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CONTRIBUTION OF PROCESS INNOVATION CAPABILITY, IT INTEGRATION AND FLEXIBILITY TO INNOVATION PERFORMANCE OF ELECTRIC AND ELECTRONICS MANUFACTURING SECTOR IN MALAYSIA

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Abstract: The purpose of this paper is to analyze the contribution of process innovation capability, IT integration and flexibility to innovation performance in the Malaysian electrics and electronics (E&E) sector. This study adopted a quantitative approach. Questionnaires were distributed to Malaysian E&E manufacturers registered with the Federations of Malaysian Manufacturers (FMM) via email and postal mail. A total of 52 valid responses were obtained and analyzed using correlation analysis. A significant but weak relationship was found between IT integration and innovation performance. A significant and strong relationship was found between process innovation capability and innovation performance. The study is among the first to look specifically at Malaysia's E&E sector. The findings are of interest to academics as well as to public and private sector practitioners in directing resources to integrating IT and increasing the process innovation capability to achieve enhanced innovation performance.

Keywords: Process innovation capability, IT integration, IT flexibility, innovation performance

1. Introduction

According to the OECD (OECD Oslo Manual, 2005, p.46), innovation is the "implementation of a new or significantly improved product (good or service) or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations". Innovation improves work coordination and cooperation leading towards greater efficiency and effectiveness. Thus, organizations work towards building innovation performance apart from other performance goals, though this varies from one industry to another. Despite its importance, innovation performance is scarcely studied specifically in the area of electrical and electronic manufacturing. The electrical and electronic manufacturing sector contributes 39.3% to the total export value in 2020 amounting to RM386.29 billion and contributes 6.3% to the GDP (MATRADE, 2020) of Malaysia. This study will contribute to better understanding of innovation performance in the electrical and electronic manufacturing sector in Malaysia.

Innovation performance was around since the 1990s (Rangus and Slavec, 2017). During the early years, scholarship examining innovation performances were mainly focused on new product development. Over the years, the perspective of absorptive capacity came into the context of innovation performance, thus acknowledging it as an important driver for "first mover advantage". In the recent decade, innovation performance is accepted to consist of innovation radicalness and innovation volume (Cui *et al*. 2015; Saunila 2014; Parida *et al*. 2012). An organization with innovation radicalness offers different products or services from the current available offerings. While an organization with innovation volume offers breadth of innovations in terms of products or services. In the context of the electrical and electronics manufacturing

sector in Malaysia, it is vital to determine the factors that influence both radicalness and volume aspects of innovation performance. Taking cue, this study aims to examine the effect of process improvement initiative, Information Technology (IT) integration and Information Technology (IT) flexibility as internal capabilities to influence innovation performance.

2. Literature Review

For each of the subsections:

a) the results of the scientometric analysis provide an overview of each antecedent of innovation separately;

b) the relationship between innovation and each antecedent of innovation is analyzed by reviewing the recent literature in tabular form; and

c) A condensed overview supplies the reader with a snapshot of recent literature.

The databases Cambridge University Press. Emerald Insight, IEEE Xplore, Oxford University Press, Sage Journals, ScienceDirect, Springer Journals, Taylor & Francis Journals and Wiley Online Library have been searched between June and July 2021.

In total three antecedents of innovation performance are covered in this paper. These are innovation performance (IP), Information Technology (IT) flexibility, IT integration and process innovation (PI). For each of these antecedents a scientometric analysis has been performed.

The used keywords for the scientometric analysis are described in Table 1.

Table 1 Keywords used for the scientometric analysis

Keywords used
Innovation performance AND innovation
IT flexibility AND information technology flexibility AND innovation
IT integration AND information technology integration AND innovation Process innovation AND innovation

Table 1 reveals the keywords used for the scientometric search. The database Scopus was searched in July 2021 and the years included are 2017 to 2021. The datasets are analyzed with CiteSpace 5.7.R5. The node types are references and keywords. The nodes colors are toggled by cluster membership to ease the visualization. For each dimension of innovation, the clusters and frequently used keywords are tabulated. The scientometric analysis shall answer the following questions:

1) What are the major areas of research based on each of the three antecedents of innovation? 2) Where are the most active areas? (Chen, 2020)

2.1 Innovation Performance

Innovation performance answers the question: What abilities and deliverables are expected from an innovation journey (El Bassiti, L. & Ajhoun, R., 2016)?

This scientometric analysis reveals clusters and frequently used keywords by analyzing the keywords innovation AND innovation performance. In total 1989 qualified records have been integrated. Figure 1 presents the clusters revealed through the scientometric analysis of the keyword innovation AND innovation performance.

