

Corporate entrepreneurship, national policies and supply chain collaborations: an empirical study of Malaysian LED manufacturers

Malaysian
LED
manufacturers

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Abstract

Purpose – This paper aims to examine the impacts of corporate entrepreneurship, national policies and supply chain collaboration on the innovativeness of manufacturers of light emitting diode (LED) in Malaysia.

Design/methodology/approach – The data were collected by using questionnaire survey from the manufacturers involved in the various echelon of the supply chain. The data collected were analyzed by using partial least square (PLS).

Findings – Corporate entrepreneurship plays a moderating role in the relationship between national policies, supply chain collaboration and innovativeness.

Research limitations/implications – This study is only focusing on the supply chain of LED in Malaysia; hence, the results may not be suitable to be generalized to wider populations.

Practical implications – The findings of this study could help the local companies to understand on how, as entrepreneurs, they could expand from small scale to contract manufacturers through enhancing innovativeness. This is important as failure to do so may cause them to be excluded from the global supply chain.

Originality/value – This study expands the existing literature by providing empirical evidence from the perspective of an emerging country, namely, Malaysia. It also attempts to close the gaps by examining the role of corporate entrepreneurship as the moderating variable.

Keywords Entrepreneurship, Innovation, Supply chain, Developing country, Light emitting diode

Paper type Research paper



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Introduction

The use of light emitting diode (LED) as an alternative to conventional lighting has been emphasized as an effective way to promote greener environment and reduce the problems caused by climate change. As it consumes lesser energy and has longer lifespan, many governments around the world have started to phase out the use of conventional lighting by replacing them with LED which leads to a growing market demand on LED (Khorasanizadeh *et al.*, 2015). The Mordor Intelligence (2019) reported that the LED industry has grown tremendously and is expected to reach US\$112.15bn by 2024 of which the biggest portion of revenue is generated from Asian countries. In the Asia regions, it appears that China has been able to attract world-class manufacturers such as Cree and Epistar to invest in the LED industry in the country which has provided window of opportunities for the local manufacturers to become their “contract suppliers”. As the country controls the input resources required for LED production, it is not surprised that they could offer lower production costs of which have attracted the multinational firms (Levy *et al.*, 2017). This situation has pressured its neighboring country, Malaysia to step out from its “comfort zones” and start to build up its innovative capabilities to sustain. They could not be the “follower” in the crowded market that has a quick declined of final price LEDs. They need to be more innovative by not only providing “cheap” resources but also able to offer distinct and unique products. This suggests that in a dynamic environment, the survival of SMEs are depending on their creativity and innovativeness (Ouedraogo and Koffi, 2018).

Based on the technological innovation literature, many scholars highlighted that economic incentives and national policy are the important institutional drivers that affect the competitiveness of local firms. For instance, Athukorala (2017) reported that tax relaxation is crucial for low and middle income countries as it provides opportunities for local firms to participate in the industrialization process. In Chile, attractive research and development (R&D) policies have contributed to the training of human capital which has helped the local businesses in enhancing their innovative capabilities (Guimón *et al.*, 2018). Similarly, in a much recent study, Gherghina *et al.* (2020) highlighted the importance of financial support to small and medium-sized enterprises (SMEs) especially on the implementation of high technologies or process automation to stimulate their expansions. In another stream of researches, some studies indicated that the interdependency between local and multinational corporations (MNCs) could influence the local firms to embrace new technology (Zimmermann *et al.*, 2016). Local firms from emerging market tend to rely on supply chain collaboration to enhance the performance of value-delivery network to support their innovation process. Through inter-organizational linkages, they could gain the access to related resources and capabilities that are difficult for them to create on their own. Despite the importance of the national policies and supply chain collaboration in fostering innovations among the local SMEs, these relationships are said to be influenced by other factors and may not be linear. In a simplest word, merely a favorable national policy and supply chain collaboration may not result in path-breaking innovations. Instead, firms’ innovativeness may be driven by the organizations’ abilities to discover, create, seize and exploit the internal and external resources so that the innovative capabilities can be reaped (Schumpeter, 2017; Kim, 2018), of which is referred to as the corporate entrepreneurship (Kuratko *et al.*, 2015). While the importance of corporate entrepreneurship has been highlighted in the existing literature, there is little empirical evidence to support the role of corporate entrepreneurship as the moderator between the national policies, supply chain collaboration and innovation. In view of this gap, this study attempts to enrich the

