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DIMENSION IN ESTABLISHING THE RESPONSIVE MANUFACTURING PERFORMANCE – A REVIEW

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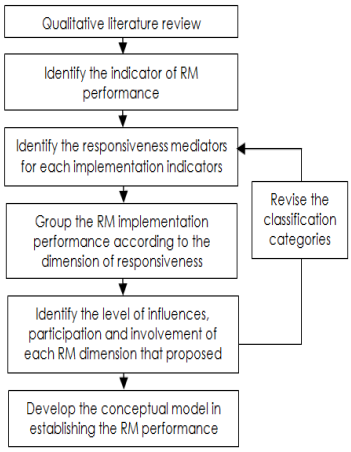
Graphical abstract



Abstract

In a contemporary manufacturing environment, the concern against the level of manufacturing responsiveness is vital in sustaining the growth of the manufacturing firms for a longer period of time. From this point of view, manufacturers do not only can improve their performance in fulfilling the volatility of demands, but also allow them to develop a better plan to become more competitive in the global market. From reviews, 28 performance indicators were identified to drive the implementation of responsive manufacturing. These performance indicators appear to be influenced by three responsiveness mediators, namely suppliers, manufacturers, and customers. From the discussion, seven dimensions of responsiveness, i.e., market trends, management information's system, environmental management, financial management, manufacturing capability, innovation, and the management of material and resources must be considered by manufacturers in coordinating, and streamlining the desired actions in establishing the responsive manufacturing practices. This information is useful as basis guidelines in formulating the strategy in strengthening the business function in achieving an exceptional responsiveness performance in manufacturing practices.

Keywords: Responsive manufacturing, responsiveness dimension, responsiveness performance, responsiveness indicators, general review

Abstrak

Dalam persekitaran pembuatan kontemporari, kebimbangan terhadap tahap pembuatan responsif adalah penting bagi mengekalkan pertumbuhan firma-firma perkilangan untuk tempoh yang lebih lama. Dari sudut pandangan ini, pengilang-pengilang bukan sahaja dapat meningkatkan prestasi mereka dalam memenuhi turun naik permintaan, tetapi juga membolehkan mereka untuk membangunkan rancangan yang lebih baik mereka untuk menjadi lebih berdaya saing dipasaran global. Dari kajian, 28 petunjuk prestasi telah dikenal pasti memacu pelaksanaan pembuatan responsif. Petunjuk prestasi ini kelihatan dipengaruhi oleh tiga pengantara responsif, iaitu pembekal, pengeluar dan pelanggan. Dari perbincangan, tujuh dimensi responsif, iaitu, trend pasaran, sistem maklumat

pengurusan, pengurusan alam sekitar, pengurusan kewangan, keupayaan pengeluaran, inovasi, dan pengurusan bahan dan sumber perlu dipertimbangkan oleh pengeluar dalam menyelaras, dan memperkemaskan tindakan yang diperlukan dalam mewujudkan amalan pembuatan responsif. Maklumat ini berguna sebagai garis panduan asas dalam merangka strategi yang diperlukan untuk mengukuhkan fungsi perniagaan dalam mencapai prestasi responsif yang luar biasa dalam amalan pembuatan.

Kata kunci: Pembuatan responsif, dimensi responsif, prestasi responsif, petunjuk responsif, ulasan am

1.0 INTRODUCTION

The emergence of high competitiveness in a global market has laid a great pressure for manufacturers. The factors such as global competition, shorter product life cycle, dynamic changes of demand pattern, product varieties, and uncertainties of internal operations has influenced the performance of manufacturing operations [1, 2]. This has urged manufacturers to increase the degrees of 'manufacturing responsiveness' to confront with the changes of customer expectations, reliability of supply chain, and time of delivery at an extremely high service levels [3, 4]. Therefore, manufacturers must capable to respond dynamically to the inconsistency of market trends covering the time of change, the type of change, and the product that is being changed [5, 6]. The ability to quickly respond to these changes (either predictable or unpredictable), and setting the immediate action to balance the stability of manufacturing operations is critical. This is to ensure an effective solution to satisfy any changes (market or customer requirement) are highly flexible and receptive.

Through core competencies, and the ability to exploit various resources to react with this challenge, manufacturers can outperform their competitors for a long period of time [7]. It has a huge impact on the financial, environmental and social performance, which is required in creating the sustainability of business in future. This focus allow manufacturers to balance the steadiness of the action taken to cope with the disruptions that affects the production plans either internally or externally [8]. Besides, the robustness of tactical action also should be prioritized, be strengthened, and streamlined in establishing high performance to rationalize manufacturing responsiveness performance [9].

Realizing to the importance of manufacturing responsiveness performance, particularly to confront with a competitive market environment, this article attempts to explore and identify based on literatures the dimension of performance which can be considered by manufacturers in responding to this requirement. Suppliers' participation in supply chain, the manufacturers' involvement, and customers' influences were three manufacturing responsiveness mediators that referred in this review, mainly in identifying the indicator that encourage the implementation of responsive manufacturing (RM) practices in manufacturing environment. These three responsiveness mediators were used to explore how RM performance can be established. This information is then used to analyse and propose the dimension that can be considered by manufacturers in establishing the stability of the RM practices in a better view.

