

UNIVERSITY INDUSTRY COLLABORATION: THE ROLE OF PUBLIC UNIVERSITIES WITHIN THE MALAYSIAN MANUFACTURING LANDSCAPE

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ABSTRACT

In developed countries, universities are reputed as hub of innovation, contrarily to developing countries, universities are intermediary platforms for the diffusion of technology from large manufacturing companies to the value chain. The Malaysian Government through its blueprints emphasize that public universities have an important role in supporting innovation and technology commercialization. Despite myriad initiatives created and executed to help universities in improving their ability to innovate, the outcomes have yet to meet national expectations. This suggest a lack of awareness on the influence of universities especially in University Industry Collaboration (UIC) towards sustainable development in the innovation ecosystem. On that grounds, it is important to address this research gap, for it will provide insights to manufacturing companies and help universities themselves in being instrumental towards the intensification of UIC. The intent of this paper is to determine the role of public universities in UIC within the Malaysian manufacturing landscape. This paper is based on findings of a quantitative approach through survey questionnaire. A total of 20 public universities and 40 large manufacturing companies were surveyed and analysed using Compare means and Pearson's correlation coefficient. For further evidence, registered intellectual property was analysed using One sample T-test. The percentage of expenditure of R&D per export value by large manufacturing companies in Malaysia was used as test value to determine the current role of public universities within the Malaysian manufacturing landscape. The findings reveal, public universities in Malaysia remain as intermediary platforms for large manufacturing companies to share their technology with the value chain. As intermediaries, public universities fortify knowledge and product development for large manufacturing companies. The findings further reveal, registered intellectual property by large manufacturing companies is a significant indicator of UIC outcomes through R&D processes. The findings of this paper add to the dimensions of empirical research on the significance of public universities in intensifying UIC. The importance of public universities in creating relevant and sustainable technology is paramount. Only when universities are solicited as hub of innovation by the manufacturing landscape, Malaysia will move up the value chain in manufacturing.

INTRODUCTION

Universities are powerhouses. Surrounded by transformative technology, today Universities innovate, integrate and educate [11]. This recognition sparks the significant role it plays in a University Industry Collaboration (UIC) setting for the development of an economy. Ultimately studies advocate, university is the source of discovery, invention and diffusion of innovation towards industrial adoption and commercial application [16]. This justifies universities as an integral component within the UIC.

UICs are considered to be the avenue where specialized knowledge and technology transfer activities from universities, intervene with production and market knowledge from industries [14]. When describing UICs in a developed economy, University is considered as a research university that projects the

“from university-to-industry role. In pursuit of this, the Malaysian government relentlessly engages public universities by design to support innovation and technology commercialization in a UIC. Ever since the 5th Malaysia Plan, there has been more than 51 vision documents produced that outlines policies, strategies and initiatives for UIC.

Despite this, national statistics on university commercialization rates are low. Based on the Malaysia 11th Plan, the commercialization rates by universities have been set at 5%. Meanwhile currently the rates are at 2.1%. While there are numerous factors that contribute to the poor rates, failure to understand the needs of the university in helping them to improve their ability to innovation is the major driving force [17]. According to Vaaland [16] fighting the “ivory tower” syndrome is crucial in a developing country and a necessity to access innovation capabilities.

This further suggest a general lack of understanding on the prominent role and influence of public universities especially in the UIC context. On that basis, it is important to address this research gap, for it will provide insights to industries and government as well as to help universities in being instrumental towards the intensification of UIC and the development of the universities themselves.

Therefore, this study arises from the urgent need to assess the role of public universities in the context of innovation for economic growth. Then university role is linked with intellectual property attained by the manufacturing companies in UIC. Ultimately, the paper establishes the role of public universities in intensifying UIC 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 on the Malaysian economy focusing on manufacturing sector. The landscape of the UIC in Malaysia and public universities are also reviewed. This is to give a better understanding on the whole ecosystem the public universities strive in. In the following sections, a methodology is presented, followed by analyses & results and conclusion.

