

Performance Indicator For Assessing The Implementation Level Of Mass Customization In Thailand's Textile And Apparel Industries

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ABSTRACT – Mass Customization has been perceived as a concept playing a crucial role in the delivery management of textile products according to fashion trends. At present, the production purposes, which aim at serving customers' needs, have completely changed due to the variety of demands, while the number of lot size orders is dramatically decreasing, causing a need to reduce delivery leadtime. Besides, there are also other demands, having changed. As opposite to the production systems in textile industries, the emphasis is still on Mass Production, which is considered as inflexible in terms of manufacturing process and technology management. This article, therefore, aims at proposing a tool that helps assess the implementation level of Mass Customization employed in textile industries, depending on three major factors: 1) Customer's need, 2) Manufacturer's readiness, and 3) Supplier's readiness. Each factor affecting the readiness of Mass Customization Implementation was obtained from exploratory research, using focus group and in-depth interview. The implementation of Mass Customization is divided into three levels, from levels one to three. The significance of this assessment can be used to consider how Mass Customization is effectively employed in particular textile industries.

Keywords – Customer's need, Manufacturer's readiness, Performance indicator, Supplier's readiness

I. INTRODUCTION

Recently, a viewpoint of economic and technological development has been significantly changed due to some principle factors including the evolution of scientific and technological matters. When analyzing the world's reports, it can be seen that the growth of technology information and communication has dramatically increased and played a crucial role in everybody's life. As perceived, the spread of news as well as information has been done rapidly and easily because of such global networks. That is, the world's communication, in particular, can be seen as though each individual stayed close to one another.

Owing to the glory of such global communication as mentioned above, human lives, ranging from daily routines, business management to society administration have also been dynamic, especially, in the field of business errands, which majorly emphasize customers' responses in order to make all clients as impressed as possible. In terms of technology, the changes that can be obviously seen are the widespread use of the internet. So far, computers have been variously improved and modified so as to serve consumers' desires. Besides, the development of mobile devices has been done along in order to, again, respond to consumers' life styles in different angles. As a result, particular creativity has been aroused, and this has, therefore, led to the invention of new innovation, on which systematic development has been focused; that is to say, a large number of data are able to be gathered and analyzed with no difficulty, which is beneficial to a dramatic increase of such new created innovation. In addition, the flexibility of production management and the efficient manufacturing process are also included in this instance. Importantly, this facilitates low-cost production and the quantity of goods produced throughout the supply chain process.

With regards to Thailand's garment industries, the development has, so far so fourth, been being pursued. The status of most of the production viewed in factories is a mere hired manufacturer, called OEM (Original Equipment Manufacturer). The textile industries in Thailand are considered as weak in either research or development and lack the school of thoughts regarding innovation. The total number of research in terms of textile having been, up to the year of 2010, conducted in Thailand is only 371 studies excluding the 73 pieces of research on garments. Meanwhile, the national policy requires the sustainable growth and potential from the development of textile and garment industries by encouraging those who are still a hired manufacturer to

become a self producer as well as to have their own brand names (OBM), which can be distributed to international markets and to propose their products to various groups of consumers (ODM). Mass customization aims to impressively respond to consumers' satisfaction by offering the effective production. This idea is, however, against the production that emphasizes a variety of products and the management of low-cost and reasonable production.

At present, the production procedure of textile industries has completely changed on account of the development of communication devices, which keep everybody in this world staying in contact. Also, they are particularly used in business and factories so as to quickly respond to fashion trends in apparel markets. As a result, it is not feasible for textile industries to avoid this kind of technology. Eventually, the concept of Mass Customization is necessarily required. Giovanni Da Silveira, Dennis and FlaHvio (2001) studied Mass Customization and proposed an idea for further research comprising some important factors that could lead to the success of the use of Mass Customization in factory production. Moreover, they also urged that appropriate goods should be adapted according to customers' needs. One of the production process that forms and shapes products from each assemble is called Modular Product. Therefore, to become accomplished, Mass Customization should be a crucial factor that is significant to the production process since it is not only convenient and versatile but also helps reduce manufacturing costs, while the products' quality is still reasonably high.