The information from this article can be used as an input for manufacturers and academicians to formulate a better strategy in approaching, integrating, and realizing the elements of responsiveness in manufacturing performance, and drive the continuous improvement practices in operations to increase the profitability and growth of business. This article is structured as follows. Second section explains the method of research used in this review. The discussion on seven dimensions of RM performance in establishing manufacturing responsiveness is explained in section 3. Finally, conclusion and suggestion for future work is deliberated in the last section.

2.0 RESEARCH METHOD

The aim of this article is to explore and identify based on literature the indicators and the dimension of implementation that should be considered by manufacturers in establishing the RM performance in their operations. At the initial stage of this research, a survey of several databases such as Google Scholar and Scopus was carried out to search the article published from the current research work that relates to the establishment of RM performance in manufacturing sectors. Keywords such as 'responsive manufacturing', 'responsiveness strategy', 'responsive supply chain', 'economic responsiveness', 'environmental responsiveness', and 'social responsiveness' were used in order to achieve the objective of this research. These keywords are chosen based on the current contemporary scenario in manufacturing industries that focuses on increasing the level of sustainability in manufacturing operations. Next, the cross checking analysis of existing and current practice of the RM that highlighted and point out from each article was analysed based on

specified scopes such as the indicators of RM performance, factors influence the implementation of RM, as well as the limitation and constraints to the implementation of RM performance.

After that, the indicator that has been identified to contribute to the implementation of RM is scrutinized based on three mediators of manufacturing responsiveness, namely the customers, the supply chain, and manufacturers. Identification and exploration of the customer responsiveness indicators are based on the engagement of action taken in fulfilling the customer needs, requirement and expectation [3, 7, 10]. As for supply chain responsiveness, the responsive indicators were classified based on the robustness of action to overcome the disturbance in supply activities to support the production operations [9, 11]. For manufacturers, the identification of responsive indicator is classified based on the ability of manufacturer to handle the volatility of demands that influence the production plans [4]. From reviews, a total of 28 performance indicators of RM practices were identified. It was then categorized into seven proposed dimensions of responsiveness, i.e., financial management, innovation, environmental management, management information system, manufacturing capability, market trends, and material and resource management.

All these dimensions were then used as the main essence in deliberating the approach to integrate the responsiveness indicators in manufacturing practice. Afterwards, the discussion on each dimension is carried out in explaining how these dimensions can be customized in establishing the responsiveness in manufacturing practices. The flow of the research method is illustrated in Figure 1.

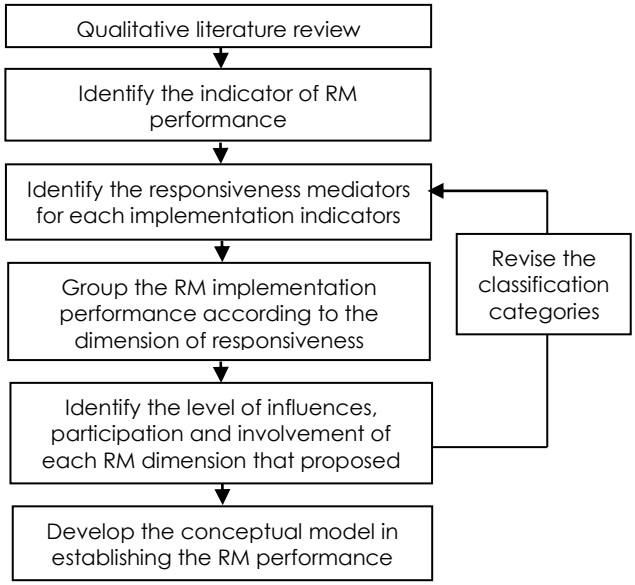


Figure 1 Research method

3.0 DIMENSION OF RESPONSIVE MANUFACTURING PERFORMANCE

Manufacturing sectors have undergone various cores transformations in operations to confront the challenge in the global market. The increase of environmental regulations, variations of demand pattern, volatility of material costs, scarcity of raw material, and the awareness to quickly react to the changes of business climate are among the challenge that has urged manufacturers to revolutionize their current manufacturing practice [4, 12, 13, 14, 15, 16, 17]. In dealing with this challenge, ascertainment of the factors to approach the RM performance is needed. With increasing competition in meeting global market needs, this performance is a prerequisite to outperform the competitors for long term operations [7]. Cooperation among interrelated parties who have a discernible interest will transform dramatically the adaptation level of RM practices to help manufacturers confront this challenge [3]. From literatures, seven dimensions had been suggested to be considered by manufacturers in establishing the responsiveness in manufacturing. The description of these dimensions is described in Table 1.

