Implementation of Set Parts System in Malaysian Automotive Industry

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Abstract

In this paper, we present a case study of Set Parts System (SPS) implementation in Malaysian leading automotive manufacturer. The SPS is based on lean concept throughout the production system in receiving and supplying parts. The idea of SPS is that a complete set of parts is put together as a set of number of processes in kitting. After the adoption of lean concept and implementation of SPS at mixed model assembly lines, we ascertained that the reduction of waste can be achieved. The case based approach is used in the paper as initial study to describe the implementation of SPS.

Keywords
Set Parts Supply, Lean Manufacturing, minomi

1. Introduction

In today’s highly competitive market, variations in models of cars are the major challenges in automotive manufacturers in order for them to remain in the industries. One way to overcome the challenge of growing variety technologies, manufacturing processes and systems is through the lean production, which need a continuous improvement in reducing waste or non value added activities. In addition, with the rapid industrial development especially in the automotive sector, research on lean production has widely spread and become more complicated. The main three reasons why lean production was adopted by most of automotive industries is to overcome poor quality, higher production cost and long lead time (Santos et al. 2006). Since lean production is an integrated system with Just in Time practice which allows only the right parts to be delivered with the right quantities at the right time and at the same time the company needs to meet their customer requirement with perfect quality by cutting down the cost of inventories and production management (Ohno 1988, Forza 1996, Shah and Ward 2007).

In many of automotive industries, customer demands have forced them to increase their varieties of cars to be manufactured in order to survive in the industry. Therefore these demands affected the method of supplying materials, material handlings at the assembly line and area of assembly at the production line (Johannson 2007, Wänström and Medbo 2008). It is because different types of car have different types of part to be assembled to it. Hence, it this situation makes JIT more challenging to be adapted. In order to solve the problem, Toyota has introduced a new concept of supplying materials at assembly line which is called Set Parts System (SPS) (Monden
The empirical study of the SPS implementation in Malaysia automotive industry will be the main focus of this research.

There are two main tasks in SPS that is selection and assemble that was originated from Japanese words, *Erabitori* and *Kumitsuke*. The first task i.e. *Erabitori* or selection is a process where each part of different models is selected. The second task *Kumitsuke* or assemble is a process when the parts are assembled to the car body. The implementation of SPS has been done by Toyota at Guangzhou plant and has been very successful. It is because with SPS, it is easy for the unskilled worker to understand and concentrate with the jobs (Toshiro 2008, Marukawa 2011). Therefore, through SPS, the time to train new assembly operator can be reduced. Deechongkit and Srinon (2009) compared three alternatives aspects of material flow in SPS. They found that SPS method was better than traditional method which can reduce distance of part supply, total time for part arrangement and investment of the method. SPS was also known as a kitting process that used to reduce time spending for searching parts and also quick response to quality control (Vujosevic et al 2008, Antonio and Pacifico 2011).

### 2. Set Parts Supply System

In this paper, we focused on a case study that has been done in a production plant of Malaysian leading automotive manufacturer PROTON. The plant runs as mixed model assembly lines where the area of the line covers approximately 814 m². The storage area before SPS was about 100 m² and the component racks that contained parts to be assembled was about 80 m². Since the line consists of large varieties of different parts, the assembly line was always congested and this increased the inventory holding cost. In order to improve the JIT in the production line, the management had approved to implement SPS as part of their *kaizen* effort to solve the congested problem. The area of implementation is called as SPS Island. The main purpose of the case paper is to present the concept of implementation SPS in Malaysian automotive industry.

#### 2.1 Before SPS implementation

In this paper, we will discuss the scenario in two different situation that is pre-implementation and post implementation of SPS. Figure 2.1 shows the one part of the production line before the SPS is introduced. It consists of 4 stations with four operators that work in shift at each station. The component racks were located at the line side of assembly line in different height, length and width. Materials with multi variants and models were put at the component racks with different methods of supplies as containers. In this line, the materials were placed according to the sequence number of assembly process. For instance, an assembly operator at process 1 will take materials A, B, C, D and E from the component racks and then assembled it to the car body to complete his job.

![Diagram of Station Layout](image)

**Figure 2.1: Layout before the SPS implementation**
So, in this case, the assembly operator had to choose the right materials and remove the Non Value-Added (NVA) such as rubber, plastic, paper and rope that used to tie the materials or to cover the materials from scratch before he can assemble the parts to the car body. In other words, he had to do two tasks that is to choose and to assemble the parts. We also found that the assembly operator at Process 2 had to walk about 11 m to move the empty rack and replace the material I and then return the empty containers. Since the space was very limited, only 3 to 4 empty containers can be put at the component racks which resulted to many returnable containers left on the shop floor. In addition, the storage area for the materials was located behind the component racks which are used to keep the reserve materials from supplier. Since this storage area was always full of containers and boxes, it is difficult to carry out 5S activities due to the condition of shop floor that is congested, crowded and unfriendly environment.

