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UNDERSTANDING RESPONSIVENESS IN MANUFACTURING OPERATIONS

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ABSTRACT: *A High responsive company becomes one of the most useful and necessary capability in today's competitive markets. In the context of manufacturing, responsiveness has been referred as the ability of manufacturing company to respond quickly customer demands and market changes. Hence, it is crucial for manufacturing companies to acknowledge the fundamental elements of responsiveness in their operations. Responsiveness in manufacturing industries has significant impact on company's competitive priorities mainly the delivery speed. Thus, this paper presents a proposed model of fundamental elements of responsiveness in manufacturing operations. A thorough study on literatures in relevant context such as flexibility, agility, responsiveness, etc. was done in clarifying the fundamental elements. Results of the study conclude that responsiveness in manufacturing operations consists of four paths: (i) Drivers, (ii) Enablers, (iii) Measures, and (iv) Impacts. The fundamental elements of responsiveness have been clarified according to the four paths. Then, the Manufacturing Responsiveness model is developed based on the concept of manufacturing Input-Output system. Relationship between the fundamental elements itself will be analysed in the next phase of this study.*

KEYWORDS: Manufacturing Operations, Responsiveness, Fundamental Elements, Drivers, Enablers, Measures, Impacts.

1.0 INTRODUCTION

The Fast pace development in the process technology and customer driven market causes fierce competition in the manufacturing business environment nowadays. It is essential for manufacturing companies to stay competitive and profitable for a long term survival in their industries. Hence, being responsive to the unpredictable changes in business requirements and customer demands has posed critical challenges to company survival.

Thus, this paper proposes a model of responsiveness in the context of manufacturing operations. The elements of responsiveness represent as the fundamental elements of responsiveness. In this regard, manufacturing companies should acquire these elements in order to be responsive in their manufacturing operations.

Up to this date, there are only three responsiveness models have been developed with regards to responsiveness issues in supply chain and customers. Holweg [1], and Reichhart and Holweg [2] developed frameworks for supply chain responsiveness. Both frameworks emphasize the concept of supply chain and its strategies. Kurnaz [3] proposed a framework for customer responsiveness in the context of assessing a variety of sequencing policies and to analyze how these policies perform under real world condition. It has been proved that reliable operations have actually aided responsiveness [1-3].

This paper is divided into five sections. After the introduction, the definitions of responsiveness are clarified in the second section. Then, the third section reviews the need of responsiveness in the aspects of manufacturing industries. The following section explains the proposed model of manufacturing responsiveness and its fundamental elements. Conclusions of the subjects discussed early are presented in the last section.

2.0 DEFINITIONS OF MANUFACTURING RESPONSIVENESS

The term responsiveness has a number of definitions which depends on where the area of responsiveness is applied. Bernades and Hanna [4] believed that the conceptualization of the term is still lagging. In 1993, the early definition of responsiveness had been viewed in a very general context. Tunc and Gupta [5] described responsiveness as the time when dealing with the customer. A few years later, Matson and McFarlane [6] defined responsiveness in the context of manufacturing application. They clarified responsiveness as the ability of a production system to respond to disturbances (originating inside or outside the manufacturing organization) which impact upon production goals. In this regard, responsiveness is seen as a requirement for an organization to achieve their goals. Responsiveness has also been viewed as the overall capability to seize business disturbances by other researchers [7-10]. Zhihong et al. [10] defined responsiveness in more specific context. They refer responsiveness as the ability to swiftly confirm the specifications and delivery dates of customers' orders. Similar definition identified as the speed of fulfilling customer orders [8, 11, 12]. Responsiveness has been defined as the ability to respond time effectively [1, 7, 13, 14].

Overall, responsiveness can be described as 'time to respond' to customer demands in the meant time serves ability to compete in rapid market changes. Thus, this paper defines responsiveness as the capability of manufacturing operations to be timely responsive in fulfilling customer demands and subsequently compete in the rapid market changes.

