## METHODOLOGY

### DATA COLLECTION AND SAMPLE

A sampling questionnaire survey was sent to manufacturing firms in Malaysia listed as exporters by the Malaysia External Trade Development Corporation (MATRADE). These firms comply with international standards including product sustainability requirements. A total of 500 firms were randomly selected from the MATRADE database (http://www.matrade.gov.my) and the questionnaire surveys were directed by email to the middle- or upper-level managers of the selected firms. Data collection was conducted between November 2018 and March 2019. To increase the response rate, follow-up telephone calls were made two weeks after sending the email. At the end of this process, 161 questionnaires were collected, representing a response rate of 32.2%. After eliminating the invalid questionnaires, 157 usable questionnaires remained in the sample. This number was deemed sufficient to proceed with the analysis of the four constructs in the developed model (Hair et al. 2010).

### MODEL AND MEASUREMENT

Structural equation modelling (SEM) was employed for the data analysis, which was done using IBM-SPSS-AMOS software (version 21.0). This type of analysis methodology was selected because it is the most efficient method for validating latent constructs in a structural model, besides its ability to simultaneously assess and organize a series of interrelationships among the latent constructs in a model (Awang 2015). The survey questions were designed to be answered on a five-point scale ranging from 1 = "strongly disagree" to 5 = "strongly agree". The study adapted and customized items from prior research and the questionnaire was then validated by academic experts. Explanatory factor analysis was performed on all the items in the survey and any items that exhibited weak factor loadings (below 0.6) (Hair et al. 2010) were deleted.

This resulted in the removal of three items. The remaining 38 out of 41 items were then subjected to further analysis. To ensure the sampling adequacy, this study measure Kaiser-Meyer-Olkin (ranged from 0.832 to 0.873) and employed Bartlett's test of sphericity. The reliability of the constructs was tested by determining the value of the Cronbach's alpha coefficient. The values for the constructs ranged from 0.732 to 0.810, thus exceeding the 0.7 threshold and specifying that the model had acceptable reliability (Hair Jr et al. 2006).

## RESULTS AND DISCUSSION

### DEMOGRAPHIC PROFILE

Profile analysis showed that 72% of the respondents were assistant managers, assistant directors or above (refer Figure 2). This indicated that quality data would be obtained by this study because this group of respondents is deemed to be more knowledgeable about their organization's strategic orientation (Campbell, 1955). In relation to the industrial subsectors covered by the survey data, most of the respondents (65%) represented the electrical and electronics, chemical, and mechanical and equipment industries, all of which are the main subsectors driving the growth of the manufacturing sector in Malaysia.

### MEASUREMENT MODEL

Four constructs, nine sub-constructs and 38 items formed the measurement model. Confirmatory factor analysis was executed to measure the model for the unidimensionality, validity and reliability of the constructs. All the factor loadings as shown in Appendix A were greater than the minimum threshold of 0.6, except for SCF2 which had a value of 0.582, hence this item was deleted. Subsequently, construct validity, convergent validity and discriminant validity were checked to ensure the significance of the measurements. Initially however, the construct validity analysis produced an unacceptable goodness of fit value, which specified that the model had an overall poor fit. Therefore, the modified index measurement value was checked, and it was found that the covariance between PS4 and PS5 was 22.575 (>15.0) and that this was affecting the fitness indices. Therefore, both of these items were set as 'free parameter estimates', which ultimately led to an improvement in the fitness index so that acceptable values were obtained (refer to Table 2).

