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The Effect of Process Innovation on Business Performance and Role of Design Management: A Structural Equation Modelling

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Abstract

The products industries will remain innovative in the current era of innovation and strive to produce goods and process products by handling their innovations correctly in order to succeed and stay profitable. In addition, products industries were also blamed for not having embraced product design attitude to boost business performance, while it is viewed as an integral part of process innovation. However, product industries in Malaysia are not achieving better business performance due to lack of process innovation orientation through design management activities. Hence, the main objective of this study is to test the mediating effect of design management on the relationship between process innovation and business performance of product industries in Malaysia. The quantitative research design approach was used in this study to collect data from 386 respondents selected from the product industries in Malaysia. The required data were obtained using simple random sampling by a validated questionnaire. Furthermore, the data collected from the survey were analyzed using Structural Equation Modelling (SEM). The results of this study showed that there is a significant relationship between process innovation and design management with business performance as well as design management mediate the relationship between process innovation and business performance of product industries in Malaysia. In addition, the study has established the key points that might lead to better business performance, which will benefit the product industries in the future.

Keyword: *Process Innovation, Business Performance, Design Management, Product Industries, Malaysia*

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I. Introduction

In the present competitive global economic environment and innovation era, it is necessary for the product industries be innovative and keep on doing product development through proper design management for their survival and to be competitive (Felker, Jomo, & Rasiah, 2013). Literature review showed that product industries have been frequently criticized for failing to adopt innovative attitudes to get better business performance (Tajudin, Ibrahim, & Ismail, 2015) though innovation is considered as the basic element to achieve maximum profitability, grow market share, and gain sales growth (Reguia, 2014). In this regard, Glindo & Meindez (2014), claimed that in the competitive global business environment, innovation becomes one of the most important factors distinguishing success from failure. However, product industries in Malaysia are not achieving better business performance due to lack of orientation with innovation and design management activities (Tajudin et al., 2015).

Moreover, design management is considered by the European Commission as a core unit of innovation management umbrella, which can also be recognized as the essential innovation aptitude for the companies to respond to new market threats and opportunities (Lai et al., 2016). Thus, innovation has been accepted as a crucial strategic method (Tajudin et al., 2015) and today management of innovation and design is deemed a formal mechanism instead of a hope-based business performance approach (Lai et al., 2016). The significance of designing is not just with new products or services, but through employing, competently managing and thoroughly implementing design throughout a company's business strategy which can create superior business performance (Singh et al., 2016). However, product industry in Malaysia is very much reluctant to orient with design management as well as various innovation types for their better success.

In recent time, Malaysia strategically highlighted innovation as the important issue for superior growth and identifies the implication of innovation as the catalyst for the country's enduring success (Quezada et al., 2016). In addition, Malaysia 's goal to become a developed nation and an economic position by 2020 can be accomplished by emphasizing better and higher production through creativity and effective management of the design industry (Zailani, Govindan, Shaharudin, & Kuan, 2017). However, there are several research available in the arena of innovation, but research from the perspective of design management of the product industries is limited. Hence, there are scopes to do further research on design management for the product industries in Malaysia.

The Innovation

The word 'innovation' has its foundations back to the Latin word 'Novus', which signifies 'new' and is inferred into the verb 'innovate' that covers the signifying 'to make new'. Along these lines, in the broadest setting, 'to innovate is 'to start or present (something new) out of the blue', and 'innovation' has the importance of 'the demonstration of presenting something new' (The American Heritage Dictionary, 2000). Innovation is perceived as a corresponding word for process made by study and experimentation. Known to be utilized etymologically well after the term 'creation', as indicated by the Process Innovation Management Association, the demonstration of innovation incorporates innovation and additionally the work required to bring a thought or

idea into definite frame (Gërguri-Rashiti et al., 2016). As indicated by Salim and Ellingstad (2016), innovation is more than basically concocting smart thoughts; it is the way toward developing them into reasonable utilize.