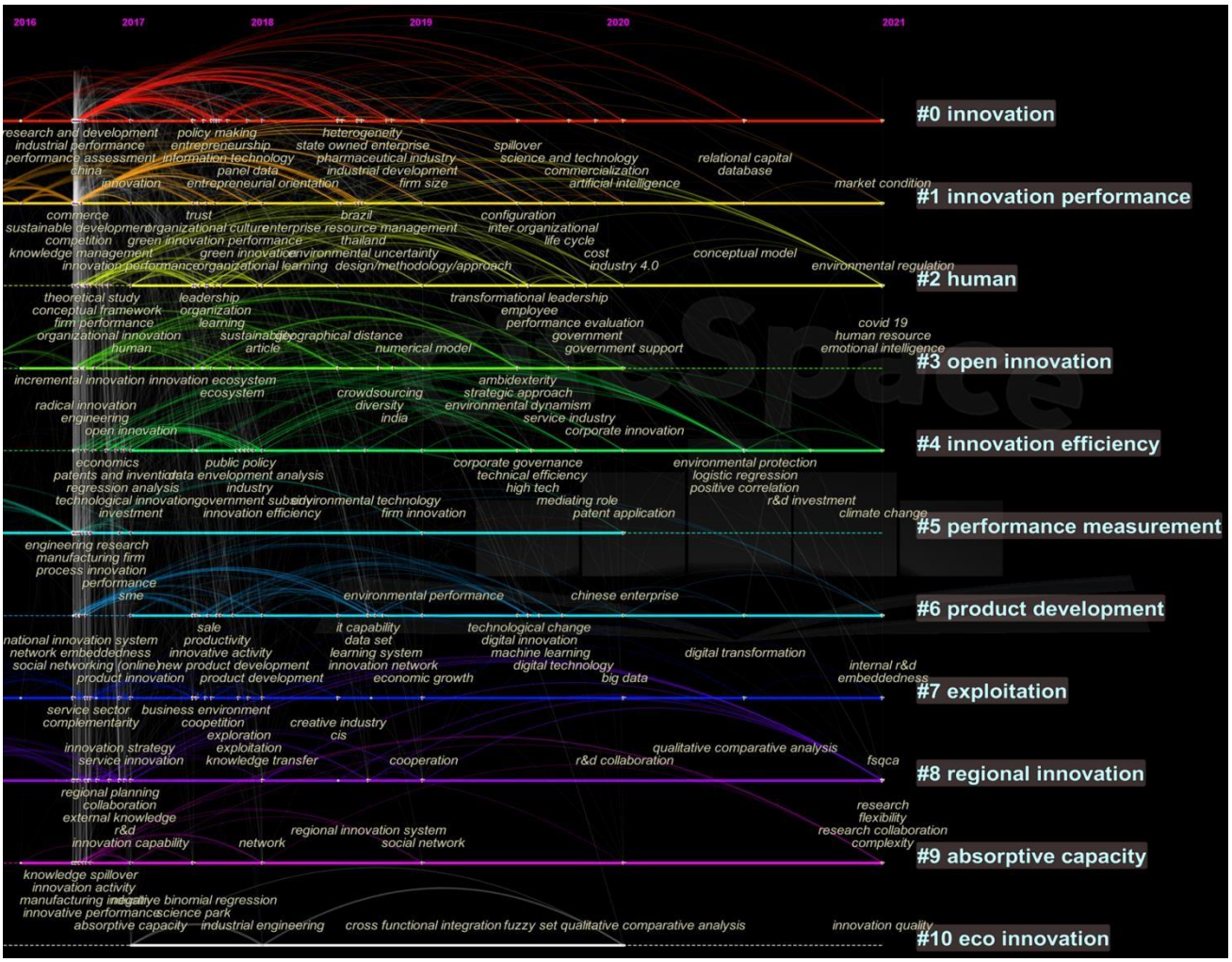

Figure 1. Scientometric analysis of the keywords innovation and innovation performance

Figure 1 reveals the top nine clusters of innovation performance. Furthermore, frequently used keywords connected to each cluster are visible by zooming in. Table 2 provides frequently used keywords counted more than 80 times of the scientometric analysis.

Table 2 Frequently used keywords of innovation AND innovation performance

Keyword	Frequency	Keyword	Frequency
Innovation performance	826	Absorptive capacity	111
Innovation	722	Performance assessment	100
China	160	Industrial performance	83
Knowledge management	117	Research and development	81
Open innovation	112	SME	81

This scientometric analysis of the keywords innovation and innovation performance reveals the major areas of research, how they are connected and where the most active areas are between 2017 and 2021. The major areas of research are open innovation and innovation efficiency. These are highly interconnected with innovation and innovation performance. Innovation is defined as applying new ideas to any aspect of a firm's activity, e.g., to processes or products (Rogers, M., 1998). The literature review focuses on innovation performance in manufacturing organizations. Table 3 provides detailed information about recent studies concerning effects on the firm’s innovation performance. The keywords, relationship to innovation performance (IP) and authors are provided.

Table 3 Keywords related to innovation performance and its relationships

Keywords	Relationship to innovation performance	Authors
Business innovation capability	triggers	Mushtaq, N. & Peng, W. W., (2020)
Collaborative innovation	ositively linked	Wang, C. & Yin, Y., (2019)
Collaboration breath	not negative	Kobarg, S., et al., (2019)
Collectivism-oriented human resource management	positively related	Chen, S., et al., (2016)
Competitive partnership	positive to IP capacity	Collinson, S. & Liu, Y., (2019)
Cooperative partnership	negative to IP time	Collinson, S. & Liu, Y., (2019)
Co-development	positive effect on IP	Tsou, H.T., et al., (2019)
Digital technologies	very low impact on IP	Usai, A., et al., (2021)
Embeddedness of local and overseas networks	significantly positively correlated	Xiong, Y. & Gao, W.W., (2020)
Employee's intrapreneurship	improvement in IP	Li, Y. et al., (2021)
Entrepreneurial orientation	positively affects IP	Song, W., et al., (2019)
Entrepreneurship	significant positive effect	Li, H., et al., (2020)
Enterprise technology strategy	positively related	Yang, Y. et al., (2017)
Experience of failure of innovation	positive influence	Wang, S. & Zhuo, H., (2020)
Exploration, transformation and exploit learning ability	significantly positively correlated	Xiong, Y. & Gao, W.W., (2020)
Explorative and exploitative learning	positive impact	Wangdu, F., et al., (2018)
External knowledge integration	positively affects	Wu, S.M. & Ding, X.H. (2020)
Government technology policy	positively related	Yang Y., et al., (2017)
Human resource management practices	no effect on IP	Chen, C.H.V., et al., (2019)
Influence of knowledge networks	positive correlation	Fang, S.C. et al. (2017)
Innovation capabilities	positively influence	Yusr, M.M., (2016)
Innovation culture	positive relationship	Hanifah, H., et al., (2019b)
Innovation culture	significantly and positively associated	Ghasemzadeh, P., et al., (2019)
Innovation culture	positively affects	Hanifah, H., et al., (2019a)
Innovation orientation	positively affects	Abdallah, A.B., et al., (2019)
Internal cooperate social responsibility	improve employee's IP	Li, Y. et al., (2021)
Knowledge absorption	no significant relationship	Robertson, J., et al., (2021)
Knowledge cooperation	positive effect	Kong, X.D. & Zhang, D. (2018)
Knowledge creation, diffusion and impact	positive relationship	Robertson, J., et al., (2021)

