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IMPACTS OF MANUFACTURING FLEXIBILITY ON PROFITABILITY: MALAYSIAN PERSPECTIVES

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ABSTRACT

As manufacturing flexibility has been purported as an unconventional manufacturing approach in safeguarding competitive advantage, this research was proposed to investigate the impact of manufacturing flexibility on profitability in the context of manufacturing industry in Malaysia. The dimensions of manufacturing flexibility were mix flexibility, new product flexibility, labor flexibility, machine flexibility, material handling flexibility, routing flexibility and volume flexibility. Impacts of manufacturing flexibility on profitability have been tested using cross sectional study employing survey methodology conducted within five manufacturing industries in Malaysia. Data obtained from returned questionnaires were analysed using regression analyses. Findings of regression analyses provided support that manufacturing flexibility has positive and significant impact on profitability. In other words, manufacturing flexibility improves profitability. In conclusion, this research contributes to knowledge gaining regarding the concept of manufacturing flexibility and its impacts.

Keywords: *manufacturing flexibility, profitability, Malaysia*

IMPORTANCE OF MANUFACTURING FLEXIBILITY: FOSTERING COMPETITIVE PRIORITY

World's business environment filling with uncertainty has led to the necessity for flexibility (Agus, 2011). The arise of manufacturing flexibility has outclassed conventional manufacturing approaches in safeguarding competitive advantage for an organization (Kaur, Kumar, & Kumar, 2016).

Since manufacturing flexibility augments the capability of a company to respond to customer requirements that are vastly diversified, it is generally acknowledged that incorporating manufacturing flexibility will help an organization to respond to changes in a better way (Mishra, Pundir, & Ganapathy, 2014; Mishra, Pundir, & Ganapathy, 2016; Pérez Pérez, Serrano Bedia, & López Fernández, 2016; Rogers, 2008). As flexibility becomes vital and recognized by executives around the world, it has been asserted as "*The Next Competitive Battle*" (Brettel, Klein, & Friederichsen, 2016; Vokurka & O'Leary-Kelly, 2000).

In current study, profitability as a core for survivability has been chosen as the dependent variable to assess the important of manufacturing flexibility towards firm's performance and ultimately to their survivability.

LITERATURE REVIEW

Manufacturing Flexibility

After extensive literature review on the potential dimensions of manufacturing flexibility, seven of them have been identified as they are those having consensus over the years of manufacturing flexibility related studies (Al-jawazneh, 2012; Helkiö, 2008; Judi & Beach, 2008; Mishra et al., 2014; Nishith, Rishi, & Sharma, 2013; Pérez Pérez et al., 2016; Rogers, Ojha, & White, 2011). The seven dimensions identified for manufacturing flexibility are mix flexibility, volume flexibility, new product flexibility, machine flexibility, material handling flexibility, labor flexibility and routing flexibility. Table 1 summarized the definitions for identified manufacturing flexibility dimensions.

Table 1
Manufacturing Flexibility's Dimensions & Definitions

Manufacturing Flexibility Dimensions	Definition
Mix Flexibility	"The ability of the manufacturing system to switch between different products in the product mix" (Judi & Beach, 2008).
Volume Flexibility	"The ability of the manufacturing system to alter the output volume of a manufacturing process" (Judi, Beach, & Muhlemann, 2004).
New Product Flexibility	"The ability of the manufacturing system to incorporate new product(s) into the existing range of products" (Judi & Beach, 2008).
Machine Flexibility	"The ability of the manufacturing machine to perform more than one operation to produce different parts or products" (Al-jawazneh, 2012; Rogers et al., 2011).
Material handling Flexibility	"The ability of the material handling system to handle various types of material, where dissimilar part are handle well without affecting the performance of the existing system" (Helkiö, 2008).
Labor Flexibility	"The ability of production workers to perform more than one task in the manufacturing system" (Rogers et al., 2011).
Routing Flexibility	"The ability of the manufacturing system to manufacture products through a variety of different routes" (Nishith et al., 2013; Rogers et al., 2011).

As manufacturing flexibility is flaunted as one of the key competitive priority, its impact on organizational performance is expected. Profitability as one of the most commonly used indicators to represent organizational performance have been chosen to validate the claims that manufacturing flexibility is a capability that enables a firm to gain long term competitive advantages.

Profitability

"The ability to consistently generating profits" is critical to the survival of a firm. Therefore, profitability, a financial indicator that is commonly used as the indicator of firm performance are chosen as the independent variable. Profitability measures a firm's ability to generate returns or earn profits (Carton & Hofer, 2006; Miller, Washburn & Glick, 2013; Santos & Brito, 2012). Its measures encompass values and

ratios which incorporate net income or one of its components such as operating income (Santos & Brito, 2012). In this study, profitability is operationalized as revenue growth rate, return on investment and firm's ability to earn profit.

Potential Gaps

Although manufacturing flexibility has been seen as a way to foster competitive advantage, there was lack of evidence in supporting that manufacturing flexibility positively affecting profitability. With profitability as a core of business performance (Carton & Hofer, 2006), it was an area worth exploring.