As per Etzkowitz and Ranga (2015), innovations increment the financial action by enacting different trailblazers by Schumpeter's definition, 'business people'. This financial action achieves a develop state and mitigates itself and economy comes back to the condition of balance. In this manner, Schumpeter trusts that innovations prompt the improvement and development of the economy, and in the long run to thriving and riches (Salim & Ellingstad, 2016).

Process Innovation

According to Davenport (1993), process innovation is a mix form for exploiting probable occupation with a state of clearing and superior outcomes. (Frishammar, Floren, & Wincent, 2011). Process innovation necessitates to examine the general business objective and considering whether the current technique for doing things is pleasant in achieving objective and if not, having an improvement or new demand of completing things to confirm objectives are capable. Process innovation is a technique characterized by carrying out work in different ways while process improvement is dealing similarly business process in a way that expands proficiency and adequacy. Process innovation services is a trying activity up close and personal especially in of organizations, which rely upon individual collaborations to achieve the best results (Johne and Story, 1998; Pezzillo, Martinez, Mangia and Galdiero, 2012). To achieve a viable innovation process, an examination concerning the present procedure is vital, at that point furnishing the firm with the right condition and ability to improve and guaranteeing that customers' needs drive the procedure innovation (Karanja, 2011; Ngo and O'cass, 2013).

Design Management

As Colledani et al. (2014) state, design is, in an extensive sense, the origination and planning imitation objects. Jackson et al. (2016) characterize product design as the action that changes an arrangement of product prerequisites into a particular of the geometry and material properties of an antique. As these authors clarify, product design is a piece of the more extensive product advancement movement, which is the general procedure of system, association, idea age, product, and showcasing design creation, and execution, assessment, and commercialization of another product (Von Stamm, 2011). Comprehends product design as a two-stage process: (1) the logical designed; and (2) the specialized innovative. The goal of the previous is to survey and break down the financial setting and the propensities inside the objective market, together with the business, vital, gainful, strategic, and mechanical features of the firm, and perspectives managing picture and correspondence, all of which decide the qualities of the product. Then again, the specialized inventive stage includes a formal and innovative understanding of the previously mentioned attributes, and the specialized determination required to decide the product. These merging and prerequisites involve a multifaceted nature of the procedure essentially bolstered and supported by certain management exercises, practices or abilities that are considered by the writing as design management.

Meanings of design management can be either certain or exceptionally extensive (Prud'homme van Reine, 2017). However, every one of them appears to underscore the requirement for certain administrative exercises or abilities to streamline the design procedure. Constructing this present examination's definition in light of Ramanathan (2017), design management is considered as a progression of organization and administrative aptitudes or practices that are required to achieve the design procedure.

Process Innovation and Business Performance

The research shows the effect on business performance in Sweden of process innovation in Löfsten (2014). Researcher gathered and evaluated data from 99 medium-sized development businesses using a regression model. They noticed that 7 variables of the 14 variables suggesting approaches for process innovation influenced process innovation efficiency. Furthermore, the success of the product invention was not impacted by business scale, company age and market life cycles. The findings also revealed that trademarks, licences and copyrights had a huge influence on revenues of the product, while the business's productivity was unrelated to it.

The Wanyoike (2016) partnership has been formed in the Mombasa Region, Kenya logistics company between innovation strategies and competitive advantage. As the nature of the study, the cross-sectional descriptive sample. The research employed a purposeful survey of interviews and questionnaire management methods used in non-probability sampling techniques. The key data gathered is the department executives, executives of human resources and managers of sales using closed-ended questionnaires aim respondents. The study has shown a substantial 5 percent cause-related association between creativity and competitiveness. There was a strong overall link between the methods used for creativity and the strategic advantage of businesses. This also indicated that the techniques for growth had a huge effect on the logistics companies ' competitive edge in Mombasa Region.

