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TECHNOLOGY SHARING THROUGH UNIVERSITY INDUSTRY COLLABORATION: INNOVATION IN MALAYSIAN MANUFACTURING LANDSCAPE

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ABSTRACT

Innovation has been the key pillar of success for economic growth especially for developing countries. Malaysia is one resorting to both universities and industries to collaborate in a more engaging and concentrated fashion to accelerate innovation growth especially in the manufacturing sector. Despite the high number of university industry collaborations, the return rate of investments is low. This suggest a mismatch between the demands of both the university and industry. On that grounds, it is important to address this research gap, for it will provide insights to help industries and universities understand how academic collaborations can be intensified to spur innovation. The aim of this paper is to establish Technology Sharing as a conduit in University Industry Collaboration to intensifying innovation within the Malaysian Manufacturing Landscape. The paper is based on findings of a quantitative approach through survey questionnaire to determine a strong relationship on Technology Sharing through University Industry Collaboration as a source of innovation in the manufacturing industry. A total of 120 companies within the manufacturing landscape were survey and analysed using paired sample T-test. The mean scores were translated into percentages to amplify the magnitude of knowledge improvement and product development with Technology Sharing in manufacturing against the Business expenditure on R&D (BERD). The findings reveal, Technology Sharing through University Industry Collaboration improves knowledge within the company significantly. This generation of new knowledge is a source of innovation in product development to enhance the product/process/technology of the manufacturing companies in Malaysia. The findings also show that with Technology Sharing, companies' absorptive capacity of new product development is significant. Improvement of knowledge translates into product development and augments innovation. This further ascertains the relationship of Technology Sharing in intensifying University Industry Collaboration to the growth of innovation within the Malaysian Manufacturing landscape.

INTRODUCTION

For the last two decades, innovation has been a primary thrust of economic growth and industries performance,(Vijayaraghavan, Pandiyan, Lumpur, Bhd, & Lumpur, 2013). Many countries have been converging its national resources to accelerate knowledge-based economic progress through developing university industry collaborations. University Industry Collaborations are bi-directional collaborations

between universities and industry establishments, to enable the diffusion of innovative ideas, significant competencies and talent with the aim of creating mutual value over time (Vaaland & Ishengoma, 2016)

In Malaysia, both the University and the Industry are urged to play important roles in nurturing innovation. The main objective of a collaboration would be on R&D and or human capital. In a perfect sense, the collaboration would allow both university and industry to coordinate their research agenda to avoid duplication and to expand on the relevance of the R&D, stimulate additional private R&D investments as well as increase labour mobility.

The 5th till 11th Malaysia Plan, Malaysia Education Blueprint 2015-2025 (Higher Education), National Survey of R&D 2015 and 51 more vision documents that have been produced over the decades are evidences that companies do collaborate with universities, and usually excited about the collaboration. Nevertheless, these collaborations mostly develop into the usual recruitment centre and seldom into significant research and development. While there are piecemeal R&D collaborations in place, the return of investment from the collaborations are rarely sustainable.

The industry's involvement in R&D is manifested in the Business Expenditure on Research and Development (BERD) per GDP, which shows the R&D intensity of the industry. In 2011, Malaysia's BERD per GDP was 0.61%, indicating the percentage of the GDP that is spent on R&D by the industry was relatively low in comparison to developed economies such as Korea (2.80%) and USA (2.03%) (Malaysian STI Indicators Report 2013). In addition to this, the commercialization rate is 2.1%. Based on the Malaysia 11th Plan (2015-2020), the commercialization rates by universities have been set at 5%.

This narrows down to the presences of a mismatch between the demands of the companies and the universities, and the roles played by each stakeholder in thecollaboration (Veera & Kaliani, 2013, Guerrero, Urbano, & Herrera, 2017). Hence, it is important to address this research gap, for it will provide insights to help industries and universities understand how academic collaborations can be intensified to spur innovation. Herein, in this paper we assess the manufacturing landscape in the context of economic growth. We then link innovation and university industry collaborations for economic growth. Finally, the paper ascertains technology sharing intensifies university industry collaborations to augment innovation within the Malaysian manufacturing landscape.