Knowledge sharing & innovation strategy positively impact		Bagherzadeh, M. et al., (2019)
Mode based on learning by doing, by significant using and by interacting (DUI) on firm's IP	positive effect	&Hu, S., et al., (2020)
Mode based on scientific and techno-logical based innovation (STI) on firm's IP	positive effect	&Hu, S., et al., (2020)
Network embeddedness	positive significant effect	Dogbe, C.S.K., et al., (2020)
Open innovation	improves IP	Wu, S.M. & Ding, X.H. (2020)
Quality & flexibility components of operations strategy	positive & significant impact	Kumar, V., et al., (2020)
Simultaneously tapping into internal and external knowledge sources	stronger IP	Wu, S.M. & Ding, X.H. (2020)
Supply chain integration	positive & significant impact	Kumar, V., et al., (2020)
Total Quality Management	triggers	Mushtaq, N. & Peng, W. W., (2020)
Total Quality Management practices	positively influence IP	Yusr, M.M., (2016)

Table 3 reveals a close link between innovation performance and entrepreneurship, innovation, knowledge and even total quality management.

2.2 IT Flexibility

This scientometric analysis reveals clusters and frequently used keywords by analyzing the keywords innovation AND IT flexibility AND information technology flexibility. In total 678 qualified records have been integrated. Figure 2 presents the clusters revealed through the scientometric analysis of the keyword innovation AND IT flexibility AND information technology flexibility.

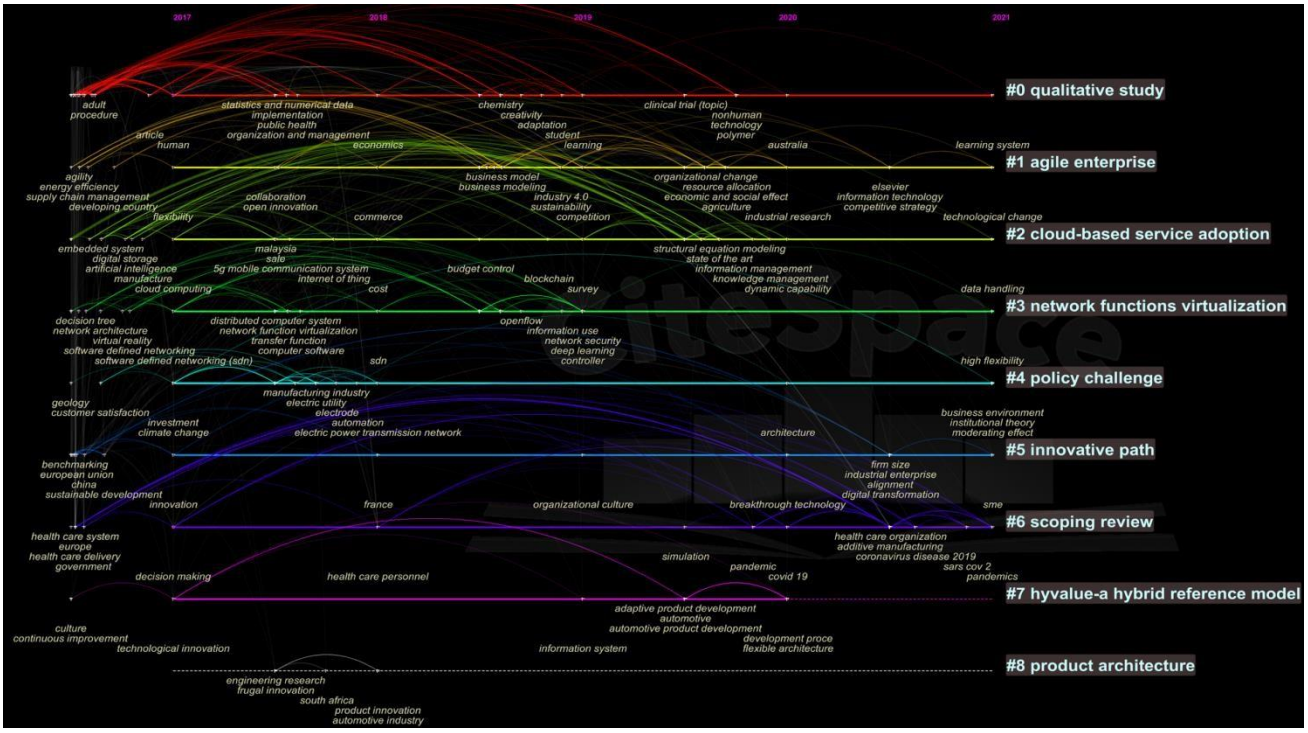

Figure 2. Scientometric analysis of the keywords innovation and IT flexibility

Figure 2 reveals the top 9 clusters of IT flexibility. Furthermore, frequently used keywords connected to each cluster are visible by zooming in. Table 4 provides frequently used keywords.

