THE IMPACT OF MODULAR PRODUCT TOWARDS COST AND FLEXIBILITY PERFROMANCE AMONG MANUFACTURING FIRM IN NORTHERN MALAYSIA

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ABSTRACT
Nowadays, modular product production approach adopted by a firm to achieve cost-effective in market, continuous increasing in production, improve process performance and to stay in competitive globally. Referring to [1] inflation rate, employment growth and production growth are the basic indicators from economists' view as determinants of business performance to bring significant contribution toward a nation's economic growth. Competitive capabilities which are cost, and flexibility would be achieve through the process of planning, implementing and controlling the operation process to fulfill customer requirement [2]. This paper aim is to determine the impact of modular product towards competitive capabilities in terms of cost and flexibility because more than one-decade, modular product has been an area of interest among businesses for achieving competitive advantage. The purpose of this paper is to examine the relationship between modular product and cost then, to examine the relationship between modular product and flexibility. This paper attempt to explore the significant of modular product in the manufacturing firm with hoping that the knowledge of this study will deliver valuable contributions to business organization in developing impressive modular design strategies and manufacturing modular product to improve organization efficiency and effectiveness.

Keywords: Cost, Flexibility, Modular Product

Introduction

Modular product is a stand-alone subassembly and can attaches to other components which have similar interfaces and contain of distinct parts that can be

connected concurrently such as, modular of machines, buildings and all those things [3]. As confirmed by [4] the existence of interchangeability and standardization of parts are theantecedents to modular product, thus the use of standardize components would assist the design of production systems and assembly of final product. Besides, [5]state that competence can be defines as the capability to undertake a certain task, action or function while performance means the achievement of a given job measured against control standards of cost, accurateness, comprehensiveness and speediness. [6] confirmed that competitive performance relates to the effects of cost, quality, flexibility, and cycle time. Therefore, this paper is additional empirical study to further clarify the relationship between modular product towards cost and flexibility performance in manufacturing firms in Malaysia's environment.

Cost and Modular Product

There are some theoretical bases for competitive capabilities and modular product connections. According to [7], cost, quality, flexibility, and cycle time benefited from application of modular product strategies because manufacturers can control and influence processes at the module level than at the system level. According to [8] limited life of modules is responsive to cost because modules need to be replaced regularly throughout the life cycle of the product. According to [9] modular product can reduce product cost due to an increase in economies of scale. However, some studies disclosed that spare parts costs will rise from higher failure rate of modules and increase in spare parts inventory. Moreover, the effects of modular product on various dimensions of competitive capabilities have not been empirically tested and explored from the previous research. Thus, this paper tries to discover the relationship between modular product and cost capabilities in Malaysia's manufacturing firm's context.

Flexibility and Modular Product

[10] state that manufacturer must know the impact of modular strategies especiallyon key dimensions of competence performance to regain competitiveness in today's environment. Modular product design enables a firm to respond quickly to changing markets and technologies by creating product distinctions based on new combinations of existing modular components [11]. As a result, modular design can be the bases of strategic flexibility. [8] added, when the current system is malfunctioning into a module,it will turn out to be intense pressure for suppliers to cut the prices. Moreover, products also will become inflexible and complex for assembler to operate. According to flexibility assisted by modular product in the sense of resource-based view of strategy because modular designs that ensuing flexibility may not be easily imitated. Previously, [12] there has been no empirical research on these issues in Malaysia. This paper is the first of its kind. Thus, this paper hints at the relationship between modular product and flexibility performance in Malaysia. The results of this study provide important references for academics and practitioners to implement the effectiveness performance strategy to examine the effect of modular product on business performance.