This study also serves as a way to empirically quantified the prophecy that manufacturing flexibility can foster competitive advantages, as competitive advantages may serve as a bridge to generate profits.

THEORETICAL FRAMEWORK AND HYPOTHESES

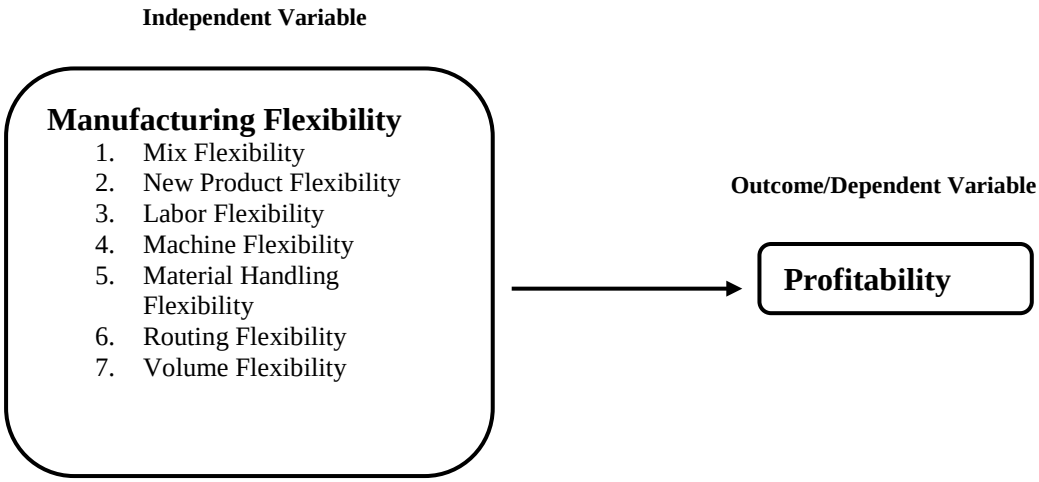

Figure 1
Research Framework for the Relationships between Manufacturing Flexibility and Profitability

Based upon Figure 1, the following hypothesis is synthesized.
Hypothesis: *Manufacturing flexibility has a positive relationship with Profitability.*

RESEARCH DESIGN AND METHODOLOGY

This research applies cross-sectional study using survey where data were collected once at a single data point (Cooper & Schindler, 2013). Using companies listed in Malaysian Investment Development Authority (MIDA) directory and Federation of Malaysian Manufacturers (FMM) directory, one thousand firms are selected using proportional stratified random sampling involving five industries (electrical and electronic, machine and equipment, chemicals, food and beverages manufacturers and also metal related products) with 137 samples returned (13.7% response rate). The survey data were collected through questionnaires and were distributed to the respondents who possess satisfactory knowledge on manufacturing flexibility and firm's performance data.

Statistical Package for the Social Sciences (SPSS) was employed for the purpose of data analyses. Data collected was analysed using regression analysis to investigate the relationship between the manufacturing flexibility and profitability.

Distribution of Population and Sample

Table 2 indicated that the collected sample provides diverse and fairly representative industrial coverage.

Table 2

Distribution of Population and Sample

Industry	Population	%	Frequency	%
Basic metals and fabricated metal	910	28.8%	31	22.6%
Machinery & Equipment	745	23.5%	26	19.0%
Electronic and Electrical	517	16.3%	34	24.8%
Chemicals Industry	493	15.6%	21	15.3%
Food and Beverages	500	15.8%	25	18.2%
Total	**3165**	**100.0%**	**137**	**100.0**

Descriptive Statistics of Variables

Minimum value, maximum value, mean and standard deviation of the data are depicted in Table 3. Those measurements are performed by using the perceptual scale where each question is answered using the following six-point Likert scale that represents the level of agreement from strongly disagree (1), disagree (2), somewhat disagree (3); somewhat agree (4); agree (5) to strongly agree (6). The descriptive statistics depicted that mean of manufacturing flexibility dimensions range from 3.99 to 4.46, with the standard deviation ranges between 0.72 and 0.86, which shown that Malaysia manufacturing firms have been implementing manufacturing flexibility dimensions in their manufacturing system. Meanwhile, moderately high mean values of profitability (4.30) with standard deviation of 0.79 also detected.

Table 3

Descriptive Statistics of the Variables

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Manufacturing Flexibility Dimensions					
Mix Flexibility	137	2.000	6.000	4.438	.815
New Product Flexibility	137	2.000	6.000	4.003	.857
Labor Flexibility	137	2.500	6.000	4.320	.750
Machine Flexibility	137	2.000	5.250	4.058	.800
Material Handling Flexibility	137	3.000	6.000	4.406	.717
Routing Flexibility	137	2.000	5.670	3.989	.785
Volume Flexibility	137	2.500	6.000	4.456	.802
Profitability	137	2.000	6.000	4.296	.794

EMPIRICAL RESEARCH: PRINCIPAL COMPONENT ANALYSIS AND SIMPLE REGRESSION

Due to high association between the independent variables where "variance inflation factor" (VIF) as high as 3.30 (VIF > 2.50) have been registered, risk of multicollinearity is foretold. To avoid misleading results of multiple regression analysis, principal component analysis that aimed to summarize most of the original information in the minimum number of factors for prediction purposes is used in conjunction with simple regression method to address the multicollinearity problem that plagued current study (Abdi & Williams, 2010; Hair, Black, Babin, & Anderson, 2013).