Malaysian Economy and Manufacturing Sector

Malaysia has come a long way since its independence on its economic frontier. From mining and agriculture since its formation in 1963, today Malaysia is a multi-sector economy based on services and manufacturing. Malaysia's GDP grew at an average of 6.5% per annum from 1957 until 2005. Foreign and domestic investments performance was at peak in the early 1980s through mid-1990s. This transformed the Malaysian economy into a diversified and modernized one, thus experiencing sustainable rapid growth with an average of 8% annually. On a macro perspective, average real GDP growth during 2011 till 2015 has been 5.3%, national per capita income in 2015 was at RM 36,937, and average annual inflation rate at 2.5%. Under the 11th Malaysia Plan timeframe, GDP is expected to grow at 5-6% per annum, GNI per capita at RM 54,100 and inflation rate will be maintained at 2.9%.

Based on Economic Census 2011, there are a total of 663,038 companies in Malaysia. Of this number, 645,136 (97.3%) companies are Small and Medium Enterprises and the balance of 17,902 (2.7%) companies consist of foreign companies 5000, government linked companies 400 and 12,502 are big companies.

On labour market, based on Labour Force Survey 2016, total working age population was 21.7 million, whereby 14.7 million are in labour force and from this 14.2 million are employed. Labour force participation rate was reported at 67.7%, employment to population ratio was recorded at 65.4% and employment by sector saw the highest percentage in Service sector which is 61.6%, followed by Industry 27.5% and Agriculture 11.4%. This confirms the success of the Malaysian economy in creating jobs especially in the Service sector to meet the demands of the people. On the contrary to the success of creating jobs as we progressed into middle income status, this rate of job creation is surprisingly lower than desired. This is evident that employment is struggling to be at par with the rise in working age population, not to discount the rate of employment creation which has been volatile due to the various global financial crises Malaysian economy faced and facing. Meanwhile the 11th Malaysia Plan projects employment to reach 15.3 million by 2020 whereby additional 1.5 million jobs will be created. Service sector is expected to contribute 62.5% to total employment, and manufacturing 18.2%. The composition of skilled jobs is projected to reach 35% of employment by 2020. However, it is noteworthy unemployment rate is projected to remain at 2.8%, thus allowing Malaysia to enjoy full employment till the end of the 11th Malaysia Plan. This growth rate on employment is in line with the shift from labour-intensive to technology and knowledge-based economy. Subsequently, this also highlights the need for structural changes that are able to drive new growth areas to amplify job creation potential in the country and strengthen labour force participation rate.

According to Department of Statistics Malaysia, 2019, on the sectoral output, the manufacturing sector is expected to record 4.2% growth per annum and to be led by domestic-oriented subsector. This growth is based on the shift towards the production of complex and diverse products and improving

productivity by adopting greater automation and upgrading skills. Key industries driving this growth would be food, beverages and tobacco; fabricated metal products; and machinery and equipment.

On the global economic front, in the first quarter of 2019, total exports were at RM236.0 billion a decline of 0.7% from 2018 and total imports at RM199.1 billion, a decline of 2.5% from 2018. With the unprecedented global trends such as disruptive technologies, on-going trade disputes and increased economic complexities, this affects Malaysia's export performance. On a brighter note, Malaysia has attracted RM21.7 billion worth of investments in forms of high-quality projects.

To withstand this pressure, Malaysia focuses on attracting investments in high technology; capital, knowledge and high value-added intensive industries; R&D activities especially on new growth areas. More importantly, there is a dire need to nurture and encourage both foreign and local investors and manufacturers to reshape their perception on the Malaysian manufacturing landscape and move up the value chain with high tech innovations and quality investments. Here, universities can play an integral role.

Malaysian Public Universities and University Industry Collaboration

There are 19 public universities in Malaysia, five universities have been accredited with Research University (RU) status and the remaining are categorised as either Comprehensive or Focus universities. A university with RU status receives additional funding for Research, Development and Commercialisation. Besides the public universities, there are 53 private universities, 6 foreign university branch campuses, 403 private colleges, 30 polytechnics and 73 public community colleges in Malaysia.

In striving to evolve greater, government recognizes the need to make innovation an essential component within the university spectrum. University ranking, publication outputs, research quality and some many other components are used as yardstick as to where Malaysian public universities stand in the international arena. In 2017, Malaysia is the world's 25th best Higher Education system according to U21, a consortium of international research universities. In addition to this Malaysia ranked 23rd in 2013 for number of publications and 43rd out of 110 countries for number of patents. In terms of quality, the number of publications in ISI indexed journals increased 3.1 times from 2007 to 2012, the highest rate of increase in the world. As for the number of citations, there was a fourfold increase from 2005 to 2012 [13].