Research Methodology

The comprehensive constructed of questionnaires is considered to acquire data from the Malaysian manufacturing firms in Northern region. The sampling data used is sample random sampling methods. [13] suggested that sample size and sampling design are very crucial as proper sampling design helps to draw conclusion that would be generalized to

the population cited in [14]. A total numbers of surveys form was distributed in 221 set of questionnaires to manufacturing firms that are presently listed with the Federation of Malaysian Manufacturers (FMM) across manufacturing sector in Malaysia. However, only 150 respondents were responded. Thus, this survey accomplished to gather 150 out of the 221 samples. Respondents are those officers that are holding the managerial positions in organizations which is among chief executive officer, general manager, and managers. The objective of this paper is to examine modular product impact on cost and flexibility performance that influencing its implementation among manufacturing firms in Northern region of Malaysia. The discussion in this paper will include the outcomes from frequency and descriptive analysis, followed by inference analysis by SPSS software program as a instrument to examine the relationship between modular product towards cost and flexibility performance. The paper has presented the relationship of modular product on cost and flexibility performance and determine the relationship of these three variables. The data and information had to be collected from the manufacturing firms that are presently disclosed with the Federation of Malaysian Manufacturers across industry in Malaysia, by examining the view on the firm involvement in the basic manufacturing competencies.

Research Framework

The framework of this paper is considered between cost, flexibility and modular product that was constructed based on inclusive literature review. Figure below presented the research framework model for this paper.

Figure 1: Framework model
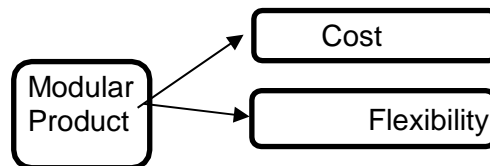
Research Hypothesis

Research hypothesis in this paper are established to validate the impact of modular product towards cost and flexibility performance in Malaysian manufacturing industry. The hypothesis of this paper are recognized as follows:
H1: Modular product will have a positive impact on cost capabilities.
H2: Modular product will have a positive impact on flexibility capabilities.

Result

This section discusses the findings and data analysis obtained from the returned questionnaires. Through the mail survey, a total of one hundred and fifty respondent representing the manufacturing firms responded. Thus, these one hundred and fifty respondents were selected as the respondents in this study. Having this in mind, thirty-two item questionnaire was developed to measure the modular product in manufacturing firms, as provided by [3, 6]. The data was collected using postal summary method from random samples. One hundred and fifty respondents participated in the study, and this accounted for 60.0% response rate. From the frequency analysis in Table 1 below, most of 150 respondents in this study have obtained secondary education until degree

education and from managerial position in the company. They are majority have been with the companies for more than 10 years. From these backgrounds, respondents are able to answer the questionnaire properly as they were asked about company's activities.

T a b l e 1

Background of the Respondents

	Frequency (n)	Percentage (%)
Gender		
Male	118	78.7
Female	32	21.3
Number of experience		
1-5 years	4	2.7
6-10 years	52	34.7
11-15 years	66	44.0
More than 16 years	28	18.7
Type of Companies		
Electronic	40	26.7
Automotive	67	44.7
Computer	12	8.0
Equipment	30	20.0
Others	1	.7
Education		
Secondary	18	12.0
Diploma	53	35.3
Degree	71	47.3
Master/PHD	8	5.3

N=150

Meanwhile, modular product constructed as the independent variables whereas cost and flexibility performance are the dependent variable. The discussion starts with the reliability and descriptive analysis of all variables and inference analysis. Inference analysis will answer the research questions and test of hypotheses developed. Result and analysis of the data are as follows.

The Result of Reliability Analysis

Reliability is an assessment of the degree of consistency between multiple measurements of variables, as provided by [15]. The most common reliability measure is Cronbach's Alpha (α). The reliability test was performed with all the items tapping in the independent variables and dependent variables included in this paper. Thus, the reliability tests were conducted based on the data collected from 150 respondents. Cronbach's Alpha for the entire variable was reexamined based on the responses of the main study's data. The result of Cronbach Alpha showed the range from 0.770 to 0.889 indicates that all scales are acceptable. Alpha values greater than 0.60 are suggested as being adequate for testing the reliability of factors, as noted by [7] From the results achieved, Cronbach's Alpha for modular product was 0.813, cost was 0.770 and flexibility was 0.889. Hence, it can be concluded that this instrument has high internal consistency and reliable (refer Table 1).

