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# Reducing customers' lead time using Make to Stock and Make to Order approach

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# Reducing customers' lead time using Make to Stock and Make to Order approach

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**Abstract**. This paper discusses about a company that adopts make-to-order strategy because the company does not have enough fund to provide raw material. The raw material is ordered when the order is received. It occurs a very long customer lead time due to the production process must wait for the arrival of material. Consequently, the company cannot meet the customer order at the due date, and the company should give a discount of 25 - 30% of the total purchases. This research aims at reducing customer lead time by determining a decoupling point. The result shows that the decoupling point is placed between the procurement of raw materials and the manufacturing process. The decoupling point denotes a boundary between the make-to-stock strategy in the previous process, and the make-to-order strategy for the process afterwards. The lead time customer is then considered start from the decoupling point to the due date.

## 1. Introduction

Companies that use make-to-order (MTO) strategy to response consumer demand faces problems of raw material delays, because the companies order the raw materials after receive the customer's order. This will extend the lead time and the due date is then violated, so that the consumers are disappointed and the company must pay a penalty cost. This problem can be overcome by sorting material that can be ordered suddenly from material that can be stored. Consequently, the strategy used is a combination of make-to-stock (MTS) and MTO.

This research discusses the reduction of lead time by combining MTS and MTO strategies by determining the Decoupling Point (DP). In MTS / MTO system, a portion of the production system is controlled by MTS strategy and completed in control of MTO strategy [1]. Production planning and control in MTO strategy focuses on the time and/or sequence of operations, while the MTS strategy focuses on preventing stock shortages at minimum inventory costs [2]. MTS strategy – a forecast-driven – is separated from MTO – a customer-order-driven – by the strategic position of DP [3]. The problem is where DP should be placed.

Research about MTO and MTS have carried out by many researchers. Nagib at al. state that the food and beverage industry choose hybrid MTO-MTS and EOQ strategy to manage raw materials at an optimal level [4]. The application of MTS-MTO hybrid consists of three levels, i.e. deciding which product will be an MTO or MTS (level 1), determining MTS and MTO lot size (level 2) and sorting and scheduling production orders (level 3). Bart and Teunter state that MTS-MTO hybrid production system can save costs up to 65% [2]. Garn and Aitken propose an outlier detection algorithm based on

special density measurements [5]. Time series requirement in MTS and MTO strategies are divided into three groups, i.e. requirement with frequent low-volume includes MTS strategies, high volumes dedicate to MTO strategies, and volumes that are in between are assigned to MTO or MTS strategies. [1] propose two strategic of decision-making structure in hybrid MTS / MTO, i.e. choosing a product delivery strategy and positioning of order penetrating point (OPP) for each product family by considering the driving factors. The decision making tool for finding the location of the OPP is chosen by the ANP method. Kober and Heinecke conclude that the MTO strategy is suitable for low and volatile demand, while the MTS strategy is suitable for high and stable demand [6].

Jia et al. propose a flexible flow-shop (FFS) production model to reduce total inventory and lateness [7]. The model divides FFS into make-to-stock (MTS) parts and make-to-order (MTO) parts by applying a decoupling point. In MTS section, work is produced into semi-finished products and then stored as inventory at the decoupling point. As soon as a customer's order is received, inventory is released into the system, starting to be processed in MTO section. This shortens manufacturing lead time. Mishra et al. find that the degree of Manufacturing flexibility varies with the position of the DP in the supply chain, whereas the position of the DP varies across different types of business strategies [8]. As such, MF is indirectly influenced by the business strategy. Daaboul state that the best mass customization strategy is obtained if the positions of the Customer Order Decoupling Point (CODP) and Product Differentiation Point (PDP) are determined simultaneously [9]. Rudberg and Wikner develop a CODP typology into the dimensions of production and engineering to obtain a reliable order promise process for mass customization [10]. CODP is defined as a point in material flow that adds value that separates decisions made based on uncertainty from decisions made based on certainty about customer demand, but is usually only used for activities related to production and distribution. Here we adapt the typical CODP typology and show how engineering resources can be integrated with the production process so as to consider the features of a mass customization environment. van Donk show the relationship between Supply Chain (SC) and CODP locations, i.e. MTO, ATO, and MTS strategies showing high levels in upstream, internal and downstream [11].

