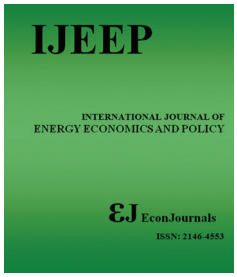
Saudi, Mohd Haizam Mohd; Sinaga, Obsatar; Roespinoedji, Djoko et al.

Article

Environmental sustainability in the fourth industrial revolution : the nexus between green product and green process innovation

Reference: Saudi, Mohd Haizam Mohd/Sinaga, Obsatar et. al. (2019). Environmental sustainability in the fourth industrial revolution : the nexus between green product and green process innovation. In: International Journal of Energy Economics and Policy 9 (5), S. 363 - 370.
http://econjournals.com/index.php/ijeep/article/download/8281/4533.
doi:10.32479/ijeep.8281.



International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2019, 9(5), 363-370.

Environmental Sustainability in the Fourth Industrial Revolution: The Nexus between Green Product and Green Process Innovation

Mohd Haizam Mohd Saudi[1], Obsatar Sinaga[2], Djoko Roespinoedji[1], Mohd Shahril Ahmad Razimi[3]*

[1]Widyatama University, Indonesia, [2]Padjadjaran University, Indonesia, [3]Islamic Business School, Universiti Utara Malaysia, Kedah, Malaysia. *Email: shahril@uum.edu.my

Received: 23 April 2019 **Accepted:** 28 June 2019 **DOI:** https://doi.org/10.32479/ijeep.8281

ABSTRACT

The actual and virtual realms in the present economies are expending to respond well to technological evolutions. In fact, the emergence of fourth industrial revolution (4IR) has stimulated the organization to adopt innovations in the production and process with extensive integration of eco-friendly practices to ensure sustainability. The automation of work and emerging digitalization is known as the 4IR. This industrial revolution has several effects on person's career involvements. Still, the past literature in careers research and vocational psychology has been surprisingly quiet on this pattern up until now. In this regard, the present study examines the impact of industrial revolution factors on environmental and economic performance (ECP) in manufacturing small and medium enterprises in Malaysia. The results of structural equation modeling confirm that green product innovation and green process innovation have positively and significant impact on project innovation (PRI). Moreover, the results further confirm that PRI has positive and significantly impact on ECP and environmental performance (ENP). Finally, economic and ENP have a positive and significant impact on competitive advantage (COM). Therefore, it is recommended that 4IR factor is a source to enhance the economic and ENP of the firm which ultimately leads the COM.

Keywords: Projection Innovation, Process Innovation, Environmental Performance, Competitive Advantage, Small and Medium Enterprises, Malaysia
JEL Classifications: Q55, Q50

1. INTRODUCTION

Technological innovations have opened the doors of progressive business operations and extensively began to be adopted in numerous economies. The evolution of technological advancements has highlighted the assimilation of virtual and actual technologies that enables the improved quality and value addition by transforming the manufacturing and processes involved in offering goods and services (Maynard, 2015; Andrade and Fiamenghi-Jr, 2018). The horizon of this approach relies on integrating technical expertise of production, process, virtual services and automations to offer the junction of technologies which is renowned in modern time by the name of forth industrial revolution (4IR). These include several technologies of Artificial Intelligence, internet of things (IOT), big data, cloud computing system and many others that have the potential to be congregated and diffused all through the civilization that can be resulted in bringing the pioneering modifications in human's lives.

The objective of 4IR stimulates to transform the standard of livings, business and managerial practices in such a way that renovates the development of mankind and the environment. The fundamentals of 4IR revolve around an exceptional combination between virtual, physical and natural advancements (Bahrin et al., 2016; Aregbeyen and Fasanyan, 2017). It is designed to foresee the changes in the process and production of the goods to provide

innovative projects. One of the crucial elements of 4IR is expressed in the technology of IOT, where the dynamic data trades between arranged gadgets and enabled the attainment of unique outcomes from assembling routine objects augmentations and management of risk (Maynard, 2015; Aremu, 2018). The expansion of technical expertise and innovative integrations resulted from IOT and sensing technologies in the manufacturing and agricultural sectors have started an exuberant process of combined information grid that empowers the ties of humans with systems.

Numerous nations whose financial base relies on agricultural sector have attempted endeavors to change their economy and revitalize the business. They experience the ill effects of developing markets and the worldwide assembling store network. In this way, these countries look for assembling procedure development, as well as starting to center around enlistment and force of administration. One of the solutions for these countries is to provide technological convergence in the not only in agricultural but also in service and manufacturing sectors, to animate the advancement of end results that can benefit the country on the national level (Cheong and Lee, 2018; Johari et al., 2018).

In this regard, the concept of "servitization" is crucial to explain the fusion of 4IR in the countries that depends on the skill set of their individuals. The term servitization is explained as the tactical innovation of a firm's abilities and process to transform from trading goods to trading integrated goods and services, which provides the due value in usage that is popularly called as Product-Service System (PSS) (Martinez et al., 2010). PSS is characterized as an arrangement of items, administrations, supporting systems, and foundation that is intended to be aggressive, fulfill clients' needs, and have a lower ecological effect than conventional plans of action (Mont, 2004). In the PSS plan of action, ventures create items with esteem included administrations, rather than a single item itself, and give their clients administrations that are required. In this relationship, the market objective of makers isn't 1-time item offering, however persistent benefit from clients by aggregate administration arrangement, which can fulfill neglected clients' needs.

