Lean Concept Development in Fast Food Industry Using Integration of Six Sigma and TRIZ Method

S Indrawati, A ‘Azzam, E Adrianto, S Miranda, and A D Prabaswari
Industrial Engineering, Universitas Islam Indonesia, Yogyakarta, Indonesia

E-mails: sriindrawati@ui.ac.id, abdullah.azzam@ui.ac.id

Abstract. The service industry plays an important role to the development of Indonesian economy. Recently, the fast food industry has a good growth due to customers preferences. This significant contribution and industrial growth are not accompanied by the quality of industrial performance. This condition lead to a weak competitiveness, especially to face of the ASEAN Economic Community (AEC). The fast food industry needs to develop a specific strategy to improve the service system. This study uses a lean approach to improve the service system in a fast food restaurant. The method used is the integration between six sigma and TRIZ (Theory of Inventive Problem Solving) to get a creative problem-solving innovation in improving service industry performance. Based on the research conducted, it can be identified that the waste occurs in fast food industry is the service delay due to the process of giving flavor with a total time of 527 seconds. Improvement strategy to reduce the waste is to change the process of giving flavor (parameter changes) and implementation of 5S in the work area (enriched atmosphere). There is a time improvement of 90% by implementing the strategies that have been obtained.

1. Introduction

In Indonesia, the service industry sector has a considerable potential development. This industrial sector has a significant contribution to the Indonesian economy, i.e. gross domestic bruto increased by 10% in 2010-2012 [1]. In addition, the service industry is able to reduce poverty in Indonesia because 52% of the workforce in this sector are women [2].

One of service industry that has a good growth is the fast food restaurant. As many as 80% of Indonesian citizen prefer to use fast food restaurant services compared to other restaurant categories [3]. This is due to a variety of unique food menu offers, fast in serving and offers an online purchases and other promotional packages.

The growth of fast food restaurant is not accompanied by some improvement strategies. Service system improvement is one strategy that should be done. With better performance, an industry can produce products with more competitive value. The improvement process can be done by business process mapping to determine the improvement priorities. Lean concepts can be developed to improve the service industry performance. This concept uses a systematic approach to identify and eliminate waste and various non-value-added activities. Lean is originally a manufacturing concept that used to improve the quality of production through efficiency by identifying and minimizing seven types of production waste, i.e. overproduction, transportation, waiting, unnecessary processes, inventory, movement and product defects [4].
The success of lean in manufacturing has triggered researchers and industry practitioners to adopt lean concepts in service industry. Implementation of lean service can increase the competitive advantage of a service industry by reducing process variability and waste of business activities [5]. Lean principles is implemented in a health care industry to improve the service performance and quality [6]. Lean implementation in health care industry in Europe, Australia, America and United Kingdom also shows a positive contribution to the industry, i.e. 50% of industries has an increased productivity and cost efficiency, service quality, patient and employee safety and financial benefits [7].

The application of lean 3P concepts (production, preparation, process) has been successfully used to rearrange the layout of hospital facilities with good effectiveness [8]. In implementing the lean service, several researchers have conducted studies on adjusting the types of waste and lean tools. Identification of appropriate lean tools for the service industry has been carried out in the mid-scale hotel industry in Europe [9]. There are five value stream mapping tools (VALSAT) that able to detect and eliminate waste in the hospitality service industry value chain, i.e. process activity mapping, quality filter mapping, demand amplification mapping, decision point analysis and physical structure [9]. Several other lean tools can also be used, i.e. supply chain optimization, ABC analysis, pareto diagrams, XYZ analysis, ideas management, Kaizen, visual management, poka yoke, PDCA, supplier management, six sigma and 5S [10].

Six sigma with the DMAIC cycle (define, measure, analyze, improve, control) can also being used as a tool for solving lean implementation problems. With six sigma, the process management, continuous improvement and business process reengineering can be done [11]. The integration of value stream mapping (VSM) with DMAIC is successfully done to reduce waste in service industry [12]. The Six Sigma method can be integrated with Theory of Inventive Problem Solving (TRIZ) to create a problem-solving innovation in improving service industry performance. The integration of TRIZ with other methods such as kansei engineering and SERVQUAL is successfully implemented to improve the quality of hotel and restaurant services [13].

2. Literature Review

2.1. Lean Concept

Lean is a continuous improvement concept to eliminate waste and increase the value added of products or services [14]. This concept can be applied to manufacturing or service companies. Implementation of this concept is based on five main principles, i.e [15]:

- Specify Value; determines the value of a product or service based on customer perspective.
- Identify Whole Value Stream; identify the business process, starting from the process of designing, ordering and making products based on the whole value stream to identify nonvalue added process.
- Flow; conduct activities that can create a value without interference, rework, backflow, waiting.
- Pulled; knowing the important activities that used to make what customer want.
- Perfection; trying to achieve perfection by eliminating waste continuously. Formatting author names

2.2. Six Sigma

Six Sigma methodology uses statistical tools to identify several important factors in improving the process quality [16]. There are five stages called DMAIC cycles, i.e.:

- Define; at this stage the problem statement is made based on existing facts, focused on what will be observed and compiled, not estimates or assumptions. After that, the objectives will be determined.
- Measure; the problem validation process is carried out.
- Analyze; an analysis of the problem root causes is carried out. Look at the process and data to identify possible causes, find the cause that is estimated and validate it.
- Improve; identify some potential solutions and select the most appropriate solution.
- Control; an evaluation of some potential problem after the solution is implemented and sets standards to maintain performance effectiveness.