II. Review Of Related Literature

2.1 Concept of Mass Customization

The concept of mass Customization was first proposed by Stan Davis in 1989 and published in *Future Perfect* in 1996. Davis studied Time, Space and Mass and mentioned about the business strategy that focused on quick response that was the origin of the concept "Any time and Any Place/Anywhere". Later, this concept was continued by B. Joseph Pine II and entitled *Forward by STAN DAVIS "Mass Customization" The New Frontier in Business Competition*, which was published in Harvard Business School Press in the year of 1993. Joseph Pine (1993) recommended a concept of perceiving two bipolar things between the large amount of production and the response to particular individuals. In the past, the large amount of production had to be dependent on quantity, time and quality; in contrast, according to Mass Customization, the creative production responding to consumers' needs related to both products and services was noticed. Consequently, it can be seen that, in comparison to Mass Customization, Mass Production cannot be all the answers of customers since it is not able to serve a variously different group of clients. Additionally, Joseph Pine proposed a management strategy for production development, successful delivery and management systems which were according to Mass Customization.

In addition to the consumers' opportunity to choose goods and services by themselves, it is also mentioned about the response of products to customers in overall picture. Thus, a concept that emphasizes on the consumers' satisfaction is suggested, which is relevant to Chamberlin's research (1962). He employed the theory of competition based on customers' needs, which was perceived as a new paradigm shift. Likewise, Lancaster (1966) mentioned that consumers always sought for products that they did need as well as services that impressed them. In a nutshell, both responses that serve particular purposes and make consumers satisfied are supposed to go together for effective marketing competition.

2.2 Factors of Mass Customization

2.2.1 Customer's need

According to Beaton (2010), the different needs of customers, in the past, were stated. The determination, however, depended on industries themselves; consequently, Mass Production played an obvious role. On the other hand, at present, most business persons have paid attention to customers' needs as they, practically, take the concept of Mass Personalization into action. Here, it is also called Mass Customization. In consistence with J.H. Mikkola (2007), Mass Customization responding to consumers' needs is an emphasis on low-cost production that aims at Thai clients. That is, the more products are produced, the more beneficial a company gets. Therefore, most of the goods in markets cannot serve particular customers with different preferences. Zhou et al. (2008) investigated the consumers' needs, based on their different points of view, which motivated them to buy products.

2.2.2 Manufacturer's readiness

Nowadays, textile and apparel industries have mostly focused on human labor rather than machines because of the production cost. Also, the majority of manufacturing conditions is still dependent upon Mass Production, emphasizing a great deal of goods produced each time, however still largely based on manufacturing operators. That is, the more effective the production can be, the faster and more accurate the

manufacturing plans are, leading to the increase of productivity, which apparently facilitates the marketing competition. Nonetheless, customers' needs have recently been varied. Consequently, the traditional production cannot serve all the demands efficiently, eventually causing such trouble to manufacturers. To sort this problem out, manufacturers must be prompt for Mass Customization production, which is more flexible in terms of designs, machines, and production management. The assessment of implementation level regarding manufacturer's readiness is, therefore, considered as a must.

2.2.3 Supplier's readiness

In relation to suppliers' management, there is also a change, which is different from the traditional production; that is, the duration of delivery, in the past, was longer, and the production planning could be prepared for years with fewer limited conditions. When compared to the present manufacturing systems, the focus is mainly on customers' needs; therefore, the concept of mass customization has affected the production process as well as the delivery periods. Hence, manufacturers have to adapt themselves in order to survive in business competition. The development of production process responding to customers has drawn such interests from a number of researchers. For example, Roderick Edward (2003) examined the effects of the internet on production in industries. Customers could easily approach suppliers via online networks. Due to a vast number of selections, the production management was required to be changed so as to be relevant to Mass Customization.

III. METHOD

3.1 Method and research instruments

3.1.1 This is an exploratory study, using focus group of 20 textile manufacturers, comprising 7 men and women's wears industries, 5 children's wears industries, 3 fabric manufacturers, and 5 home textile manufacturers. In-depth interview was done with 5 industries as samples of the study.

3.1.2 The research instruments were questionnaires and interview.

3.2 Data analysis

In accordance with the data collected from the different industries, the performance indicator was developed in order to assess the implementation level of Mass Customization, which was then authentically used with one company, selected as a representative. Also, this was a well-known original design manufacturer (ODM) in Thailand. The implementation levels of Mass Customization, concerning three factors, customer's need, manufacturer's readiness, and supplier's readiness, are presented in Findings.

IV. FINDINGS

With regards to the analysis of the implementation level of each factor, the data were analyzed, using a particularly created formula.

4.1 Assessment of customer's need

The statistics used was percentage, which was then calculated with a particularly created formula, in order to measure the levels of the evaluation scores, ranging from 1 to 5.

$$\text{Customer of Score levels} = [(\% \text{ of Evaluation (X)} - 1)/20]+1$$

$$CX = [(Ex-1)/20]+1$$

$$\overline{CS} = \sum_{i=1}^n \frac{CS_i}{N}$$

as $x - 1/20$ was only calculated in integers.