Table 4 Frequently used keywords of IT flexibility AND innovation

Keyword	Frequency	Keyword	Frequency
Innovation	73	Sustainable development	25
Human	63	Cloud computing	20
Article	49	Female	18
Commerce	27	Software defined network	16
Decision making	27	Flexibility	16

This scientometric analysis of the keywords innovation and IT flexibility reveals the major areas of research, how they are connected and where the most active areas are between 2017 and 2021. The major areas of research are agile enterprise, cloud-based service adoption and network functions virtualization through qualitative studies. In contrast to Figure 1, the level of interconnectedness is very low. Table 5 provides detailed information about recent studies concerning the effects of IT flexibility on innovation. The keywords, relationships and authors are provided.

Table 5 Keywords related to IT flexibility and its relationships

Keywords	Relationship	Authors
Absorptive capacity	positively associated with manufacturing flexibility	Pinheiro, J., et al., (2021)
Adoption of innovation	the greater the organization's flexibility the higher its adoption of innovation	Farnese, M.L., et al., (2016)
Explorative innovation competencies	positively related to manufacturing flexibility	Pinheiro, J., et al., (2021)
Exploratory innovation competencies	not related to manufacturing flexibility	Pinheiro, J., et al., (2021)
Knowledge acquisition	positively related to innovation flexibility of SMEs	Liao, Y. & Barnes, J., (2015)
Innovation	flexibility positively impacts innovation	Bag, S., et al., (2018)
Innovation performance	Operations strategy flexibility has positive & significant impact	Kumar, V., et al., (2020)
Learning orientation	has a positive and significant impact on flexibility	Kumar, V., et al., (2020)
Openness towards innovation	the greater the organization's flexibility the higher its openness towards innovation	Farnese, M.L., et al., (2016)
Organizational flexibility	impact on performance in radical innovation	Puriwat, W. & Hoonsopon, D., (2021)

	positive impact on performance	Puriwat, W. & Hoonsopon, D., (2021)
	in incremental innovation	
	positively related to innovation	Saeed, M.A., et al., (2020)
Process innovation capability	insignificant relationship to IT flexibility	Tajudeen, F.P., et al., (2021)
Strategic flexibility's association business with model innovation (BMI)	no significant relationship to IT flexibility	Miroshnychenko, I., et al., (2021)
Strategic flexibility's association with absorptive capacity	positive relationship to IT flexibility	Miroshnychenko, I., et al., (2021)
Supplier relationship management	positively impacts flexibility	Bag, S., et al., (2018)
Sustainability in supplier networks (SSN)	flexibility positively impacts SSN	Bag, S., et al., (2018)

In contrast to innovation performance the keywords IT flexibility AND information technology flexibility AND innovation provide a less affirmative relationship. On top of that the literature does not focus solely on IT flexibility. It is more concerned about the organization's flexibility and manufacturing flexibility. Nevertheless, this study aims to investigate the relationship by formulating the hypothesis:

Hypothesis 1: IT flexibility has a significant relationship with innovation performance.

2.3 IT Integration

This scientometric analysis reveals clusters and frequently used keywords by analyzing the keywords innovation AND IT integration AND information technology integration. In total 1995 qualified records have been integrated. Figure 3 presents the clusters revealed through the scientometric analysis of the keyword innovation AND IT integration AND information technology integration.

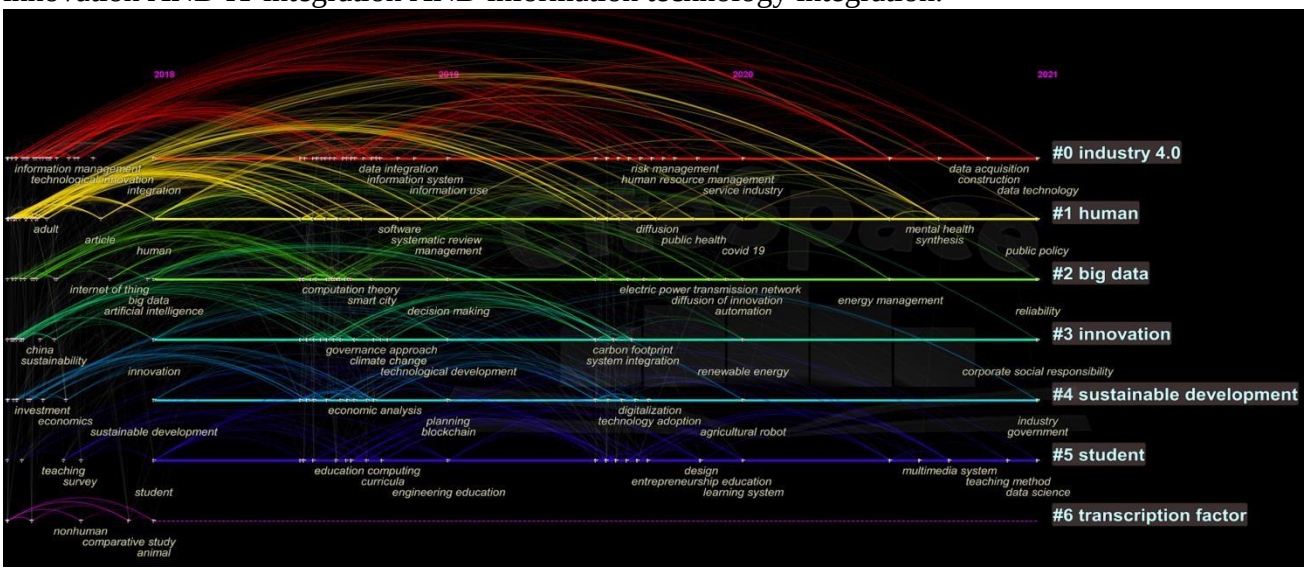

Figure 3. Scientometric analysis of the keywords innovation and IT integration

Figure 3 reveals the top seven clusters of IT integration. Furthermore, frequently used keywords connected to each cluster are visible by zooming in. Table 6 provides the frequently used keywords.