existing literature by examining the interaction among the variables through quantitative survey method. This study is guided by the following research questions:

- RQ1.* What is the impact of supply chain collaboration and national policies on innovations of Malaysian LED manufacturing companies?
- RQ2.* How does the corporate entrepreneurship moderate the relationship between supply chain collaboration, national policies and innovations of Malaysian LED manufacturing companies?

To have deeper understanding, this study used the institutional theory and resource-based view. This study is expected to enrich the existing literature in several ways. First, this study expands the existing literature by proposing a new conceptual framework. In this study, institutional theory and resource-based view are integrated, and it postulates that the innovativeness of a firm may be influenced by the interaction between external supports and internal factors. In this study, the favorable national policies and supply chain collaboration represent the external support, while internal factor is represented by corporate entrepreneurship. It is also proposed in this study that the ability of a technological firm to reap the benefits of national policies and supply chain collaboration is depending on the firm's ability to discover, creates, seize and exploit opportunities ahead of their rivals, which is represented by the corporate entrepreneurship. Second, this study closes the gap in the existing literature by looking into the Malaysian context. As a middle-income country, Malaysia is reported to be trapped in the middle in which the local firms were reported to be unable to compete with the low wage nations and at the same time they were not incapacitate to participate in higher value added production and services globally (Raj-Reichert, 2020). As Malaysia is dominated by multi-national firms which are only interested in low wage labors with low interest to upskill the workforce, the country has been slow in absorbing the knowledge transfer (Doner and Schneider, 2016). Hence, in such situation, entrepreneurs who are dynamic and have the ability to reconfigure internal and external resources may play a role in the development of local manufacturing sector. In fact, this had enabled South Korea and Taiwan to successfully narrow the income gaps and come out from the middle-income traps. Third, from the practitioner's perspective, this study is expected to facilitate the local LED firms in understanding on how as entrepreneurs, they could expand from small scale to contract manufacturers through enhancing innovativeness. This is important as failure to do so may cause them to be excluded from the global value chains.

Literature review and hypotheses development

Light emitting diode, its characteristics, potentials and industry growth

LED or "solid-state lighting" was introduced in the lighting industry as one of the solutions to reduce greenhouse gas emissions. In comparison with the incandescent and fluorescent bulb, the LED bulb produces high-quality light with a relatively lower consumption of electricity which has help to save the consumers' money and reduced the use of electricity (Khorasanizadeh *et al.*, 2015). As LEDs emit light from a piece of semiconductor known as LED chip, they are able to reduce 47% of energy consumption. It is projected that in 2027, LED usage will be able to help to save 348 TWh of electricity which represents a total savings of more than US\$30bn worth of electricity. Thus, if the conventional lighting can be replaced with LED, there will be tremendous drop in the energy consumption which eventually will lead to a greener environment.