The interpretation of each level is as follows:

- 1 = The least
- 2 = Little
- 3 = Neutral
- 4 = Much
- 5 = The most

Needs of MC applications	Factors for MC effective	Evaluation details	Evaluation (x)	Score levels
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evaluation		%		
Customer	Product	CP1: Product variety	75	4
		CP2: Orders to Small lot size	70	4
		CP3: Short lead time delivery	84	5
		CP4: Other special products	32	2

$$\bar{x} = 3.75$$

Condition: If the mean score is less than 2, it is not necessary to implement the MC model.

Table 1 The evaluation of customers' needs

According to Table 1, it can be seen that *product variety* was assessed at level 4 or 75%, which means this factory very much requires the variety of products. With regards to *orders to Small lot size*, the assessment is at level 4, while *short lead time delivery* was at level 5 or 84 %, which means that this factory requires this factor the most. On the other hand, the need of *other special products* was at only level 2.

4.2 Assessment of manufacturer's and supplier's readiness

The statistics used was percentage, which was then calculated with a particularly created formula, in order to measure the levels of the evaluation scores, ranging from 1 to 5.

$$\text{Manufacturer of Score levels} = [(\% \text{ of Evaluation } (X) - 1)/20]+1$$

$$MY = [(Ey-1)/20]+1$$

$$\overline{MS} = \sum_{j=1}^n \frac{MS_j}{N}$$

as $x - 1/20$ was only calculated in integers.

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Readiness for mass customization	Factors for MC effective evaluation	Evaluation details	Evaluation (y) %	Score levels
Manufacturer	Process	MP1: Multi functional production	24	2
		MP2: Production versatile	45	3
		MP3: Production flexibility	42	3
		MP4: Effectiveness for modular design architecture, including product, process, and logistics and supplier configurations	33	2
		MP5: The development of functional similarity and process similarity to standardization	30	2
	Technology	MT1: Machinery system adaptation	45	3
		MT2: The development of technology to enhance production effectiveness for both common and special products	23	2
		MT3: The advanced application of technology, responding to high flexibility	21	2
	Management	MM1: Effective administration between sub systems	58	3
		MM2: Effective management of supply chain and logistics management	65	4
		MM3: Production planning with flexibility	55	3
		MM4: Co-designing or co-producing between customers and sub contractors	58	3
	Readiness for mass customization	Factors for MC effective evaluation	Evaluation details	Evaluation (y) %

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		MM5: Effective management of IT internal and external organizations	76	4
Supplier	Process	SP1: Quick response and on-time delivery	70	4
		SP2: Effectiveness for managing specification that can be customized based on customers' needs	50	3
		SP3: Quality production management affecting quality materials	85	5
	Technology	ST1: Machinery system adaptation	40	2
		ST2: Effective waste-time management	55	3
	Material	SMAT1: Basic material management applicable to a variety of products	45	3
	Management	SMgnt1: Effective planning between customers	65	4
		SMgnt2: Effective IT management in internal and external organizations	45	3

Table 2 the evaluation of manufacturer's and supplier's readiness for mass customization

In accordance with Table 2, it is obvious that multi functional production, effectiveness for modular design architecture, the development of functional and process similarity to standardization, the development of technology to enhance production effectiveness, the advanced application of technology, and ST1: machinery system adaptation were assessed at level 2. In terms of production versatile, production flexibility, MT1: machinery system adaptation, MM1: effective administration between sub systems, MM3: production planning with flexibility, MM4: Co-designing between customers and sub contractors, SP2: effectiveness for managing specification, ST2: effective waste-time management, SMAT1: basic material management, and SMgnt2:

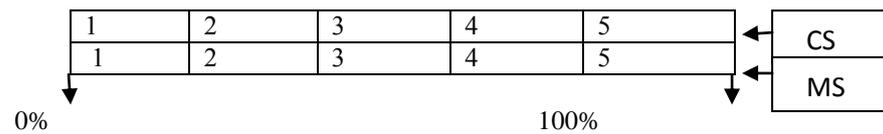
effective IT management were evaluated at level 3, while MM2: effective management of supply chain, MM5: effective management of IT, SP1: quick response and on time delivery, and SMgny1: effective planning between customers were at level 4, which was considered as a high need in this factory. Interestingly, there was only one factor assessed at level 5, which was SP3: quality production management affecting quality materials. That is, this factory requires the quality of production management the most in order to enhance its manufacturing effectiveness according to Mass Customization.

