The Influence of Proactive Capabilities and Knowledge-Based Dynamic Capabilities on the Competitive Advantage of Manufacturing Firms

Norhuda Salim, Mohd Nizam Ab Rahman, and Dzuraidah Abd. Wahab

***Abstract*—Achieving and sustaining competitive advantage is a goal among firms, but it is increasingly challenging in a rapid changing and sophisticated environment. Most of the environmental management undertaken by firms in developing countries are not able to increase the competitive advantage of the product. Hence, this study investigates proactive capabilities that need to be developed in a dynamic environment where it involves green product innovation, environmental proactivity, alliance pro-activeness, and knowledge-based dynamic capabilities that impact on competitive advantage performance. This study involved a survey of 157 manufacturing firms with ISO 14001 certification throughout Malaysia. By implementing structural equation modelling approach, the results provided evidence of positive and significant direct effects of green product innovation and environmental pro-activity on firm's competitive advantage. The relationship of alliance pro-activeness was fully mediated by the presence of knowledge-based dynamic capabilities as a condition to survive and prosper in a competitive market.**

***Index Terms*—Alliance pro-activeness, environmental proactivity, green product innovation, knowledge-based dynamic capabilities.**

I. Introduction

The rise of environmental practice and the role of green innovations as tools to reach competitive advantage have gained the attention of evolutionary innovation scholars [1]–[3]. Remarkably, many researchers progressively discovered that firms that are proactive on environmental strategies may be able to seize opportunities for competitive advantage [4]–[6]. Regarding this matter, several researchers revealed that Environmental Management System (EMS) - ISO 14001 positively affects competitive benefits [3], [7] besides stimulating product innovations towards environmentally friendly which is increasingly becoming a trend [8].

Nevertheless, it is agreed that the adoption of an EMS on its own without appropriate capabilities does not suffice to improve firm's competitiveness [9]. Hence, drawing on the dynamic capabilities view, the present paper aims to investigate the relationship between proactive capabilities considering the constructs of Green Product Innovation (GPI), Environmental Proactivity (EP), Alliance Pro-activeness (AP) and Competitive Advantage (CA). The study also measures the mediating effect of Knowledge-based Dynamic Capabilities (KDC) in the relationship between the AP and CA as shown in Fig. 1.

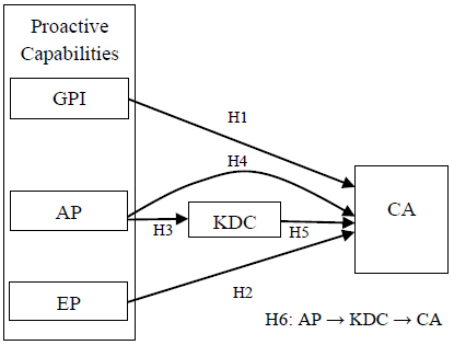

Fig. 1. Conceptual model.

Those internal capabilities are chosen as they are critical in the context of the environment and still has arguments pertaining their relationships [10]. Previous studies discovered that GPI has an impact on firm's competitive advantage [11], cost efficiency and firm profitability [12]. However, other researchers argued that by practicing GPI alone may not easily meet competitive advantage and this situation somehow depends on the background of the firms [13]. Thus, it is worth to investigate the direct relationship between GPI and competitive advantage over the ISO 14000 implementers. Besides, prior study shows that EP gives direct positive effect on operational and financial performance [14]. Similarly, Primc [15] managed to prove that EP provides positive impact on competitive advantage. On the other hand, a study done by Ryszko [16] did not confirm that EP strategy directly affects financial and operational performance unless with the existence of technological eco-innovation in the relationship. For that reason, the significant effect of EP on CA needs to be further tested. Regarding AP, by right, pro-activeness tendency will enable the firm to react quickly to the collaborative environment, and will utilize their own resources and partners [17]. Yet, AP depends on partner selection which involves a complex process and decision that affects alliance outcomes [18]. Thus, it is necessary to further examine the interrelation specifically on AP towards CA among ISO 14001 players. Concerning KDC, a number of studies agreed that knowledge management escalates competitive business and economy [19], [20]. However, the role of KDC needs to be extended especially in developing

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countries with many catching up firms [21]. Consequently, the following hypotheses are proposed:

H1: GPI has a positive and significant effect on CA
H2: EP has a positive and significant effect on CA
H3: AP has a positive and significant effect on KDC
H4: AP has a positive and significant effect on CA
H5: KDC has a positive and significant effect on CA
H6: KDC mediates the relationship between AP and CA

II. Method

A. Data Collection and Sample

This study conducted a sampling questionnaire survey on manufacturing firms in Malaysia that obtained ISO 14001 certification for at least two years from Standard and Industrial Research Institute of Malaysia (SIRIM) Berhad which is believed to be able to respond well to all the items in the survey. In total, 450 firms were randomly selected from the list provided by SIRIM. The survey questionnaires were distributed and 157 valid questionnaires were obtained and the effective response rate was 34.9% of the firms. The survey was directed by e-mail and letter to mid and upper level managers in which the contact information was obtained from SIRIM database. After two weeks of sending e-mail and letter, follow-up telephone calls were done to increase the response rate.