The effect of Consumer Development on Small and Medium Enterprises (SME) in Tanzania has been discussed in Ndesaulwa and Kikula (2017). The conclusion has demonstrated that product creativity has a beneficial impact on organization productivity and results which needs two reasons. The first problem is that developments in technologies and product advancement will not be treated as a cost-effective measure but as a meaningful addition to the company’s performance. Furthermore, these expenditure demands are related to the costs of production to demonstrate the true usage of the capital of this business. Moreover, a greater ratio indicates the high degree of willingness of management to engage in emerging technologies adoption and creativity, whereas the smaller percentage demonstrates the reverse, suggesting an old-style, non-innovation approach for business development approaches. Hence the hypothesis of the study is giving below:

H_1 There is a significant relationship between process innovation and business performance.

Process Innovation and Design Management

Roucoules, Yahia, Soufi, and Tichkiewitch, (2016) proposed an extension of a design development, meta-model that intended at locating the project design memory. As the metaphor of a film, industrial design is a procedure where stakeholders take decrees from product needs to the last designed scheme. Unfortunately, the

industries absence in a long-term project planning goes back and forth to remember activities and decrees. Therefore, this generated time intense recovery tasks that have finally no added value meanwhile they intended on pursuing previous information. Instead of pursuing previous information, businesses can look ahead innovation and accomplish variations coming from fresh KPI, resources, and technologies.

Prud'homme (2017) discussed the design philosophy for innovation in the wider perception of organizational culture. They used the framework of nine innovation culture impasses as an organizing scheme to examine the current literature on design philosophy for innovation and accounts of expanding design philosophy for innovation in practice. It is contended that the power of design philosophy is in the strain among apparently opposite means of thinking, such as intuitive thinking against analytic thinking, and thinking in iterative practices against linear thinking. For design philosophy to display, it is required to be embedded in an organizational culture is capable of sustaining a vibrant balance on integer of important tensions in innovative developments. It is shown that the innovation impasses framework can be used as a systematic tool to assess what degree organizations are armed to benefit from design philosophy for innovation. Hence the hypothesis of the study is giving below:

H_2 Process innovation has significant relationship with design management

Design Management and Business Performance

Ndesaulwa and Kikula (2017) researched the usage of concept management in a large United Kingdom government, building and development business to boost performance. This explores the effect on product management success in the industry of the teaching program, essential methodology and a set of 25 resources. A formal survey, concept management skill assessment, semi-structured interviews and case analysis were used in the research. In addition, the report discusses the drawbacks of the program and the methods and resources necessary to effective design management.

Wanyoike (2016) discussed how design management can play a relevant role to improve the performance of small Mexican technology-based enterprises (TBEs) in new technological industries. The study used a multi-methods design strategy (QUAL&quan), as it explored the effect of design management on the performance of small Mexican TBEs in new technological industries. The findings suggested that the implementation of design management can help small Mexican TBEs in new technological industries to improve their performance. Hence the hypothesis of the study is giving below:

H_3 Design management has significant relationship with business performance

Mediating Effect of Design Management on Innovation Types and Business Performance Relationship

The effect on the performance of companies and how the relation is managed by the design management were examined by Chiva and Alegre (2009). This thesis employed a questionnaire quantitative method. Modeling of the structural equation has been used to monitor the study hypotheses of data from

ceramics in Italy and Spain. The findings indicate that design management and increased corporate efficiency are also essential to analyze the impact of design expenditure on corporate performance, presenting empirical evidence that expenditure in the product is related significantly to business administration. Organizations that effectively accomplish design and that work well than most.

The management of the design field mediates the interaction between engineering activity and product improvement results, Fernández-Mesa, Alegre-Vidal, Chiva-Gomez and Gutiérrez-Gracia (2012). The structural equation modeling (SEM) is used to test hypotheses from research on a SME data set from the ceramic tile industry in Italy and Spain. The findings show that the process of creativity boosts product quality. The capacity to control architecture often plays a significant role as mediator in assessing the influence of engineering process on the performance of process innovation. Hence the hypothesis of the study is giving below:

H_4 Design management mediates the relationship between process innovation and business performance.