Given its environmental-friendly characteristics, it is not surprised that the demand has grown up tremendously over the years. In 2012, the LED market globally was reported to reach US\$10.1bn with an increase of 13.4% as compared to 2010 (Mordor Intelligence, 2019). This figure had grown up tremendously to US\$51.8bn in 2018 and is expected to reach US\$112.15bn by 2024. Major portions of LED revenues were generated from Asian countries, with Taiwan and Korea being the largest emerging markets (Sanderson and Simons, 2014). However, in term of the revenues of LED-based fixtures, Europe appears to represent one-third of the total market size with China being the closest competitor. Strong intervention by the Chinese Government in the LED industry has led to the tremendous growth of the sector which has attracted world-class manufacturers such as Cree, Epistar and Formosa Epitaxy to invest and expand their production bases in the country. As China possesses huge domestic market, it is expected that China is able to grasp a big slice of the revenues in the industry in future. Similarly, the development of LED market in Malaysia has flourished attributed to the supportive government policy. For instance, the decision to ban the usage of incandescent lamps or traditional luminaires in buildings or real estates started in 2014 has been seen as a successful way to promote LED growth. This has offered opportunities for related businesses to engage in the LED value chains, either by focusing on upstream or downstream market or both. Despite the supportive government policy, the industry players were still facing challenges in participating in the value chain.

The rate of LED development in Malaysia differs from Japan, China and Europe. In Malaysia, it appears that the local firms face difficulties to compete even in the local market as it is flooded with products from China which are marketed at a much cheaper price. As China appears to be controlling the upstream market due to possession of the rare-elements resources, it enables them to market the products at a lower price (UN Environment, 2017). Profound technology in LED industry has also transformed and sparked the development of the other markets, namely, modules, drivers and lighting application, creating a new market for the local companies to produce low-end drivers and modules. While it seems to be a business opportunity to the local companies, in fact it makes the products to be much easier to assemble with less R&D capability required and this has created another worrying situation. It is foreseeable that this market will be saturated very quickly due to the low entry requirements (Sanderson and Simons, 2014). They may not be able to sustain in long term as they are not able to invest in R&D and produce distinct and unique products. Their limited knowledge on lighting market and inability to assess the distribution channel may hinder them from offering good LED products. The situation becomes worse with the participation of companies in other industries, namely, semiconductor and television manufacturers, which have higher technological capabilities.

Institutional theory

Institutional theory suggests that a firm's decision may be influenced by the institutional environment in which the firm is operating (DiMaggio and Powell, 1991). The institutional environment consists of external parties such as government departments, trade and industry associations as well as buyers and suppliers. They may have forced the firms to adopt certain practices through coercive, normative and mimetic pressures. Several institutional pressures have been discussed in the technological innovation literature. For instance, government department has been highlighted as an entity which plays an important role in providing a pervasive environment to support technological innovations through economic incentives, tax relaxation, supportive regulations and national policy for training and maintaining adequate technological workforce. These forms of supports are crucial for emerging economies as the firms in these regions are usually relying on public

sector due to lack of internal financial resources. They have limited ability to undertake R&D activities and acquire resources internally. In China, Zheng (2014) pointed out that the government focused on providing tax concession on certain industries to help promoting technological innovation in products and processes at organizational level. In another study conducted by Deng (2009), it was found that inefficient legal framework and weak intellectual property protection had hindered businesses to invest in R&D and establish global brands. In Malaysia, Al Mamun *et al.* (2019) highlighted the importance of enterprise development trainings that were provided by the external institutions, such as government in improving the socio-economic of micro-enterprises.

The interdependency between a firm and its supply chain partners may also serve as a factor that will influence an organization to embrace new technology. For instance, a dominant firm like MNC may exercise coercive power to influence their chain members to adopt similar technology at firm level. For firms that are coming from emerging markets, they tend to rely on their supply chain partners to enhance the performance of value-delivery network in supporting their innovation process. Through inter-organizational linkages, they could gain the access to related resources and capabilities that are difficult to create on their own (Zimmermann *et al.*, 2016). Supply chain partners' supports are also important as it helps to reduce the costs, shorten the time-to-market and reduce market risks of an innovation. Based on these arguments, this study postulates that:

- H1. National policies are positively related to innovation.
- H2. Supply chain collaboration is positively related to innovation.