Table 1 The dimension of responsive manufacturing and its descriptions

Dimension in RM	Description
Market Trends	The overall direction of the market environment based on demand pattern or behaviour varying over the time [1], [6],[8],[12],[18]
Management Information System	Communication interaction in channelling the information within organization to quickly respond to the changes [7],[19]
Environmental Management	Organizational responsibilities in maintaining ecosystem performance to exploit the marketability of products and services [5],[7],[15],[18],[20]
Financial Management	Aim to control the financial flows effectively in any situation to achieve organizational objectives [7],[18],[19]
Manufacturing Capability	Strategic role by manufacturers in transforming production plans to absorb any changes in demand [1],[6]
Innovation	The ability to streamline the action to balance the product development cycle with customer needs [1],[13],[18],[21]
Material and Resource Management	Integrated approach to manage the material and resources to support the production plans and avoid any disruption in manufacturing operations [8],[18],[22]

Manufacturer involvements, effects of customer perceptions, and supplier participations in the supply chain are three mediators that contribute and influence the proposed dimensions of RM performance. These subsequently influence the role in

determining the actions to respond to the disruptions of production plans, and the ability to increase the speed of supply chain performance in fulfilling the customer expectations and demand fluctuations [8, 9, 10, 23, 24, 25, 26]. All the responsiveness mediators identified to have a multi-lateral relationship with seven dimensions of RM implementation performance. The relation of RM dimension, responsiveness mediators and the indicators of RM implementation is summarized in Table 2.

Table 2 Dimension, indicator of implementation and responsiveness mediator

Dimension of responsiveness	Indicator of implementation	Responsiveness mediator		
		Supply chain	Manufacturer	Customer
Market Trends	Respond to the market changes or fluctuation demand pattern [1],[5],[13],[16],[17],[27],[28],[29],[30]	•		•
	Utilize green material in product development [15],[18],[29]		•	
	Respond to the customer opinions on products and services provided [7],[20],[31]	•		•
	Regularly evaluates product satisfaction by customers [7],[11],[13],[32]	•	•	•
	Regularly investigates the effects of the market condition on economic situations [5],[7],[10],[14],[22],[27],[31],[33],[34]	•	•	•
Management Information System	Respond to customers need and changes in a timely manner [6],[7],[9],[11],[12],[13],[31]	•		•
	Regularly distribute the latest information to all departments [4],[7],[9],[18],[19],[21],[22],[31]	•	•	
	Establish proactive interaction with external communities [4],[6],[7],[11],[15],[28],[31]	•		•
	Use the reliable information and communication technologies [1],[4],[11],[12],[18],[22],[27]	•	•	•
Environmental Management	Implement the pollution prevention programs [5],[16],[29],[35]		•	
	Establish a corporate environmental policy [5],[15],[16],[33]		•	
	Provide adequate organizational support [5],[15],[16],[21],[29],[34],[36],[37]	•	•	
Financial Management	Respond to products price changes [1],[5],[7],[10],[22],[27],[29],[31]	•		•
	Consider the investment trade off decisions (capacity, production, inventory) [11],[13],[27],[31],[34]	•	•	
	Use strategic resource and actions in marketing strategies [7],[9],[10]		•	
Manufacturing Capability	Able to adopt the customers change request after the initial entry of orders [1],[4],[9],[12],[13],[19],[22],[27]	•	•	•
	Adopt the concurrent engineering and flexible manufacturing [3],[4],[13],[21],[28],[37]	•	•	•
	Establish strategic strategies for anticipating demand changes [1],[4],[6],[8],[10],[11],[12],[17],[28],[29]	•	•	•
	Product are produce and deliver as needed (right amount, right time, right quality) [3],[4],[6],[9],[10],[13],[14],[21],[22],[27],[31]	•	•	•
Innovation	Able to redesign process to support the configuration of design [27],[28],[32],[35]		•	
	Integrate market feedback and product information in the innovation process [1],[4],[6],[7],[9],[18]	•	•	•
	Introduce innovative product with shortening development cycle [1],[[3],[6],[8],[9],[10],[11],[12],[22],[31],[32]		•	
	Respond to market competition, technology and environmental legislation [5],[7],[16],[30],[33]	•	•	•
Material and Resource management	Utilization of new resources [7],[9]		•	
	Consider the changes of the material in operation [32],[20],[9]		•	
	Improve material consumption, material flow and inventory control [11],[21],[30],[31]	•	•	
	Utilize various resources to meet the customers need and react to competitor decisions [7],[9],[10],[18],[34]		•	•
	Establish supplier integration within the organization [3],[4],[11],[14],[27],[28],[37],[31]	•		

3.1 Market Trends

The propensity to respond to market trends for short term or long term will influence the direction of the business either generate a profit or losses. The level of responsiveness on this dimension is essential in stabilizing the operations and the financial performance through a dynamic price controls. This will influence significantly to the growth of business, either makes the business becomes saturated, booming or vice versa. The willingness to regularly investigate the market condition and react to market changes allow the manufacturers to exploit their available resources strategically, and becomes a competitive player in the current business environment in achieving a superior financial performance [7, 9, 10].

