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The Use of Virtual Stream Mapping in Business Process Re-Engineering for Order Fulfillment Improvement at PT. X

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ABSTRACT

MSMEs in the manufacturing sector often face challenges in the efficiency of the production process, especially when implementing a make-to-order system that leads to high product variety and long lead times. This research aims to design improvements in the production process at PT. X, a furniture MSME in Bandung, by applying the Value Stream Mapping (VSM) and Business Process Re-engineering (BPR) methods. VSM is used to map initial conditions and identify non-value-added activities (waste), while BPR is used to formulate radical remedial solutions. The results of the analysis showed several main problems, namely delays in the supply of raw materials, the absence of standardization of sofa frames and covers, and production processes that ran in parallel. The proposed solutions include the implementation of make-to-stock and make-to-order hybrid systems, the implementation of safety stock of frame materials, and the standardization of dimensions and processes. These changes result in more efficient production processes, shorten order fulfillment times, and improve product quality consistency. This research shows that the integration of VSM and BPR can be a strategic approach in improving the manufacturing performance of MSMEs.

Keywords: *MSMEs, make-to-order, Value Stream Mapping, Business Process Re-engineering, production process*

Introduction

MSMEs are one of the largest economic sectors in Indonesia due to the large number and types. In the process, MSMEs that have more effective processes compared to their competitors have more potential to become a larger-scale business. Therefore, it is possible that the progress of MSMEs into a large-scale manufacturing industry can start from improving their manufacturing processes [1].

MSMEs generally have manufacturing businesses with a make-to-order system. This is because the quantity produced by MSMEs still has a small amount [2]. Therefore, MSMEs have a much greater variety of products compared to the manufacturing industry engaged in the same field. However, this does not stop MSMEs from applying techniques or applications used in modern manufacturing in general [3].

In redesigning the MSME production system with a make-to-order system, an analysis will be carried out using Value Stream Mapping to analyze waste or waste carried out by MSMEs to make production design more effective and efficient [4].

PT. X is an MSME-scale furniture manufacturing company based in Bandung, Indonesia. PT. X manufactures furniture products for sale in business partner stores. PT. X has a vision to change the main target market to a market targeted at low-income consumers because it has the greatest market potential [5]. Therefore companies must pursue quantity to get maximum profits. PT. X has four identifiable departments, namely procurement, production, marketing, logistics. The job of the marketing department is to find orders from its business partners or consumers for the company. His duties include negotiating, accepting orders, ensuring payment, and introducing new products from the company. The procurement department's job is to ensure that production has all the materials needed to make a product; His positions include negotiating material prices, procuring necessary materials, and providing safety stock. The job of the production department is to produce finished products to sell to consumers or business partners. Finally, logistics jobs are responsible for delivering finished products to customers. This includes scheduling transportation, finding the right vehicle to transport the finished product and the actual delivery of the product to the consumer. PT. Manufacturing company x is MSMEs (Micro, Small and Medium Enterprises), meaning PT. X is still a thriving company with plenty of room for improvement. One of the improvements that the company will make is to standardize the production process owned by PT. X. The effort made is to use VSM to standardize the production process of PT.X.

Research Methods

Virtual Stream Mapping (VSM)

According to [5], [6], [7], [8], [9], VSM is a tool that describes the flow of materials and the flow of information in completing a product to consumers. VSM has the advantage that allows all parties to see the flow of information and material flow in a process or value stream (Nash and Polling, 2008) VSM is a plan that is the basis for the implementation of the system so that it becomes lean and can see the main source of waste. This map also shows the relationship between the flow of information and the flow of material that occurs in a process using symbols and numbers [10], [11], [12]. VSM is also the key to knowing the production process from raw materials to finished products.