Resource-based view

The RBV suggests that the organizational performance is influenced by a firm's internal characteristics (Barney, 2001). Firms that possess resources that are valuable, rare and difficult to be duplicated and substituted would be able to sustain in longer term. A firm's ability to deploy and coordinate these resources is a driver for innovative capabilities. Although R&D plays an important role in technological innovations, an increase in financial allocation on R&D activities alone may not guarantee proportional growth in returns. This has been proven in the previous studies conducted by Yam *et al.* (2004) and Liu *et al.* (2009). They indicated that innovation capabilities are neither driven solely by R&D nor technological resources, but driven by organizational culture and structure that support innovation. As firms are moving towards global competitiveness, they need to acquire the abilities to look beyond their organizational boundaries and evaluate how the external resources, capabilities and supports of their supply chain partners, government departments and industry associations can be optimized to create exceptional values (Zimmermann *et al.*, 2016). As such, this study suggests that corporate entrepreneurship may play a role in product and process innovations of a firm.

Corporate entrepreneurship refers to the ability of an organization to discover, create, seize and exploit opportunities ahead of their rivals (Kuratko *et al.*, 2015). It only exists in organizations where leaders and the culture works together to generate impetus to innovate, take risks and pursue new opportunities (Dess and Lumpkin, 2005; Hsu *et al.*, 2014). It is viewed as an effective way to promote entrepreneurial spirit and behavior within an organization (Tseng and Tseng, 2019). In an organization with high corporate entrepreneurship, the leader will act as a gatekeeper and always finds ways on how to optimize internal resources to achieve success (Eggers *et al.*, 2013). A corporate leader who exhibits entrepreneurial behavior tends to create a working environment and

corporate culture that stimulate and support creativity. In a high corporate entrepreneurship organization, employees are motivated to work in a more proactive manner which encourages the development of employees' capabilities and absorptive capacities. Especially in a high technology industry, technically skilled engineers, scientists and entrepreneurs who are able to acquire, translate and distribute external knowledge to colleagues and promote creative ideas will become the assets of a company as they could help the organizations in forming and adapting new ideas for problem solving as well as to exploit new knowledge for innovation (Song *et al.*, 2017). As the LED industry is in a high volatile market with short product lifecycle, the manufacturers need to be agile and responsive to the needs of their customers. As such, a LED manufacturing company needs to have the right employees, who can extract information from market insights and generate creative ideas to spearhead the innovation capability in a timely manner. Based on these arguments, this study postulates that:

- H3. Corporate entrepreneurship moderates the relationship between national policies and innovations.
- H4. Corporate entrepreneurship moderates the relationship between supply chain collaboration and innovations.

Based on the above literature review and hypotheses developed, this study has developed a research framework as follows (Figure 1).

Method

Operationalization

This study adopted measurements from the existing literature and adapted them to suit the context studied. National policy was measured using three items adapted from King *et al.* (1994). These items evaluate the degree of government support in offering economic incentives (i.e. subsidies, grants and tax concession), providing training programs and establishing sufficient regulatory environment to support innovations. Supply chain collaboration was measured using the nine items drawn from Cao and Zhang (2011). These items measure the extent of collaborative practices between the responding firm and its immediate supply chain partners. Based on Joshi *et al.* (2019), five items which measure corporate entrepreneurship were adapted.

Survey administration and sample

This study used quantitative methodology to test the hypotheses and the research framework developed. The questionnaire used was pilot tested with a sample of 15 manufacturers in the LED industry. Based on the feedback gathered from the pilot test, the questionnaire was further refined where the inconsistencies of wordings were rectified and unclear or ambiguous items were removed or rephrased. The targeted population of this study consists of manufacturing firms involved in the Malaysian LED industry. The