TABLE I: EFA of Observed Variables

Observable variables
Green Product Innovation (GPI) - **Green Design (GD)** - **Innovativeness (IN)** Sources: [23], [24] Mean 4.701 Standard Deviation 0.549 Cronbach's Alpha 0.732; KMO 0.667
Alliance Pro-activeness (AP) Sources: [25], [26] Mean 4.643 Standard Deviation 0.481 Cronbach's Alpha 0.785; KMO 0.818
Environmental Proactivity (EP) Sources: [27] Mean 4.522 Standard Deviation 0.504 Cronbach's Alpha 0.810; KMO 0.836
Knowledge-based Dynamic Capabilities (KDC) - **Knowledge Acquisition & Integration (KAI)** - **Knowledge Sharing (KS)** - **Social Media Usage (SU)** Sources: [28], [29] Mean 4.735 Standard Deviation 0.418 Cronbach's Alpha 0.870; KMO 0.789
Competitive Advantage (CA) - **Product Success (PS)** - **Product Competitiveness (PC)** Sources: [30], [31] Mean 4.384 Standard Deviation 0.614 Cronbach's Alpha 0.785; KMO 0.759

B. Model and Measurement

This study employed a Structural Equation Modelling (SEM) approach and the data was analyzed using IBM-SPSS-AMOS (version 21) software. SEM is the most significant technique to estimate and organize a series of inter-relationships among latent constructs simultaneously in a model, and it could be employed to test the hypothesis for mediators in the model [22]. The test for the mediating hypotheses was conducted by comparing the coefficient value of direct effect and indirect effect in the model. To address the issues of construct validity and reliability, the Confirmatory Factor Analysis (CFA) was carried out. The survey questions were designed in an interval scale (1 to 5) ranging from "1= strongly disagree" to "5=strongly agree". The study adapted, customized and modified items from previous research and the questionnaire was then validated by academician experts. Via Explanatory Factor Analysis (EFA), any items that exhibited weak factor loadings were deleted. The remaining 36 items out of 40 items proceeded to the next analysis. To measure the quality of the results, this study assessed Kaiser-Meyer-Olkin (KMO) values and Bartlett's test of sphericity. The construct reliability was tested by examining Cronbach's alpha coefficients. Table I shows the alpha coefficients of the five constructs that ranged from 0.732 to 0.870 and all exceeded the 0.7 threshold for acceptable reliability. By applying the Varimax Rotation, the factorial loads were above 0.5 for all the observable variables.

III. Result and Discussion

A. Profile of Respondents

Profile analysis shows that 37% of the respondents were assistant managers and above, 31% were assistant directors and above, while 25% were engineers or executive officers, and 7% were senior technicians or supervisors. Regarding educational level, 54% had a bachelor degree/professional qualification or higher, 41% had a diploma and another 5% had a certificate and below. Among them, 59% worked with the company for more than ten years and held high positions in the organization. Thus, it is believed that they can provide answers to the questionnaire well and contribute to good results. Additionally, all selected respondents obtained at least two years of ISO 14001 certification duration and 56% of them have been certified for more than 10 years. Concerning the category of firms, 48.6% of respondents were local-SMEs, 46.7% were MNCs firms and 4.7% were local-non SMEs.

B. Measurement Model

For the measurement model, 5 constructs and 7 sub-constructs were developed based on theory with 36 individual items. The CFA was executed to confirm the measurement model by evaluating the uni-dimensionality, validity and reliability of the latent constructs before modelling the inter-relationship in a structural model. The pooled CFA results showed the Fitness Indexes and factor loading for every item together with its squared multiple correlation. The uni-dimensionality was achieved after two items out of 36 were deleted (refer Table II) as the factor loading was less than 0.6. Then, the construct validity, convergent validity, and discriminant validity were examined to confirm the significance of the measurements.

The fitness indexes for the model were assessed as presented in Table III where several indexes were used to assess the model fitness. The model fit showed to be acceptable based on the conditions stated by Hair [32]. The Root Mean Squared Error (RMSEA) should not be above

0.08, the Goodness of Fit Index (GFI) should exceed the recommended value of 0.9, the Comparative Fit Index (CFI) should exceed 0.9, the Tucker-Lewis Index (TLI) should exceed 0.9, and the Chi-square normalized by degree of freedom should not exceed 3. Besides, the values of Average Variance Extracted (AVE) surpassed the threshold of >0.5 which represented the convergent validity, and Composite Reliability (CR) also surpassed the adequate threshold level of >0.6. After the fitness indexes were achieved, the normality distribution of the data was assessed before proceeding to structural model by examining the skewness for each item. The reading shows that all the displayed values were lower than 1.0 which indicated the data were normally distributed.