Hence, the concept of 4IR bargains innovation of product and process offerings to achieve greater environmental and economic benefits. These benefits have the utmost impact on the organizations' competitive advantage (COM) (Ahmed et al., 2017). The technological expertise of the firm not only enhances its efficiency but enable it to fulfill the broader goal of analytical manufacturing in the future commerce with improved sustainability (Lee et al., 2013; Saudi et al., 2019a). In the existing literature, the concept of 4IR is considered a fresh domain and applied mostly in the context of mega firms that are extensively resource empowered. However, recognizing the significance of technological innovations, strategic operations optimizations, automation of processes; the concept of smart businesses have been initiated in Small and medium enterprises (SMEs). With the motive of embracing sustainable and esteem-based economy; the efforts for building advanced networks, making computerized imaginative start-up systems, sensory techniques in farming, and setting up automations in physical products for SMEs (Koanantakool, 2016; Sangwanna and Pupat, 2014; Sinaga et al., 2019a), have turned into the major Malaysian government's goal. In this regard, SMEs of Malaysia are also motivated to embrace 4IR (Luff, 2017; Saudi et al., 2019b) and stimulated to assimilate the sustainable practices in manufacturing to make certain that the technological progress would not result in environmental degradation. In this regard, the significance of environmental sustainability is the vital part of 4IR as it drives the way of future existing of people and economies. The integration of 4IR in to the businesses of the country would help to respond to the issues of inadequate food, hygienic water, power, environment and comprehensive health.

In light of the above, the objective of the present study is to amalgamate the strategical innovative practices of the SMEs of Malaysia to strengthen the environmental sustainability in the course of adopting and implementing 4IR goals. Focusing on the convergence of environment friendly managerial strategies along with the adoption of inventive technologies, the current study aims to identify the influence of green product and process innovations (PCIs) to impact green project innovation (PRI) in SMEs in Malaysia. Knowing the limitation of limited resource availability in the small businesses, the study also investigates the effect of green PRIs to influence not only the environmental performance (ENP) but also the economic performance (ECP) of SMEs (Haseeb et al., 2019). Lastly, the objective of the study is further extended to determine the overall impact of fusing sustainability into 4IR goals to subsequently impact SMEs COM (Sinaga et al., 2019b). In all the above-mentioned ways, the present study offers unique approach of identify the environment of 4IR in Malaysian SMEs and its effect on sustainable performance and competitive edge of the organizations. The discoveries drawn from such broad investigation will be helpful for policymakers in articulating related policies for the evolution of 4IR practices in Malaysia.

Finally, the structure of the further study is described as below. The next section presents variable description, their theoretical connections and the hypothesis development. It is followed by section three that encompasses the methods and instruments description. Section four highlighted research findings and finally section five concludes the results and recommendations in the light of the outcomes.

2. LITERATURE REVIEW

2.1. Green Innovation

Green innovation is an amalgamation of green product and PCI. It includes variant domains of lessening energy consumption, toxic emissions, waste disposals, efficiency enhancement and financial benefits of superior project allocation in the process of adopting technological evolutions and sustainable operations. Peters and Romi (2014) explained that the way organizations are managed tends to augment its environmental legitimacy. The methods, strategies and the practices define organization's attitude towards sustainable development. Focusing on the features of hyper connectivity and super intelligence, it is considered that 4IR can enhance product servitization and introduce the new alternatives of prevailing forklifts in SMEs. In this way, the emphasis of firm in encouraging product innovation (PDI) lead

to improve the long-term PRI's vision and therefore benefits in multiple ways. In addition, the studies of past emphasize greatly on green purchasing and demonstrated that the advantages of businesses in implementing green methods in production resulted into improved environment in the form of eliminating the negative effects of pollution, wastes and toxic emissions to offer greater sustainability of the atmosphere (Murphy et al., 2006; del Rı´o Gonza´lez, 2005; Zhu et al., 2007).

Therefore, the present study hypothesized the following:
H1: Green PDI is significant to enhance PRI of SMEs

The capacity of business and their abilities to correspond with increasing sustainable measures is a complete necessity (Haseeb et al., 2019; Hitt et al., 2011; Hussain et al., 2019) that is largely dependent on the firm's capacity and the industry in which it operates. In this regard, organizations are confronted with several internal and external pressure and limitations that make the process of adopting sustainable technological evolutions challenging. However, possible managerial paybacks of implementing firm's ecological accountability measures along with green processes comprise reduction in energy dependence, reduction in natural resource utilization, enhanced monetary settlements, augmented corporation market value, amplified business image along with superior awareness to societal anticipations for environment (Zhu et al., 2007; Artha and Mulyana 2018). Such advantages encourage the management of the firms to implement and assimilate greater innovations in the processes such as recycling etc., that can enable form to have higher efficiency levels along with better eco-friendly image as a result of green methods.