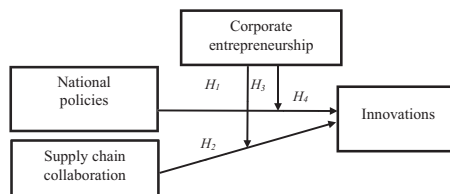


Figure 1.
Research framework

Table 1.
Respondents'
demographic profiles

Demographic	Frequency	(%)
<i>Position in the chain</i>		
Wafers and die manufacturers	10	8.8
LED packaged manufacturers	12	10.6
LED lamps and luminaires manufacturers	68	60.2
End-use application manufacturers	23	20.4
<i>No. of employees</i>		
5-50	20	17.7
51-100	79	69.9
101-150	10	8.8
More than 150	4	3.6

sampling frame of this study consists of the Malaysian LED manufacturers registered with the Federal Malaysian Manufacturer (FMM). It was found that a total of 1,326 manufacturers were registered with FMM as of March 2019. This study adopted systematic sampling technique by selecting every second consecutive manufacturers on the list, yielding a total of 500 firms. The questionnaires, including a cover letter in self-addressed and stamped envelopes, were sent to the selected companies by mails. Out of the 500 questionnaires that were sent out, 113 were returned which brought to a response rate of 22.6%. [Table 1](#) presents the profiles of the respondents. Majority of the respondents are involved in producing LED lamps and luminaires with number of employees between 51 and 100. This is what has expected as most of the Malaysian firms are involved in the downstream segment of the supply chain as lesser resources are required.

As the response rate was only 22.6%, there may be non-response bias in the findings of this study. To overcome this issue, this study conducted an independent *t*-test, in which the responses of the early and late respondents were compared ([Armstrong and Overton, 1977](#)). Respondents who completed the questionnaires within one-month were categorized as early respondents, while the rests were categorized as late respondents. The results of the independent *t*-test showed that the *p*-values were above 0.05 which demonstrated that non-response bias did not exist in the data collected ([Table 2](#)).

Results

Measurement model

This study used partial least squares path modeling (PLS-SEM) to examine the validity and reliability of the measurement model used. Two psychometric tests, namely, convergent and discriminant validity were conducted to confirm that the measurements adapted are in agreement and do not reflect other variables ([Hair et al., 2016](#)). This study evaluated the convergent validity of the measurement model by inspecting the factor loadings, composite reliability and average variance extracted (AVE). The results as depicted in [Table 3](#) shows that all the measures were loaded significantly at $p < 0.001$, with all of them having factor loadings of above 0.6. Additionally,

Variables	Early respondents (<i>n</i> = 79)	Late respondents (<i>n</i> = 34)	<i>t</i> -value	Significant level
Government support	4.12	4.11	1.21	0.22
Supply chain collaboration	3.97	4.01	1.81	0.12
Corporate entrepreneurship	4.01	4.11	1.01	0.51
Innovations	3.98	3.86	1.22	0.22

Table 2.
Assessment of non-
response bias

Variables	Loadings	t-values	Average variance extracted	Composite reliability
<i>National policies</i>				
economic incentives	0.795	26.43***	0.677	0.57
relevant training	0.821	30.71***		
adequate intellectual property	0.747	20.08***		
<i>Supply chain collaboration</i>				
exchange relevant information	0.781	18.61***	0.811	0.753
jointly plan and workout solutions	0.833	24.21***		
share costs, benefits and risks	0.749	13.69***		
use cross-organizational teams	0.865	31.23***		
share technical support	0.775	15.42***		
share equipment	0.823	24.11***		
jointly acquire new knowledge	0.811	23.24***		
jointly learn the capabilities	0.772	11.32***		
<i>Corporate entrepreneurship</i>				
<i>Our firm is likely to...</i>				
Be more innovative	0.882	33.21***	0.887	0.79
Be more risk-taking	0.876	28.21***		
Be more aggressive	0.881	33.11***		
Be more proactive	0.862	27.14***		
Give more autonomy to employees	0.879	29.22***		
<i>Innovations</i>				
<i>Product innovations</i>				
produce variety of products	0.767	10.88***	0.76	0.70
produce good quality products	0.781	12.17***		
produce new products in a timely manner	0.776	12.19***		
<i>Process innovations</i>				
Improved process responsiveness	0.812	22.34***	0.76	0.70
Improved traceability and monitoring	0.788	20.12***		
Improved transport and storage conditions	0.841	30.23***		