The average variance extracted (AVE) was also inspected and it was found that all the AVE values exceeded the threshold of 0.5, indicating that all the items were significantly loaded onto their construct, as shown in Table

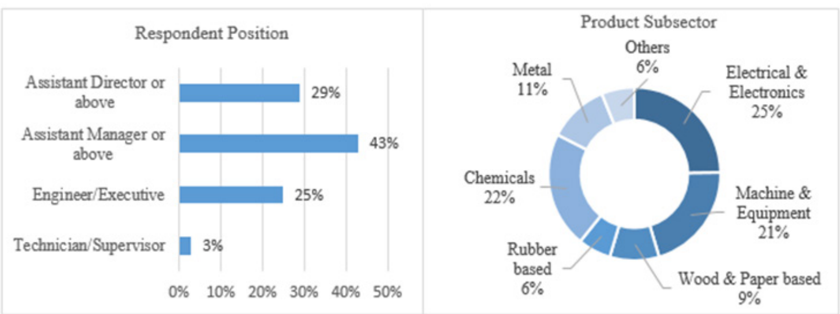


FIGURE 2. Profile Analysis

3. The composite reliability values also surpassed the minimum threshold level of 0.70 (Hair et al. 2010), which meant that the constructs could be considered to be reliable and consistent.

In addition, Table 3 shows that the diagonal value (representing the square root of AVE) for each construct was higher than the values in the rows and the columns, which proved that the discriminant validity for all constructs was attained. Further, the construct correlation values were below 0.85, specifying that this model had no multicollinearity problems.

### SEM - STANDARDIZED PATH COEFFICIENTS

After the measurement model was proven valid and reliable, SEM was run to examine the hypotheses. Figure 3 depicts the standardized path coefficients of the model. At this stage, the coefficient of determination ($R^2$) was assessed. Referring to Figure 3, the value of $R^2$ for PCA was 0.73. This value implies that 73% of the PCA performance could be estimated by using GPI and SF in the model. In other words, the contribution of GPI and SF in estimating PCA was 73%.

In addition, EP and SF contributed 72% of the variance in estimating GPI, indicating good support for the developed model. Besides, the fitness index has also surpassed the minimum value and the factor loading for all items has exceeded 0.6. Furthermore, the value of standardized residual covariance was also observed, and was found to have an absolute value of less than 2, indicating that the structural model was correctly specified.

### HYPOTHESIS TESTING

The statistical results support H1, H2, H3, and H5, but unexpectedly reject H4 (refer to Table 4). The results indicated that EP had a significant positive effect on GPI ($\beta = 0.420$, $p < 0.001$), hence H1 was accepted. Indeed, EP and GPI are closely related in the pursuit of green activity. Concerning H2, EP showed a significant positive effect on SF ($\beta = 0.515$, $p < 0.001$), consequently H2 was supported. Firms that truly care about the environment will consider flexible work processes to meet their diverse needs. Accordingly, the results also supported H3, where SF showed a positive significant effect on GPI ($\beta = 0.614$, $p < 0.001$). This means that flexibility in the supply chain, resources, and functionality facilitates product innovation.

However, H4 which predicted that SF would have a positive and significant effect on PCA, was not supported. Even though the direct link between SF and PCA showed a positive effect, it was insignificant ($\beta = 0.017$, $p > 0.1$), therefore H4 was rejected. Although SF is considered to be a dynamic capability that drives the firm's competitive advantage (Santos-Vijande et al. 2012), the direct effect of SF on PCA was not proven by this study. Finally, the results revealed that GPI exerted a significant positive effect on PCA ($\beta = 0.760$, $p < 0.001$), as postulated by H5. This indicates that GPI can increase the competitiveness of a product in the market.

### MEDIATION ANALYSIS

This study applied the method in Baron and Kenny (1986) to test the mediator effects in the model. Referring to Figure 3, the direct effect between EP and GPI was significant with a value of 0.39. As for the indirect effect, which involved the link between EP → SF and SF → GPI, this was also significant with a coefficient value of 0.29 (0.50 x 0.58). This result indicated that SF acts as a partial mediator in the relationship between EP and GPI, hence H3a was supported. As regards the direct effect between SF and PCA, this effect was not significant. However, the indirect effect, which involved the link between SF→ GPI and GPI → PCA, was significant with a coefficient value of 0.49 (0.58 x 0.84),