In short, due to the presence of the multicollinearity problems, the contribution of the independent variables to the dependent variable should be analysed communally with the help of principal component analysis (PCA), which PCA will describe the interrelated independent variables as a unified set, rather than as separate.

The summary of simple regression analysis is shown in Table 4. Regression coefficients are statistically positive and significant at $\alpha = 0.05$ with R^2 values of 56.3%. This suggests that manufacturing flexibility dimensions collectively contribute to profitability. In specific, the implementation of manufacturing flexibility dimensions significantly improves organization performance in terms of profitability. Thus, hypotheses for this study are not rejected.

Table 4

Results of Simple Regression Analysis between the First Principal Component Score of Manufacturing Flexibility Dimensions and Profitability

Model	Unstandardized		Standardized Beta	t	Sig.	R^2
	Beta	Std. Error				
(Constant)	.299	.307		.976	.331	0.563*
Regression	.359	.027	.750	13.178	.000	
IV = PCA of Manufacturing Flexibility						
DV = Profitability						

IV = Independent variable; DV = Dependent variable; Principal component score is obtained from PCA; * F statistics are significant at the 0.05 level.

The first principal component or linear combination of manufacturing flexibility dimensions (63.74% variance explained) is obtained from the linear combination of the relevant variables as described below: 0.274 * Mix Flexibility + 0.360 * New Product Flexibility + 0.407 * Labor Flexibility + 0.383 * Machine Flexibility + 0.405 * Material Handling Flexibility + 0.381 * Routing Flexibility + 0.416 * Volume Flexibility. The empirical evidence presented in this section indicates that manufacturing flexibility has a significant positive impact on profitability. In specific, hypotheses that manufacturing flexibility dimensions have positive relationship with profitability is empirically supported.

The overall conclusions based on the findings are manufacturing flexibility dimensions (collectively) able to explain a significant percentage of the total variance

of profitability. Thus, enhancing manufacturing flexibility dimensions are vital since manufacturing flexibility is found to have tremendous effects on business capability to generate profit.

CONTRIBUTIONS OF THE RESEARCH

Generally, manufacturing flexibility as a key competitive priority are foretold to have an effect on profitability, this study provides empirical evidence to support this prophecy.

Secondly, with the empirical evidence readily available, industry practitioners can have more confident to pursue manufacturing flexibility practices. This removes a barrier to further promote the usage of manufacturing flexibility.

This research provides Malaysian perspective on the contribution of manufacturing flexibility towards Malaysian manufacturing industries. Apart from that, the current state of implementation of manufacturing flexibility in Malaysia is also expressed with the satisfactory mean ranging from 3.99 to 4.46. This indicates that although manufacturing flexibility is a new concept in Malaysia, even if unplanned, some of the elements are indeed implemented by current practitioners.

Besides, a parsimony set of manufacturing flexibility's dimensions is also established for further study. This provides an easier path to further develop this emerging idea. On the other hand, the multicollinearity within manufacturing flexibility dimensions did imply that manufacturing flexibility must be implemented holistically where collective effects of manufacturing flexibility's dimensions improved profitability.

POTENTIAL FUTURE RESEARCH

Manufacturing flexibility as an emerging idea to foster competitive advantage has been lacking in literature. To further support the idea, more researches are needed to understand and ultimately apply the approach. This study suggests that more study should be carried out especially in the context of Malaysia perspective. Besides profitability, more performance indicators of a firm can be included to further strengthen the idea of "manufacturing flexibility foster competitive advantage". As this study apply cross-sectional study, a longitudinal study can be carried out for future endeavour. Others statistical technique can also be carried out to triangulate the result of this study to further enhance the knowledge-based of manufacturing flexibility. Last but not least, external sources of influence toward the relationship between manufacturing flexibility and profitability (potential mediator and moderator) can also be assessed as one of the future researches.

CONCLUSION

This research provided valuable insights for manufacturing firms on impacts of manufacturing flexibility and its dimensions on organization performance. The results indicate that manufacturing flexibility which comprises of mix flexibility, new

product flexibility, labor flexibility, machine flexibility, material handling flexibility, routing flexibility and volume flexibility has a significant positive impact on profitability. As the goal of a business is to maximize profits for its stakeholders, the empirical study that supports the roles of manufacturing flexibility in fostering a firm's ability to generate profit has provided confidence to manufacturing companies to adopt manufacturing flexibility, especially in the context of Malaysia manufacturing industry. With the support of empirical evidence, manufacturing flexibility can be seen as a critical source of competitive advantage and long term benefits await those who have implementing manufacturing flexibility. Last but not least, researchers believe that the execution of this research would inspire further researches towards this research topic and expand the pool of researches in this context.

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