Therefore, the present study hypothesized the following:
H2: Green PCI is significant to enhance PRI of SMEs.

2.2. Green PRI

Green PRI is directed to a broader paradigm of implementing green programs with the objective of sustaining long-term goals. The rising significance of sustainability is translated in numerous aspects of business practices. Practicability' and "Feasibility" are considered as the drive force that encourages 4IR objectives in the SMEs automation in Korea. Hence, the abilities that can transform the vision of 4IR along with sustainable development can be recognized in the systematic thinking, reproduction, co-operation, technological awareness and responsiveness to values. Such aspects identify the surge to investigate the prominence of green practices and behaviors in converging the benefits of sustainable business methods into environmental and ECP. In this context, Christmann (2000) stated that increase levels of innovation are more beneficial in implementing the progressive conservation strategies. Similarly, many scholars highlighted that organizations have huge capabilities to influence modifications in their society and environment through better investment in firm's communal and ecological initiatives. Similarly, Chen et al. (2015) also establish that green innovation is significant to enhance the organization's ENP.

Therefore, the present study hypothesized the following:
H3: Green PRI is significant to enhance ENP.

In considering the requirements of Automated Driving Vehicles in Korean factories, Cheong and Lee (2018) identified the importance of 4IR objectives in SMEs. The study stated that several nations invest abundant energy and resources to excel smart factories with the objective to augment firm's attractiveness and sustainability. Similarly, Chiou et al. (2011) established that organizations implement Green programs in the cases that solely resulted in augmented financial gain, functioning enhancement, and higher COM. However, implementation of green attitudes, methods and behaviors in organization is a complicated procedure necessitating multiple level coordination, along with vast alterations in the existing methods of business operations (Russo and Fouts, 1997). In the domain of 4IR, the related cost is also a critical factor as the SMEs are operated with limited resources. Hence, the later have varied outcomes that can be some critical effects on firm's profitability.

In this context, few researchers argue that enhanced ENP and COM cannot guarantee economic benefits. The organization in some cases fails to assimilate the technological expertise in environmental efficient ways but may lose the focus on economic benefit. The case is evident in the horizon of small firms. The SMEs due to insufficient resources and limited financial capabilities may end up in failing the profitability aspect in fulfilling the fusion of 4IR with sustainable practices. Contrarily, De Giovanni (2012) establish that green programs are not only the effective measures of eliminating and reducing ecological footprints of products and processes, but it also has the greater tendency of offering exceptional approach of enhancing economic paybacks of the organization.

Therefore, the present study hypothesized the following:
H4: GLLreen PRI is significant to impact ECP.

2.3. ECP

Keeping the balance among organizations ECP along with vast resource utilizations is considered as an enduring challenge which most of the organizations faced in maintaining the image of eco-friendly, technological advanced and supreme economic value organization (Chan et al., 2012). The ECP denotes the increments in organization's monetary and marketing performance in response to assimilate the green methods into its operations that augment the firm's position relative to the industry average (Green and Inman, 2005; Zhu et al., 2013).

Many studies of the past have identified the positive association of green methods of business operations and technological innovations in enhancing firms' performance. In addition, the improved profitability and market shares ensure the likelihood of the organizations in having higher COMs.

Therefore, the present study hypothesized the following:
H5: ECP is significant to enhance Firm's COM.

2.4. ENP

The existing literature on the topic of sustainability have ample variations. In this regard, Ehnert (2006) demonstrated that the horizon of sustainability is of keen interest to three diversified

groups of individuals. First it is crucial for ecologist as the attributes of eco-protection and fortification of environment is their prime concern. Second, the domain is also critical for businesses as the related strategies have the long-term effects on COMs and tend to disrupt the visionary goals. Third, the concept is also important for economists and policymakers as the notion of sustainable development encompasses the numerous aspects of societal and economic development. By definition, the term sustainability comprises of the kind of evolutions that can satisfy the present needs of mankind without disrupting the capability of future generations to do the same (Rayner and Morgan, 2018).

The concept of resource based view (RBV) approach demonstrates how some organizations in the similar industry can have different performance outlook and therefore seek for internal aspects of the organization that lead to sustain the COM. Even though the approach of RBV presents no treatments, the theory is still considered critical to the managers strategic thinking (Kraaijenbrink et al, 2010).

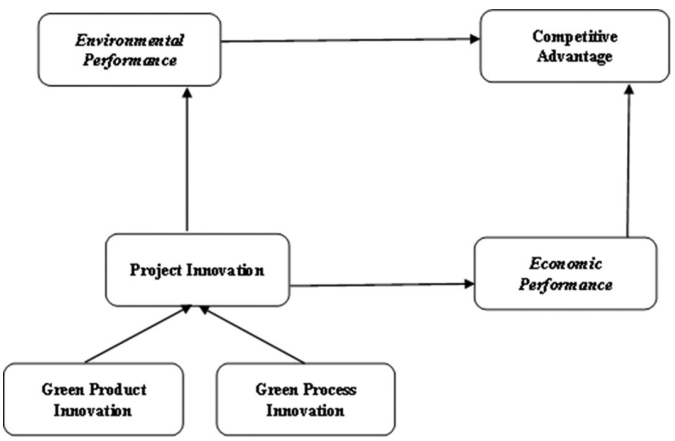
Therefore, the present study hypothesized the following:
H6: ENP is significant to enhance Firm's COM.