TABLE 2. Fitness Indices of the Measurement Model

| Category | Index | Initial Index Value | Final Index Value | Comments | Level of Acceptance |
|---|---|---|---|---|---|
| 1. Absolute fit | RMSEA (Root-Mean-Square of Error Approximation) | 0.044 | 0.041 | Achieves the required level | RMSEA < 0.08 |
| | GFI (Goodness of Fit Index) | 0.789 | 0.806 | Achieves the required level | GFI > 0.8 |
| 2. Incremental fit | CFI (Comparative Fit Index) | 0.946 | 0.953 | Achieves the required level | CFI > 0.9 |
| | TLI (Tucker-Lewis Index) | 0.941 | 0.949 | Achieves the required level | TLI > 0.9 |
| 3. Parsimonious fit | Chisq/df (Chi-square/Degree of Freedom) | 1.290 | 1.251 | Achieves the required level | Chi-square/df < 3 |

TABLE 3. Discriminant Validity Index Summary for the Constructs

| | CR | AVE | MSV | PCA | EP | SF | GPI |
|---|---|---|---|---|---|---|---|
| PCA | 0.824 | 0.702 | 0.681 | 0.838 | | | |
| EP | 0.856 | 0.749 | 0.411 | 0.641 | 0.865 | | |
| SF | 0.831 | 0.622 | 0.587 | 0.679 | 0.496 | 0.788 | |
| GPI | 0.832 | 0.713 | 0.681 | 0.825 | 0.635 | 0.766 | 0.844 |

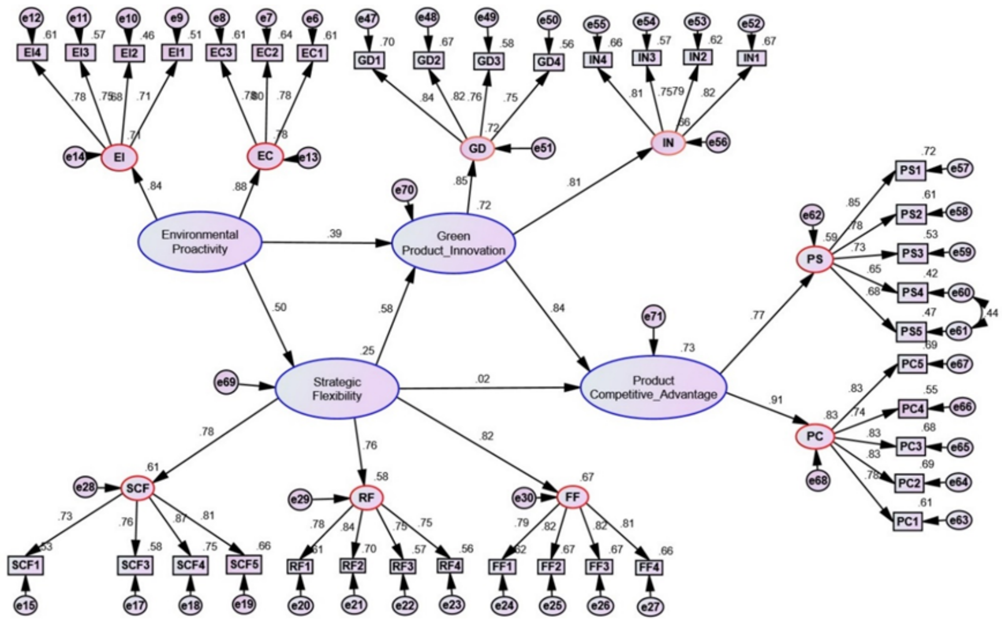


FIGURE 3. Standardized path coefficients

TABLE 4. Regression Path Coefficients and Their Significance

| | Hypothesis | | | Est. β | SE | CR | P | Result |
|---|---|---|---|---|---|---|---|---|
| H1 | Green Product Innovation_GPI | ← | Environmental Proactivity_EP | .420 | .118 | 3.558 | *** | Significant |
| H2 | Strategic Flexibility_SF | ← | EnvironmentalProactivity_EP | .515 | .122 | 4.214 | *** | Significant |
| H3 | Green Product Innovation_GPI | ← | Strategic Flexibility_SF | .614 | .125 | 4.914 | *** | Significant |
| H4 | Product Competitive Advantage_PCA | ← | Strategic Flexibility_SF | .017 | .164 | .103 | .218 | Not Significant |
| H5 | Product Competitive Advantage_PCA | ← | Green Product Innovation_GPI | .760 | .187 | 4.058 | *** | Significant |

