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Simulation-based performance improvement towards mass customization in make to order repetitive company

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Abstract

The diversity of customers needs and wants leads the manufacture to be agile. The products must be high customized products and very close to the customers' expectations. In order-based manufacturing environment such as Make to Order (MTO) company, production activity could be started only after the orders were received. However, naturally, customers don't want to wait for long time, hence, short lead time is a must besides high customization. Such situation forces the company to combine the concept of order-based and stock-based manufacturing. This study presents the design of manufacturing that has high flexibility to produce many type of products with short manufacturing lead time using Mass Customization (MC) concept. Improvement of the manufacturing system is carried out through the definition of Customer Order Decoupling Point (CODP). The manufacturing design and analysis is conducted using simulation approach while the case study is taken from real manufacturing system which is a furniture company in Indonesia. Result of this study shows that the proposed manufacturing design could reduce the manufacturing lead time from 43 days to 24 days or about 44.19% when producing 15 types of product with varying demand.

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Keywords: order-based manufacturing; stock-based manufacturing; mass customization; simulation; lead time reduction, CODP

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1. Introduction

High competition market encourages manufacturing to be able to produce products that are very close to customer's needs and wants. Tseng (2001) stated that the key to success in the highly competitive manufacturing enterprise is the company's ability to design, produce, and market high-quality products within a short time frame and at a price that customers are willing to pay [1]. In addition, he argued that Mass customization (MC) introduces multiple dimensions, including drastic increase of variety, multiple product types manufactured simultaneously in small batches, product mixes that change dynamically to accommodate random arrival of orders and wide spread of due dates. MC has capability of reducing costs and lead time. In order to anticipate the increasing customers order, a method to produce mass product but still customized to meet individual desires is needed. MC comes to answer this problem.

Telsang (2007) stated that the production activities in Make-To-Order company will be initiated only after the confirmation of the orders and the orders are not supplied from the stock [2]. Since the production activity is started suddenly, hence the production lead time will be longer. Such condition leads to low productivity and high production cost. MC comes to overcome that problems. Pollard et al. (2008) mentioned that one of MC advantages is short time of responsiveness that leads to high productivity and low production cost [3].

Since the production activity is depend on the orders, hence, reactive strategy which will start the production once after an order was received will be very costly and cause nervousness in production execution. In the other side, sometime, several orders are similar and can be planned together. Therefore, order postponement can be a strategy to reduce dynamics in MTO production activities. However, the orders will come to the company dynamically. Hence, a method to estimate the demand in the future is required and simulation can be an alternative to do that.

2. Related Works

There are several previous studies that are very related to MC. Gupta and Benjaafar (2003) has investigated about lead time in MTO company [4]. In such study, a mathematical models are presented to compute cost and benefit of the application of delaying product differentiation strategy. Analysis and numerical examples is given to assess the benefit of delayed differentiation in settings where the lead times are load dependent. The result shows that a tighter capacity in the MTO segment is more detrimental to the desirability of delayed differentiation since there is no inventory to buffer and caused longer lead times in the MTO segment. The delaying differentiation is also proposed for strategic decision-making and for building intuition regarding the complex interactions between capacity, congestion, inventory levels, quality of service and cost.

Kumar et al. (2008) stated that MC is a unique strategy where the implementation promises across the board improvement in four of the competitive priorities (price, quality, flexibility, and speed) simultaneously. Some key success factors of MC to achieve large scale customize product at high speed production are modularity and postponement [5]. Hvam (2006) documented American Power Conversion (APC) Company case that used the principles of MC by using module-based product range and product configuration. APC started from traditional Engineering-To-Order then implemented mass production of standard components in the Far East with final assembly (per a customer's order) at various sites around the world and resulted a reduction of the overall delivery time for a complete system from around 400 to 16 days [6].

Da Cunha et al., (2010) conducted study to analyze four different methods (random selection, pattern-based selection, component-entropy selection, and pattern-entropy selection) for MC. Such methods permit to decrease the mean final assembly time for a product family in an ATO context and based on a case study, it is concluded that component-entropy and pattern-entropy have the best performance [7]. Another research conducted by Wang et al., in 2010. They discussed about three-dimensional (product, engineering, and production) method for positioning the efficient Customer Order Decoupling Point (CODP) to provide the highest level of customer value in terms of engineering adaptations and the lowest lead time of customer orders [8]. Based on the previous studies, MTO company can combine appropriate modularization and postponement technique to minimize lead time for improving customization level toward MC.