Exhibited in Figure 1 is the research model for the present study.

3. METHODOLOGY AND MEASURES

The present study has gathered data from lower, middle and top managers from the Malaysian small and medium size enterprises. In this research, we target managers in SEMs, those who involved most in purchasing and manufacturing department can specify green PDI and green PCI, which is very related to from 4IR talk with around seventy-five companies during initiating the survey research. Furthermore, a positive connection is found between 4IR and ENP (Bowen et al., 2001). The current study used convenience sampling during a conference on 4IR strategies. A collectively 315 survey instruments distributed to the low, middle and upper level managers of purchasing and manufacturing department in Malaysia. After removing the uni-variate, multi-variate outlier and missing cases, we found a final of 280 sample from the different level of managers in SMEs in Malaysia.

Figure 1: Fusion of environmental sustainability in fourth industrial revolution



The research instruments comprise on 6 variables for a current study that includes: green PDI, green PCI, PRI, ECP, ENP and COM. The adopted instrument includes characteristics of these factors focused on earlier research and follow the Likert scale from 5 = strongly disagree to 1 = strongly disagree. The items in the current instrument is adopted from earlier researches like green PDI, green PCI and PRI have four items in it and adopted from (Lai et al., 2003; Wen and Chen, 1997), ECP have also four items and is adopted from the study of Zhu et al. (2005) and Green and Inman (2005), ENP also have four items and adopted from the study of Zhu et al. (2013) and Zhu et al. (2008) whereas, four items of COM is adopted from the study of Chen et al. (2006).

4. DATA ANALYSIS AND DISCUSSION

For the data analysis of the current study, we used the Statistical Packages for Social Sciences (SPSS) version-23 and Analysis Moments of Structure (AMOS version-23) software's. The total final usable sample for the current research is 290 after removing uni-variate, multi-variate outlier and blank responses. Uni-variate outliers are removed by using Z-test score whereas, multi variate outliers are removed by Mahalanobis Distance (D2) criteria. Table 1 shows the summary and composition of the answers that are used in the present research. Likewise, Table 2 specify the average, standard deviation and correlation of the variables. Furthermore, the current study focused Hair et al. (2010) conclude that the values of coefficient of correlation should be <0.90 to avoid the issues of multicollinearity among the variables. Consequently, the results of Table 2 confirms the absence of multicollinearity between the predictors (Sharif and Raza, 2018; Afshan et al., 2018; Afshan and Sharif, 2016; Sharif and Bukhari, 2014).

Next, the study further applies exploratory factor analysis by using highly preference method of factoring i.e. (principal components) in order to converge a total of \twenty-four questionnaire Liker

Table 1: Descriptive statistics

Descriptive statistics		Frequency	Percent
Gender			
Valid	Male	209	75
	Female	71	25
	Total	280	100
Age (year)			
Valid	20-30	82	29
	31-40	160	57
	41-50	20	7
	51 and above	18	6
	Total	280	100
Working Experience (years)			
Valid	1-5	178	64
	6-10	82	29
	11-15	12	4
	More than 15	8	3
	Total	280	100
Education			
Valid	Undergraduate	70	25
	Graduate	167	60
	Post Graduate	30	11
	Others	13	5
	Total	280	100

Table 2: Means, standard deviations, pearson correlations

Variables	MEAN	SD	PDI	PCI	PRI	ECP	ENP	COM
PDI	3.824	1.001	-					
PCI	3.329	1.028	0.483**	-				
PRI	3.820	1.237	0.405**	0.376**	-			
ECP	4.392	1.129	0.368**	0.410**	0.361**	0.534**	-	
ENP	4.532	1.029	0.413**	0.435**	0.358**	0.514**	0.409**	-
COM	3.483	1.160	0.432**	0.268**	0.311**	0.490**	0.422**	0.498**
N=280								

**Correlation is significant at the 0.01 level (2-tailed). PDI: Product innovation, ECP: Economic performance, PRI: Project innovation, ENP: Environmental performance, COM: Competitive advantage

Table 3: Factors loading and variance explained[a]

Variables		PDI	PCI	PRI	ECP	ENP	COM
Eigen value		12.5	8.3	4.2	2.4	1.5	1.0
% variance		19.6	14.5	11.2	10.2	9.5	7.4
Cum. %		19.6	34.1	45.3	55.5	65.0	72.4
PDI	PDI1	0.923					
	PDI2	0.902					
	PDI3	0.891					
	PDI4	0.889					
PCI	PCI1		0.893				
	PCI2		0.888				
	PCI3		0.856				
	PCI4		0.802				
PRI	PRI1			0.856			
	PRI2			0.834			
	PRI3			0.803			
	PRI4			0.799			
ECP	ECP1				0.823		
	ECP2				0.801		
	ECP3				0.798		
	ECP4				0.773		
ENP	ENP1					0.802	
	ENP2					0.793	
	ENP3					0.773	
	ENP4					0.753	
COM	COM1						0.783
	COM2						0.727
	COM3						0.721
	COM4						0.713
Extraction Method: Principal Component Analysis							
Rotation Method: Varimax with Kaiser Normalization							