*Note:* ***$p < 0.001$

thus GPI acts as a full mediator in the relationship between SF and GP and H5a can be supported.

THE RELATIONSHIP BETWEEN EP AND GPI

The finding of this study that EP affects GPI is in line with the findings put forward by previous researchers, who link EP to innovation (Garcés-Ayerbe et al. 2016; Garcés-Ayerbe and Cañón-de-Francia, 2017; Ryszko 2016). Primc and Čater (2016) emphasized that firms with higher levels of EP tend to innovate due to a higher degree of risk-taking behaviour. On this point, EP supports decision-making in the eco-design process and the selection of methods for eco-product development (Mahmood et al. 2018). In addition, EP facilitates the forecasting of future norms and social trends, thereby enabling firms to embrace green creativity to improve their green product development performance (Chen et al. 2016). In other words, EP can stimulate a more responsive GPI implementation.

THE MEDIATING IMPACT OF SF

This study found that SF partially mediates the relationship between EP and GPI is in line with the results reported by Chen et al. (2017), who found that SF partially mediates the effect of IT support on firm performance because SF drives firms to customize and optimize the use of their resources to improve their strategic plans. Firms with greater flexibility are able to quickly modify their product specification to react to the changing market environment and technological opportunities. Moreover, firms in emerging economies desperately need SF because they are more likely to experience serious resource scarcity and high contextual uncertainty (Li et al. 2017). However, having said that, in the context of green manufacturing, SF is crucial for translating the benefits of EP practices and for improving GPI.

THE RELATIONSHIP BETWEEN SF AND PCA

The results of this study showed that SF does not have a significant effect on PCA. Similarly, Kortmann et al. (2014) found that SF does not directly affect operational efficiency, but requires the presence of innovative ambidextrous capabilities in order to tie both of these factors together. In this regard, Ahmadi and Mohd. Osman (2018) argued that SF alone is not enough to achieve sustainable competitive advantage. Basically, SF requires that new information and knowledge is assimilated and configured in such a way so as to benefit the firm (Fernández-Pérez et al. 2012). Therefore, SF needs the assistance of other relevant factors to create and support a more focused and integrated strategy to ensure product competitiveness.

### THE MEDIATING IMPACT OF GPI

In this study, GPI was proven to be a full mediator linking SF and PCA. Prior literature suggested that balancing the trade-off between GPI and PCA is important in developing a competitive business strategy. Enhancing the functionality of products through innovative green design may increase their value through, for example, the usage of recyclable, non-toxic and less-polluting materials, and may also reduce the negative environmental impacts of a product's total life cycle (Chen et al. 2016; Suhariyanto et al. 2018). In a dynamic market, firms must strive to produce outstanding products to gain competitive advantage in order to generate value for the firms. Therefore, the role of GPI as a full mediator in the relationship between SF and PCA is of great importance.

## CONCLUSION

The findings of this study enrich the literature on the efforts of firms to improve GPI in order to achieve product competitiveness through the investigation of the role of proactive capabilities according to the DCV. Specifically, the empirical results of this study suggest that SF is an important factor that can boost GPI. Moreover, GPI seems to be a crucial factor that may be able to translate green practices into competitive advantage. The identified correlation between EP and GPI may encourage firms to pursue environmental strategies in order to achieve high level of competitiveness. Manufacturing firms need to be able to align and strengthen their internal capabilities to innovate continuously and faster than their rivals. In this regard, top management need to be proactive in changing, developing, and restructuring their internal strategy over the long term to ensure that their firms are and continue to be strategically flexible in producing an extensive range of products to stay competitive.