II. Research Framework

This research was focused on Resource Based View (RBV) of process innovation that suggests innovation is a powerful tool contributing to improved market results. The frameworks under analysis are then seen in the following scheme.

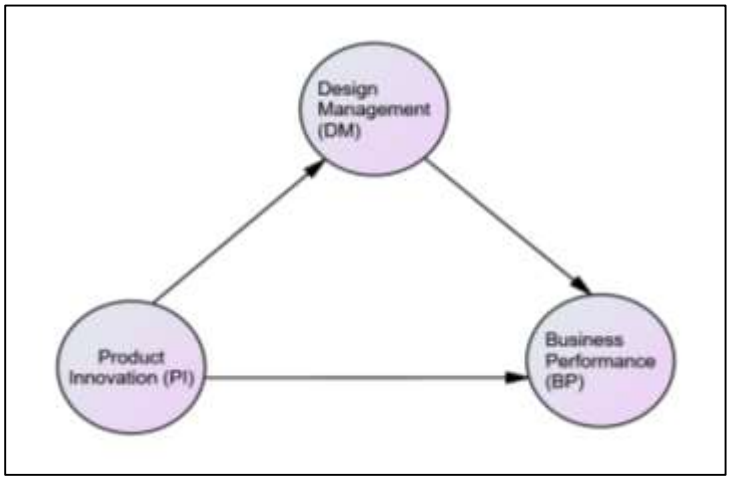


Figure 1. Research Framework

III. Research Methodology

The study will explore Process Innovation and Design Management's impact on Business Performance. For the intention of evaluating such relationships, a self-administered survey was circulated to the randomly selected employees of product industries in Malaysia. There were issued a total of 384 questionnaires that could

be included. Gender-driven males accounted for 63.86%, whereas 36.14% of the sample population were females.

The measures of process innovation were evaluated through a measurement instrument developed by Wanyoike, (2016) having 4 items grouped into 1 dimension and 5 items scale grouped into one dimension namely Business performance by Hajek and Henriques (2017) were used in this study as well as 5 items scale grouped also into one dimension namely design management by Wilson et al, (2007) were used in this study too.

IV. Results

Measurement Model

Measurement model validation requires at the beginning of the study for validity, reliability, and unidimensionality (Hoque and Awang, 2019). Hoque et al. (2017a) mentioned in their studies that when the factor loading for all items shows positive minimum value of 0.6 then achieved the unidimensionality. Whereas, if the measurement model meets the Incremental fit, Absolute fit, and Parsimonious fit criterions then the Construct validity is achieved. Moreover, if all the constructs in a model are not highly correlated then Discriminant validity is achieved (Fornell and Larcker, 1981).

