the university, commercialisation is treated less important, and it is still long way to achieve commercialisation stage. In fact, academics prioritise their publications to fulfil their key performance index and to get promoted. The worst part is that some academics found that commercialisation has no relevance to them, and some may think that commercialisation requires too time consuming. Thus, this perception needs to be changed towards achieving a sustainable commercialisation stage especially in the university(Han *et al.*, 2023).

There are many ways on how university supports for commercialisation of the research product. This can be made, for example through research contract, consultation and joint research. Apart from these, university also facilitates through the development of the research management centre or technology transfer office. This centre is dedicated to encourage,

administer and facilitate the commercialisation activity, to link with the industry people and to safeguard the interest of the university through intellectual property rights(‘NIH Guidelines for Conducting Research in MOH, 2021 i’, 2021).

Furthermore, the success for commercialisation activities is also supported by strategic collaboration with the industry partner. Academic discussions emphasised that collaboration between university and industry can increase the rate for commercialisation of the research products. However, to have an effective link with the industry, university should produce research product that meet the market requirement and consider the technological trend in the industry . To reduce the gap between university and industry, there are many strategic approaches either industry financially supports the university and academics are free to decide their research as agreed, or industry involves as part of the members but does not involve in research activities or industry requires specific types of research to the university, and they have more rights on the result from the research or industry and university are equally agreed on the research and its benefit. Commercialisation policy and other key legislation are also important to promote rapid diffusion of the research product to reach the industry and to govern academic rights, ownership rights and sharing of the profit. Apart from that, collaboration between university and other agencies including research centres and industries are one of the strategies to encourage for research product commercialisation. The Triple Helix model was introduced to capture the collaboration between university, industry, and government and to promote a positive impact of commercialisation activities(Azlin *et al.*, 2019).

1.3 Research Questions

RQ1: Do Quality of Research, Technology Transfer, and Intellectual Property Development significantly influence Commercialization?

RQ2: Does Continued Venture Innovation significantly influence Commercialization?

RQ3: Do Quality of Research, Technology Transfer, and Intellectual Property Development significantly influence Continue Venture Innovation?

RQ4: Does Continued Venture Innovation mediate the relationship between Quality of Research, Technology Transfer, Intellectual Property Development and Commercialization?

RQ5: Does Industrial Partner moderate the relationship between continued ventured innovation and Commercialization?

1.4 Research Objectives

The main objective of the study is to determine the effect of quality of research, technology transfer, intellectual property continue venture innovation and industrial partner on new technology commercialization. With the following specific objectives:

RO1: To determine if quality of research significantly influence commercialization.

RO2: To determine if technology transfer significantly influence commercialization.

RO3: To determine if intellectual property significantly influence commercialization.

RO4: To determine if continue venture innovation significantly influence commercialization.

RO5: To determine if quality of research significantly influence continue venture innovation.

RO6: To determine if technology transfer significantly influence continue venture innovation.

RO7: To determine if intellectual property significantly influence continue venture innovation.

RO8: To examine if continue venture innovation mediate the relationship between quality research and commercialization.

RO9: To examine if continue venture innovation mediate the relationship between technology transfer and commercialization.

RO10: To examine if continue venture innovation mediate the relationship between intellectual property and commercialization.

RO11: To examine if industrial partner moderates the relationship between continue venture innovation and commercialization.

1.5 Significant of the study

The theoretical significant: The study is significant theoretically becasue commercialization is significant as it demonstrates the value and impact that a research project has delivered to the industry and community. It plays a crucial role in translating the findings of research into practical applications that can benefit society. The commercialization of research leads to the development of new products and services that can solve pressing problems and improve people's lives. Additionally, the study of factors, models and hypothesis affecting the commercialization of new research products and its outcome on university performance helps understand the dynamics involved and aids in enhancing the effectiveness of research commercialization efforts.

The practical significant of this study, the commercialization of research products holds significant importance in various aspects. it can contribute to economic activity by creating marketable tests, interventions, and other products. This can lead to the generation of revenue and job opportunities, thus promoting economic growth. Additionally, commercialization allows for the advancement of public health by translating research findings into practical

applications. It fosters collaborations between universities and industries, promoting knowledge transfer and innovation.

1.6 Scope of the study

A qualitative research method using structured questions was employed to answer the research questions. Malaysian public university researchers and industries have been selected for the participant. This study focus on four main impactful factors that determine for a successful commercialisation of the research products in the Malaysian public universities, these include quality of research, transfer of technology, intellectual property, continue venture innovation, and industrial partner.

1.7 Definitions of Key Terms

-**New Technology Commercialization**: Process of introducing high-technology innovations to the market and making innovative products beneficial to society**.**

-**Technology transfer** is the process of disseminating scientific and technological developments to a wider range of users who can further develop and exploit the technology. It involves the transfer of knowledge and intellectual property, enabling organizations to protect their inventions and control their use. Technology transfer can occur between universities, businesses, and governments, and it can involve various steps such as knowledge creation, IP protection, fundraising, marketing, and commercialization. The aim of technology transfer is to make scientific and technological developments accessible to a wider range of users and to connect innovation stakeholders. It plays a crucial role in moving inventions from creators to users and can involve horizontal and vertical transfer. Technology transfer is facilitated by spin-outs and technology brokers. Overall, it contributes to innovation, industrial competitiveness, and economic growth.