TABLE II: THE CFA REPORT FOR MEASUREMENT MODEL

Construct	Sub-Construct	Factor Loading	CR	AVE
GPI	GD	0.907	0.934	0.876
	IN	0.964		
KDC	KAI	0.990	0.868	0.692
	KS	0.759		
	SU	0.721		
CA	PS	0.899	0.904	0.825
	PC	0.918		
Sub-construct	Item			
GD	GD1	0.88	0.898	0.746
	GD2	0.87		
	GD3	0.84		
	GD4	deleted		
IN	IN1	0.91	0.924	0.753
	IN2	0.88		
	IN3	0.85		
	IN4	0.83		
AP	AP1	0.86	0.882	0.654
	AP2	0.90		
	AP3	0.73		
	AP4	0.73		
EP	EP1	0.80	0.901	0.646
	EP2	0.76		
	EP3	0.90		
	EP4	0.77		
	EP5	0.78		
KAI	KAI1	0.76	0.826	0.508
	KAI2	0.67		
	KAI3	0.68		
	KAI4	0.68		
	KAI5	0.70		
KS	KS1	0.74	0.898	0.747
	KS2	0.91		
	KS3	0.93		
SU	SU1	0.71	0.882	0.652
	SU2	0.82		
	SU3	0.88		
	SU4	0.81		
PS	PS1	0.73	0.788	0.553
	PS2	0.72		
	PS3	0.78		
	PS4	deleted		
PC	PC1	0.86	0.937	0.788
	PC2	0.89		
	PC3	0.89		
	PC4	0.91		

C. Structural Models and Hypothesis Testing

The resulted measurement model after CFA was assembled into structural model to test the research hypotheses. The standardized estimate for the model is presented in Fig. 2. To ensure a good model, the coefficient of determination (R^2) was assessed which specified the amount of variance of the dependent construct that can be described by the independent constructs. The analysis exhibiting high R^2 values (greater than 0.4) reflects the contribution of all exogenous constructs in estimating endogenous construct is good. In other words, the theory for that particular constructs and sub-constructs connection is well supported. From Fig. 2, the value of R^2 for the whole model which is located at the endogenous construct (CA) is 0.79. This concluded that the model is good since 79% of the CA performance could be estimated by using four exogenous constructs in the model namely Green Product In-novation (GPI), Alliance Pro-activeness (AP), Environmental Proactivity (EP) and Knowledge-based Dynamic Capabilities (KDC). Additionally, to inspect the wellness of the structural model, the standardized residual covariance was assessed. The data shows that all the standardized residuals are less than two in absolute value which indicates that the model is correctly specified.

TABLE III: THE FITNESS INDEXES FOR MEASUREMENT MODEL

Category Index	Index	Value	Comments
1. Absolute fit	RMSEA	0.061	Achieve the required level
	GFI	0.911	
2. Incremental fit	CFI	0.967	Achieve the required level
	TLI	0.958	
3. Parsimonious fit	Chisq/df	1.397	Achieve the required level

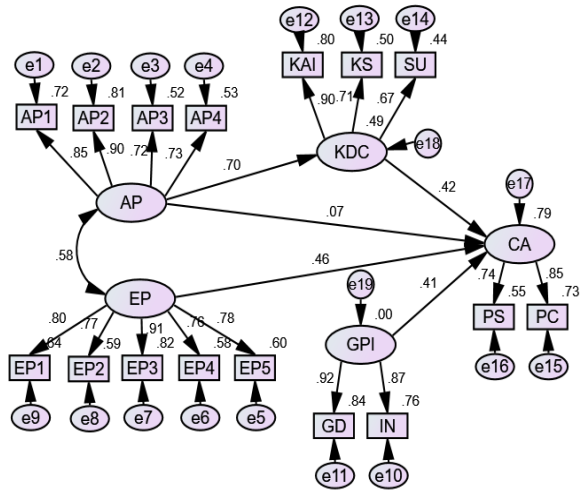

Fig. 2. The Standardized path coefficients.