Table 6 Frequently used keywords of IT integration AND innovation

Keyword	Frequency	Keyword	Frequency
Innovation	186	Artificial intelligence	86
Human	147	Big data	83
Integration	124	Student	79
Sustainable development	117	Technological innovation	73
Article	94	Sustainability	62

This scientometric analysis of the keywords innovation and IT integration reveals the major areas of research, how they are connected and where the most active areas are between 2018 and 2021. The major areas of research are first and foremost Industry 4.0, human, big data, innovation and sustainable development. The level of interconnectedness is medium between Industry 4.0, big data and innovation. Table 7 provides detailed information about recent studies concerning the effects of IT integration on innovation. The keywords, relationships and authors are provided.

Table 7 Keywords related to IT integration and its relationships

Keywords	Relationship	Authors
Crowdsourcing platforms	facilitate open innovation	de Mattos, C.A., et al., (2018)
Customer integration	positively impacted by internal integration	Freije, I., et al., (2021)
High-tech entrepreneurial enterprises	fully integrate internal and external innovation resources to achieve sustainable growth	Pan, X., et al., (2018)
Knowledge breath and knowledge depth	IT capability has a positive impact on it	Wei, S., et al., (2021)
Knowledge integration capability	IT positively related to it	Nieves, J. & Osorio, J., (2019)
Management innovation	significant positive effect on big data analytics capability (BDAC)	Henao-Gracia, E., et al., (2021)
New product development (NPD)	integrated IT strategy directly relates to positive NPD outcome	Ettlie, J.E., et al., (2017)
Organizational knowledge	IT positively related to it	Nieves, J. & Osorio, J., (2019)
Process innovation capability	significant positive effect on BDAC	Henao-Gracia, E., et al., (2021)
Supply chain information management	significant relationship with supply chain integration	Sudram, V.P.L., et al., (2019)
Supply chain information system integration	significant relationship with manufacturing performance	Sudram, V.P.L., et al., (2019)
Technology access modes	prejudge successful integration of new technologies	Mathauer, M. & Hofmann, E., (2019)

A direct relationship between IT integration and innovation has not been confirmed by the recent literature. However, distinct evidence exists. Therefore, this study intends to investigate the relationship by formulating the hypothesis:

Hypothesis 2: IT integration has a significant relationship with innovation performance.

Process Innovation

This scientometric analysis reveals clusters and frequently used keywords by analyzing the keywords innovation AND Process innovation. In total 1056 qualified records have been integrated. Figure 4 presents the clusters revealed through the scientometric analysis of the keyword innovation AND process innovation.