3.0 THE NEEDS FOR RESPONSIVENESS

As the world market becomes increasingly rapid and dynamic, manufacturing companies require responsive manufacturing systems that are capable of responding rapidly to market changes in order to fulfill customer requirements and to rival with business competitors [15]. The markets are influenced by intense foreign competition, shorter product life cycle and customers increasingly unwilling to settle their demands with limited value [16-18]. These issues demand greater responsiveness to a dynamic set of requirements and a new competitive environment [15, 19] which eventually expose companies to compete for their survival in the industry.

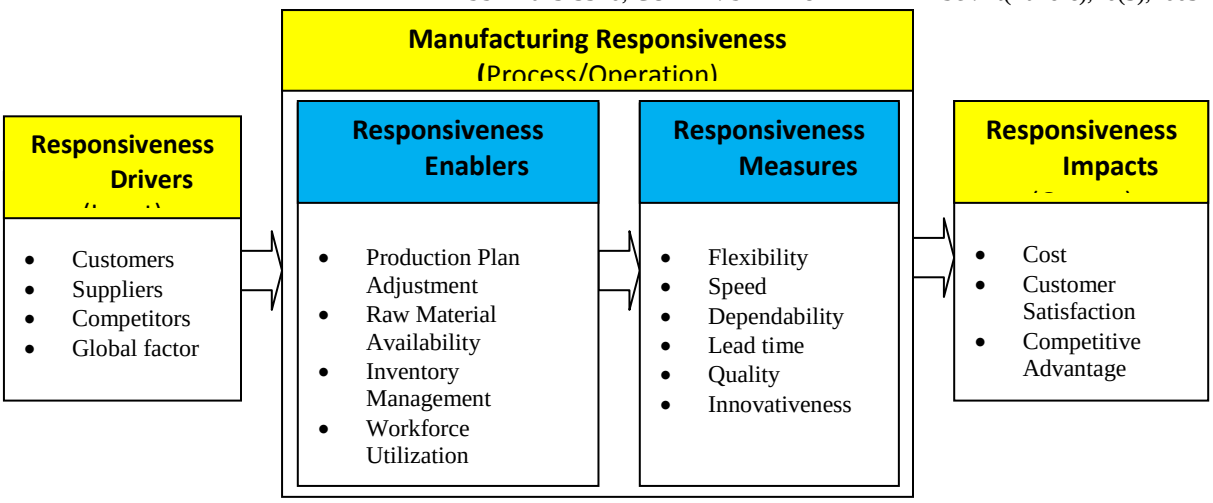

Figure 1: Proposed model for responsiveness in manufacturing operations

Table 1: Components description of the proposed model

Elements	Components	Descriptions
Responsiveness Drivers	Customers	Variations in customer demands drive the company to be responsive.
	Suppliers	Reliable suppliers drive the company to be responsive
	Competitors	Competitors drive the company to gain advantage and compete in market place.
	Global Factor	Social changes, Technological developments, Economic changes and Political changes (STEP factor) are the global factors have driven the company to responsiveness.
Responsiveness Enablers	Production Plan Adjustment	Responsiveness needs for ability to quick response on demand changes in production plan adjustment.
	Raw Material Availability	Responsiveness needs for ability to provide critical raw material availability for ensuring adequate level for production.
	Inventory Management	Responsiveness requires for flexible inventory level to meets customer demand.
	Workforce Utilization	Responsiveness requires for flexible workforces to deal with demand fluctuation.
	Information Technology	Responsiveness needs for ability to make a quick decision making.
Responsiveness Measures	Flexibility	Total number of product variety and volume changes of each product variety.
	Speed	Response time needed for each order.
	Dependability	On-time delivery as per schedule.
	Lead Time	Total production time that starts from customer order entry to the delivery of finished product.
	Quality	Total defectives include rework and reject.
	Innovativeness	Number of process innovations versus number of product variety.
Responsiveness Impact	Cost	Being responsive will increase following costs: • Cost of adjusting capacity, changing labor force levels and changing the ways of using technology to respond to fluctuations in volume. • Overhead cost due to more complex technology for producing high product variety to fulfill customer variety requirements • Holding cost for keeping inventory and holding products before they are demanded due to respond to variation.
	Customer Satisfaction	Being responsive will increase customer satisfaction in term of: • Quick respond • Respond to what customer want • Fulfill customer requirements accurately
	Competitive Advantage	Being responsive will increase competitive advantage of the company: • React quickly and purposefully to commercial opportunities and threats. • Flexibly to its environment and meet the emerging challenges with innovative responses.