The rest of the paper is organized into four sections. First a literature review is carried out with a focus on the landscape of the manufacturing sector in Malaysia, innovation and economic growth and technology sharing as a mode to university industry collaboration. In the following section, a methodology is presented, followed by analyses & results and conclusion.

LITERATURE REVIEW

Malaysian Manufacturing Landscape

The manufacturing sector has been a catalyst of growth for many economies, favoured by foreign firms and where technological spill overs takes place (Vaaland & Ishengoma, 2016). Malaysia is of no exception to this, where manufacturing has been the key pillar of economic success for many years. This growth has been attributed by various commodities such as rubber, palm oil, tin and has been evolving in accordance with time. Today the manufacturing sector with 22% share of Gross Domestic Product (GDP), records a steady growth of 4.2%, whereby electrical and electronic products is the highest manufactured (DOSM, 2019). Meanwhile, Producer Price Index (PPI) within the manufacturing sector which measures the average change over time in selling prices received by domestic producers of goods and services stands at 106.20 (DOSM, 2019)

The manufacturing landscape in Malaysia has a total of 49,101 companies, whereby 97.14% are Small and Medium Enterprises (SME's) and 2.86% are Large establishments. From the SME percentage, 46% are micro, 48% are small and 6% are medium enterprises with a growth rate of 6.8% in 2017 and 21.5% share of SMEsGDP (DOSM,2018). Even though small-sized companies dominate the manufacturing sector, the difference in domination by firm size here is relatively small and the expansion of either firm size could be dependent on the growth of the country's economy.

SMEs dominate almost 60% of local market but by focusing on ready products for labelling and packaging (Yasin, Hassan, & Osman, 2015). Interestingly with the large percentage of representation, only 10.4% of SMEs are suppliers to foreign firms or multinational corporations in Malaysia (SME Annual Report 2017/2018). Of this percentage, 53.9% supply directly to MNCs meanwhile 34.1% supply indirectly to MNCs through another local SME. The percentage of SMEs supplying through another SME indicates the existence of tiers within the SME landscape. Despite the fact that this helps to create niche markets, multi number of tiers contributes to the higher cost, low quality products and therefore unable to attain

economies of scale (Saleh & Ndubisi, 2006, Ahmad 2009). Accordingly, as we move from producing raw products to capital and knowledge-based products, the challenge in real time is to exalt from low value to high value-added products within or across sectors. Here knowledge, innovation and productivity become the central to value creation.

Innovation and Economic

Shifting global trends, namely disruptive technologies and on-going trade disputes are negatively affecting Malaysia's growth momentum to persist going forward. Malaysia's strategy of not being dependent on a specific commodity, or export market has given us the advantage of economic complexities, thus making it is easier for Malaysia to embark for higher added value production of goods and services. Thus, to ensure the economy is of high-value and knowledge-based, innovation has been identified as the most distinctive feature for economic growth (Malaysia 11th Plan (2015-2020)). With the combination of new knowledge and resources together with implementation of those in practice, innovation is portrayed as a dynamic force that causes a continuous transformation of social, institutional and economic structures (Fagerberg, Fosaas, & Sapprasert, 2012). From an economic perspective, innovation leads to increased productivity, thus higher wages to workers and greater purchasing power. Businesses become more profitable and in return allows for higher investments. Innovation also generates additional revenue by the development of new products and services that will meet unmet customer demands, and at times opening up the Pandora's Box.

An innovative ecosystem allows intensification of research culture in an economy. As economies transform in knowledge-based, the capacity for innovation increases proportionately (Malaysia Education Blueprint, 2015-2025 (Higher Education). To create the innovation ecosystem, many initiatives were placed at national level. With the budget for research and development was RM3.07 billion from 2011-2014, various programs to induce and inject innovation were put in place. Amongst the popular initiates are creating talent pool of world class researchers, KPIs on academic publications, and increased budget for collaboration between research institutes and industries. Despite such efforts, collaborations were still limited, the produced R&D outputs did not meet the demands of the industry, hence returns on investment in research and development was low and did not support competitiveness and productivity for the industry.

