

Manufacturing Technology Impact on Environmental Factors and Manufacturing Performance

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Abstract. The purpose of this study is to study the impact of manufacturing technology in facilitating lean manufacturers in achieving superior manufacturing performance while operating with various challenges from external environment. The paper is based on a survey research done on lean manufacturers in Malaysia and their adoption of manufacturing technology to couple the implemented lean system in mitigating challenges. The challenges faced by lean manufacturing firms in many developing countries includes adopting the right technology, using it efficiently and continuously reviewing production technology in order to gain maximum output. Model from this empirical study is expected to contribute towards the enhancement of theory on contingency and its effect on performance. At theoretical level, the study results showed that of manufacturing technology mediate the relationship between environmental factors and performance of lean manufacturers.

Introduction

In Malaysia, the manufacturing sector is the second largest contributor to GDP at 26.2%, it is the main source of employment with total employment rate of 28.4%, and it remains as the main sector for contributing toward the Malaysian economic growth [1-3]. These facts show how pertinent the manufacturing sector is to the overall economic health of Malaysia. This sector continues to propel the economy forward through synergistic relationships with others such as trading, financial, transportation, and services. Therefore it is without any doubt that the manufacturing sector is one of the most important drivers of the growth of the Malaysian economy, which to date employs more than one million workers nationwide [4]. However due to globalisation and the increased demand for better products by customers, manufacturers nowadays face intense multifaceted pressure to perform. Influx of foreign products, new product introduction by competitors, shorter product lifecycle, rapid technology updates, and changes in customer demand have forced manufacturers to re-examine their current strategy and achievements [5-7].

Literature Review

Manufacturing Performance. As a nation, Malaysia is an open economy which depended heavily on external trade to achieve its economic growth [8], [9]. In a dynamic environment, manufacturers also face a high level of uncertainty caused by these on-going changes. The electronics industry which had been shown earlier as Malaysia's chief export earner since 1974 and the leading contributor of employment had experienced performance downturn since 1997. Given the openness of its economy, the negative wealth effects of the global crisis on demand and world trade have resulted in a decline in Malaysia industrial production and manufacturing exports. Due to a relatively small population, Malaysia domestic market is insufficient to finance additional growth for Malaysia's economy. As a result of that, the international trade has been crucial in the development of Malaysia economy and foreign trade has been a significant and substantially rising portion of the nation's gross domestic product (GDP) in the last three decades [9]. Findings from a study by [10]

suggested that trade is an important variable in promoting economic growth for Malaysia; its exposure to international instability is inevitable. Due to such heavy dependence on external trade, Malaysia economy can be considered sensitive to any external shocks that could range from economic crises to intensifying global competition

Environmental Factor. Heavy dependence on exported performance meant that any changes in global economy will have a more focal and significant impact on the local manufacturers. The downslide of manufacturing performance in Malaysia is in tandem with the decline in global market shares of exports. In 2009 alone, the Productivity Report posted a massive drop of 8.6 % in terms of total manufacturing productivity due to deterioration of electrical and electronic product cluster, which contracted a share of about 22.8%. Since manufacturing constitutes the largest single component of Malaysia's economy, sluggish manufacturing performance without doubt would affect the nation's overall economy as well. To cope with these uncertain environments, manufacturers must continuously examine their strategies, practices, capabilities and identify the impact between these elements and their performance [11], [12]. In searching for a new manufacturing paradigm, existing prominent manufacturing strategy such as manufacturing technology has been used by many Malaysian manufacturers to mitigate external environmental factors such as global competition, escalating raw material cost, supply chain variability, intensifying complex and hostile business environment and others.

Manufacturing technology (MT). One aspect that manufacturers focus on is the ability of the current manufacturing technology on hand to meet these challenges in the turbulent environment [13]. From a strategic perspective, manufacturing technology acts as a tool used by firms to adapt and react to the increasingly volatile and complex business environment [14]. In the context of this research, manufacturing technology is defined as advanced manufacturing technologies which consists of a group of computer based technologies that includes computer aided design, computer aided manufacturing, manufacturing resource planning, robotics, group technology, flexible system, automated material handling system, computer numerically controlled machine tools, bar coding or other automated identification techniques as well as any additional or advanced technology when compared to previous manufacturing technologies [15-17]. Manufacturing technology is a generic term for a group of manufacturing technologies which combines both scope and scale capabilities in a manufacturing environment.

Research Questions and Hypotheses. The research questions for this study are as follows :

- 1 Does external environmental factor influence the performance of Malaysian manufacturers?
- 2 Does manufacturing strategy such as manufacturing technology mediate the relationship between external environmental and manufacturing performance?