As all of these are good yardsticks, an innovative ecosystem would also require close collaborations of the academia, government, industry and the community. This collaboration on incubating, developing and marketing new ideas nourishes the economic and technological growth of Malaysia.

University Industry Collaboration (UIC) has been in existence within the higher education system for a very long time. UIC are linkages between universities and industries for mutual gains, expanding on concepts, ideas, skills and people [16] and primarily focuses on research and development (R&D) and human capital [5]. UIC through R&D, capacity building, commercialisation, consultation and endowments are very popular methods to bridge innovation. Today, UIC is making headway on its capability as a component to national innovation systems. While developed economies such as Korea, Japan, and US capitalize rigorously on R&D, developing countries such as Malaysia, Indonesia and Thailand, focusses more on human capital. The lack of competitive skills as per requirement within the sectors of industry in a developing economy [16] compels policy makers and universities to centralize its efforts towards capacity building.

As a developing country, Malaysia needs to harness innovation as the main source of growth. Innovation allows productivity acceleration and spins off many more relating benefits for the growth of the economy. In Malaysia, both the university and the industry are seen to play important roles in nurturing innovation. The main objective of the collaboration would be on R&D and human capital. The collaboration between these entities allow both university and industries 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 R&D investments by the collaboration between universities and industries commonly revolve between three categories. The three categories are as follows [10]:

- a) Joint Knowledge Creation that expands to joint research, contract research and partnerships. Partnerships is established for information, personnel exchange, joint research grant or human resource development;
- b) Transfer of Knowledge that expands to licensing patent, consulting by Professors, student/lecturers and materials such as journal papers, books and conference presentations; and
- c) University spin offs that expands into commercializing university research results for industry innovation.

The importance of establishing UIC comes in many folds for a developing country such as Malaysia. UIC will allow the intensification of demand driven innovation activities (National Innovation Strategy), it helps increase commercialization rate [12] and to develop knowledge-innovation based economy.

To this, the Government of Malaysia has diffused a quadruple helix model comprising university, industry, government and community [13]. This model ensures closer linkages between demand from industry and supply of talent and technologies from the university. Besides employability of graduates, and R&D, to accelerate commercialization of ideas is an element of focus under this model. By focusing on national priority research areas, increasing investments and providing a supportive environment, acceleration of commercialisation of ideas will be achieved.

Based on the Malaysian Science, Technology and Innovation (STI) Indicators Report 2013, Malaysia ranked 18th out of 144 countries in terms of UIC in R&D. This is relatively a good achievement when compared to countries such as China (35th), Thailand (46th) and Indonesia (40th).

Some of the existing UIC initiatives that have been established includes a string of spin off agencies/companies namely Malaysian Technology Development Corporation (MTDC) in 1992, Malaysian Industry-Government Group High Technology (MIGHT) Technology Nurturing in 2001, Collaborative Research in Engineering, Science and Technology (CREST) in 2012 and some recent initiatives include Malaysian Global Innovation & Creativity Centre (MAGIC) 2013, Steinbeis Malaysia Foundation 2014 and Public Private Research Network, 2015. All of these initiatives focus towards contributing to the development and acceleration of science and technology for the growth of the country.

Nevertheless, engagement levels with the industries and community is still not extensive as desired. This is validated through the U21 rankings where Malaysia ranked 35th for a component on connectivity – collaboration globally and with industry. In addition to that, a comparison of Gross Domestic Expenditure on R&D as percentage of GDP (2012) by funding sources saw Malaysian Government financing the highest percentage of 41% as compared to countries like South Korea (25%), Japan (16%), Germany (30%) and United States (31%) (MEB (HE) 2015-2025). This shows that Malaysia lacks contributions and absolutely requires higher R&D investments from the industries.

Many factors contribute to the success of collaboration between universities and industries. Favourable university policies, adequate resources, flexible regulations and good incentive systems fuel the rise of collaboration between universities and industries. On the other hand, industries are motivated to collaborate with universities based on their industry sizes, R&D intensity, the corporate strategy and the industry sector characteristics [10].