TABLE IV: THE REGRESSION PATH COEFFICIENTS AND ITS SIGNIFICANCE

Hypothesis			Est	S.E.	C.R.	P-value	Result
H1	CA	<--- GPI	.366	.073	4.980	***	Significant
H2	CA	<--- EP	.394	.089	4.444	***	Significant
H3	KDC	<--- AP	.493	.069	7.109	***	Significant
H4	CA	<--- AP	.055	.106	.521	.603	Not Significant
H5	CA	<--- KDC	.466	.143	3.254	.001	Significant

The results of hypotheses testing are shown in Table IV. Findings of this study present that for H1, GPI is positively related to CA (estimate = 0.366, $p < 0.001$). Thus, H1 is supported. For H2, EP is positively related to CA (estimate = 0.394, $p < 0.001$). Hence, H2 is also supported. Concerning H3, AP is positively related to KDC (estimate = 0.493, $p < 0.001$). As a result, H3 is supported. Furthermore, for H4, AP

is not significantly related to CA (estimate = 0.055, p = 0.603). Therefore, H4 is not supported. Finally, for H5, KDC is positively related to CA (estimate = 0.466, $p < 0.05$) which indicates that H5 is supported.

D. Mediation Analysis

The presence of mediator can be confirmed if there is a clear difference in path coefficients of the model integrating the mediator and those of the model without the mediator. This study discloses that the indirect effect between AP and CA (AP to KDC and KDC to CA) was 0.294 (0.70×0.42) higher than the direct effect of 0.07 (refer Fig. 2). Thus, the result indicates that KDC is a mediator in the connection between AP and CA, and this supports Hypothesis 6. The type of mediation here is full mediation as the direct effect is not significant.

This situation shows how important the KDC is in an organization because without its presence, the AP does not have any effect on CA. Proactive internal capabilities are important to be developed and need to be prioritized [10], so as not to be left behind in the rapidly changing environment.

IV. Conclusions

Although the study of competitive advantage has been carried out for a long time, the development of the influencing factors should continue to be studied in depth. This is because competitive advantage is influenced by ever-changing environment and sophisticated technology. Products with high value and able to compete for long periods of time in a market would bring the firm towards better performance. The confirmed hypothesis in this study is very important especially for certificate owners of ISO 14001 where these firms need to be proactive in managing the environment. These firms are believed to be able to compete and survive in the market but this will only happen if the firm has a sound and robust strategy.

In this study, GPI, AP, EP are parts of important proactive capabilities in ensuring that firms are always intelligently aggressive in product creation that is new, unique, coveted by consumers and sustainable in the market. Generally, ISO 14001 practitioners are concerned about the environment and this inspires the firms to generate new ideas for innovation in shaping green products that have been successful in attracting consumers. Although some researchers argued that not all ISO 14001 practitioners are active in product innovation, nevertheless the results of this study clearly prove that GPI is positively related to CA and this supports some of other studies before.

On top of that, it is found that AP has a positive effect on competitive advantage only if there is a presence of KDC. This is because proactive attitude in the relationship has its own risk, which is largely dependent on the suitability of the partners on an ongoing basis and the extent to which the relationship can be utilized as well. With this regard, the role of KDC is very important to dynamically manage knowledge wisely and to benefit in that relationship as much as possible. KDC allows AP outcomes to be systematically managed to achieve CA. With this, the role of KDC as a full mediator is very significant.

In relation to EP, it is found to have a direct impact on CA and the findings support the previous studies although some say that EP is unlikely to directly affect CA. In the case of respondents who have ISO 14001 certification, it is clear that EP is able to bring firms to compete in the market. The path coefficient of EP to CA is 0.46 where this value is slightly higher than the coefficient of GPI to CA value of 0.41. This means the effect of GPI to CA is less than EP to CA. This situation indicates the manufacturing sector is more likely to comply with environmental regulations as it becomes an important advantage in business competition rather than initiative to produce green products that are still limited in demand. Table V presents the research hypotheses final result.

TABLE V: The Hypothesis Statement For Every Path

	Hypothesis Statement	Decision
H1	GPI has a positive and significant effect on CA	Supported
H2	EP has a positive and significant effect on CA	Supported
H3	AP has a positive and significant effect on KDC	Supported
H4	AP has a positive and significant effect on CA	Not Supported
H5	KDC has a positive and significant effect on CA	Supported
H6	KDC mediates the relationship between AP and CA	Supported

The limitation of this study is about the respondents' classification where there is no splitting up of SMEs and MNCs. There may be more specific and deeper results if comparisons are made. Further research may consider the type or size of the firm and also investigate other mediators that may influence the formation of more specific models.

In addition, it is important to consider external factors that drive and give impact on the findings. Finally, this framework can be referred by manufacturing industry players to improve their business strategy. Firms that are not yet ISO14001 certified can also refer to these findings to identify factors that affect the firm's growing competitiveness at present.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Norhuda Salim designed the study, performed the analysis; Mohd Nizam Ab Rahman supervised the study, reviewed the results; Dzuraidah Abd. Wahab verified the manuscript content; all authors contributed to the final manuscript.

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