The Result of Descriptive Analysis

This section evaluates the level of respondents' agreement towards entire variables

tested in this study. Respondents were asked to indicate their agreement towards the statements of the variables, using the five points Likert-scale. Then, means score for each variable were computed to determine the level of their agreement. The levels of agreement were categorized into three groups as follows:

1.00 to 2.33 = Low

2.34 to 3.66 = Moderate

3.67 to 5.00 = High

The descriptive analysis results for modular product are shown in Table 2. The agreement among the firms towards modular product is moderate (mean=3.54, sd=0.45). Respondents perceived high agreement towards cost capabilities (mean=3.84, sd=0.60). However, respondents rated the moderate level on flexibility capabilities (mean=3.55, sd=0.63).

Table 2

Reliability and Descriptive Analysis

Variable	Mean	SD	Cronbach's Alpha (α)
Modular Product	3.54	0.45	0.813
Cost Capabilities	3.84	0.60	0.770
Flexibility Capabilities	3.55	0.63	0.889

The Result of Normality Analysis

Statistical techniques are based on various underlying assumptions. One common assumption is that a random variable is normally distributed. In many statistical analyses, normality is often appropriately assumed without any empirical evidence or test, nevertheless normality is critical in many statistical methods. When this assumption is violated, interpretation and inference may not be reliable or valid. The primary main assumption to be encountered is normality. The assumption of normality is a prerequisite for most inferential statistic methods such as regression analysis. Normality test refers to the shape of data distribution for each variable and its correspondence to normal distribution. Thus, the skewness and kurtosis tests being objective procedures of testing the normality were carried out by [13]. In statistics, normality tests are used to determine whether a data set is well-modeled by a normal distribution or not, or to calculate how probably an underlying random variable is to be normally distributed. There are two ways of testing normality that are numerical (statistical) methods and graphical methods.

a) Normality Result by Numerical Methods (Statistical)

Numerical or statistical methods present summary statistics such as skewness and kurtosis or conduct statistical tests of normality. Graphical methods are intuitive and easy to interpret, while numerical techniques provide objective ways of examining normality. Results of normality test using numerical method in presented in Table 3. It is found that value of Skewness for all variables are between -1.20 to 0.30, while the values of Kurtosis are ranged -0.70 to 2.30. According to Sekaran, (2003), a normally distributed random variable should have skewness and kurtosis near zero and three (or -3) if values are less than zero, respectively. Thus, it can be concluded that this set of data is normal distributed

Table 3

Test of Normality Using Numerical Method

Variables	Skewness	Kurtosis
Modular Product	0.288	-0.707
Cost Capabilities	0.213	0.725
Flexibility Capabilities	-1.188	2.281

a) Normality Result by Graphical Method

The other step in analyzing the data for this study is to examine the normality of the data by assessing the shape of distribution. A test was conducted to determine variable through visual inspections testing. An informal approach to testing normality is to compare a histogram of the sample data to a normal probability curve. The empirical distribution of the data (the histogram) should be bell-shaped and resemble the normal distribution. Histogram in Figure 1 to Figure 3 shows the normality test for all variables. It is clearly found that the shape was well bell-shaped.
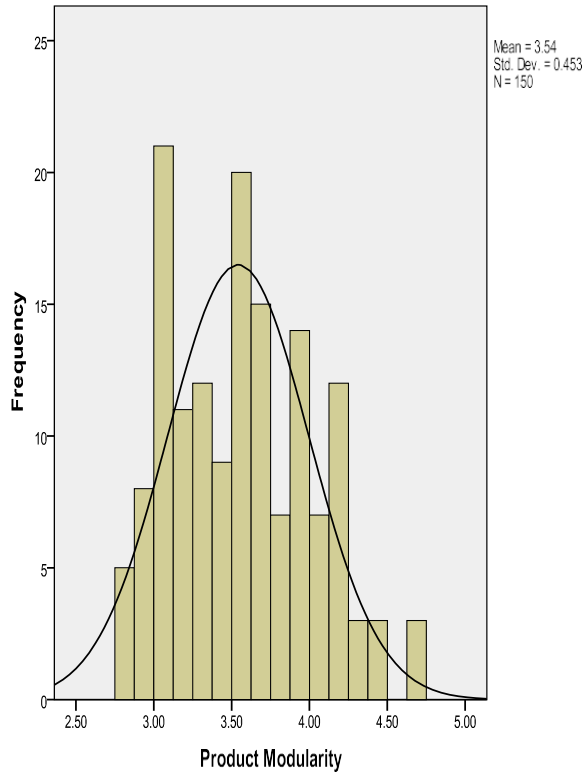