Hou and Wang determine the optimal position of CODP through numerical simulations [12]. The optimal CODP position moves downstream after adding an intelligence module, thus shortening response time to customer orders, increasing customer satisfaction, fostering customer loyalty and increasing customer rigidity. Wikner and Johansson introduce a comprehensive classification scheme for types of process-based decoupling points into eight types of strategic and tactical decoupling points for designing flow [3]. van Donk states that the determination of DP's position is influenced by two sets of characteristics, namely product and market characteristics, and process and stock characteristics [13].

This study aims at reducing customer lead time by combining MTS and MTO strategies to determine DP location. DP determination refers to van Donk [13]. This paper is organized as follows. Section 2 explains the methodology, Section 3 shows the results, Section 4 discusses the results, and Section 5 presents the conclusions.

## 2. Methodology

DP is determined by considering the characteristics of the process, stock, product and market as seen in Table 1 [13]. The effect of each term on each characteristic of the DP position is shown in Figure 1. Figure 1 must be interpreted as follows, i.e. irregular market conditions or specific products have an upstream effect on the location of the DP, while short delivery time or high delivery reliability will force the DP more downwards.

**Table 1**. Determinant of the decoupling point [13].

| Product and market characteristics | Process and stock characteristics |
|---|---|
| Required delivery reliability | Lead times and costs of steps in the (primary) process |
| Required delivery time | Controllability of manufacturing and procurement |
| Predictability of demand | Cost of stock-holding and value added between stock points |
| Specificity of demand | Risk of obsolescence |
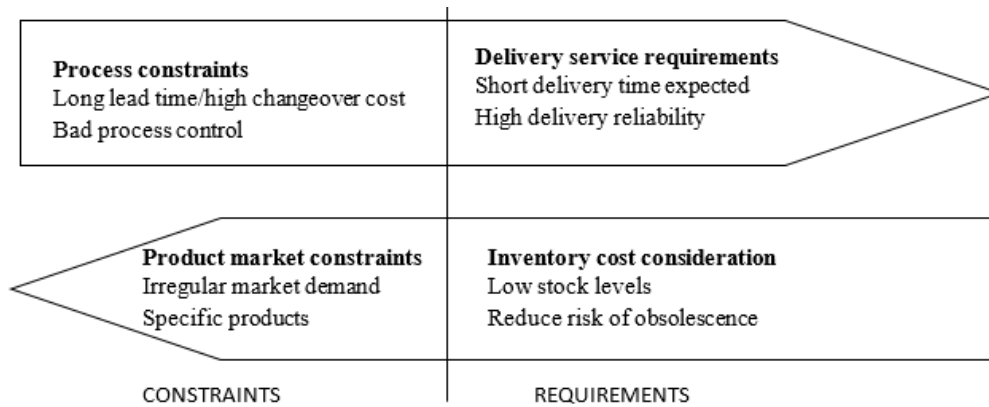


