

# Factors that Contribute in Successful Implementing of Modularity Product: Study of Manufacturing Firm in Malaysia

Amlus Ibrahim<sup>1</sup>, Rohafiz Sabari, Mohamad Harith Amlus, Ahmad Shabudin Ariffin  
Naimah Amlus and Shahimi Mokhtar

<sup>1</sup>*School of Technology Management and Logistic, Universiti Utara Malaysia, amlus@uum.edu.my*

## ABSTRACT

Today's business environment is becoming more turbulent as the rate of change accelerates and new technologies allow information to spread globally almost instantly. Organizations are finding themselves pulled into a vortex of complexity and increased customer demand. Generally, modularity is the important factor in running and developing business. Hence, this research is aimed to identifying the relationships between factors that to make sure the companies can survive among companies across industries in the Malaysia. Those identified factors are customer demand, manufacturing flexibility, cost, and supply chain. Through the mail survey, a total of 150 respondent representing from the manufacturing firms responded. The hypotheses involved were tested using correlation and regression techniques. The multiple regression analysis indicates that there are significant relationships among the factors on each criterion to modularity except cost. It is believed that results of this study will be beneficial for shareholders and directors of companies to apply these modularity concepts. This study investigate the significant relationship of independent variables on overall manufacturing capabilities, the results of this study indicate that customer demand, manufacturing flexibility and supply chain is a significant contributor in achieving product modularity process. Based on the results, it support the hypothesis that the customer demand, manufacturing flexibility and supply chain is essential in product modularity process.

## I. INTRODUCTION

This study is to identify empirically factors that influence making of product modularity in manufacturing companies, across industry in the Malaysia. The rationale of the study stems from the major consideration, that is, the emerging concern of share holders of the manufacturing

companies and the directors of the companies in this industry in particular to develop product modularity manufacturing in economy downturn. Having this in mind, thirty-two item questionnaire was developed to measure the product modularity in manufacturing firms, as provided by (Parente, 2003; Lau Antonio et. al. 2007). 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.

Customer demand, manufacturing flexibility, cost, and supply chain were the independent variables whereas product modularity is dependent variable. The descriptive analysis based on the respondents' perception of product modularity in manufacturing companies showed that manufacturers took a lot of effort in customer demand, manufacturing flexibility, cost, and supply chain in achieved high degree of product modularity process. The findings of the study are presented to answer research questions and research objectives. The study examines the direct relationship between independent variables and product modularity. The manufacturing sector is an important contributor to the economic growth and development of Malaysia which accounts for 31.6% of Malaysia's gross domestic product and exports of manufactured goods make up 78.4% of the country's total exports (MIDA, 2005). One of the critical missions of the Ninth Malaysia Plan is to further move all sectors of the economy up the value chain. One of the key sectors being targeted by the Ninth Plan is the manufacturing sector. The Plan will continue to focus on enhancing the capability of the manufacturing sector to meet the competitive global environment. During the Ninth Plan, the sector is expected to grow by 6.7 per cent per year (up from 4.1 per cent per year during the Eighth Plan) with resource-based industries to grow by 6.0 per cent per year and non-resource based industries by 7.1 per cent (MITI, 2007).

Modularity emphasized product module expansion with minimum dependency on other components for maintenance, as mentioned by Dzuraidah et al. (2008). Manufacturing sector, includes electric and electronics, food and beverage and automotive. Thus, manufacturing sector develops the world's economy and provides job opportunities. Manufacturing capability in developing country and developed country are different, in terms of the time and management set up in the beginning, as stated by Grobler, (2007). The new and the established manufacturing firm are different, which has established for a long period, the mile stone to be achieved must be different from the firm that is new in this area. Manufacturing capabilities refer to the manufacturer's contribution to get success in their areas and something that the manufacturers do to generate profit through their products and services, as noted by Li, (2000).