Figure 1
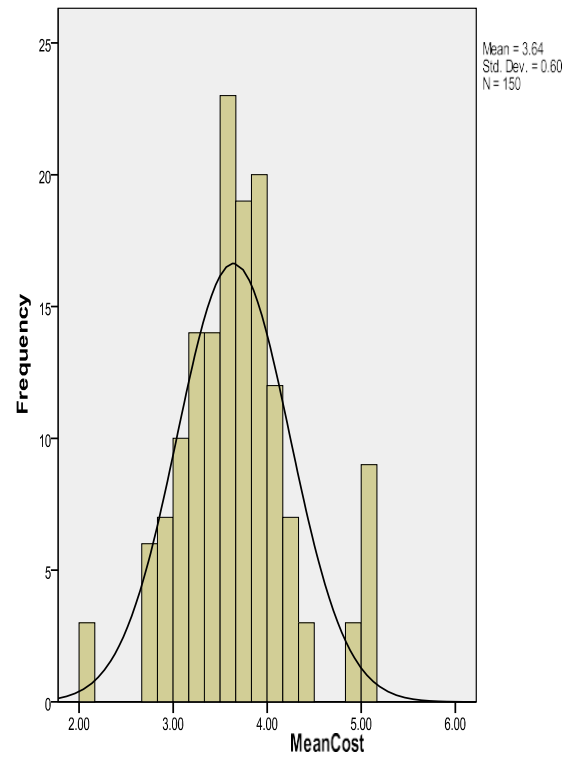*Histogram of Modular Product*

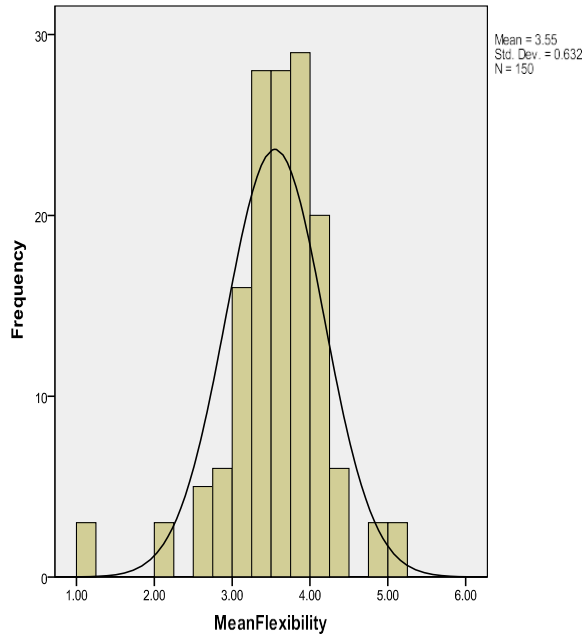Figure 2
Histogram of Cost Capabilities

Figure 3
Histogram of Flexibility Capabilities
Relationship among Variables

Correlation analysis will be used to determine the relationship of the variables in this paper, specifically between modular product and cost capabilities and flexibility capabilities. The results are presented in Table 4. It is exposed that modular product was highly associated with all the tested variables, that are cost capabilities (r=0.575, p<0.01) and flexibility capabilities (r=0.391, p<0.01). It is also found that the relationship among all variables were positive.