In closing, some limitations of this study should be noted. First, this study does not distinguish the effects by the size or level of the firm. Therefore, the differentiation of firms into small and medium-sized enterprises or multinational corporations, for example, would generate more detailed results and facilitate comparisons between groups. Second, this work focuses on manufacturing firms listed as exporters in Malaysia with a small number of respondents, which limits generalizability of the findings. Therefore, future research may gather much larger data sets and may involve sample from multiple countries.

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## APPENDIX A

| Indicator | Factorial load |
|---|---|
| EP<br>Sources: Sambasivan et al. (2013), Sen et al. (2015) | |
| Environmental Initiative (EI) | |
| EI1) Create recycling initiatives | .715 |
| EI2) Implement environmental criteria in supplier selection | .681 |
| EI3) Identify new environmental aspects in terms of their impact | .753 |
| EI4) Regular volunteering of information about environmental management to stakeholders/customers/communities | .784 |
| Environmental Commitment (EC) | |
| EC1) Top management support for environmental training | .779 |
| EC2) Actively comply with environmental regulations | .801 |
| EC3) Has clear objectives and long-term environmental plans | .783 |
| SF<br>Sources: Duclos et al.(2003), Oke (2013), Stevenson and Spring (2007), Zhang et al. (2003) | |
| Supply Chain Flexibility (SCF) | |
| SCF1) Well-developed supplier selection systems | .730 |
| SCF2) Flexibility terms are included in the supply contracts | .582 (deleted) |
| SCF3) Efficiently handle emerging customer demands in terms of product changes or customer location changes | .765 |
| SCF4) Find alternative sourcing partners to meet customer needs | .867 |
| SCF5) Align labour skills in supply chain activities | .811 |

*cont.*

*cont.*

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|---|---|
| Resource Flexibility (RF) | |
| RF1) High degree of sharing the same resources across units | .783 |
| RF2) High degree of utilizing the same resources for different products | .839 |
| RF3) Low difficulty of switching from one use of resources to another | .752 |
| RF4) Often finds new combinations of existing resources | .749 |
| Functional Flexibility (FF) | |
| FF1) Workers can perform many types of operations | .815 |
| FF2) A typical worker can use many different tools | .788 |
| FF3) Workers can operate various types of machines | .818 |
| FF4) Cross-trained workers can perform a wide range of manufacturing tasks | .819 |
| GPI<br>Sources: Chen et al. (2006), Gabler et al. (2015) | |
| Green Design (GD) | |
| GD1) Choose the materials that produce the least amount of pollution | .809 |
| GD2) Choose the materials that consume the least amount of energy/resources | .749 |
| GD3) Consider whether the product is easy to recycle, reuse & decompose | .712 |
| GD4) Designs products for longevity and durability | .630 |
| Innovativeness (IN) | |
| IN1) Frequently utilizes new opportunities in new markets | .820 |
| IN2) Innovation is carried out as planned | .786 |
| IN3) Management actively seeks innovative ideas | .753 |
| IN4) Commercializes products that are completely new to the organization | .811 |
| PCA<br>Sources: Kam-Sing Wong (2012), Liu (2017) | |
| Product Success (PS) | |
| PS1) Products are in compliance with environmental directives | .850 |
| PS2) Products bring in more revenue than competing products | .778 |
| PS3) Products are more profitable than competing products | .729 |
| PS4) Product variety is increasing | .646 |
| Product Competitiveness (PC) | |
| PC1) Products offer benefits that are not found in competing products | .782 |
| PC2) Products are superior in durability | .830 |
| PC3) Products are of higher quality | .826 |
| PC4) Products are superior in terms of technical performance | .744 |

DECLARATION OF COMPETING INTEREST

None.

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