[a]Rotation converged in 8 iterations. PDI: Product innovation, ECP: Economic performance, PRI: Project innovation, ENP: Environmental performance, COM: Competitive advantage

items into final six factors. In order to examine sample adequacy, the value of Kaiser–Meyer–Olkin (KMO) (0.925) recommend that data is suitable for making the factors as the cut off value of KMO should be >0.70 as suggested by Barkus et al., (2006). Furthermore, the outcomes of Barlet Test of Sphericity also suggest that $P < 0.050$ which indicates the rejection of null hypothesis explain the non-appearance of correlation identity matrix (Frooghi et al., 2015; Waseem et al., 2013). These final six factors successfully defined 72.4% of the total variance explained. The explanation of rotated component matrix highlights a total of twenty-four items that showed the factor loadings more than 0.70 and are above the benchmark of 0.55 as suggested by Tabachnick and Fidell (2007).

The value of factor loading of each item is displayed in Table 3. Moreover, collected data is further tested for discriminant validity, convergent validity and reliability. In order to confirm that whether

Table 4: Cronbach alpha, composite reliability and average variance explained

Constructs	CA	CR	AVE
PDI	0.882	0.873	0.623
PCI	0.890	0.883	0.684
PRI	0.850	0.801	
ECP	0.839	0.820	0.601
ENP	0.902	0.841	0.589
COM	0.821	0.788	0.660

Source: Authors' estimation. PDI: Product innovation, ECP: Economic performance, PRI: Project innovation, ENP: Environmental performance, COM: Competitive advantage, CA: Cronbach Alpha, AVE: Average variance explained, CR: Composite reliability

Table 5: CFA measurement model fit indices

Indices	Final measurement model
CMIN/df	1.361
CFI	0.956
RMSEA (P-Close)	0.040 (0.673)
SRMR	0.037

Source: Authors' estimation. RMSEA: Root Mean Square Error of Approximation

the instrument used in the study associates with the factors with which it should be theoretically linked, convergent validity of the instrument is tested. On the other hand, composite reliability (CR) ensures the construct validity by analyzing the inclusive reliability of similar but heterogeneous constructs (Fornell and Larcker, 1981).

In the current research, we investigate all measures to check the construct validity. The results of construct and convergent validity with CR, Cronbach Alpha (CA) and average variance explained (AVE) is presented in Table 4. The value of CR and CA should be >0.7 as recommended by (Afshan et al., 2018; Frooghi et al., (2015); Sharif and Raza, 2017; Afshan and Sharif, 2016; Sharif and Bukhari, 2014; Waseem et al., 2013). In our case the results of value of CR and CA are >0.70. Likewise, the value of AVE is considered good if it is >0.50 as suggested by Molina et al. (2007); Arif et al. (2016). In our case the value of AVE for all the fifteen factors are >0.50 it also fits the goodness of fit criterion.

Generally, the outcomes of measurement outline propose that the discoursed six factors model fits the data very well. Also, the threshold value for CMIN/DF should be <2 as explain by Tabachnik and Fidell, (2007); Bryne (2016); Kline (2005). In our results the value of CMIN/DF is 1.361 and it fits the goodness of measurement model. Along with this, the Comparative Fit Index value should be >0.90 which consider as good and >0.95 which

Table 6: SEM hypothesis testing

Hypothesis	Hypothesized Path	Path Coefficient	CR	P value	Remarks
H1	PRI←PDI	0.399	6.171	0.000	Supported
H2	PRI←PCI	0.259	2.798	0.006	Supported
H3	ECP←PCI	0.082	1.201	0.236	Not-Supported
H4	ENP←PCI	0.348	4.317	0.000	Supported
H5	COM←ECP	0.224	2.957	0.000	Supported
H6	COM←ENP	0.247	3.529	0.000	Supported
Level of Significance (5% i.e., 0.050)					

Source: Authors' Estimation. PDI: Product innovation, ECP: Economic performance, PRI: Project innovation, ENP: Environmental performance, COM: Competitive advantage, CA: Cronbach Alpha, AVE: Average variance explained, CR: Composite reliability

consider as excellent as suggested by Hu and Bentler, (1999). In our case the value of CFI is 0.956 and it also fits the goodness of fit standard. Also, the value of Root Mean Square Error of Approximation (RMSEA) should be <0.07 as recommended by Steiger (2007). In our results the value of RMSEA is 0.040 which is <0.07. The results of RMSEA suggested that our collected data fit very well with our hypothesized framework. Finally, the Standardized Root Mean Square Residual is also significant if it is smaller than 0.08 as suggested by Hu and Bentler, (1999). Our results explain that the value of SRMR is 0.037 and it also fits the goodness of fit criterion. It is also reported that our ultimate framework has involved various correlated error term inside a variable (Abdullah et al., 2018).