The way to describe VSM consists of several steps. The first step is to map/describe every production process that occurs in a system. The result of the depiction is called the current state map. The next step is to conduct a validity test. The validity test can be done by comparing the current state map with the actual conditions. The validated current state map can be used to make a proposed improvement. Proposed improvements are useful for designing future state maps. Value stream mapping aims to:

a. Reduce working capital both inventory and production floor space
b. Increase production capacity
c. Reduce production costs, direct and indirect labor costs and administrative costs
d. Increased flexibility
e. Reduce production lead time
f. Improve quality
g. Improve consumer satisfaction

Business Process Re-engineering (BPR)

Business Process Re-engineering is a fundamental re-thinking and radical re-design of the business process to get a dramatic improvement, a dramatic increase in important aspects in measuring a performance are cost, quality, and speed. [13], [14], [15], [16]. Here are the points in Business Process Re-Engineering.

a. Literature Studies

Literature studies are carried out by analyzing previous research in its methods and applications. The literature study will show the synthesis of the research as well as the position of the research to be carried out. In addition, the literature study also analyzes the novelty of the research to be carried out so that the research can produce maximum benefits.

b. Problem Formulation

The formulation of the problem is carried out by analyzing the existing situation and the symptoms that occur in each process in factory X. The existing situation that is the problem is analyzed and used as an initial hypothesis in the research [16], [17], [18], [19].

c. Data Collection

The data was collected at a furniture factory X, where furniture factory X is an MSME engaged in making sofas. X accepts the store as a consumer with a process of making make-to-order goods so that the order is received first and then the ordered product is made. The company still uses traditional business processes and is open to re-analysis for each part of the process [20], [21], [22], [23].

d. Perform data analysis

After the collection is carried out, a more detailed study will be carried out using VSM as a tool. The wastes found in the VSM analysis will be used as a basis to create a more effective and efficient production system [24], [25], [26], [27].

e. Proposed Improvements

Repairs to the system were carried out using related waste as a base. The generation of solutions will be carried out by making a future state map from the current state map that has been made [28], [29], [30], [31].

Results

From the current state map produced, several problems can be identified, namely

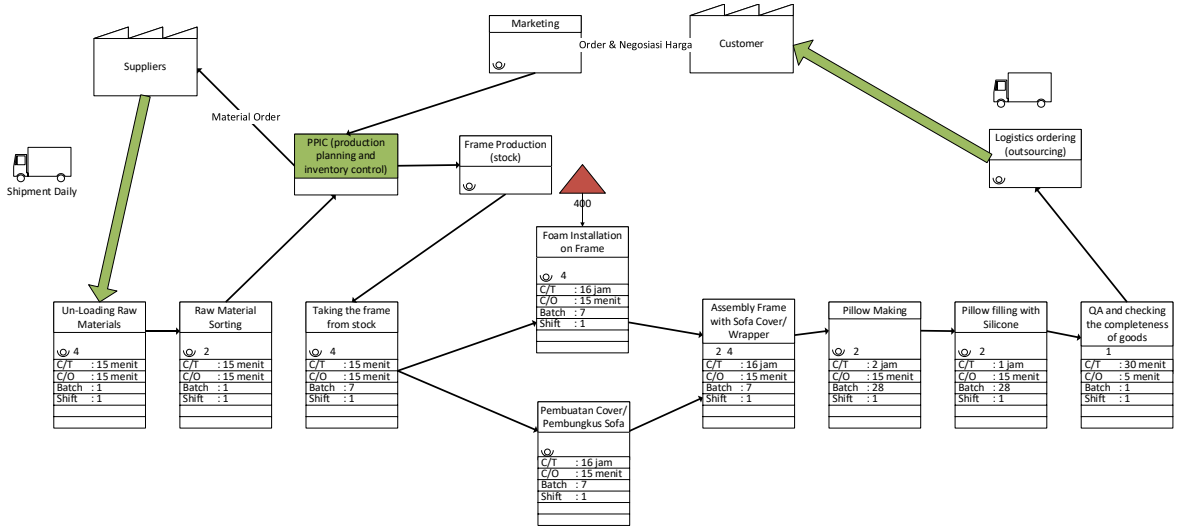
a. The receipt and un-loading of raw materials only follows a make-to-order pattern