Besides initiatives that focus towards R&D, there has been numerous programs established at ministerial and university level on employability programs. Among the programmes, whereby students obtain high-end certificates that are recognised by industry on top of the degree that they have received, is Bridging the Gap programmes, Degree++, Apprenticeship programmes, Entrepreneurship Programs and Finishing School Programs. Some of the latest addition includes the Industry Centre of Excellence (ICoE), Knowledge Transfer Program (KTP), 2u2i, CEO Faculty and APEL. All of these programmes are initiated to address Graduate Employability (GE), in preparing them for the challenges in the future.

Intermediary Platform vs Hub of Innovation

A country's economic development can be distinguished based on its gross domestic product (GDP) per capita and commodity exporting. The three main phases are factor driven, efficiency driven and innovation driven. In a developed country, economies are innovation driven, whereas in a developing country, economies are efficiency driven for higher productivity and economies of scale [9]. According to Vaaland's conceptual model 2016 [16], in developed countries, universities are reputed as hub of innovation, contrary to developing countries, universities are intermediary platforms for the diffusion of technology from foreign companies to the value chain. Universities in an innovative economy are able to create, preserve and disseminate knowledge and technology for industries to adopt and apply. This role "from-university-to-industry" in a UIC significantly influences the creation of new jobs and positively induces economic growth and wealth in a developed country. Meanwhile in a developing country, the knowledge and technology by foreign companies is transferred to the university through UIC and this innovation capabilities are then inherited by the local companies. In simple terms, its "from-industry-to-university". As Malaysia is a developing country (World Bank Group, 2019), public universities in Malaysia is the connective link in the national innovation system, within the UIC setting, which is acquired with large companies.

It is also pertinent to note that foreign firms have inter-firm linkages with the local companies within the supply chain. While acquiring raw materials from local companies, foreign companies are able to diffuse knowledge and technology directly to these companies, without the help of universities. In

Malaysia, 10.4% of total local companies (Small and Medium companies) are suppliers to multinational companies. Out of this, 53.9% are 1st tier suppliers and 34.1% are tier two and above suppliers [15].

Based on Vaaland [16], the role of Malaysian public universities in university industry collaboration can be conceptualised as in Figure 1.

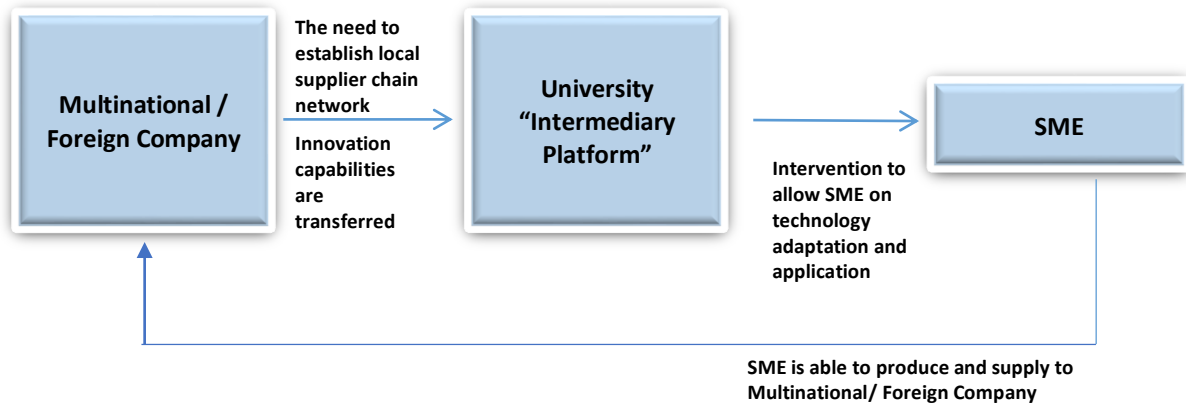


Figure 1 The role of Malaysian Public Universities in a University Industry Collaboration

Source: Adapted from Vaaland and Ishengoma 2016

As per Figure 1, the need to establish this role is to allow the better understanding of the university position in the UIC. It will help the university to structure the direction of the UIC at the beginning of the collaboration itself. Industry innovation process begins with a clear formulation of the problem and this process is enhanced with the UIC interface. There are no specific parameters to this as the focus is on establishing the role universities in intensifying UIC and not to assess the role itself. There are many studies that proof the role of university in a UIC determines the augmentation but not necessarily success [2],[3],[6],[8], which is exactly what UIC must incorporate in the collaboration so that the collaboration is intensified and it grows innovation for economic growth [8].