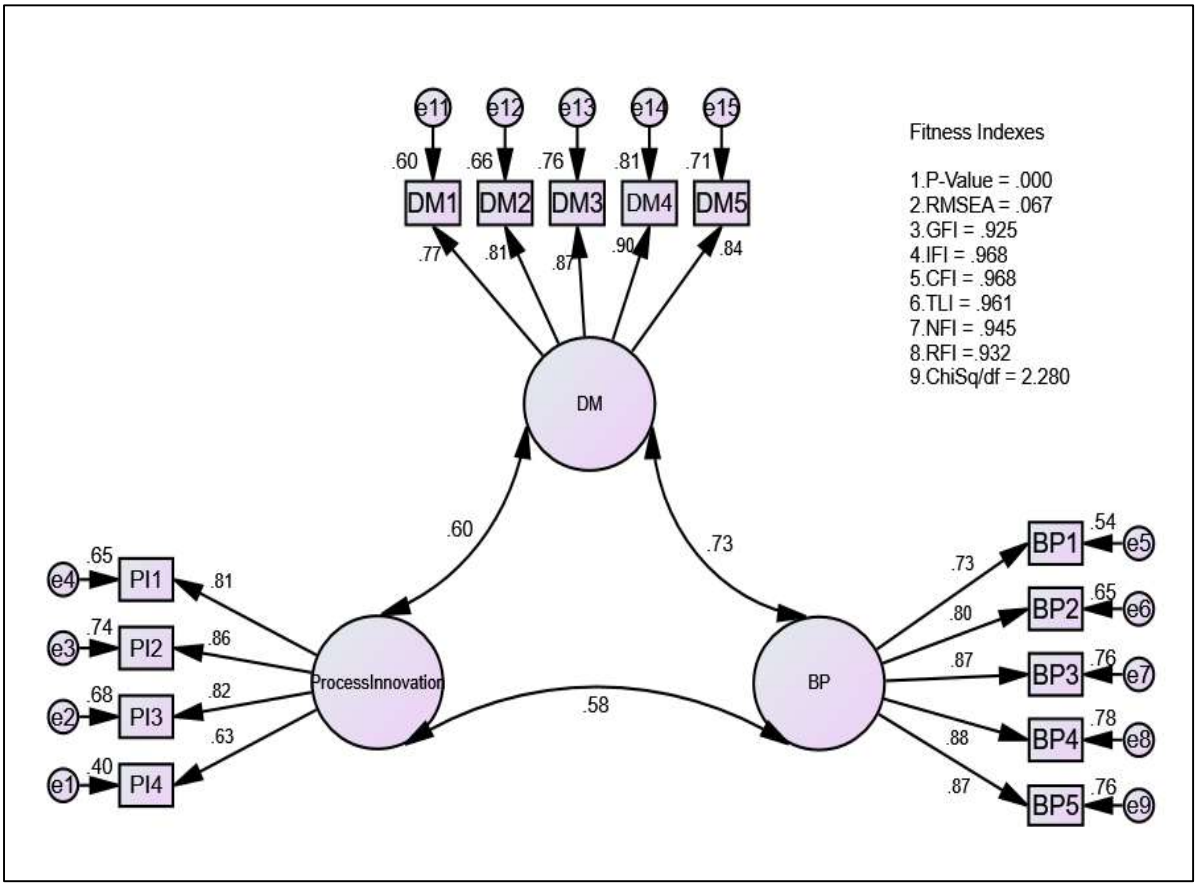


Figure 2: Pooled CFA Results and All Fitness Indexes

Internal reliability of the items in this study is achieved as the value of Cronbach Alpha shows the minimum value is 0.7 or above (Awang *et al.*, 2017a; Fornell and Larcker, 1981; Nunnally, 1978). As, P-Value=.000; RMSEA=.067; GFI=.925; IFI=.968; CFI=.968; TLI=.961; NFI=.945; RFI=.932; ChiSq/df=2.280 (shown in Figure 2). As a result, the ProI, DM and BP latent constructs' measurement model fulfilled the requirement and meets the data and showed a good result for all indexes. Therefore, the construct validity was obtained (Hoque, Siddiqui, Awang, and Baharu, 2018c; Awang *et al.*, 2017b; Hoque and Awang, 2016a).

Table I: Cronbach's Alpha, CR and AVE

Construct & Dimensions	**Items**	**Item Factor Loading**	**Cronbach's Alpha**	**CR** (above 0.6)	**AVE** (above 0.5)
Process Innovation (ProI)	PI1	0.81	0.879	0.864	**0.616**
	PI2	0.86			
	PI3	0.82			
	PI4	0.63			
Design Management (DM)	DM1	0.77	0.855	0.902	0.704
	DM2	0.81			
	DM3	0.87			
	DM4	0.90			
	DM5	0.84			
Business Performance (BP)	BP1	0.73	0.892	0.918	0.692
	BP2	0.80			
	BP3	0.87			
	BP4	0.88			
	BP5	0.87			

Diagonal value is the meaning of $\sqrt[2]{AVE}$ for the specific constructs in the Discriminant Validity Index Overview Table II, whereas other values correlate constructs. As $\sqrt[2]{AVE}$ is greater than correlation values in rows and columns of the respective constructs, Distinguishing validity of the constructs is therefore achieved (Fornell and Larcker, 1981).