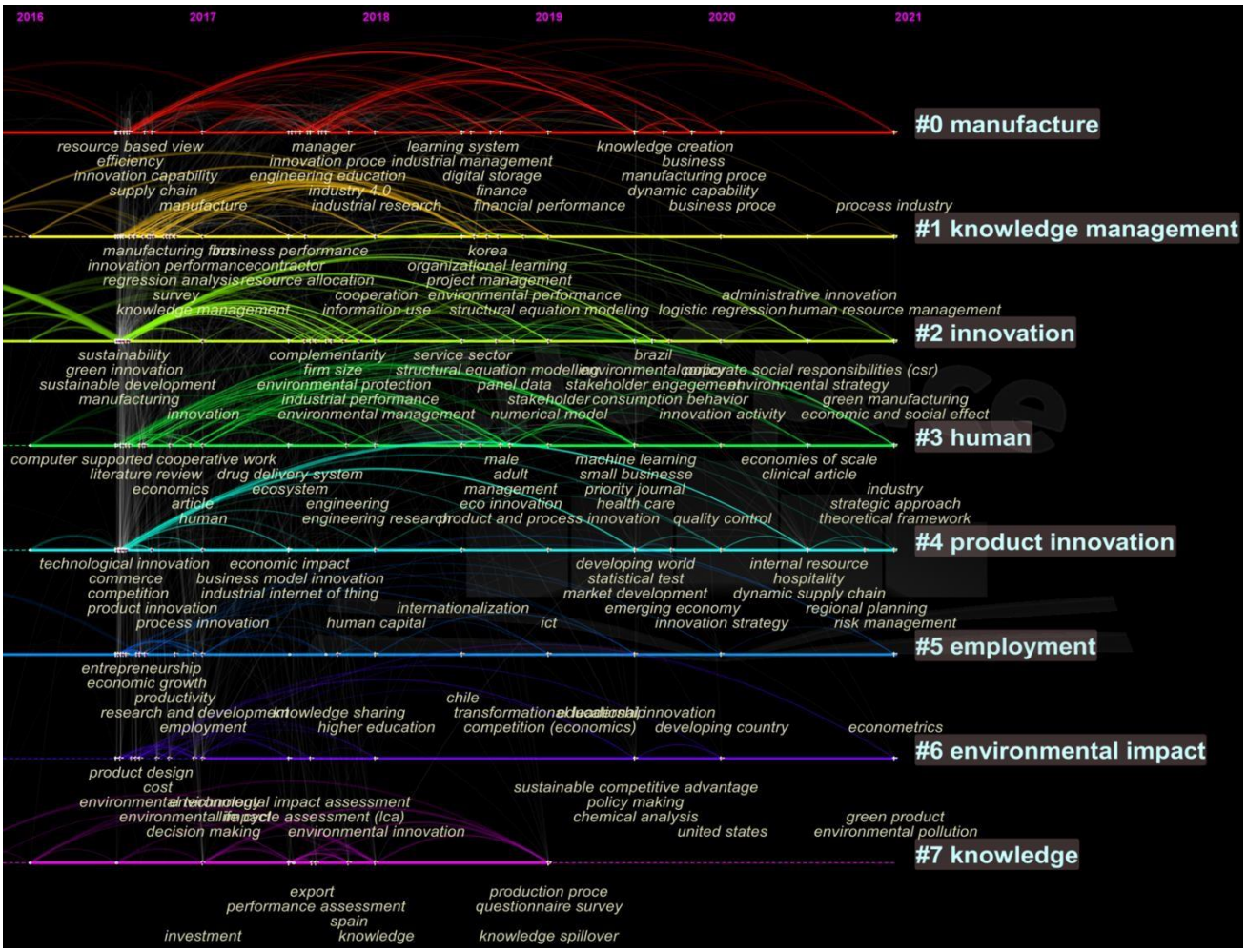

Figure 4. Scientometric analysis of the keyword innovation and process innovation

Figure 4 reveals the top eight clusters of innovation performance. Furthermore, frequently used keywords connected to each cluster are visible by zooming in. Table 8 provides frequently used keywords.

Table 8 Frequently used keywords of process innovation AND innovation

Keyword	Frequency	Keyword	Frequency
innovation	360	Sustainable development	47
Process innovation	321	Competition	43
Product innovation	135	Human	35
Manufacturing	53	Green innovation	34
Manufacture	52	Knowledge management	34

This scientometric analysis of the keywords innovation and process innovation reveals the major areas of research, how they are connected and where the most active areas are between 2017 and 2021. The level of interconnectedness is low. The first cluster #0 manufacture indicates that process innovation is mainly performed in manufacturing organizations. Table 9 provides detailed information about recent studies concerning effects of process innovation on innovation. The keywords, relationships and authors are provided.

Table 9 Keywords related to innovation performance and its relationships

Keywords	Relationship to process innovation (PI)	Authors
Absorptive capacity	moderates positive impact of collaborative innovation networks on process innovation capability	Najafi-Tavani, S., et al., (2018)
	Enhances the product and process innovation performance	Gao, H., et al., (2020)
Application of digital technologies	co-create novel digitally enabled process innovation	Kamalaldin, A., et al., (2021)
Artificial intelligence	co-creates novel digitally enabled process innovation	Kamalaldin, A., et al., (2021)
Business performance	significantly influenced by PIs	Turulja, L. & Bajgoric, N., (2019)
Business systems leveraging	PI has a positive moderating on Business systems leveraging	Chang, H.H., et al., (2019)
Capture existing mass markets	through process innovation	Lazonick, W., (2010)
Collaborative innovation networks	no direct impact on PI capability	Najafi-Tavani, S., et al., (2018)
Coopetition	enables digitally enabled PI	Kamalaldin, A., et al., (2021)
Demand-pull effect	PI lower than product innovation	Dawid, H., et al., (2020)
Digitalization, its adoption and implementation	many advantages for PI	Chirumalla, K., (2021)
Economic performance	improved by PI based on Industry 4.0 technologies	De Giovanni, P. & Cariola, A., (2020)
Ecosystem collaboration	process innovation depends on it	Kamalaldin, A., et al., (2021)
Employment growth	PI has no clear-cut effects	Calvino, F., (2019)
Firm performance	negatively impacted by environmental turbulence	Turulja, L. & Bajgoric, N., (2019)
Firm size and age	no impact on business performance	Turulja, L. & Bajgoric, N., (2019)

Information and internal knowledge management	positive effect on PI	Beltramino, N.S., et al., (2020)
Innovative organizational culture	positive effect on PI	Beltramino, N.S., et al., (2020)
Integration of emerging technologies	process innovation depends on it	Kamalaldin, A., et al., (2021)
Intra-firm collaboration capability	Antecedent in developing a disruptive process innovation	Radnejad, A.B. & Vredenburg, H., (2019)
IT capabilities	moderating role to IP and PI	
Knowledge, internal and external sources	positively affect process innovation generation	Dost, M., et al., (2020)
Knowledge search strategies	directly significant impact on product and process innovation	Gao, H., et al., (2020)
Operational performance	improved by PI based on Industry 4.0 technologies	De Giovanni, P. & Cariola, A., (2020)
Organization dependent, strategic decisions	process innovation is based on these decisions	Van Looy, A., (2021)
Participatory management is preferred leadership style	develops radical technological process innovation	Radnejad, A.B. & Vredenburg, H., (2019)
Performance	positively effected by PI	Beltramino, N.S., et al., (2020)
Process innovation capability	positive effect on new product performance	Najafi-Tavani, S., et al., (2018)
Product innovation	better econometric results than only engaging in PI	Dawid, H., et al., (2020)
Product development process	PI contributes significantly to it	Chirumalla, K., (2021)
Radical innovative capability	strengthens the effect of internal and external sources of knowledge on PI	Dost, M., et al., (2020)
Sources of knowledge, external	positively affect process innovation adoption	Dost, M., et al., (2020)
Supply chain performance (SCP)	PI has a positive moderating role on SCP	Chang, H.H., et al., (2019)

Table 9 reveals that product innovation has a higher impact on innovation than process innovation. Nevertheless, process innovation impacts operational and economic performance. This study intends to investigate the relationship by formulating the hypothesis:

Hypothesis 3: Process innovation capability has a significant relationship with innovation performance.