METHODOLOGY

Based on the objectives of the paper, two sets of questionnaires were administered, unique to the required respondents, which are:

- To respond on their opinion on the role of universities in UIC [16],
- The relationship between registered intellectual property and the role of university [1],[4],
- Product development and the role of universities in it [7]: and
- The association between the university role and the university focus [2].

There were 2 categories of respondents for this research, which are:

- Malaysian public universities - Public universities are categorized into 4, which are Research Universities, the Malaysian Technical Universities, Focused and Comprehensive universities. The research universities are universities recognised by the Ministry of Education as leading research and educational hubs.
- Anchor Companies (companies that have existing collaborations with Malaysian public universities) - from 3 catalytic sectors in the manufacturing sector which are electric and electronics, chemicals, and machinery & equipment [12].

Questionnaires were sent to a total of 20 public universities and 60 Large companies within the manufacturing sector. The questionnaires were administered through email. Results from the questionnaire were tested by using One sample T-test and Pearson's correlation coefficient. Specifically, one sample T-test was used to determine whether the population mean (public universities) is significantly

different from the hypothesized value. The hypothesized value is obtained from Vaaland's theory/study. Pearson's correlation coefficient was used to measure the strength of the association between university role and focus as well as product development. For registered intellectual property it was analysed using one sample T-test. The hypothesized value was obtained from the percentage of expenditure of R&D per export value by large manufacturing companies in Malaysia to determine the current role of public universities within the Malaysian manufacturing landscape.

RESULT AND DISCUSSION

A one sample t-test was conducted on the role of public universities in Malaysia by universities themselves and anchor companies. This test was conducted to see if the university role differs significantly from Vaaland's theory/study. According to Vaaland's study, in developing countries, universities play the intermediary role between multinational and local companies, while in developed countries, universities are acknowledged as the hub of innovation. Here the latter has been given the test value of 1 and former 2.

Table 1 One Sample T-Test – Role of Public Universities by Universities and Anchor companies

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Role by Uni	17	1.59	.507	.123
Role by Anchor	41	1.73	.449	.070

One-Sample Test

	Test Value = 1					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Role by Uni	4.781	16	.000	.588	.33	.85
Role by Anchor	10.445	40	.000	.732	.59	.87

In Table 1, the one sample t-test compared university role as intermediary platform or hub of innovation. There was a significant difference in scores for Role by Uni (M=1.59, SD=0.507) conditions; $t(16) = 4.781, p=.000$ and Role by Anchor (M=1.73, SD=0.449) conditions; $t(40) = 10.445, p=.000$. This shows us that this sample mean significantly differs from the hypothesized value. The mean of the variable university role for this particular sample of universities and anchor companies is statistically significantly different from test value of 1. Since the One-Sample Statistics box revealed that the mean for Role by Anchor was greater than Role by Uni, it can be concluded that both Universities and Large companies believe that the public universities in Malaysia play the role as a hub innovation. This is attributed by the fact that Universities are important agents in National Innovation Strategy [13] and there are numerous scientific studies that justifies universities as new knowledge providers.

In Table 2, a Pearson product-moment correlation coefficient was computed to assess the relationship between University focus and the role of the University. There was no statistically significant correlation between the two variables, $r = -0.023, n = 17, p = 0.932$. Overall, there was a weak and negative correlation between University focus and the role of the University. This shows that a change in university focus did not correlate with changes in University role. While the policies for Universities are underlined in the many national strategy blueprints, as time passes, the accelerated evolution of technology and the dynamics of the national economy forces the Universities to realign its role, at times forsaking the passé policies.