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2.3. Theory of Inventive Problem Solving (TRIZ)
TRIZ is a method invented by Genrich Altshuller in 1940. Therefore, TRIZ comes from the Russian language, namely the Theory Resheniya Izobreatatelskikh Zadatch or in English known as Theory of Inventive Problem Solving. TRIZ is a strong methodology for finding solutions to a contradictive problem [17]. There are 11 types of TRIZ tools, i.e. function analysis, cause and effect chain analysis, perception mapping, ideality, S-curve analysis, trends of engineering system evolution, trimming, transfer features, function-oriented search, 9-windows and engineering contradiction. The entire tool can be used simultaneously or independently to get innovative solutions to a problem in a systematic and structured manner [17].

3. Method
Research on the integration of Six Sigma and TRIZ methods in lean concepts development for a fast food restaurant industry consists of five main stages, i.e.:
- Define; identification of business processes, process time, customer needs, number of workers and the number of customers in a fast food restaurant are used to develop the current value stream map. The function of this map is to provide an integrated information of current service conditions.
- Measure; identification of waste and performance measurements from the current process.
- Analyze; the integration process of six sigma and TRIZ is done to identify and analysis the causes of waste and contradictions that occurs.
- Improve; contradiction that already found then minimized or eliminated using 40 principles of invention.
- Control; a performance measurement process is estimated.

4. Result and Discussion
The service industry used in this research is a fast food restaurant that offers fried chicken-based foods with eight flavors. The main raw material is chicken meat from a supplier. There are four main processes carried out in this industry, i.e. the process of shoving chicken, frying, giving sauce according to customer orders and serving. Potential Customer from this industry are 2-25 years of age with professional dominance as students.

The detailed process consists of 18 activities on 6 workstations. The production time data has been tested for adequacy with N for all samples of 10. Based on the current value stream mapping, the delivery of 2000 pcs of raw materials or 50 packs to the store is done every day as shown in Figure 1. The cooking process capacity is one pack or 40 pieces of chicken. The cooking process begins in the process of chicken combing with three types of activities, i.e. the process of making flour, the process of dyeing chicken into the water and mixing the chicken with flour.
Figure 1. Current VSM of Fast Food Industry

The processing time is 742 seconds. Next is the frying process where in this process there are two types of activities, i.e. frying and draining by a worker within 895 seconds. When the chicken cooking process is complete, then work in process waits until there is a customer order.

The arrival of customer with an average of 4 people starts with the queue process to get product information and ordering services. Then customer will go to the cashier to make payments. The process of this customer arrival has a cycle time of 665 seconds. After the order process, the customer will wait for the order to be delivered. In this process, production activities at giving flavor station with cycle time of 527 seconds.

Based on the current VSM, customer waiting time is 10 minutes. The customer waiting time will cause a waiting time for the next order. To reduce customer waiting time, a process activities mapping (PAM) is used to identify the types of activities based on the categories of value added (VA), non-value added (NVA) and necessary nonvalue added (NNVA) activities. There are two types of PAM, i.e. production and service process. Based on current PAM in the production section, there are 70.7% of activities included as VA, 5% NVA and 23.9% NNVA. While in the service section, there are 25% of activities included as VA, 37.5% NVA and 37.5% NNVA.

The biggest NVA activity in the service process is the customer waiting time at 653 seconds. The production activities done in that time are the process of giving flavors and serving. That production activities time must be reduced to gain a better customer satisfaction. However, if the flavoring process takes over a longer time, the spices can absorb better even though the waste of time and energy becomes larger. There is a contradiction in this case, if one parameter is improved, the other parameters will decrease in performance. The TRIZ method can be used to solve these problems with three main stages, i.e.:

a. System parameters: There are two parameters identified from the fast food restaurant case, i.e.
   - Improving parameters: Result or Output Produced
   - Worsening parameters: Waste of Energy
b. Contradiction matrix: In the contradiction matrix for business and management [17], the identified system parameters have the following code, i.e.
   - Improving parameters: Result or Output Produced
   - Worsening parameters: Waste of Energy
c. Inventive Principles: There are three alternative solutions that can be implemented, i.e.
   - Prior action (10)
   - Parameter changes (35)
   - Strong Oxidants / enriched atmosphere / accelerated oxidants (38)
Based on the TRIZ method, the process improvement that can be done is to change the giving flavor process by pouring sauce over the chicken according to the standard (parameters changes) and the implementation of 5S in the work area (enriched atmosphere). With these improvements, the process of giving a flavor only take 48 seconds. So that the time reduction is 90%.

5. Conclusion

Based on the results of research on the integration of six sigma and TRIZ methods on lean service, it can be concluded that:

- The type of waste that occurs in the fast food industry is service delay. This waste is caused by the process of giving flavor with a time of 527 seconds.
- Improvement strategy to reduce waste that occurs in the fast food industry is to change the process (parameter changes) and implementation of 5S in the work area (enriched atmosphere). There is a time reduction of 90% by implementing the strategies.

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