**Figure 1.** Business characteristics classified according to their nature and influence on the DP [13].

## 3. Result and discussion

In this research, a T-shirt producer is taken as a case study where the production process is shown by Fig. 2.
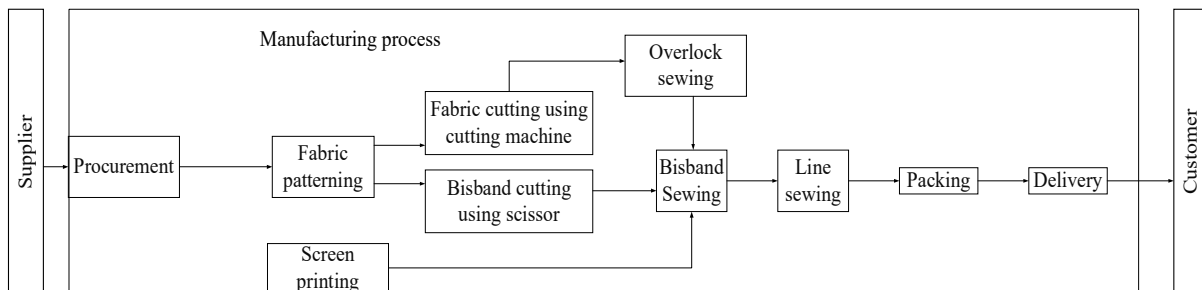


**Figure 2**.  Production process of case study company.

DP provides a boundary where inventory is determined by MTS or MTO strategies, in order to shorten customer lead times. The result of DP locating is as follows.

### 3.1. Result

In this study, DP is determined by referring to van Donk as shown in Table 1, which considers the characteristics of the product, stock, market, and process [13].

*3.1.1. Product and stock.* T-shirt products can be stored for a long time, not perishable product or not outdated. However, the product is delivered after completed due to MTO strategy implementation. The raw materials are ordered when customer order is received. The order lead time of the main raw material, i.e. fabric, is actually 3 days, but often delayed up to 9 days. The extended lead time causes delayed delivery of the finished product, so that the company must pay a penalty cost to compensate the delayed delivery. The additional materials do not occur delay problems

*3.1.2. Process.* Figure 2 shows that the manufacturing process of the product begins with making pattern of the body parts of the shirt, and the "bisband" on the fabric material. The fabric is then cut according to the pattern that is made. The front and back of the T-shirt body parts are combined using an overlock machine, and then "bisband" of arms and neck are sewn. The bottom of the shirt is then sewn for neatness. The next step is to sort out the products into 2 groups, i.e. non defective and defective products. The non-defective products are then packaged and deliver to customers.

*3.1.3. Market.* The company only produces 1 type of shirt with several sizes ranging from 30 to 42. The customer orders are received every month with varying amounts.

Refer to the product, stock, process and market of the T-shirt, DP determination should consider as follows:
- The arrival of fabric material often delays.
- T-shirt products only have variations in size, so that work in process (semi-finished products) as a basic form to accommodate demand variations does not required.
- There are variations in the size of the shirt when patterning product.

Thus, the DP is the stock of fabrics raw material, located between the ordering process and patterning. The fabric raw materials can be ordered before the customer order is received (MTS), while the manufacturing process start from the patterning process to the product delivery is carried out after the customer order is received (MTO). The DP position is shown in Figure 3.
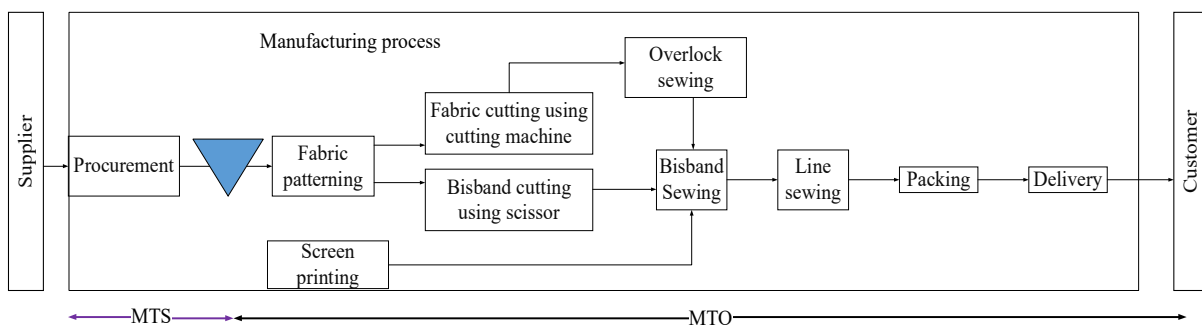


**Figure 3**. DP position.

DP placement after procurement causes stock of fabric raw materials. However, these inventory costs can be minimized by adopting EOQ method. The customer lead time is then considered start from the DP to the due date. Applying DP reduces customer lead time from 20 days into 11 days, due to the availability of the fabric material so that the order can be responded as soon as it is received.