Technology Sharing Intensifies University Industry Collaborations

With the current problems in hand, research must be driven by industry demand to fortify collaborations. Popular methods in UIC such as the number of memorandums signed, intern placement rate, contributing old machinery to university for the purpose of learning by undergraduates and research are antiquate methods that does not sync with national aspirations. There are numerous studies that suggest technology transfers via spinoffs, also a mode of university industry collaborations to be implemented (Yasin et al., 2015, Fini R. 2017, Audretsch, Lehmann, & Wright, 2014, Crawford, 1984, Lind, Styhre, Aaboen, Lind, & Aaboen, 2013). The significance of citing Crawford, 1984 shows us that technology transfers is not a new term within the university industry collaboration. Technology transfer requires transfer of funds, expertise, infrastructures, core mechanical components (Kim, Sohn, Lee, Chung, & Kim, 2016) which are not available in local firms (Saleh & Ndubisi, 2006). The method of technology transfer is also seen as a barrier for so many reasons including foreign firms are reluctant to share advance technologies with local companies to protect their business. Technology transfer fails when the form of technology used is inappropriate for the setting (Bozeman, 2000).

In addition to that, in Malaysia spinoffs are not doing great (Yasin et al., 2015, Sobry 2014). With issues such as absorptive capacity, the real need of the local companies needs to be put first (Gray, 2006). Also, to be followed by investment and commitment by both university and industry.

Evidently there are various factors influencing technology transfer. Nonetheless, most of the research on technology transfer has been focused transferring the essence of the new knowledge and no reference was found on what is to be produced that is to be transferred. The factors identified from the published literature were therefore used as a basis for the conceptual model.

METHODOLOGY

With relevance to university industry collaborations, we propose that technology transfer has to be tweaked to suit the collaboration. Instead of transferring the new knowledge, technology is to be shared. As a multi-dimensional concept, the technology goes beyond the installation of hardware. It refers to sharing tacit and explicit knowledge embedded in diagrams, technical knowledge, know-how, methods, processes, products and university research achievements. There are no specific parameters to this as the focus is on producing the right product and not the composition of the product itself. There are many studies that proof technology promotes innovation (Sharif, 1986, Wong, VGR Chandran 2012, David & Sijde, 2015) which is exactly what UIC must incorporate in the collaboration so that the collaboration is intensified and it grows innovation for economic growth (Guerrero et al., 2017).

The intensification of university industry collaboration through technology sharing for innovation can be summarized in Figure 1.

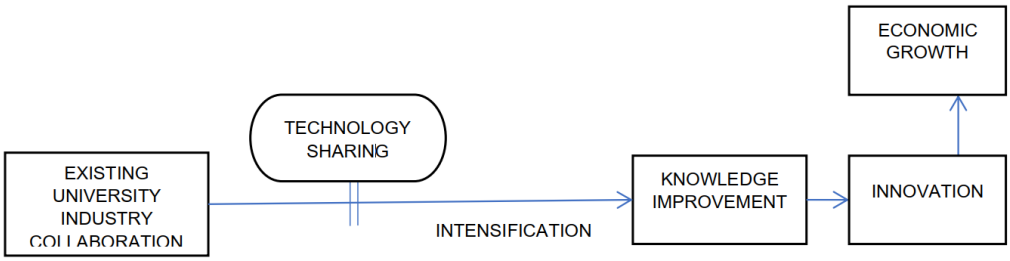

Figure 1: Conceptual Model

To ensure comprehensive understanding on the intensification of UIC towards innovation and the growth of the economy, there is a need to study 3 most important respondents for this research, which are:

a) SMEs in the manufacturing sector (companies that have no experience in collaborating with universities)
b) Local Government Universities
c) Anchor Companies (companies that have existing collaborations with local universities)

Generally, all three questionnaires require respondents to respond their opinion on the success of Technology Sharing (Autio, 2015), factors influencing the absorptive capacity of the stakeholders (Mustapha Kamal & Veera & Kaliani, 2013) and the factors to a successful UIC (Brimble & Doner, 2007, Egbetokun, 2015). Questionnaires were sent to a total of 2050 SMEs companies within the manufacturing SME sector, 20 local government universities and 60 Large companies within the manufacturing sector. The breakdown of the manufacturing sector is as per Table 1 (11th Malaysia Plan 2015-2020)

Table 1: Malaysian Manufacturing sector breakdown

Catalytic Sectors	Related subsectors
a. E&E	a. Medical devices b. Rubber-based c. Wood-based d. Textiles e. Palm Oil based f. Pharmaceuticals g. Transport Metal h. Aerospace i. Food processing j. Remanufacturing
b. Chemicals	
c. Machinery & Equipment	