Table II: Discriminant Validity Index Summary

Construct	Process Innovation (ProI)	Design Management (DM)	Business Performance (BP)
Process Innovation (ProI)	**0.784**		
Design Management (DM)	0.602	**0.839**	
Business Performance (BP)	0.579	**0.727**	**0.831**

The Structural Model

As shown in Figure 3, three hypotheses (H_1, H_2, & H_3) are supported. In H_1, Process Innovation (ProI) has a positive and significant direct effect on Business Performance (BP) (β=0.270, P=.000). In H_2, Process Innovation has a positive and significant effect on Design Management (DM) (β=0.688, P=.000), while in H_3, where DM also has a positive and significant effect on BP (β=0.640, P=.000). The structural model explains 56% variance in Business Performance.

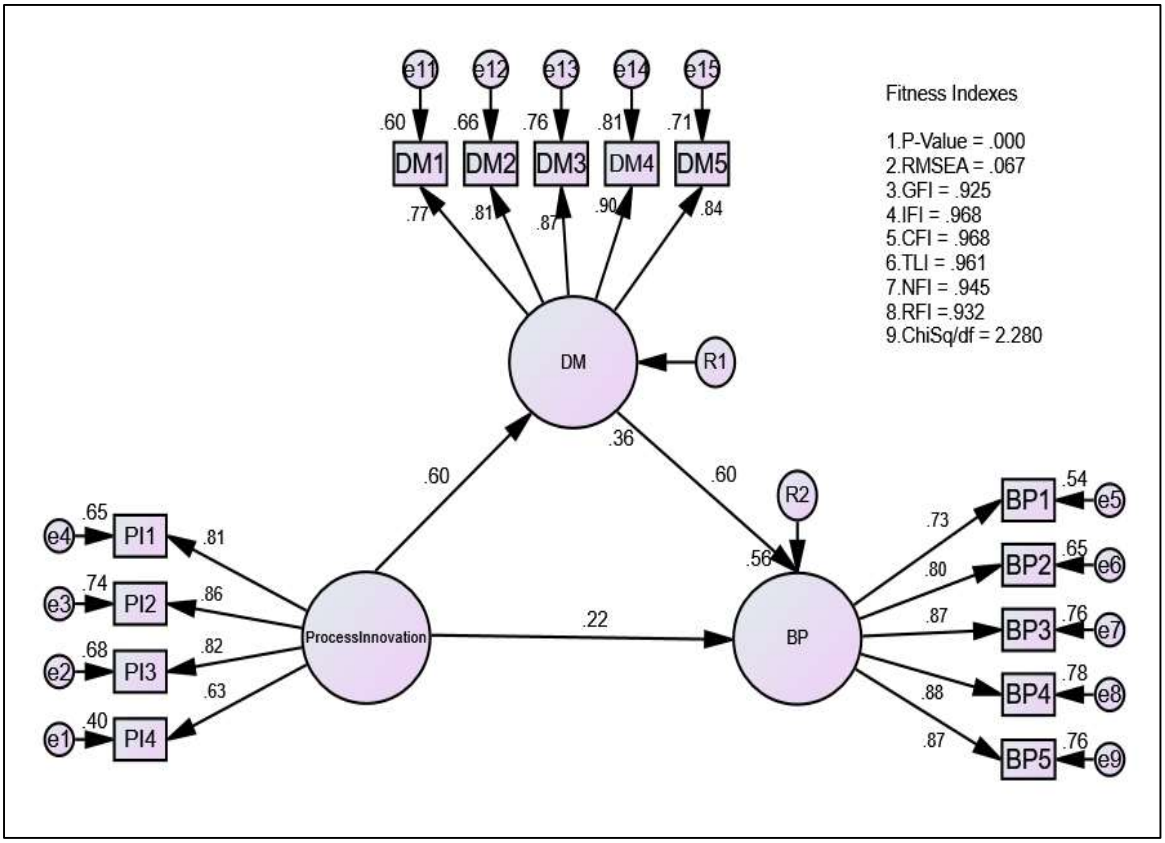
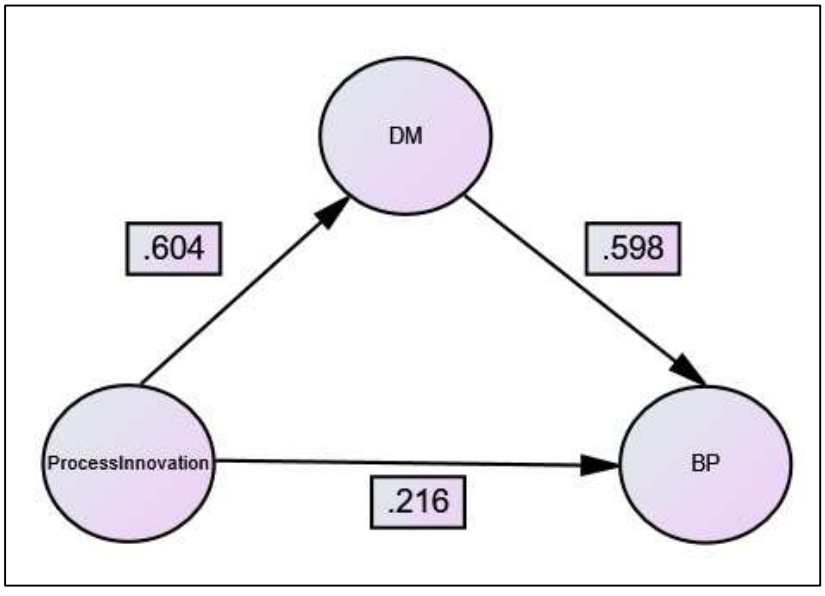