According to Lim and Zhang [1], there are two market change situations: new product introductions, and demand fluctuations of existing products. In approaching this dimension, manufacturers must shift from fixed-capacity operations to the customer-responsive orientation operations in addressing both changes. Demand patterns, customer perceptions, customer satisfaction, market volatility, economic situations, and the use of eco-material in products are the useful input that must be underlined in this dimension. Ability to react to market trends by considering these inputs will let manufacturers make a strategic decision in aligning the manufacturing operations. This will allow the manufacturer to define the duration of product life cycle, production volumes, and time window for change [6, 38].

In pioneering the new markets, proliferation of product varieties in fulfilling customer request should not be ignored [4]. This includes the response to the requirement to utilize green technology and eco-friendly material in product development to conserve the environmental [35, 39, 40]. By considering the environmental responsiveness, manufacturer can be more proactive in managing the future market [20, 33, 41]. Thus, manufacturers should always ask for customer opinions on the product and services provided [42, 43]. It is useful in ensuring the development of products is evaluated regularly to satisfy the customer needs and enhance the marketability of the product [44]. In fact, the consideration of market trends in establishing responsive manufacturing performance can be used to develop a self-assessment strategies in pioneering the new marketing strategies [29]. This allows the manufacturer to adjust the flow of material and resources required in managing the production capacity to quickly respond to the sudden market changes or the internal system change [21]. The direction of responsiveness against market trends is illustrated in Figure 2.

3.2 Management Information System

In establishing the RM performance, the use of management information system is compulsory. The use of reliable information and the sophisticated information communication technologies allow manufacturers manage the flow of market information effectively to achieve superior performance of responsiveness [7, 12].

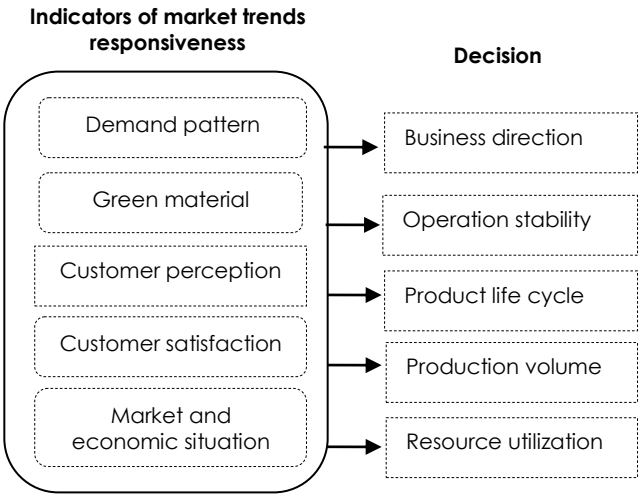


Figure 2 Responsiveness indicators of market trends

The focus on the development of efficient information management will give advantages to manufacturers to respond to any changes and meet customer needs in a timely manner. In fact, it's become a vital success factor for the manufacturer that has a policy to accept customers' change orders, in which all changes must be processed as quickly as possible [19, 45, 46]. The decent information management will affect the level of robustness manufacturing performance [9]. Hence, the information transparency [9], availability of information [27], interconnected information networked (level and quality) [22, 31] should be dealt with wisely. High responsiveness level in this dimension will increase the reliability level of latest information structure, which should always be distributed regularly to all departments involved for immediate action. Besides, the responsive information has high rated in establishing the proactive interaction with stakeholders and external parties [3, 20]. This is much needed for information exchange in handling that confounded by rapid changes in business operations and customer demands across business units.

Effective cross-organizational information sharing in this situation will ensure the decisions made operationally, tactically, and strategically [4, 21];. This will make operation becomes more transparent with more realistic measures s in approaching the high RM level. This suggests that in establishing the responsiveness level in manufacturing, the seamless and instant information flow between suppliers, manufacturers and customers is vital in manufacturing operations [47]. In general, the influence of management information system in establishing the manufacturing responsiveness is shown in Figure 3.

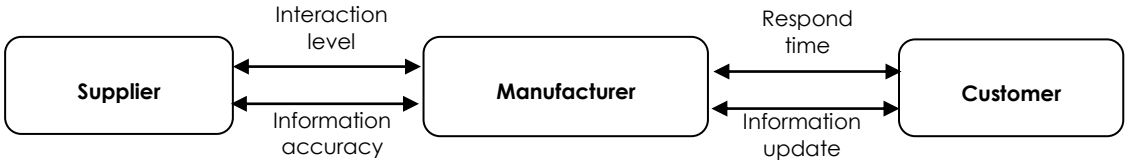


Figure 3 Influence of management information system to approach the level of manufacturing responsiveness

3.3 Environmental Management

The responsiveness on environmental management has become a vital success factor for manufacturers in tandem with the increasing of stiff competition in fulfilling the customer needs [7]. The focus on this dimension will encourage the sense of responsibility through the development of strategies, policies, objectives and targets [20, 48]. It will increase the appropriate corporate marketing initiatives through marketing mix strategies involving product, place, price and promotion [15]. Antecedents, drives and responsive components of environmental management must be determined wisely in approaching this dimension because the level of responsiveness is largely influenced by social judgments and perceptions. This has much contributed in choosing a pioneering strategy to tackle the environmental hostility and creating better environmental dynamism to expand business and market opportunities [29]. According to Sandhu *et al*. [16], this dimension could be approached and realized through two distinct levels. Level one stressed on the policy that aim at pollution prevention, and level two emphasize on product stewardship stage (see Figure 4). Both levels are genuinely important in influencing the environmental responsiveness to meet global market challenges.