The receipt and un-loading of raw materials carried out at the beginning of the production process is one of the wastes in the order fulfilment process of PT. X. this is because PT. X only orders raw materials when the order is received. Several times there are problems because the necessary raw materials are out of stock or cannot be delivered in the near future. In addition, orders are placed to several suppliers at once, so it is very possible that there will be delays in this fulfilment order process.

b. No standardization of frame manufacturing

PT. X does not have standardization in making frames, this is because the order receipt system at PT. X follows a make to order system. As a result, the production process of making the frame has a long changeover time. In addition, because there is no standardization, there is a risk of quality differences in the goods produced

c. There is no standardized cover template
PT. X does not have a standardized template for creating covers. This causes every incoming order to have to be re-templated to meet consumer demand. This is waste that must be eliminated, besides that there is also a risk of quality differences between goods in the production process



The pillow making is done when the entire process is completed
The manufacture of pillows that is carried out when the production process has been completed is one of the waste that can be eliminated. The making of pillows should be able to be done simultaneously and not wait for the assembly between the frame and the sofa to be completed.

Business Process Re-engineering Analysis
The following are alternative solutions that are generated using BPR
a. Preparing stock for frame materials and general materials
Safety stock is applied to prepare for the manufacture of frames that will be made by upholding the make-to-stock system. The frame will continue to be made so that the manufacture is not waiting for the making of the frame and can be immediately applied to the finishing process or installing the cover when the order is placed by the consumer. This improvement will ensure that the manufacture of the frame can continue to be carried out and there is no need to wait for orders from consumers to come in. Safety stock is also enforced so that the production process does not have to wait for a long time from the supplier so that there is a significant cut in processing time.
b. Standardization for frame manufacturing
Standardization is carried out so that the made-to-stock process can run smoothly. This standardization process will ensure that the frame can meet all model standards offered to consumers. Standardization also ensures that the construction of the frame can take place more effectively and efficiently. This is because the variables of decisions made by workers are reduced. The standardization that will be carried out will refer to the dimensions and materials required for the manufacture of the frame. The standardization of frame making also makes the process of installing foam on the frame can be done side by side with the process of making sofa covers. This is because with the standardization of the process, there is no need to wait for the frame to be completed with foam installation to make a cover that is in accordance with the order that has been made by the consumer
c. Frame manufacturing using make-to-stock system
As mentioned above, the manufacture of the frame will use a make-to-stock system. This frame manufacturing system will refer to the standardization of dimensions and materials that have been carried out at the previous stage. In addition, the safety stock that has been carried out at the previous stage will refer to the materials used to make the frame. The manufacture of frames that have been applied in advance using the make-to-stock system will speed up the fulfilment order process because the process applied is only the finishing process or the installation of sofa covers.

d. Standardization of sofa cover templates

The standardization of the creation of sofa cover templates is carried out to reduce the time of the finishing process where in the current situation the creation of templates is carried out when the order has been received. This is due to the non-standardized creation of the frame so that the creation of the template must follow the frame that has been made. By standardizing the framework, the creation of templates can also be standardized. The finishing process will be faster and the time required for the order fulfillment process will be more effective and efficient.

Analyzing the Future State Map

The changes made are as follows.

a. Ordering materials for frames is done periodically while ordering materials for sofa covers/wraps is done when the order has arrived.