However, in order to check the structural relationships, Table 6 explained the results of SEM regression path, standardized regression coefficient, critical ratio, significance value and remarks of the hypothesis. The results of SEM explain that green PDI ($\beta = 0.399$, $P < 0.05$) and green PCI ($\beta = 0.259$, $P < 0.05$) have positive and significantly impact on green PRI that confirming H1 and H2. Whereas, green PRI has an insignificant impact on ECP. On the other hand, the results also suggested that green PRI ($\beta = 0.348$, $P < 0.05$) have a significant impact on ENP. Moreover, Competitiveness is positive and significantly influence by ECP ($\beta = 0.224$, $P < 0.05$) and ENP ($\beta = 0.247$, $P < 0.05$) therefore confirming H4, H5 and H6. This model explains 63.68% variance of COM by all the factors of 4IR in Malaysia (Ya'acob et al., 2018).

5. DISCUSSION AND CONCLUSION

The actual and virtual realms in the present economies are expending to respond well to technological evolutions. In fact, the emergence of 4IR has stimulated the organization to adopt innovations in the production and process with extensive integration of eco-friendly practices to ensure sustainability. The automation of work and emerging digitalization is known as the 4IR. This industrial revolution has several effects on person's career involvements. Still, the past literature in careers research and vocational psychology has been surprisingly quiet on this pattern up until now. In this regard, the present study examines the impact of industrial revolution factors on environmental and ECP in manufacturing SMEs in Malaysia. The total final usable sample for the current research is 290 after removing uni-variate, multi-variate outlier and blank responses. Uni-variate outliers are removed by using Z-test score whereas, multi variate outliers are removed by Mahalanobis Distance (D2) criteria. The present study has gathered data from lower, middle and top managers from the Malaysian small and medium size enterprises. In this research, we target managers in SEMs, those who involved most in purchasing and manufacturing department can specify green PDI and green PCI, which is very related to from 4IR talk with around seventy-five companies during initiating the survey research. A final sample of 280 is used for this research after eliminating the outliers, missing and blank responses (Taib et al., 2018).

The results of structural equation modeling confirm that green PDI and green PCI have positively and significant impact on PRI. Moreover, the results further confirm that PRI has positive and significantly impact on ECP and ENP. Finally, economic and ENP have a positive and significant impact on COM. Therefore, it is recommended that 4IR factor is a source to enhance the economic and ENP of the firm which ultimately leads the COM.

REFERENCES

Abdullah, N., Safiah, N., Ghani, A.A., Maamor, S., Wahab, N.A., Razimi, A., Elias, N.H. (2018), Examining level of spirituality among malaysian youth. Indian Journal of Public Health Research and Development, 9(11), 1515-1520.

Afshan, S., Sharif, A. (2016), Acceptance of mobile banking framework in Pakistan. Telematics and Informatics, 33(2), 370-387.

Afshan, S., Sharif, A., Waseem, N., Frooghi, R. (2018), Internet banking in Pakistan: An extended technology acceptance perspective. International Journal of Business Information Systems, 27(3), 383-410.

Ahmed, U., Isa, N.M., Majid, A.H.A., Zin, M.L.M., Amin, B.M. (2017), Towards understanding work engagement: can HR really buffer HR? Test of a moderated model. International Journal of Economic Research, 14(20), 1-18.

Andrade, A.F., Fiamenghi-Jr, G.A. (2018), Sheltered children's psychological suffering and carers' lack of training: Observations from a Brazilian sheltered home. International Journal of Social Sciences Perspectives, 3(1), 34-37.

Aregbeyen, O., Fasanyan, I.O. (2017), Oil price volatility and fiscal behaviour of government in Nigeria. Asian Journal of Economic Modeling, 5(2), 118-134.

Aremu, J.O. (2018), A historical analysis of the nature, causes and impact of the foreign debt crisis in Latin America, 1970-1980. Humanities and Social Sciences Letters, 6(3), 74-83.

Arif, I., Afshan, S., Sharif, A. (2016), Resistance to mobile banking adoption in a developing country: Evidence from modified TAM. Journal of Finance and Economics Research, 1(1), 25-42.

Artha, I.W.B., Mulyana, B. (2018), The effect of internal and external factors of companies on profitability and its implications on stock price index of state-owned banks. The Economics and Finance Letters, 5(2), 58-71.

Bahrin, M.A.K., Othman, M.F., Nor, N.H., Azli, M.F.T. (2016), Industry 4.0: A review on industrial automation and robotic. Journal Teknologi, 78(6-13), 137-143.

Barkus, E., Stirling, J., Hopkins, R., Lewis, S. (2006), The presence of neurological soft signs along the psychosis proneness continuum. Schizophrenia Bulletin, 32(3), 573-577.

Bowen, F.E., Cousins, P.D., Lamming, R.C., Farukt, A.C. (2001), The role of supply management capabilities in green supply. Production and Operations Management, 10(2), 174-189.