Table 2 Pearson's Correlation– Relationship between University Focus and University Role

Correlations

		Uni Focus	Uni Role
Uni Focus	Pearson Correlation	1	-.023
	Sig. (2-tailed)		.932
	N	17	17
Uni Role	Pearson Correlation	-.023	1
	Sig. (2-tailed)	.932	
	N	17	17

Table 3: Pearson's Correlation- Relationship between University Role and Product Development

Correlations

		Perceived role	Product development
Perceived role	Pearson Correlation	1	.279
	Sig. (2-tailed)		.077
	N	41	41
Product development	Pearson Correlation	.279	1
	Sig. (2-tailed)	.077	
	N	41	41

Pearson product-moment correlation coefficient was also computed to assess the relationship between the perceived role of Universities by Anchor companies and product development in Anchor companies, as per Table 3. There was no statistically significant correlation between the two variables, $r = 0.279$, $n = 41$, $p = 0.077$. Overall, there was a weak but positive correlation between the perceived role of Universities by Anchor companies and product development in Anchor companies. Increase in perceived role of Universities by Anchor companies do not significantly relate to product development in Anchor companies. This relates to the fact that while Anchor companies may be appreciative on the acquired knowledge from the Universities, it does not necessarily mean the Anchor companies will capitalize on them [14].

Table 4: Export value and R&D expenditure of Malaysia's Top 10 manufacturing industries owned by Malaysian residents 2015

Industry (Malaysian)	Export Value (RM '000)	R&D (RM '000)	%R&D/Export Value
Refined petroleum products	78,852,527	495,686	0.63
Vegetable & animal oils and fats	38,279,595	734,822	1.92
Electronics components & boards	19,578,773	213,957	1.09
Rubber products	16,149,706	116,280	0.72
Basic chemicals, fertilizer and nitrogen compounds, plastic & synthetic rubber in primary forms	11,175,869	237,650	2.13
Products of wood, cork, straw and plaiting materials	8,506,363	50,538	0.59
Plastics products	7,481,818	97,596	1.30
Other fabricated metal products; metal working service activities	6,339,717	32,479	0.51
Other food products	5,460,784	63,408	1.16
Non-metallic mineral products n.e.c.	4,597,504	126,475	2.75
		Average	1.28%

Source: Malaysia Science Outlook Report,2017

Another one sample t-test was conducted to see if the registered IP differs significantly from %R&D expenditure per export value. ASM Outlook 2017 states the % R&D expenditure per export value by top

Malaysian manufacturing companies is at 1.28%, as per Table 4. The Registered IP for manufacturing companies in this study is statistically significant ($M=3.44$, $SD=1.871$) compared to %R&D expenditure per export value of top Malaysian Manufacturers $t(40) = 7.387$, $p=.000$.

Table 5: One sample T-test- Relationship between Registered IP and % R&D expenditure per export value

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Registered IP	41	3.44	1.871	.292

One-Sample Test

	Test Value = 1.28					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Registered IP	7.387	40	.000	2.159	1.57	2.75

The mean of the variable Registered IP for this particular sample of Malaysian Manufacturing companies is 3.44, which is statistically significantly different from the test value of 1.28. This indicates the group of companies in this study has a significantly higher mean on the % R&D expenditure per export value than 1.28. This is justified as this sample encompasses manufacturing companies which have collaborations with public universities and the registered IPs is a significant indicator of UIC outcomes.

Despite the fact, one particular test suggest that public universities are the hub of innovation, subsequent test proves in Malaysia, large manufacturing companies do not fully rely on public universities on new product innovation. Anchor companies may be appreciative of the new knowledge generated but it does not necessarily translate into a new product. Taken together, these findings reveal public universities in Malaysia currently serve as intermediary platforms for large manufacturing companies to share their knowledge and technology to local companies as well as within the value stream as per Vaaland's model. By personating the intermediary role, public universities are able to help large manufacturing companies to fortify knowledge and product development. The results further reveal registered intellectual property by Anchor companies is a significant indicator of outcomes from collaborations with public universities through the R&D process. Even though on the overall, the results show weak correlation, but there is a positive relationship, indicating a reality for public universities to develop further as hub of innovation, with the help of appropriate policies in place.

CONCLUSIONS

In a nutshell, this study results affirm the role of public universities in UIC is very much dependent on the economic development of Malaysia. University is the innovation link that helps flourish the business between the multinationals and local companies. The role a university plays in a UIC also determines the mode of knowledge and technology diffusion to local companies. The findings of this paper also add to the dimensions of empirical research on the significance of reinforcing UIC to produce research output and public universities as fundamental constituent in intensifying UIC. The importance of public universities in creating relevant and sustainable technology is paramount. Only when universities are solicited as hub of innovation by the manufacturing landscape, Malaysia will move up the value chain in manufacturing.

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