Corresponds to the definition of responsiveness in the context of manufacturing operations, Carter and Baker [20] believed that "speed to market" is the main concept to company survival. According to Cooper and Kleinschmidt [21], a shorter product life cycle result in reduction of product development times to meet quickly changing market

needs that gives a major impact to manufacturing operations. In this regard, the organization with the ability to respond quickly is likely to win the market order. Meanwhile, Keen [22] claimed that responsiveness should be based on a holistic approach, with the customer "get it right first time", and close relationships with suppliers through appropriate information systems. Therefore, responsiveness is necessary for the new era of global market. It is crucial for manufacturing companies to be competitive and survive in their industry.

4.0 PROPOSED MODEL FOR RESPONSIVENESS IN MANUFACTURING OPERATIONS

The fundamental elements of responsiveness presented in the model are determined through literature studies in the context of manufacturing operations. At least one hundred journals have been targeted in order to clarify the fundamental elements that contribute to responsiveness. As a result, 118 relevant journals on manufacturing operations were thoroughly studied. Analysis on the statistical data of the most cited elements were done by identifying the similarities in term of its definition. Using the basic concept of 'Input-Output (IO)' system, the proposed model of responsiveness is developed based on the basic concept of manufacturing 'Input-Output (IO)' diagram. Thus, the model consist of three major components; (i) Input, (ii) Operations/Processes, and (iii) Output.

In this paper, the Input component has been referred as responsiveness drivers. Barclay et al. [11] defined responsiveness drivers as the events or influencing factors to which the company has to respond. In this regard, the responsiveness drivers are concerned with changes in both of the company's internal events and external environment [16]. In this study, four elements of responsiveness drivers are identified as [4, 11, 12, 23]: (i) customers, (ii) suppliers, (iii) competitors, and (iv) global factor.

For Operations/Processes component, it is referred as manufacturing responsiveness that consists of responsiveness enablers and responsiveness measures. Responsiveness enablers refer to the methods of creating responsiveness [14] such as production plan adjustment, raw material availability, inventory management, and workforce utilization. These are the methods which support the responsiveness in manufacturing operations [11, 24]. Responsiveness measures have been referred as measureable elements of responsiveness that present the performance of processes/operations. In this regard, time is the scale used for responsiveness measures. Thus, the elements of responsiveness measures include flexibility [1, 25, 26], speed [11, 25], dependability [2, 5, 25, 26], lead time [1, 2, 11, 27], quality [2, 11, 25] and innovativeness [15, 19, 28, 29].

Responsiveness impacts represent the Output component. In this paper, responsiveness impacts refer to the positive and negative impacts on manufacturing cost, customer satisfaction, and competitive advantages of manufacturing company. Responsiveness influences cost of production through volume fluctuation, variety requirements by customers, and variations (i.e. processes/operations) [24, 25, 27]. Responsiveness increases customer satisfaction with a highly responsive company [11, 25, 30, 31]. Customer satisfaction in responsiveness refers to quick respond to customer demand, prompt fulfilment of any requirements and its changes, and deliver quality products [14]. Responsiveness enhances manufacturing competitive advantages that is referred as the ability to react quickly and purposefully to commercial opportunities and threats which are flexible to its environment in meetings the emerging challenges with innovative responses. [13, 32, 33].

Figure 1 presents the proposed model of manufacturing responsiveness. The fundamental elements of responsiveness are presented according to responsiveness drivers (input), manufacturing responsiveness (processes/operations), and responsiveness impacts (output). Descriptions of each fundamental element are shown in Table 1.

5.0 CONCLUSION

The proposed model of manufacturing responsiveness presents the fundamental elements of responsiveness that are correlated with each other in the forms of responsiveness driver, responsiveness process/operations, and responsiveness impacts. The proposed model is developed based on the basic concept of Input-Output system in the context of manufacturing operations. Thus, it is crucial for manufacturing companies to have all the fundamental elements of responsiveness in order to survive in the rapid changes of market demands. The Relationship between the fundamental elements will be analyzed in the next stage of this research.

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