Table 3. Convergent validity **Note:** *** $p < 0.01$

Variables	Mean	SD	GS	SC	CE	IV
National policies	4.15	0.94	0.822			
Supply chain collaboration	3.97	0.55	0.44	0.9		
Corporate entrepreneurship	4.11	0.72	0.65	0.66	0.94	
Innovations	3.88	0.45	0.72	0.43	0.78	0.87

Table 4. Discriminant validity

both the composite reliability and average variance extracted indicated the values of more than 0.6. These results confirmed the convergent validity of the measurements used in this study (Bagozzi and Yi, 1988). This study further tested the discriminant validity by comparing the squared correlations of AVE and correlations with other variables (Fornell and Larcker, 1981). As shown in Table 4, all the variables were seemed to have higher average variance extracted value as compared to their squared correlation with other variables; hence, it confirmed its discriminant validity.

Structural model

Upon evaluating the validity and reliability of the measurement model used, this study performed a non-parametric bootstrapping with 5,000 replications. This was to test the hypotheses and research framework developed. The results indicated that the model was capable of explaining 42.1% of variance in innovations. Based on the path analysis, it was found that the effects of national policies ($\beta = 0.754, p < 0.001$) and supply chain collaboration ($\beta = 0.64, p < 0.001$) on innovations were positively significant. Hence, *H1* and *H2* are supported (Table 5).

To test the moderating effect, this study performed a multi-group analysis. The respondents were divided into two groups according to their corporate entrepreneurship scores (CE). With score of 3.81 as the median split, the respondents were classified into low and high CE groups. The high CE group ($n = 65$) had a mean level of 4.17 and a standard deviation of 0.28, whereas the low EC group ($n = 48$) had a mean level of 3.88 and a standard deviation of 0.51. The moderating effect of EC is shown in Table 6. The interaction effect was calculated based on Keil *et al.* (2000), in which bootstrapping approach was adopted. The results as shown in Table 6 indicated that the coefficients of the path between government support and innovations as well as between supply chain collaboration and innovations for the high and low CE groups were significantly different ($p = 0.03$) from their coefficients in the structural model.

Discussion

The rapid development of LED market has provided window of opportunities for the local firms. However, their position in the global value chain may still be threaten due to the floods of China LED products which are much cheaper. In view of this, it is important for the local firms to start building up their innovative capabilities as this not only could help them in producing differentiated products but also is able to help them to lower the production costs in the longer term. Based on the two established theories, institutional-based view and RBV, this study postulates that the innovativeness of a firm may be influenced by the interaction between external supports or pressures as well as internal factors.

The findings of this study highlighted the importance of favorable national policies in fostering the innovations of a local firm which is in line with the findings of the studies conducted by Zheng (2014) and Deng (2009). This result is not surprised considering that Malaysia is an emerging country. As a developing economy, the local firms are still relying very much on the economic incentives and government intervention. In the technological

Hypotheses	Relationship	Path coefficient	t-value	Decision
<i>H1</i>	National policies → Innovations	0.754	4.282**	Supported
<i>H2</i>	Supply chain collaboration → Innovations	0.641	3.827***	Supported

Note: *** p -value significant at 0.001

Table 5.
Structural model
analysis

Hypotheses	Relationship	Path coefficient		t-value	Decision
		High CE	Low CE		
<i>H3</i>	National policies → Innovations	0.418	0.824	2.282	Supported
<i>H4</i>	Supply chain collaboration → Innovations	0.532	0.677	2.342	Supported

Table 6.
Moderating effect

industries such as LED industry, the national policy would have driven the MNCs to leverage on the host countries' tax benefits and R&D funding to innovate new products or technology. They will take this opportunity to work with the local manufacturers in generating new product and process.