2.2 After SPS implementation
The main goal of SPS implementation is to eliminate the storage area and replace them with standard component racks. Figure 2.2 shows the schematic layout of the production line after the SPS is introduced. In the SPS line, a number of new racking has been designed to accommodate the materials in good arrangement. The materials are arranged based on the container size and racking size without following the sequence of assembly process. By this way, the space area for materials storage can be reduced. In addition, the new design of racking is able to locate more empty containers compared to the racks before SPS is implemented. Furthermore, in order to increase the working efficiency of the operators, the task of assembly and selection are done by different operators. So, by adding 2 more operators to do the selection job as shopping operator, they can focus on selecting and supplying materials from component racks to the SPS trolley. These shopping operators read the information sheet as a signage of pull system or Kanban before selecting the parts and fill up the empty SPS trolley with a complete set of parts by selecting the right materials. The shopping operators also have to remove the NVA materials to the bin and put the materials at the right position on the SPS trolley.

In other word, the task of the shopping operator is to ensure the materials are in good quality and meet the requirement and before pushing the SPS trolley to the first station. Then the SPS trolley will flow along the assembly line using a rail guide to keep the trolley moving in track. The assembly operator will pick up the required materials and push the trolley to the next station. At the end of the assembly process, the empty SPS trolley is pushed to the shopping operator and then the process of selection will be repeated again.

One of the main differences of the SPS line is that most of the containers that holds the materials were eliminated and replaced by custom-made delivery trays or hangers called minomi which are dedicated for individual parts. Minomi is originated from Japanese word which means parts only and has been implemented in many Toyota

![Diagram of SPS implementation](image-url)
plants. The advantages of minomi is that it is very flexible and can be designed to handle any size or shaped part. Figure 2.3 shows an example of minomi used in the plant.

![Figure 2.3: Example of minomi](image)

**3. Results**

As a result of SPS implementation, the assembly line became uncluttered, wider and more clear. Therefore the assembly line there are only the SPS trolleys with a ‘set of parts’ that need to be assembled at the door. In addition, by implementing SPS, it is much easier to implement 5S. For example before adopting the SPS, the height of component racks are different from each other with the maximum rack is about 1.8 meter. However after implementing SPS, the height of the racks have been standardized to 1.6 meter. Figure 3.1 (a) and Figure 3.1(b) show the component racks before and after SPS implementations respectively.

![Figure 3.1: Component racks before and after standardization](image)

(a) Before SPS 

(b) After SPS 

The second benefits that we found in this case study is that the storage area of 100m² that was used to keep the parts before they were assembled has been eliminated. We also compared the method of material handling of the
components before and after the SPS was used in the plant. For example, for material A before the SPS is implemented, it was supplied by using a container with polystyrene with bigger size and it was limited to supply only 6 containers as shown in Figure 3.2.

![Figure 3.2: Material handling of material A with container](image)

However, after few designs considered by them, they changed the method of supplying material A into more arranged boxes. The materials were supplied using a corrugated board as a kit that is more smaller in sizes but able to supply material A up to 10 kitting as shown in Figure 3.3. The main benefits of this minomi concept is that we didn’t used any container to hold the materials but only a kit.

![Figure 3.3: Container eliminated for material A](image)

Similarly we made comparison for material B that before SPS used a container that can holds up to 40 parts as shown in Figure 3.4 (a). On the other hand, by using the minomi method, supply of the same part can be done up to a quantity of 90 parts per delivery.

The other findings is that by removing storage area, the walking distance for each operators have been reduced. Before SPS is introduced, the assembly operator has to walk about 11 m to replace the empty rack and the material was supplied by forklift directly which was difficult to handle. So after the storage area is eliminated, the walking distance of the shopping operator is 5 meter for him to replace the empty rack and the material is supplied manually by minomi trays which is more easier to be handled.
4. Conclusions
In this paper, we presented a case study of a new concept of material handlings system called SPS implemented in Malaysian automotive manufacturer. The SPS is regarded as one of the alternatives of JIT practices that used to improve the number of defect, repair and reject and avoid missing process and wrong installation of parts. SPS can reduce the usage of racking at line side area and the ultimate goal is cost reduction. The damaged materials and part shortage can be identified earlier by creating the clean area, wider and well ordered workplace. The continuous improvement at the line side is carried out as part of lean strategy to the SPS Island.

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