Byrne, B.M. (2016), Structural Equation Modeling with AMOS: Basic Concepts, Applications, and Programming. New York: Routledge.

Chan, H.K., He, H., Wang, W.Y. (2012), Green marketing and its impact on supply chain management in industrial markets. Industrial Marketing Management, 41 (4), 557-562.

Chen, Y., Tang, G., Jin, J., Li, J., Paillé, P. (2015), Linking market orientation and environmental performance: The influence of environmental strategy, employee's environmental involvement, and environmental product quality. Journal of Business Ethics, 127(2), 479-500.

Chen, Y.S., Lai, S.B., Wen, C.T. (2006), The influence of green innovation performance on corporate advantage in Taiwan. Journal of Business Ethics, 67(4), 331-339.

Cheong, H.W., Lee, H. (2018), Requirements of AGV (automated guided vehicle) for SMEs (small and medium-sized enterprises). Procedia Computer Science, 139, 91-94.

Chiou, T.Y., Chan, H.K., Lettice, F., Chung, S.H., (2011), The influence of greening the suppliers and green innovation on environmental performance and competitive advantage in Taiwan. Transportation Research Part E: Logistics and Transportation Review, 47(6), 822-836.

Christmann, P. (2000), Effects of "best practices" of environmental management on cost advantage: The role of complementary assets. Academy of Management Journal, 43(4), 663-680.

De Giovanni, P. (2012), Do internal and external environmental management contribute to the triple bottom line? International Journal of Operations and Production Management, 32(3), 265-290.

del Rı´o Gonza´lez, P. (2005), Analysing the factors influencing clean technology adoption: A study of the Spanish pulp and paper industry. Business Strategy and the Environment, 14(1), 20-37.

Ehnert, I. (2006), Sustainability Issues in Human Resource Management: Linkages, theoretical approaches, and outlines for an emerging field. In: 21st EIASM Workshop on SHRM. Birmingham: Aston. p30-31.

Fornell, C., Larcker, D.F. (1981), Structural equation models with unobservable variables and measurement error: Algebra and statistics. Journal of Marketing Research, 18, 382-388.

Frooghi, R., Waseem, S.N., Afshan, S., Shah, Z. (2015), Effect of offline parent brand dimension on online trust, satisfaction and loyalty: In context of newspaper industry. Journal of Management Sciences, 2(2), 223-254.

Green, K.W., Inman, R.A. (2005), Using a just-in-time selling strategy to strengthen supply chain linkages. International Journal of Production Research, 43(16), 3437-3453.

Hair, J.F., Ringle, C.M., Sarstedt, M. (2010), PLS-SEM: Indeed a silver bullet. Journal of Marketing Theory and Practice, 19(2), 139-152.

Haseeb, M., Hussain, H.I., Ślusarczyk, B., Jermsittiparsert, K. (2019), Industry 4.0: A solution towards technology challenges of sustainable business performance. Social Sciences, 8(5), 154.

Haseeb, M., Zandi, G., Hartani, N.H., Pahi, M.H., Nadeem, S. (2019), Environmental analysis of the effect of population growth rate on supply chain performance and economic growth of Indonesia. Ekoloji, 28(107), 417-426.

Hitt, M.A., Dacin, M.T., Levitas, E., Arregle, J.L., Borza, A. (2000), Partner selection in emerging and developed market contexts: Resource-based and organizational learning perspectives. Academy of Management Journal, 43(3), 449-467.

Hu, L.T., Bentler, P.M. (1999), Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Structural Equation Modeling: A Multidisciplinary Journal, 6(1), 1-55.

Hussain, H.I., Salem, M.A., Rashid, A.Z.A., Kamarudin, F. (2019), Environmental impact of sectoral energy consumption on economic growth in Malaysia: Evidence from ARDL bound testing approach. Ekoloji, 28(107), 199-210.

Johari, M., Jalil, M., Shariff, M.M. (2018), Comparison of horizontal axis wind turbine (HAWT) and vertical axis wind turbine (VAWT). International Journal of Engineering and Technology, 7(4.13), 74-80.

Kline, R.B. (2005), Methodology in the Social Sciences. New York, US: Guilford Press.

Koanantakool, T. (2016), Digital Park for SMEs. Available from: http://www.tinyurl.com/ll8e6zn.

Kraaijenbrink, J., Spender, J.C., Groen, A.J. (2010), The resource-based view: A review and assessment of its critiques. Journal of Management, 36(1), 349-372.

Lai, S.B., Wen, C.T., Chen, Y.S. (2003), The Exploration of the Relationship Between the Environmental Pressure and the Corporate Competitive Advantage. Vol. 22. In: Proceedings of the 2003 CSMOT Academic Conference. Hsin-Chu, Taiwan: National Chiao Tung University.

Lee, J., Lapira, E., Bagheri, B., Kao, H.A. (2013), Recent advances and trends in predictive manufacturing systems in big data environment. Manufacturing Letters, 1(1), 38-41.

Luff, P. (2017), The 4th industrial revolution and SMEs in Malaysia and Japan: Some economic, social and ethical considerations. Reitaku International Journal of Economic Studies, 25, 25-48.