4.3 Analysis of appropriateness for the MC model implementation at each level

The mean score of customers' needs from Table 1 and the mean score of the manufacturer's and supplier's readiness from Table 2 were analyzed to find correlation, using the following formula:

$$MC = \frac{\overline{CS} \times \overline{MS}}{25} \times 100 = 4 \times \overline{CS} \times \overline{MS}$$

Being normalized in order to obtain a comparing scale



When MC is the mass customization level

\bar{x} is the mean score of customers' needs

\bar{y} is the mean score of manufacturer's and supplier's readiness

The data obtained were analyzed and calculated as follows:

$$MC(\bar{x}, \bar{y}) = \frac{3.75 \times 3}{25} \times 100$$

$$= 45 \%$$

Evaluation criteria	MC levels	Guiding implementation		
		Product	Process	Technology
Less than 30 %	MC level 1	<ul style="list-style-type: none"> - Adapting basic technique, and designing products consistent with the customers' demands - Analyzing rough product structures for part common components and functions 	<ul style="list-style-type: none"> - Improving production process for quick manufacturing - Improving production process by developing product planning systems more consistently and appropriately - Analyzing standard time in the production process 	<ul style="list-style-type: none"> - Applying technology and machines which can be adjusted based on the customers' demands at basic levels
Between 31-60%	MC level 2	<ul style="list-style-type: none"> - Analyzing functional similarity and product family 	<ul style="list-style-type: none"> - Analyzing process similarity for evaluating factors affecting the production cycle and taking it into modular systems - Employing automation to assist the production bottle neck 	<ul style="list-style-type: none"> - Developing technology supported the production, both common and special, to enhance the manufacturing effectiveness
More than 60 %	MC level 3	<ul style="list-style-type: none"> - Developing product architecture to standardization structures - Developing product prototype appropriate for mass customization 	<ul style="list-style-type: none"> - Adjusting the production process to be highly flexible and developing logistics systems internally and externally 	<ul style="list-style-type: none"> - Applying advanced technology responding to the flexible production

Table

3 Guiding implementation for mass customization model at each level

V. CONCLUSION

In accordance with the review of the literature and the data obtained from the representative company in order to in-depth examine the factors related to the assessment of the implementation level of Mass Customization , it

can be concluded that mass customization is perceived essential to be evaluated prior to taking the Mass Customization model into practice. From the results, it is reasonable to say that the development of mass customization levels is correlated to the effective implementation of the mass customization model. The analysis of Phase 1 covered three evaluated components, customers' needs, manufacturer's and supplier's readiness for mass customization. Last but not least, the evaluation in terms of mass customization of the representative company was at Level 2, which means improvement

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REFERENCES

- [1]. Giovani, D. S., Denis, B., and FlaHvio, S.F. Mass customization: Literature review and research directions. *Int. J. Production Economics* 72 (2001) 1 }13. [www. Elsevier.com/locate/dsw](http://www.Elsevier.com/locate/dsw). 2001.
- [2]. Stan,D. *Future Perfect*, 10th anniversary edition, Addison-Wesley Pub Co, Harlow, England, 1996.
- [3]. Pine, B. J. *Mass Customization - The New Frontier in Business Competition*, Harvard Business School Press, Boston, Mass., 1993.
- [4]. Chamberlin, E.H. *The Theory of Monopolistic Competition*, 8. ed., Cambridge: Harvard University Press, 1962.
- [5]. Lancaster, K. A New Approach to Consumer Theory. *Journal of Political Economy*. 74 132-157.1966.
- [6]. Beaton ,E. Give the people what they want. *Profit*. Toronto: Jun 2010. Vol. 29, Iss. 3; pg.11, 2 pgs. 2010.
- [7]. Mikkola , J H . Management of Product Architecture Modularity for Mass Customization: Modeling and Theoretical Considerations. *IEEE Transactions on Engineering Management*. New York: Feb Vol. 54, 2007.
- [8]. Zhou,C.,Lin,Z., and Liu, C. Customer-driven product configuration optimization for assemble-to-order manufacturing enterprises. *International Journal of Advanced Manufacturing Technology*; Aug2008, Vol. 38 Issue 1/2, p185-194, 10p, 5 Diagrams, 4 Charts, 1 Graph.2008.
- [9]. Roderick, E. ON TIME, EVERY TIME. *Manufacturing Engineer*; Apr/May2003, Vol. 82 Issue 2, p20, 4p. 2003.