The explicit support and commitment from top management is crucial in establishing the credential of this dimension. It will reflect the level of organization environmental responsiveness through appropriate strategic decisions to respond to the environmental issues [33]. This will produce environmental product benefits in tandem with technical and economic cost-effectiveness management [5].

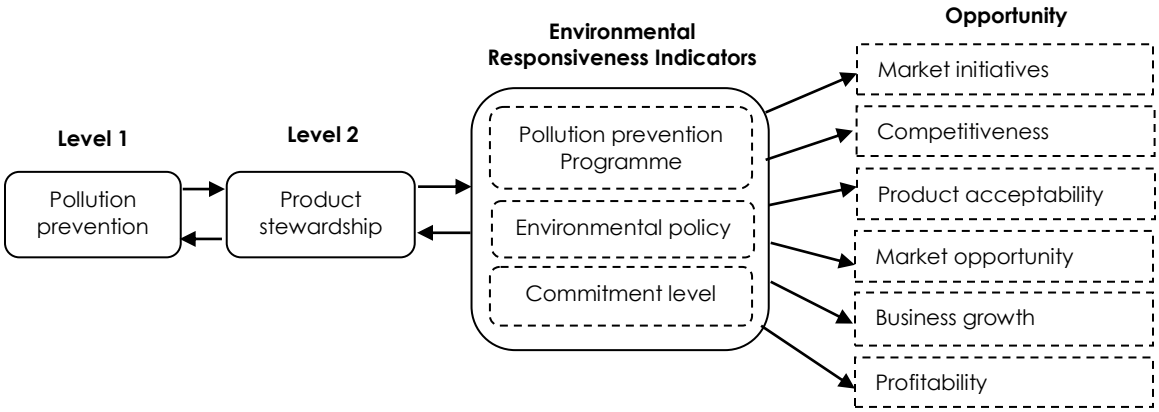


Figure 4 Levels and opportunities in responding to environmental responsiveness indicators

3.4 Financial Management

As a core component of business, the involvement of top management is mandatory in establishing this dimension. It has required the involvement of top management in determining the level of equity capital, cash flow and business funds for profit maximization [30]. It is not only contributing in determining specialized function of production line, but also involving the management of the capacity of resources in operations [34]. High focus of this dimension in adapting the RM practices will force manufacturers develop better plans to raise the operating capital, and allocate correct capital budgeting in dealing the market volatility. Besides, the organizational responsiveness towards its customers and competitors will enable manufacturers to exploit its resources in establishing market strategic plans [7]. It is vital in dealing with the challenge of satisfying the demand of customers that want high quality products, but low price [22]. Thus, manufacturers must respond quickly with any price changes, and it is unavoidable in approaching this dimension [1, 5, 29, 31]. This input will help manufacturers determine the most critical

determinants in dealing with the changes of cost involved [19]. It is consequently influenced the level of trade off decision involving capacity, production and inventory [11, 13, 27, 31].

Awareness in focusing this dimension becomes a backbone in shaping the strategy in establishing the RM performance. It will influence how manufacturers use its resources strategically, and how the strategic action is planned in developing the marketing strategy and business direction in establishing competitive marketing advantages [9, 10]. Figure 5 shows the relation between constraints, inputs and decision in establishing financial management responsiveness.

3.5 Manufacturing Capability

This dimension is obligatory in planning the volume of products that should be produced by production line in a given period using available resources. Its enable manufacturers execute the production planning in tandem with business strategy using a combination of different manufacturing resources, both tangible and intangible. Customers have become harder to satisfy [6]. In coping with the volatility of the global marketplace, manufacturers must respond to this dimension. Global competition, short product life cycles, changes of demand pattern, product varieties and internal uncertainties (material shortage, limited resources or machine breakdown) must be considered in establishing this dimension [1].

According to Salvador and Forza [28] and Váncza *et al*. [3], the industrial production dramatically changed. It was characterized by the customer expectation that requires shorter delivery time, customized and personalized products at a high level. This has become a key competitive factor in responding to the customer request or change [4]. The focus in this dimension relatively can avoid the disruptions and provide improved customer responsiveness [8]. It will influence the speed of agility at which the product reaches the customer, and how manufacturers adopt the customers' change request after the initial entry of the orders, particularly for the manufacturer that accept the policy of customer change order [10, 19]. Figure 6 shows the potential driving factors and outcomes against the responsiveness of manufacturing capability. In achieving a high level of responsiveness of this dimension, the implementation of concurrent engineering and flexible engineering has a significant impact in this dimension [49]. Ability to adopt these principles has a significant impact in establishing the strategy for anticipating the demand changes [50]. It will ensure the products are produce and deliver as needed at the right amount, at the right time with the right quality [3, 22].