Market demands have changed dramatically over the past decades and today's competition is on variety and time to market, with price and quality continuing to play their ever important role, as noted by Banker et al. (2006). Moreover, competition from the manufacturers is showing a sharp decline. Thereafter, many firms decided to close their operations in this economy environment if the firms are unable to achieve their target and profit. To regain competitiveness in this environment, Malaysian's manufacturers must refocus and define new and innovative strategies to struggle, as mentioned by Li, (2000). Although, competition in Malaysian industries has been increased for recent years, according to the 2004 World Competitiveness Yearbook released by the Institute for Management Development (IMD) based in Lausanne, Switzerland, Malaysia is the fifth most competitive country in the world among countries with a population of greater than 20 million (MIDA, 2005). It has improved from the seventh position that Malaysia attained in 2003. One of the ways for local manufacturers to remain competitive is to be able to upgrade their manufacturing capabilities especially during economy downturn, as stated by Leung, (2004).

Consequently, to keep up with the current situation, local manufacturers need to keep their value-added chain and keep increasing the quality, flexibility, and innovativeness of their organization, process, technologies and product. To enable firm to keep up with value added

activity, manufacturing capability is the main factor to be considered because if firm has strong capabilities, it achieves competitive advantage and capable of surviving in the current situation. Modular design divides a system into physical and functional modules that can be arranged to facilitate design and servicing. Product design architecture can be categorized into integral design and modular design, as noted by Mostia, (2004). Modular architecture differs from integral architecture in terms of the former product's functional element that is performed by one physical block. Thus, the advantages of the modular architecture enable design improvements to be conducted on a particular block, as mentioned by Ulrich et. al. (2004). The aim of modular design architecture is to allow independence and interchangeability between units in fulfilling the various functions of the product. Modularity enables modification to several product functional elements separately without affecting the design of the other elements, as noted by Huang et. al. (1998). Modularity emphasized product module expansion with minimum dependency on other components for maintenance, as mentioned by Dzuraidah et al. (2008).

This is in line with the Ninth Plan, together with the Third Industrial Master Plan that takes a holistic approach in facilitating the transformation process by enhancing the sector's capability, including SMEs, to produce high value added products and services and also to develop new sources of growth to remain competitive. The drive to enhance the sector's innovative capacity will contribute to the sustainability of long-term growth of the sector and the economy (MITI, 2007).

Manufacturing capability is the concept of strategic capabilities that determine a manufacturing's contribution to the success of a firm is closely related to the notions of strategic resources, competences and priorities, as noted by Teece et al. (1997). In contrast to capabilities, resources are something a firm possesses or has access to, is very important to consider for competitive advantage, as noted by Banker et al. (2006). Manufacturing capability is developed to make sure the productivity is at higher level, which can be ensured by high quality product. Consequently, the company which develops high manufacturing capability can survive in the long term, as mentioned by Li, (2000). Through

manufacturing capability, the company can developed their competitiveness, use their resources at optimum level and keep on adding value not only in stable economic condition, but also during recession, as stated by Leung, (2004).

## II. RESULT

### Descriptive Statistic of Variable

Variables	Mean	Standard Deviation
Product Modularity	3.8419	0.55714
Customer Demand	4.1089	0.56461
Manufacturing Flexibility	4.3308	0.37378
Cost	4.2589	0.50962
Supply Chain	4.1493	0.44763

The hypotheses are concerned with the investigation of the simultaneous effects of the four independent variables on the product modularity. The result of hypotheses reveal that all the three independent variables, which are customer demand, manufacturing flexibility, and supply chain significantly explain the variance in of product modularity, except cost. In this respect, the results have provided sufficient evidence to infer that the three independent variables are significant determinants of product modularity in manufacturing companies,

This study indicated the positive relation between customer demand and product modularity.  $r=0.694$   $p<0.01$ , 2. positive relation between manufacturing flexibility and product modularity.  $r=0.519$   $p<0.01$ , positive relation between cost and product modularity.  $r=0.418$   $p<0.01$ , positive relation between supply chain and product modularity,  $r=0.516$   $p<0.01$ , Result shows that all the hypothesis supported.

four variables were highly explained product modularity for 54.6 percent ( $R^2=0.546$ ,  $F=43.628$ ,  $p<0.01$ ). The results also suggest that only three variables that can be used to predict product modularity, that are customer demand ( $B=0.523$ ,  $t=7.150$ ,  $p<0.01$ ); manufacturing

flexibility ( $B=0.313$ ,  $t=3.170$ ,  $p<0.01$ ) and Supply Chain ( $B=0.199$ ,  $t=2.278$ ,  $p<0.05$ ). Customer demand, manufacturing flexibility and supply chain were found to have a significant positive effect towards product modularity.