Table 3

Relationship among Variables

	Modular Product	Cost Capabilities	Flexibility Capabilities
Modular Product	1		
Cost Capabilities	.574**	1	
Flexibility Capabilities	.391**	.717**	1

Notes: **p<0.01

Hypotheses Testing

The hypothesis of this study would be tested by using regressions analysis to determine the complex relationship between the variables. The regressions analysis will be used to test the proposed model and it serves as a tool to validate the underlying structure of modular product. Specifically, regressions analysis is a statistical technique that combines more than one variable, which facilitates the researcher to evaluate relatively complex interrelated independent relationships and their effect on dependent

variables. Regression's analysis uses an independent variable to predict the dependent variable. Regressions analysis is closely connected to Pearson's correlation. Regression is a powerful tool for summarizing the nature of the relationship between variables and creating prediction of possible values of the dependent variable. The idea of regression is to summarize the relationship between two variables by generating a line which fits data.

H1: Modular product will have a positive effect on cost capabilities.

This hypothesis attempts to examine the effect of modular product on cost capabilities. A result of regression analysis to test this hypothesis is summarized in Table 5. Modular product was found to have 32.9 percent effect on cost capabilities ($R^2=0.329$, F=72.660, $p<0.01$). Modular product was also significantly predicting cost capabilities (B=0.759, t=8.524, $p<0.01$), suggesting the positive effect on cost capabilities. Hence, H1 is accepted.

Table 4

Effect of Modular Product on Cost Capabilities

	R^2	F	B	t	Sig.
Product Modularity	0.329	72.660	0.759	8.524	0.000

H2: Modular product will have a positive effect on flexibility capabilities.

Result of regression analysis to examine the effect of modular product on flexibility capabilities is shown in Table 5. It is found that modular product explained 15.3 percent of flexibility capabilities ($R^2=0.153$, F=26.652, $p<0.01$). The effect of modular product on flexibility capabilities is positive. The increase in modular product will significantly increase flexibility capabilities (B=0.545, t=0.391, $p<0.01$). The result advocates that modular product have a positive effect on flexibility capabilities. Hence, H2 is accepted

Table 5

Effect of Modular Product on Flexibility Capabilities

	R^2	F	B	t	Sig.
Modular Product	0.153	26.652	0.545	0.391	0.000

Data Analysis

The hypotheses involved were tested using correlation and regression methods. The multiple regression analysis indicates that there are significant relationships among the factors on each criterion to competitive capabilities. It is supposed that results of this paper will be beneficial for shareholders and directors of companies to apply these modular product concepts. This study investigates the significant relationship of independent variables on competitive capabilities. The results designate that cost and flexibility is a significant contributor in accomplishing modular product process. Based on the results, it supports the hypothesis that the cost and flexibility is essential in modular product. The hypotheses are concerned with the exploration of the simultaneous effects of modular product on the competitive capabilities. The result of hypotheses discloses that modular product significantly explains the variance in of cost and flexibility. In this respect, the results have provided sufficient evidence to infer that the independent variables are significant determinants of competitive capabilities in manufacturing firms. This study

indicated the positive relation between modular product and cost r=0.329 p<0.01 and positive relation between modular product and flexibility r=0.153 p<0.01. Result indications that the entire hypothesis supported. The results also suggest that all variables that can be used to predict modular product, that cost capabilities (B=0.759, t=8.524, p<0.01) and significantly increase flexibility capabilities (B=0.545, t=0.391, p<0.01). Modular product was found to have a significant positive effect towards cost and flexibility capabilities. In conclusion, the results have successfully answered all research questions and tested the hypotheses developed. Overall, this result has supported all hypotheses.

Conclusion

The conclusion outlines the analysis from the data. The descriptive analysis is based on the respondents' perception of modular product in manufacturing companies showed that manufacturers took a lot of effort in cost and flexibility in achieved high degree of modular product process. The findings of the study are presented to answer research questions and research objectives. This study examines the relationship between modular product and competitive capabilities performance. The first research objective is to determine the relationship between modular product and cost capabilities. The findings in this study show that, the independent variables could bring significant positive relationship on competitive capabilities performance. The correlation tables indicate that modular product was significantly positively related to the competitive capability's performance knowingly as cost and flexibility. These findings are supported by previous researchers who have studied in modularization process [3, 7]. The correlation coefficients between modular product and competitive capabilities performance indicate the strength of the relationships among them. The correlation tables demonstrate that cost was the priority to choose by manufacturer, following by flexibility. From the above discussion, we can recapitulate that in economy downturn, the policy maker, managers, and engineers must focus and develop a modular product in term of cost and flexibility to make sure their firm and company still in the right track during economy slowdown.