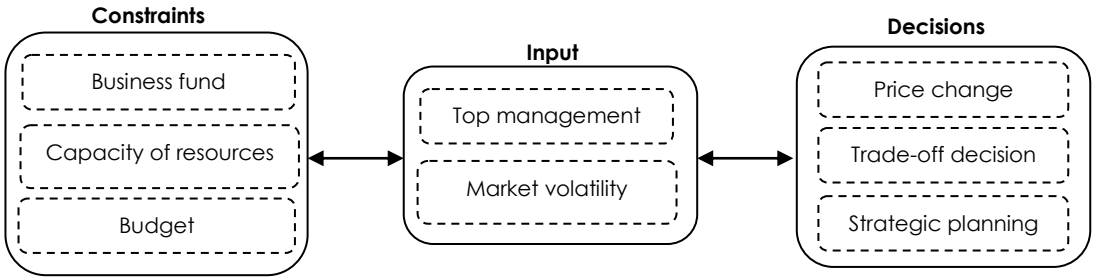


Figure 5 Relationship between constraints, inputs and decision in establishing financial management responsiveness

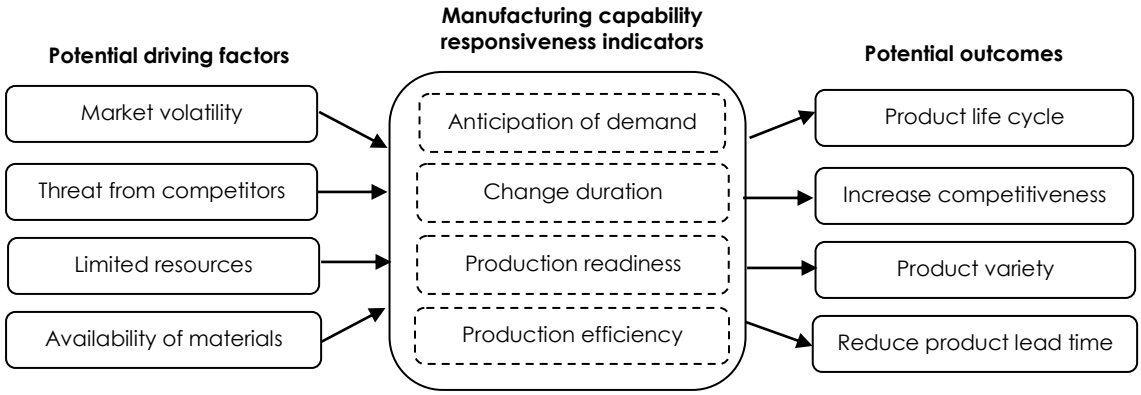


Figure 6 Potential driving factors and outcomes in approaching manufacturing capability responsiveness

3.6 Innovation

The readiness of manufacturer on this dimension has high consequences in realizing the RM practice. The awareness of this dimension will encourage manufacturer to develop the best solutions and strategies to meet new requirements or existing market needs [51, 52, 53]. Market feedback, and product information are imperative input in approaching this dimension [1, 29]. It will help manufacturers track issues and trends for better decisions in operations. Thus, appropriate attention must be taken into account in ensuring both of information can be accurately integrated comprehensively.

In general, this dimension can be realized through the innovation in production practices, product development and market competition. The innovation in production practices can be implemented through the focus in redesign the process to support the configuration of design and market volatility [9]. The blending of new and existing idea in this process will improve the efficiency of product design in producing better products [31]. Moreover, it's also allowed manufacturers to change the production operation, so it can run smarter, faster and simpler in a more efficient way of coping with any changes, and outperform the competitors in the long term [3]. This suddenly enable manufacturers to exploit its resources in achieving superior financial performance [7].

In terms of product development, the focus on introducing the innovative product with shortening development cycle is essential in improving the responsiveness to customer demand and process variations [22]. Lower material utilization, and reduce manufacturing costs and support costs should be considered in these terms. Thus, accounting of materials, engineering design and manufacturing process have to be integrated in the development of product design [28]. This will help manufacturers build and maintain its existence in a competitive market environment on global operations.

As for market competition, this dimension requires manufacturers respond to the changes in the industry in terms of competition, technology, and environmental legislations [5, 33, 37]. This will influence the span of planning and execution in entire manufacturing operations in meeting demand changes through the synchronization of engineering and management in dealing the tides shift in the market. It will help to strengthen the operation, and avoid wide-ranging repercussions on quality issue which may influence on consumer acceptance and product reputation. On top of that, manufacturers can coordinate a flexible practice within better value of chain in operations [6, 13].