3. Research Design

The questionnaire developed for this study comprises two sections. Section one consists of 14 questions adapted from past studies. IT Integration variable consists of 4 items and adapted from Barua et al (2004); Rai

& Tang (2010) and Cui et al., (2015). IT flexibility consists of 4 items adapted from Fichman (2004a); Saraf et al., (2007) and Cui et al., (2015). The 11 items for process innovation capability were adapted from Tuominen & Hyvönen (2004) and Camisón & Villar-López (2010, 2014). The 6 items to measure innovation performance were adapted from Jiménez-Jiménez & Sanz-Valle (2011) and Rangus & Slavec (2017). Section 2 of the questionnaire consists of questions related to the firm and respondent's profile. The questionnaire is available in Appendix 1.

A pilot test was carried out to determine the reliability of the questions presented in the questionnaire for each variable. Overall, the reliability analysis revealed good Cronbach alpha for all variables (above 0.7 as indicated by Hair et al.). The Cronbach alpha for IT integration was 0.913, IT flexibility was 0.852, process innovation capability was 0.926 and finally innovation performance was 0.830.

The data was collected from 52 electrical and electronic manufacturing firms in Malaysia. The list of organizations was retrieved from the Federation of Malaysian Manufacturers (FMM). From the list, the organizations with reachable contact details were shortlisted and contacted through email. About 813 firms were contacted via email inviting them to participate in this survey. Furthermore, 615 firms were contacted via postal mail. The unit of analysis were middle management and above as these are the people who will possess sufficient knowledge about IT and innovation performance of their firms.

4. Findings and Discussion

The data analysis was performed based on the 52 completed responses. Table 8 provides details on the characteristics of the survey respondents and their organizations. The majority of the respondents were senior and middle managers (76%). Most of the respondents had up to 10 years work experience (52%). This demonstrates that the persons who responded to the survey had substantial work experience; hence their responses can be relied upon. The majority of the organizations have annual sales of more than RM15 million (66%) and most of them are large organizations with more than 50 employees (68%).

Table 10 Demographic Profile of Respondents

Measure	Items	Frequency	Percentage [%]
Position	Senior Management	20	38
	Middle Management	20	38
	Executive	12	24
Working Experience in	Less than 5 years	14	27
Current Company in Years	More than 5 years to 10 years	16	31
	More than 10 years to 15 years	11	21
	More than 15 years	11	21
Number of Years of Service	Less than 5 years	15	29
In Current Position	5 to 10 years	17	33
	More than 10 years to 15 years	8	15
	More than 15 years to 20 years	9	17
	More than 20 years	3	6
Number of Employees	Less than 5 employees	2	2
	5 to 49 employees	15	29
	50 to 250 employees	17	33
	More than 250 employees	18	35
Sales	Less than RM300,000	2	3
	RM300,000 to RM15 million	16	31
	Above RM15 million to RM50 million	19	37

More than RM50 million	15	29

Apart from analyzing the demographic profile of the respondents, descriptive analysis for the variables were also done. The means for IT integration and IT flexibility were 3.84 and 3.86 respectively with standard deviation as 0.69 and 0.62 respectively; indicating that the majority of respondents agreed with the items raised in the questionnaire for these variables. Process innovation capability and innovation performance had slightly lower means of 3.78 and 3.70 respectively with standard deviations of 0.50 and 0.52 respectively. Overall, the means and standard deviations are indicative that the respondents reacted positively to the questions asked for all four variables.

The hypotheses were tested using the Statistical Package for Social Sciences (SPSS) based on correlation analysis using hypotheses significance (*p*). Table 10 below presents the correlation analysis. Based on the Pearson correlation and p values, it is observed that IT Integration is positively influenced by IT flexibility (p value = 0.000) and innovation performance (p value = 0.039). IT Integration and IT flexibility have medium strength in relationship (Pearson correlation = 0.635) and IT integration and innovation performance have a weak relationship (Pearson correlation = 0.290). IT flexibility has a weak but significant relationship with process innovation capability (Pearson correlation = 0.276 and p value = 0.05) with no significant relationship with innovation performance (Pearson correlation = 0.210 and p value = 0.140). Lastly, process innovation capability to innovation performance has a strong positive relationship (Pearson correlation = 0.765 and p value = 0.000).

Table 11 Correlation Analysis

	IT Integration	IT Flexibility	Process Innovation Capability	Innovation Performance
IT Integration	0.635 (p value =0.000)		0.245 (p value = 0.083)	0.290 (p value = 0.039)
IT Flexibility			0.276 (p value = 0.050)	0.210 (p value = 0.140)
Process Innovation Capability				0.765 (p value = 0.000)

The study failed to explain significant relationship between IT flexibility and innovation performance (hypothesis 1 was not supported). While this study found a significant relationship between IT integration and innovation performance (Hypothesis 2 was supported). Although there is a significant relationship, the strength of the relationship is weak. Lastly, this study found significant relationship between process innovation capability and innovation performance. Hypothesis 3 was supported and the strength of the relationship is strong.

5. Conclusion

This study brought to light that although IT flexibility and IT Integration are the way forward in digitalization, it does not necessarily assist in innovation performance. Past researches have demonstrated a significant relationship between IT flexibility, IT integration and organizational performance. However, this study indicates that it does not really help with bringing about innovation performance. Process innovation capability on the other hand, does help with organizational performance (as indicated in past researches) and also

strongly influences innovation performance. The key takeaway is that managers should put emphasis on process innovation while working on all digitalization efforts in order to reap benefits of innovation. Industry 4.0 is the direction for all businesses in Malaysia and the E&E sector is of no exception. This study reminds the E&E sector that process innovation capability is an important factor to stay innovative as well.