Whereas descriptive analysis purpose is to examine the level of companies' commitment towards competitive capabilities performance, it is found that all companies implement modular product in their activities. The commitment from the companies is high with mean score is more than 3.50. Respondents perceived that product used modular concept can achieve a higher variety. The findings also perceived that company implements a high degree of modular in production and use modular design as a general set of principles for managing complexity. This study also found that the companies perceived a high agreement towards all variables. Level of agreement towards cost is the highest compared to flexibility. This finding shows that cost is the most important factor to implement modular product in the production process. In addition, research questions tend to examine the relationship between cost and flexibility to the implementation of modular product. Simple linear regression analysis results show that these variables have significantly affected and can be used to predict modular product. The findings also show the similar result as above. Cost is found to have strongest influence on the implementation of modular product in companies' production. It is followed by flexibility.

From this study, it provides good information that can be used in guiding to develop modular product in manufacturing. All these information was beneficial to Malaysia's manufacturer. Furthermore, from this study, it can have provided an information for Malaysia to be a guideline in create a mission of manufacturing sector to be an important contributor and being a landmark for being a competitive global country. All the information can be used in all variety of economy and Malaysia doesn't wait for a long time to take a plan to move forward. Other than that, every state in Malaysia especially an industrial state, can used this information to continue focusing on enhancing the capabilities of

manufacturing sector, to meet competitive global state and keep up their value chain using their resources-based view to grow. This guideline helps them to go faster than other competitors. Besides that, this research helps a ministry of finance to make a good policy and create a mission on Malaysia Plan to further move all sectors of economy especially manufacturing sector. From the policy, this study also helps Federation of Manufacturing Malaysia (FMM) as a Factory Association of Malaysia to help give this information to all factory in Malaysia, including all manufacturing sector like electric and electronic, machinery and equipment and others. This information can be valuable to all this factory and firm to apply in economy downturn.

Recommendation for Further Research

The results from this study offer several implications in developing firms' modular product manufacturing. Several theoretical and practical implications have merged from this study. The findings on the main from this study have extended beyond the results of other previous studies and thus have contributed new information to the body of modular product process research. First, this study demonstrates the relationship of modular product to cost and flexibility. The present study focuses on independent variable to bridge the gap in predicting and developing the modular product manufacturing in the Malaysia context. This study found evidence to support the hypotheses. This reveals that cost and flexibility measures are an important function of firm cooperative action. The findings confirmed the studies by and which cost, and flexibility characteristic plays the intermediary role and firm should pay more attention for this part. Manufacturers need to develop cost and flexibility to ensure the success in developing modular product manufacturing. This study shows strong relationship for cost and flexibility to develop modular product manufacturing.

Future study may be extending to include other variables that would account for the modular product manufacturing and widen the scope of the current research. Furthermore, modular product manufacturing considered for this research was at least one process or the whole manufacturing capabilities. There are several companies perform only certain process of modular product manufacturing. Therefore, it could not cover all the important issues with regard for the modular product manufacturing. It is suggested that a comparative study should be conducted between different sectors to determine whether there are significant in the differences sectors. Thus, using multiple data sources by different sectors will present how they develop modular product manufacturing in their situation. This would further support the claim on generalizing manufacturing modular capabilities. Finally, manufacturing capabilities takes a long period of time. Companies go through drastic changes and modification in the modular product manufacturing. Therefore, to examine the effects, a longitudinal study is suggested. The advantage of longitudinal study is that it can track changes over time. For an in-depth study, other types of studies can be used such as qualitative studies (as opposed to quantitative data gathered through questionnaires) where data collected through observation or interviews, and another type of research involve in-depth in case study.

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