Figure 3: The Standardized Regression Weights for Every Path in the Model

Test of Mediation



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The Indirect Effect = 0.604 x 0.598 = 0.361 and the Direct Effect = 0.216. Since the Indirect Effect > Direct Effect as well as both Indirect path (Process Innovation to DM and DM to BP) are significant, **partial mediation** occurs. As a result, Design Management partially mediates the relationship between Process

Innovation and Business Performance since the indirect effect is **higher** than the direct effect and the direct effect is still significant after mediator enters the model.

Confirming the Mediation Result Through Bootstrapping

Table 3: Summary of Bootstrapping Result

	Indirect Effect	**Direct Effect**
Bootstrapping Results	**0.361**	**0.216**
Does mediation occur?	**The mediation occurs since the indirect effect is greater than direct effect**	
Bootstrapping p-value	**0.001**	**0.002**
Results	Significant	Significant
Type of Mediation	**Partial Mediation** since the direct is still significant.	

Table 3 provides a beta estimation of the effects on business performance (β)=0.361 and 0.216 (under bootstrapping) both indirectly and directly from process innovation. Throughout fact, it indicates the relative and actual P-value impacts on business performance for process innovation (P-value = 0.001 and 0.002 respectively). Given the results of the bootstrapping in Table 3, the ties between process innovation and business performance are clearly mediated by design management. Consequently, the H_4 of this study which posited that Design Management mediate the relationship between process Innovation and Business Performance is also supported by the data of this study.

V. Conclusion

This research analyses process innovation's impact on BP in Malaysia's chemical industry. The result of this analysis is that Process Innovation has a strong and very important impact on BP. Process innovation has a favourable and extremely significant influence on DM and DM on BP. In addition, DM mediates the Process Innovation-Business Performance interaction. Therefore, it can be determined that process innovation is in Malaysia to achieve Design Management's efficiency, sustainability and market output of the food industry. In addition, a report on the application of the process innovation method may include details as to what can modify strategies to boost and preserve the food industry's market results. While this study confirms Process Innovation and DM as a key facet of corporate strategy, further research aims to improve understanding and to identify other measurements of business performance in this critical process innovation construct.

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