3.7 Material and Resource Management

The meticulous effort in supervising this dimension has influenced on financial performance, storage availability, and distribution of facilities. It does contribute to the readiness of production floor in responding to the volatility of the demands and changes of customer orders [54, 55, 56]. The consideration of this dimension in establishing RM performance requires manufacturers emphasizes on the deployment of an organization resources involving financial resources, inventory, manpower, production resources and material [27]. It will impact the schedules and budgets in levelling the material and resources used for achieving manufacturing system efficiency and flexibility [6]. The signals, factors and indicators in establishing the material and resource management responsiveness is depicted in Figure 8. In this dimension, the consideration in changing the material used in production with materials that are more efficient, economical and environmentally friendly is extremely rational to be implemented [20]. This will help to reduce the production cost, as well as in responding to the current market needs and legislations [57, 58, 59]. In a business where revenues are dependent on product sales, the ability to improve material consumption, material flow and inventory control has a profound impact against the performance of manufacturers in fulfilling the RM performance [21]. Focus on eliminating excess inventory, efficient in managing inventory change volume with less material inputs is necessary in response to sudden market changes or intrinsic system change [5, 11, 14 31]. It can be more valuable through the establishment of supplier integration in the supply chain within the organization [39].

According to Wong *et al*. [13] and Zhang *et al*. [60], willingness in adopting market responsive supply chain allows manufacturers plan a necessary buffer inventory to reduce lead time, and provides fast and reliable delivery. This expected to increase in sales and profitability instead of suffering from excessive lost sales and obsolete inventory. Robustness in the supply chain will influence the speed at which products reach the customers [9]. On top of that, the manufacturer must also consider the development and utilization of new resources [7]. Effective and proactive resource management will deliver the utmost optimization level in allocating the resources [10]. This will drive the highest utilization of various resources to meet the customer needs, and in responding to the competitors' decisions. This will ensure the resources are provisioned in advance of business needs, and align with overall business priorities and objectives.

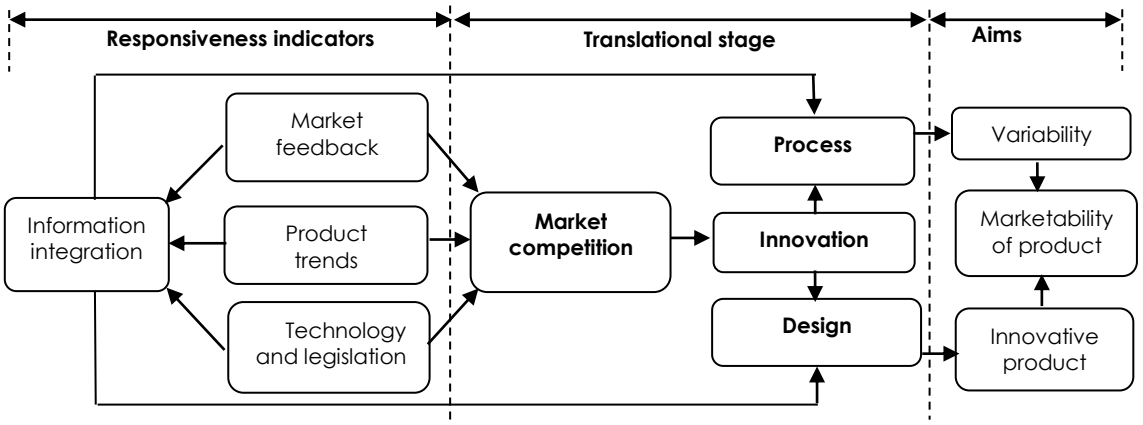


Figure 7 Translational stages in establishing innovation responsiveness

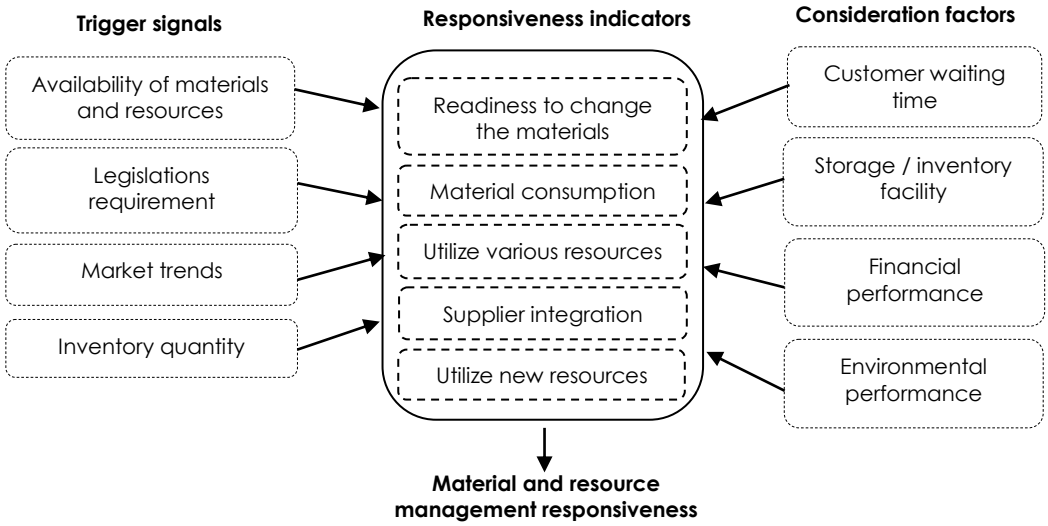


Figure 8 Trigger signal, factors and indicators in establishing material and resource management responsiveness

4.0 CONCLUSION AND FUTURE RESEARCH

Three responsiveness mediators: customers, the supply chain, and manufacturers are identified to contribute significantly with each other in establishing the RM performance. All three mediators have a large influence in formulating the plan to realize the RM performance, especially in strengthening the performance to continually remain competitive in the global market. From literatures, focus in tandem of continuous effort in seven transformation dimension as proposed, namely market trends, management information system, environmental management, financial management, manufacturing capability, innovation and material and resource management able to increase the chances of manufacturer in approaching and establishing the RM performance in manufacturing operations.