## 4. Discussion
DP point availability will reduce the customer lead time so that the due date can be met. It causes the company should not pay a penalty cost. However, availability of fabric material rises inventory cost. When the inventory cost is less than the penalty cost, it will profitable, and vice-versa. In our case, the penalty cost of Rp.44,200,000/year, while the inventory cost of Rp.44,100,000/year. There is just a little difference between the penalty cost and the inventory cost, but meeting the due date is more important because it will rise company reputation. Therefore, applying DP point will reduce customer lead time and keep the company reputation.

## 5. Conclusion
The decoupling point will reduce customer lead time and the due date is not violated. It will profitable if rising of the inventory cost is less than the penalty cost due to.

**Acknowledgment**

**References**
[1]    Hemmati S, Rabbani M and Ebadian M 2009 Positioning of order penetrating point in hybrid MTS/MTO environments. *EMS 2009 - UKSim 3rd Eur Model Symp Comput Model Simul* pp 263–268

[2]    Bart B, Land M and Teunter R 2016 Hybrid MTO-MTS production planning: An explorative study. *Eur J Oper Res* **248** 2 pp 453–461

[3]    Wikner J and Johansson E 2015 Inventory classification based on decoupling points. *Prod Manuf Res* **3** 1 pp 218–235

[4]    Nagib A N M, Adnan A N, Ismail A, Halim N H A and Khusaini NS 2016 The Role of Hybrid Make-to-Stock (MTS) - Make-to-Order (MTO) and Economic Order Quantity (EOQ) Inventory Control Models in Food and Beverage Processing Industry *IOP Conf Ser Mater Sci Eng* **160** 0123003 DOI: 10.1088/1757-899X/160/1/012003

[5]    Garn W and Aitken J 2015 Splitting hybrid Make-To-Order and Make-To-Stock demand profiles, available at http://arxiv.org/abs/1504.03594

[6]    Köber J and Heinecke G 2012 Hybrid production strategy between make-to-order and make-to-stock - A case study at a manufacturer of agricultural machinery with volatile and seasonal demand *Procedia CIRP* **3** pp 453–458

[7]    Jia Y, Weng W and Fujimura S 2017 A hybrid MTS-MTO production model with a dynamic decoupling point for flexible flow shops *Proc - 16th IEEE/ACIS Int Conf Comput Inf Sci ICIS 2017* pp 803–807

[8]    Mishra D, Sharma R R K, Gunasekaran A, Papadopoulos T and Dubey R 2019 Role of decoupling point in examining manufacturing flexibility: an empirical study for different business strategies *Total Qual Manag Bus Excell* **30** pp 1126–1150

[9]    Daaboul J, Da Cunha C, Le Duigou J, Novak B and Bernard A 2015 Differentiation and customer decoupling points: An integrated design approach for mass customization. *Concurr Eng Res Appl* **23** pp 284–295

[10]   Rudberg M and Wikner J 2004 Mass customization in terms of the customer order decoupling point. *Prod Plan Control* **15** pp 445–458

[11]   van Donk D P and Van Doorne R 2016 The impact of the customer order decoupling point on type and level of supply chain integration *Int J Prod Res* **54** pp 2572–2584

[12]   Hou Q and Wang J 2016 Positioning of Customer Order Decoupling Point in the Internet Environment **16** pp 337–344

[13]   van Donk DP 2001 MTS or MTO : The DP in the food processing industry *Int J Prod Econ* **69** pp 297–306