## III. CONCLUSION

The results from the study offer several implications in developing firms' modularity product manufacturing. A number of theoretical and practical implications have merged from this study. The findings on the main and interacting effects from this study have extended beyond the results of other previous studies and thus have contributed new information to the body of product modularity process research. First, this study demonstrates the relationship of customer demand, manufacturing flexibility, cost, and supply chain to the product modularity. The present study focuses on independent variable to bridge the gap in predicting and developing the modularity product manufacturing in the Malaysia context. Based on correlation analysis, the result suggests that manufacturers with higher efforts of manufacturing flexibility, cost, supply chain, and customer demand are more likely to report more success in developing the modularity product manufacturing. The second contribution is to study the comparison of develop modularity product manufacturing on customer demand, manufacturing flexibility, cost, and supply chain in normal economy or in economy down turn.

Next, the results also highlight the importance of having strong factors for modularity product manufacturing. From the managerial point of view, the findings from this research suggest that companies need to concern modularity product manufacturing in term of customer demand, manufacturing flexibility, cost, and supply chain. This requires the companies' efforts to adopt related customer demand, manufacturing flexibility, cost, and supply chain into their organization to enhance the modularity product manufacturing and develop the high degree of modularity product manufacturing in driving their companies to compete with other competitors. In terms of customer demand, manufacturing flexibility, cost, and supply chain this study found that the companies must consider this independent variable to develop the high degree of modularity product manufacturing. Besides, this study also points out that multiple relationships help to focus and

assess the important factors that must be focused in developing manufacturing capabilities. For instance, the companies should focus on customer demand, manufacturing flexibility, cost, and supply chain in developing the modularity product manufacturing. Customer demand, manufacturing flexibility, cost, and supply chain will assist manufacturers in utilizing at optimum level due to operation attained from diversity of technology. Therefore, companies become more competent and sustainable in any economy recession. This study found evidence to support the hypotheses. This reveals that customer demand, manufacturing flexibility, cost, and supply chain measures are an important function of firm cooperative action. The findings confirmed the studies by (Schilling, 2000; Todorova et. al. 2002) which customer demand, manufacturing flexibility, cost, and supply chain characteristic plays the intermediary role and firm should pay more attentions for this part.

Manufacturers need to develop customer demand, manufacturing flexibility, cost, and supply chain to ensure the success in developing modularity product manufacturing. This study show strong association for customer demand, manufacturing flexibility, cost, and supply chain to develop modularity product manufacturing.

organizational forms. In R. K. F. Bresser, M. A. Hitt, R. D. Nixon, & D. Heuskel (Eds.). *Winning strategies in a deconstructing world* (pp. 25-50). New York: John Wiley and Sons.

## REFERENCES

- Banker, R. D., Bardhan, B., Chang, C.C., & Lin, Y. K. (2006). Plant Information systems, manufacturing capabilities and plant performance. *MIS Quarterly*, 30(2), 315-317.
- Dzuraidah, A. W., Ching, K. E., Boay T. E., Ramli, R., & Hussain, A. (2008). Product redesign for ease of maintenance: A case study. *International Journal of Mechanical and materials engineering (IJMME)*, 3(2), 153-159.
- Grobler, A. (2007). A dynamic view on strategic resources and capabilities applied to a manufacturing strategy literature. *Journal of Manufacturing Technology Management*, 18(3).
- Huang, G. Q., Lau, J. S. K., & Mac, K. L. (2003). The impacts of sharing production information on supply chain dynamics: A review of the literature. *International Journal of Production Research*, 41(7), 1483-1517.
- Leung, S. L. L. (2004). Strategic manufacturing capability pursuance: A conceptual framework. *Benchmarking: An International Journal*, 11(2).
- Li, X. (2000). Manufacturing capability development in a changing business environment. *Industrial Management & Data Systems*, 100(6), 261-270.
- Parente, R. C. (2003). Strategic modularization in the Brazilian automotive industry: An empirical analysis of its antecedents and performance implications.
- Schilling, M. A. (2000). Toward a general modular systems theory and its application to inter-firm product modularity. *Academy of Management Review*, 25(2), 312-334.
- Schilling, M. A., & Vasco, C. E. (2000). Product and process technological change and the adoption of modular