And, the local government universities consist of the following categories:

a) Research Universities – 5
b) Malaysian Technical Universities Network – 4
c) Focused/Comprehensive Universities - 11

RESULT AND DISCUSSION

A paired sample T-test was conducted to compare Knowledge Improvement with Technology Sharing and Knowledge Improvement without Technology Sharing conditions. There was a significant difference in scores for Knowledge Improvement with Technology Sharing (M=35.5985, SD=14.6109) and Knowledge Improvement without Technology Sharing (M=3.6750, SD=0.63195) conditions; t (79) =19.613, p=.000). It can be concluded that there is a statistically significant difference between Knowledge Improvement with Technology Sharing and Knowledge Improvement without Technology Sharing. Since the Paired Sample Statistics box revealed that the mean for Knowledge Improvement with Technology Sharing was greater than Knowledge Improvement without Technology Sharing, it can conclude that SME's believe that Technology Sharing would improve Knowledge significantly than without technology sharing.

Table 2: Paired Sample T-Test- Knowledge Improvement with Technology Sharing and Knowledge Improvement without Technology Sharing

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Knowledge improvement	35.5985	80	14.61095	1.63355
	Knowledge within the company	3.6750	80	.63195	.07065

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Knowledge improvement - Knowledge within the company	31.92346	14.55800	1.62763	28.68374	35.16319	19.613	79	.000

To amplify the Knowledge Improvement with Technology Sharing, the mean scores have been converted to percentages to show the performance of the score relative to the Business Expenditure in Research and Development. The mean score M=31.92346) based on the Paired Samples Test box is then compared to the highest score M=35.1659. The mean score as a percentage for Knowledge Sharing withTechnology Sharing is 90.77%. This percentage is then observed against the BERD value which is 0.61% (less than 1 %). This means Technology Sharing will improve knowledge in a company which will attribute towards the increase of business expenditure on research and development.

In addition, a paired sample T-test was conducted to compare Product development after Technology Sharing and Absorptive Capacity before Technology Sharing conditions for Large companies. There was a significant difference in scores for Product development after Technology Sharing (M=0.88, SD=0.331) and Absorptive Capacity before Technology Sharing (M=0.27, SD=0.449) conditions; t (40) =7.202, p=.000). It can be concluded that there is a statistically significant difference between Product development after Technology Sharing and Absorptive Capacity before Technology Sharing. Since the Paired Sample Statistics box revealed that the mean for Product development after Technology Sharing was greater than Absorptive Capacity before Technology Sharing, we can conclude that Large companies believe that absorptive capacity of the Large companies improves significantly with technology sharing whereby products are developed.

In the Large companies setting, to signify the magnitude of Product development after technology sharing, the mean scores have been converted to percentages to show the performance of the score relative to the Business Expenditure in Research and Development. The mean score (M=0.610) based on the Paired Samples Test box is then compared to the highest score M=0.781. The mean score as a percentage for Product development after technology sharing is 78.10%. This percentage is then observed against the BERD value which is 0.61% (less than 1 %). This means Technology Sharing will increase Product

Development in a company which will attribute towards the increase of business expenditure on research and development.

Table 3: Paired Sample T-Test- Product development after Technology Sharing and Absorptive Capacity before Technology Sharing

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Product development	.88	41	.331	.052
	Absorptive capacity b4 TS	.27	41	.449	.070

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Product development - Absorptive capacity b4 TS	.610	.542	.085	.439	.781	7.202	40	.000

CONCLUSION

The results affirm that the generation of new knowledge is a source of innovation in product development to enhance the product/process/technology of the manufacturing companies in Malaysia. The findings also show that with Technology Sharing, companies' absorptive capacity of new product development is significant. This further ascertains the relationship of Technology Sharing in intensifying University Industry Collaboration to the growth of innovation within the Malaysian Manufacturing landscape. In short, this study shows university industry collaborations must be demand driven and technology sharing platforms will help drive private investments especially with the manufacturing companies in research, development, commercialisation and innovation. Intensified university industry collaborations will help reshape research culture, relevance and outcome.

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