Hypotheses for the study are as follows:

H1: Lower level of external environmental factors positively impacted manufacturing performance.
 H2: Lower level of external environmental factors negatively impacted manufacturing technology implementation.

H3: Higher manufacturing technology implementation will positively affect manufacturing performance.

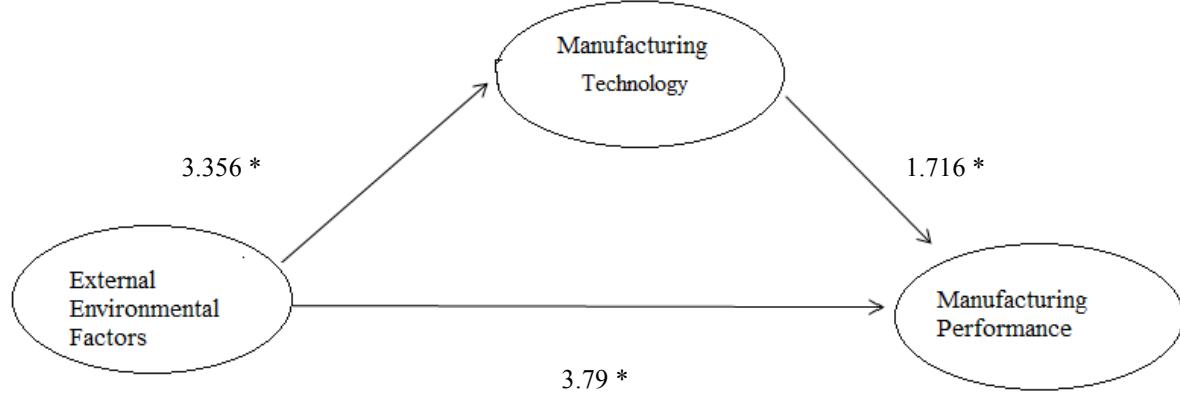
H4: Manufacturing technology mediate the relationship between external environmental factors and manufacturing performance.

Methodology

The questionnaires were distributed to managers, executives and engineers who were involved directly with the operation of manufacturing plants. For the purpose of this research, these managers, executives and engineers were defined as full time technical, management or highly skilled employees who have been employed for more than six months at the company and were attached to the operation side of manufacturing function such as quality, production, maintenance or engineering departments. Results were analyzed using SmartPLS software.

Results

PLS is best used with the casual steps approach that relies on regression analysis. The path coefficients generated by PLS provide an indication of relationships and can be used similarly to the traditional regression coefficients[18]. Testing the first hypothesis, the relationship between the independent and dependent variable were tested. The first hypothesis is lower level of external environmental factors positively impacted manufacturing performance. The relationship is significant at $p<0.05$. In the next phase, manufacturing technology (MT) was introduced as the mediator between external environment and manufacturing performance.



*significant at $p < 0.05$

Figure 1.0 Structural model results

Discussion

In this research, result indicated that higher level of external environmental factors represented by dynamism and hostility caused lower level manufacturing performance. Hypothesis 1 is solidly supported. The performances were measured by both financial and non-financial measures. As anticipated this finding is consistent with [19], [20] earlier works. As well as cemented the work by [21] whom stressed that environmental factors played a significant role in firm's performance. Earlier researchers such as [22] whom also studied the relationship between environmental dynamism and environmental hostility had mentioned the existence of mediators in the form of manufacturing strategy and operation strategy. In an environment perceived to be threatening to the organization and operation of any manufacturers, the affected manufacturers would have to react swiftly in order to maintain survival and ensure future prosperity. One of the main paths taken by manufacturers are through the re alignment, re adjustment and re thinking of their manufacturing strategy.

However findings also showed cautious approach from manufacturers are not unknown and paramount to manufacturing technology researchers. As it is, similar result was observed in tandem with previous researchers where in a more stable environment, manufacturer adoption and implementation of manufacturing technology was higher when compared to the niche with higher level of dynamism and hostility. Even though the use of manufacturing technology in modern production system is unavoidable, some author [23] showed that only modest benefits can be accrued from such huge investment. Perhaps due to this concern, most firms which intended to invest in technology prefer to do in a more stable environment.

Conclusion

Based on early data analysis, manufacturing technology mediate the relationship between environmental factor and operational performance. Further analysis need to be done in order to differentiate the effect of different types of technology on operational performance. This study managed to answer the intended research question where it was shown that in context of Malaysian

manufacturers, their performance is affected by the external environmental factors and such impact can be mediated by the implementation of manufacturing technology. However, Malaysian manufacturers tended to be cautious in implementing manufacturing technology as it required a large investment for its implementation.

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