This study has some limitations which is it was carried out using a cross-sectional method in order to determine relationship among variables. Nevertheless, the natures of the variables are dynamic, thus challenging to capture the true state at one point in time alone. Therefore, future researchers may adopt longitudinal methods to collect data over a specified period of time.

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Appendix 1: Survey

No	Items	Much Worse than Competitors	Response Same as Competitor		Much Better Than Competitors
		1	2 3	4	5

ITI1	The IT systems can easily access data from innovation collaborators' systems.
ITI2	The IT systems can provide seamless connection to the innovation collaborators' systems
ITI3	The IT systems have the capability to exchange real-time information with innovation collaborators.
ITI4	The IT systems can easily aggregate relevant information from the innovation collaborators' databases.
IT Flexibility (ITF)	
ITF1	The IT systems are organized and integrated to allow for rapid changes.
ITF2	The IT systems are highly scalable.
ITF3	The IT systems are designed to support new collaborative innovation relationships easily.
ITF4	The IT systems can be easily extended to accommodate new applications or functions.

PIC5 knowledge on the best processes and systems for work organization The organisation when compared to competitors organizes

PIC6 development of products/services efficiently The organisation when compared to competitors assigns resources

PIC7 to the development of product/service department efficiently

The organisation when compared to competitors is able to maintain

PIC8

a low level of stock without impairing service The organisation when compared to competitors is able to offer

PIC9

❑	❑	❑	❑	❑
❑	❑	❑	❑	❑
❑	❑	❑	❑	❑
❑	❑	❑	❑	❑
❑	❑	❑	❑	❑
❑	❑	❑	❑	❑
❑	❑	❑	❑	❑
❑	❑	❑	❑	❑

No Items	Much Worse than Competitors	Response Same as Competitor	Much Better Than Competitors
	2	3	5

Process Innovation Capability (PIC) The organisation when compared to competitors is able to create

PIC1

and manage a portfolio of interrelated technologies. The organisation when compared to competitors is able to master

PIC2

and absorb the basic and key technologies of business. The organisation when compared to competitors continuously

PIC3

develops programs to reduce production/services costs The organisation when compared to competitors has valuable

PIC4

knowledge for innovating and technological processes The organisation when compared to competitors has valuable

environmentally friendly processes.

❑	❑	❑	❑	❑
❑	❑	❑	❑	❑
❑	❑	❑	❑	❑
❑	❑	❑	❑	❑
❑	❑	❑	❑	❑
❑	❑	❑	❑	❑
❑	❑	❑	❑	❑
❑	❑	❑	❑	❑
❑	❑	❑	❑	❑

PIC10 The organisation when compared to competitors manages development of product/service efficiently

PIC11 The organisation when compared to competitors is able to integrate management of product/service development activities

Innovation Performance (IP)

IP1 In the last 3 years, your organization has performed worse/better than competitors with regards to… The number of new products/services launched

IP2 In the last 3 years, your organization has performed worse/better than competitors with regards to… Pioneering the introduction of new products/services (you were one of the first to introduce a new product/service)	❑	❑	❑	❑	❑
IP3 In the last 3 years, your organization has performed worse/better than competitors with regards to… The effort invested in the development of new products/services, taking into consideration the number of hours, people, teams and trainings	❑	❑	❑	❑	❑
IP4 In the last 3 years, your organization has performed worse/better than competitors with regards to… The number of introduced changes in processes	❑	❑	❑	❑	❑
IP5 In the last 3 years, your organization has performed worse/better than competitors with regards to… Pioneering newly introduced processes (you've been one of the first to introduce new processes)	❑	❑	❑	❑	❑
IP6 In the last 3 years, your organization has performed worse/better than competitors with regards to… Responding to new processes introduced by other companies in your field	❑	❑	❑	❑	❑
	❑	❑	❑	❑	❑
	❑	❑	❑	❑	❑

Company Information

1. Nature of production at your organization (in percentage)
- % Make-to-order (customized product)
- % Make-to-stock (common product)

2. Please classify the products your organization produces as (please check one)

Electronics

Components
- Semiconductors
- Passive components
- Printed circuit boards
- Metal stamped parts
- Precision plastic parts

Consumer
- Television receivers
- Portable multimedia players
- Speakers
- Cameras
- Electronic games

Industrial
- Computers and computer peripherals
- Telecommunication & office equipment

Electrical
- Boards, panels, consoles and switching apparatus
- Lamps
- Air conditioners

- Vacuum cleaners
- Ovens
- Transformers
- Cables and wires
- Primary cells and batteries
- Solar cells and modules

3. What is the number of employees in your organization?
- Large – above 250 employees
- Medium – 50 to 250 employees
- Small – 5 to 49 employees
- Micro – Less than 5 employees

4. What is the amount of annual sales of your organization in RM?
- Large – above RM50 millions
- Medium – RM15 million to RM50 million
- Small – RM300,000 to RM15 million
- Micro – Less than RM300,000

Respondent's information

5. How long have you been working for this company? _____ in years
6. How long have you been working at your present position? _____ in years
7. Your present position is
- Manager
- Chief Operating Office
- Chief Technology Officer
- Director
- Founder
- Others: _____

8. Your gender is _____ Male _____ Female

9. Your age is _____ 25-30 years _____ 31-35 years
_____ 36-40 years _____ 41-45 years
_____ 46-50 years _____ 51-55 years
_____ 56-60 years _____ 61-65 years
_____ above 65 years