Martinez, V., Bastl, M., Kingston, J., Evans, S. (2010), Challenges in transforming manufacturing organisations into product-service providers. Journal of Manufacturing Technology Management, 21(4), 449-469.

Maynard, A.D. (2015), Navigating the fourth industrial revolution. Nature Nanotechnology, 10(12), 1005.

Molina, L.M., Llorens-Montes, J., Ruiz-Moreno, A. (2007), Relationship between quality management practices and knowledge transfer. Journal of Operations Management, 25(3), 682-701.

Mont, O. (2004), Product-service Systems: Panacea or Myth? Sweden: Lund University.

Murphy, P.R., Poist, R.F., Braunschweig, C.D. (2006), Green logistics: Comparative views of environmental progressives, moderates, and conservatives. Journal of Business Logistics, 17(1), 191-211.

Peters, G.F., Romi, A.M. (2014), The association between sustainability governance characteristics and the assurance of corporate sustainability reports. Auditing: A Journal of Practice and Theory, 34(1), 163-198.

Rayner, J., Morgan, D. (2018), An empirical study of 'green'workplace behaviours: Ability, motivation and opportunity. Asia Pacific Journal of Human Resources, 56(1), 56-78.

Russo, M.V., Fouts, P.A. (1997), A resource-based perspective on corporate environmental performance and profitability. Academy of Management Journal, 40(3), 534-559.

Sangwanna, S., Pupat, P. (2014), Thai industrial cluster promotion model development for region 8: Rajamangala university of technology and suvarnabhumi airport. Asian International Journal of Social Sciences, 14(2), 84-103.

Saudi, M.H.M., Sinaga, O., Roespinoedji, D., Jabarullah, N.H. (2019a), Industrial, commercial and agricultural energy consumption and economic growth leading to environmental degradation. Ekoloji, 28(107), 299-310.

Saudi, M.H.M., Sinaga, O., Roespinoedji, D., Razimi, M.S.A. (2019b), The role of renewable, non-renewable electricity consumption and carbon emission in development in Indonesia: Evidence from distributed lag tests. International Journal of Energy Economics and Policy, 9(3), 46-52.

Sharif, A., Raza, S.A. (2017), The influence of hedonic motivation, self-efficacy, trust and habit on adoption of internet banking: A case of developing country. International Journal of Electronic Customer Relationship Management, 11(1), 1-22.

Sharif, A.A., Bukhari, S.W. (2014), Determinants of brand equity of qmobile: A case study of Pakistan. Journal of Management Sciences, 1(1), 49-60.

Sinaga, O., Saudi, M.H.M., Roespinoedji, D., Jabarullah, N.H. (2019a), Environmental impact of biomass energy consumption on sustainable development: Evidence from ARDL bound testing approach. Ekoloji, 28(107), 443-452.

Sinaga, O., Saudi, M.H.M., Roespinoedji, D., Razimi, M.S.A. (2019), The dynamic relationship between natural gas and economic growth: Evidence from Indonesia. International Journal of Energy Economics and Policy, 9(3), 388-394.

Steiger, J.H. (2007), Understanding the limitations of global fit assessment in structural equation modeling. Personality and Individual Differences, 42(5), 893-898.

Tabachnick, B.G., Fidell, L.S. (2007), Using Multivariate Statistics. Boston, MA: Allyn and Bacon/Pearson Education.

Taib, C.A., Ashraf, M.S., Razimi, M.S.B. (2018), Productivity change in the efficiency of the insurance and takaful industry of Pakistan. Academy of Accounting and Financial Studies Journal, 22(1), 1-11.

Waseem, S.N., Frooghi, R., Afshan, S. (2013), Impact of human resource management practices on teachers' performance: A mediating role of monitoring practices. Journal of Social Science Education, 1(2), 31-55.

Wen, C.T., Chen, T.M. (1997), The exploration of the organizations of green innovation in Taiwan. National Taiwan University Management Review, 8(2), 99-124.

Ya'acob, A., Razali, M.M., Anwar, U., Radhi, M.M., Ishak, M., Minhat, M., Teh, C. (2018), Investigation of closed compartment molding for pull-winding process. International Journal of Engineering and Technology, 7(13), 107-111.

Zhu, L., Wu, Y., Wang, J., Lin, X., Ju, J., Xie, M., Daut, G. (2008), Environmental changes since 8.4 ka reflected in the lacustrine core sediments from Nam Co, central Tibetan Plateau, China. The Holocene, 18(5), 831-839.

Zhu, Q., Sarkis, J., Geng, Y. (2005), Green supply chain management in China: Pressures, practices and performance. International Journal of Operations and Production Management, 25(5), 449-468.

Zhu, Q., Sarkis, J., Lai, K.H. (2007), Green supply chain management: Pressures, practices and benefits within the Chinese automobile industry. Journal of Cleaner Production, 15, 1041-1052.

Zhu, Q., Sarkis, J., Lai, K.H. (2013), Institutional-based antecedents and performance outcomes of internal and external green supply chain management practices. Journal of Purchasing and Supply Management, 19(2), 106-117.