Similar with [Zimmermann et al. \(2016\)](#), this study indicated the importance of supply chain collaboration in nurturing innovations. As the majority of the respondents were medium size enterprises, it is expected that they would have limited internal resources to pursue innovation activities and processes. This situation urges them to work cooperatively with their supply chain partners in developing new range of LED chips, imaging modules and multi-port sensors. Collaboration with downstream partners may help them to obtain information on the market updates relating to customers' demands, while collaboration with upstream partners may help them to explore on how the materials supplied could be used to develop emerging LED products such as smart sensors and wearable technology.

The results of this study have also proven the role of corporate entrepreneurship as the moderator between the national policies, supply chain collaboration and innovativeness. This shows that although there are institutional supports given by the government as well as supply chain partners in building up a firm's innovative capabilities, the extent of success is still depending on the abilities of the firm to identify, exploit and coordinate the resources obtained. While Malaysia has attracted foreign direct investment through tax relaxation and low wages in the past, the local firms are still facing the problem of up scaling their technology as many of these MNCs are not interested to meet the demands of local workforce for betterment of education ([Doner and Schneider, 2016](#)). This situation requires the local firms to develop internal capabilities, by identifying, seizing and exploiting the external resources obtained from the government and the MNCs, which demonstrates the importance of having corporate entrepreneurship. This in turn helps them to surpass their middle-income status. For instance, Hong Kong has successfully narrowed down their income gaps against the Western developed nations through local Chinese dynamic entrepreneurs, who had started their businesses in the 1960s. The findings also show the importance of having a leader, manager or owner who is able to drive strategic innovations, extract ideas from market insights and promote them within the company. It also highlights the crucial role of the leaders in promoting organizational cultures that encourage employees to "think out of box" and try out new practice on their own initiatives.

Conclusion

Based on the cross-sectional data collected from the local LED manufacturers in Malaysia, this study has proven the importance of both external support (national policies and supply chain collaboration) and corporate entrepreneurship in generating innovations. The findings of this study enrich the existing limited literature in explaining on how the interaction of these dimensions could drive the innovative capabilities of LED manufacturers in Malaysia.

The findings of this study suggest that in the context of developing countries, such as Malaysia, supportive national policy plays an important role in encouraging local firms to invest in product and process innovations. Government funding and grants could help the local manufacturers especially the medium size enterprises which are notably lacking in resources. However, more concerted efforts are needed to encourage them to connect with the global value chains. This includes coordinating joint-venture between the local manufacturers and MNCs, making it possible for them to reap the benefits from transfer of foreign state-of-the-art technologies and further tapping into markets dominated by major competitors.

The results of this study also suggest the companies to consider the strategic role of supply chain collaboration in upscaling innovativeness. They need to actively work with their supply chain partners in designing new products or enhancing existing processes, and venturing into markets that have not explored before. This is because, by collaborating with supply chain partners, they are able to reconfigure their internal resources and create synergies. Although the local firms are less bureaucratic due to their smaller size, the challenges of lacking of financial resources or expertise may inhibit them to reap the innovative capabilities. Hence, to be able to be innovative, they should jointly work with their supply chain partners.

While the crucial role of national policies and supply chain collaboration for technology firms in Malaysia cannot be denied, the findings of this study suggest that that home-grown companies can sustain better if they focus on developing internal capabilities. For example, learning and knowledge creation culture can be stimulated through corporate entrepreneurship, which is necessary to drive the process and product innovations. The top management or leaders' role in the company are crucial. They need to motivate and shape entrepreneurial behaviors in the organizations and create an environment that promotes freedom to experiment without the fear of reprisal when initiatives taken fail to bring to desired outcomes.

It is to note that this study is not without limitations. In particular, it would be more interesting for future studies to use a longitudinal methodology as technological innovation and social changes may shift over the time. Although this study only focused on the LED sector, it is believed that the findings of this study may also be applied in different industries with similar setting in different countries.

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