Demand pattern, utilization of eco-material, customer perception, customer satisfaction, market and economic situations are the information that should be evaluated and refined in the dimension of market trends. This will ensure business is executed collectively, so that business continuity can be maintained for a longer period of time. In the dimensions of management information system, response time, information updates, interaction levels, and information accuracy are the criterion that needs to be emphasized to support the development of the RM performance. This will improve the efficiency in identifying price change; determine the trade-off decisions, and establishing strategic planning in financial management dimensions. These indicators are vital to survive against any climate change in manufacturing.

As for the dimension of manufacturing capability, the level of responsiveness is fuelled by change duration, production readiness, anticipation of demand, and production efficiency. The particular attention to these changes will influence the ability to

handle any change requests in efficiently and quickly. This potentially improves the level of competitiveness in increasing the market of the product produced. In the innovation dimension, indicators such as increase the process variability, integrate the market information on products; produce more innovative products, and the adaptation of technologies and legislation in products able to improve the level of responsiveness to current markets as well as operational performance. This is important in strengthening the business existence, particularly in balancing the financial allocations in manufacturing operations. Meanwhile, for the dimension of materials and resource management, reasonable use of resources, readiness to change the material with more efficient material, the level of material consumption, ability to utilize various resources, and supplier integration will provide a substantial implication in balancing the production floor, financial management, and ability to meet market changes. All the dimensions and its indicators that proposed in establishing the RM performance are summarized in Figure 9.

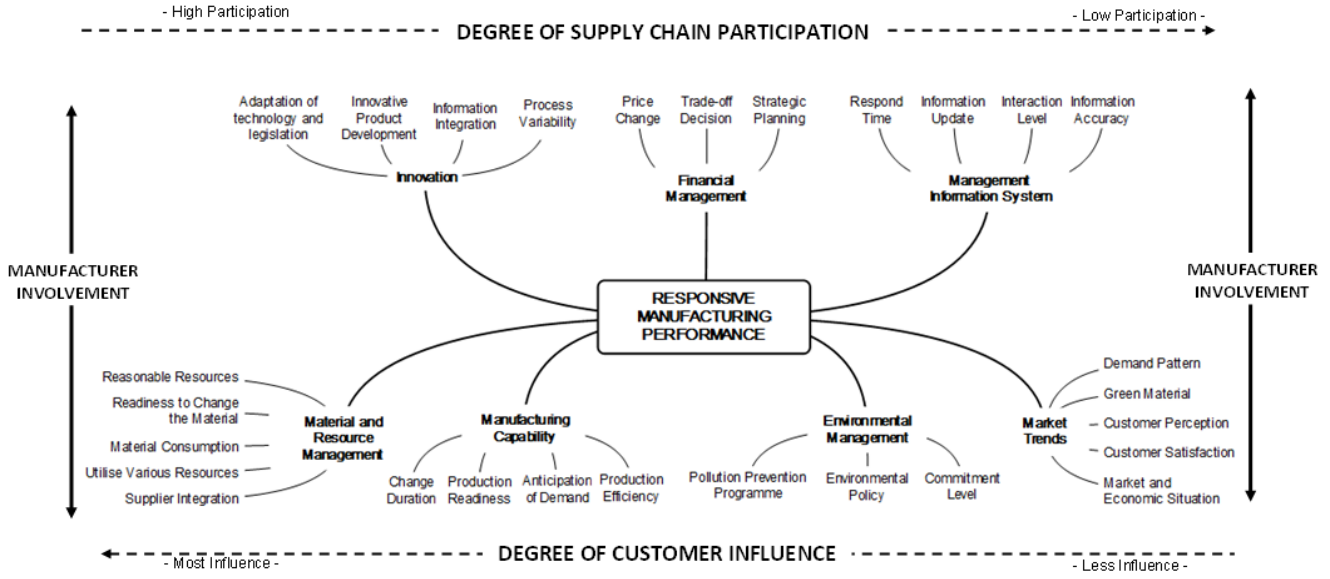


Figure 9 Level of participation, influence and involvement of responsiveness mediators in establishing the responsive manufacturing performance

For future research, the questionnaire survey in Malaysia's manufacturing industry is proposed as a target to investigate the reliability and validity of the proposed dimensions. This approach was used since it is the available method in collecting the data from large populations [61]. The findings will be used to establish the diagnostic model to reach the required level in RM practices. This potentially helps the manufacturer and academician to develop a better strategy in enhancing the effectiveness of RM practices, primarily in shaping the strategic manufacturing performance to achieve the sustainable manufacturing practices.

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