The process improvement carried out is the implementation of a hybrid system in the fulfilment order process with the manufacture of frames to be make-to-stock and the rest is done on a make-to-order basis, therefore so that the manufacture of frames can always continue to run, the order of raw materials for the frame will be carried out periodically, while the order for other raw materials will be carried out when the order from the consumer has been received by the marketing department. The amount of raw materials that are reduced when orders are placed for order fulfillment will be reduced because wood that consumes a considerable volume has been sorted when the raw materials arrive periodically.

b. The manufacture of the frame is done separately and follows a make-to-stock system

Frame manufacturing that was previously quite time-consuming has been converted to make-to-stock resulting in a significant reduction in order fulfilment time. The order fulfilment process is now faster because the frame that previously had to wait to be made became a semi-finished goods pickup, namely the frame that was produced previously.

c. The manufacture of the sofa cover/wrap is carried out in parallel with the installation of foam on the frame.

The standardization of frame manufacturing that has been carried out before makes the production process not need to wait for each other to complete orders by consumers. The manufacture of covers and the installation of foam can be done side by side because the standardized process ensures that the orders produced have the same quality, materials, and dimensions according to the standards that have been set. This process carried out side by side will significantly reduce the order fulfilment process time while improving the accuracy of the quality of goods for consumers

Discussion

This study shows that the integrated application of MTBF, MTTR, and FMEA methods has succeeded in identifying critical components of CO_2 welding machines that are often damaged, especially PCB Control, Contact Tip, and Nozzle. These findings are in line with the results [32] which show that the integration of FMEA and reliability analysis is able to improve the reliability of boiler engines by identifying the main components causing downtime [33].

The average machine availability of 97% also indicates a high level of performance exceeding the global standard of 90%, supporting the claims of and reinforced by [34], [35], [36] who show that the combination of MTBF and MTTR is effective in reducing the downtime of kernel heater production machines. This indicates that a similar approach can be widely used in the manufacturing industry with high-intensity machines.

However, focusing on CO_2 welding machines without involving comparisons between other types of machines limits the generalization of results. In this context, [37], [38] provide a comparative study between bending and stamping machines that show that maintenance strategies must be tailored to the functional characteristics of each machine.

In terms of risk prioritization, the use of RPN (Risk Priority Number) has been shown to be effective in literature such as [39], where RPN differences greatly determine the maintenance strategy of the HD785 mining truck. The journal also notes that Control PCBs have the highest RPN value (180), indicating a major impact despite the low frequency of damage—something that was also found by [Pasaribu et al. (2021)] in an FMEA analysis of screw press machines in the palm oil industry.

One of the main strengths of this journal is the preventive approach based on risk priority. This is similar to the study [40]which emphasizes that RPN-based maintenance is more adaptive to actual damage patterns in the field. Meanwhile, [41], [42] expands it with an RCM (Reliability Centered Maintenance) approach that can be considered as a further development of the conventional MTBF-MTTR method.

However, this study has not considered the integration of digital monitoring systems or real-time sensors used in predictive maintenance. [35] raised the importance of implementing IoT-based predictive maintenance

that allows damage analysis even before it occurs, reducing the risk of total failure that is not detected by static FMEA.

In terms of cost efficiency, the findings in this journal are reinforced by [7] which shows that preventive maintenance, although having a higher initial cost, in total lowers long-term breakdown costs. [3] also emphasizes the importance of planned maintenance for operational expenditure efficiency.

However, from the aspect of work system development, this journal's approach has not taken into account the impact on operator workflows, ergonomics, and technician training, as discussed in [10] [20]which highlight the importance of human readiness and supporting procedures.

The Pareto analysis used in this study proved to be an effective tool to focus attention on the major components that contribute to downtime. It is also used by [38] in developing risk-based production maintenance strategies in the assembly industry.

The use of field observations and interviews as the basis for initial data enriches the validity of the primary data. This is supported by [5], who states that in-depth interviews with chief technicians and operators are key to understanding the latent causes of damage.

Finally, it should be noted that the discussion in this journal does not highlight the sustainability of the proposed maintenance system. In the context of the modern manufacturing industry, this aspect is very important as stated by [18] in his paper on the efficiency and sustainable safety of preventive maintenance.

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