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Effect of Part Components' Kitting on Productivity in an Axle Manufacturing industry

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Abstract—Productivity improvement and Productivity enhancement has been one of the major concerns of every manufacturing firm. There are various several available methods that are implemented to improve productivity out of which Lean manufacturing Principles and Strategies stands out to be the pioneer, most efficient and feasible methods from which on can attain tangible benefits by minimizing waste and non value added activities. This paper presents the effect of part components' kitting system on productivity rare in a rear axle manufacturing industry taken in particular. Since the operators constantly move around the products and alternate between the products and sub assembly stations, the work pattern only exemplifies the assembly work but not the flow of product. Therefore, an important reason for kitting is the description aspect of any product's Assembly. A basic principle is that the materials kit should function as a structured material handling system enabling the operators to govern their work. This paper depicts how Kitting Provides Benefits to solve space problems, solve quality problems, achieve material handling, flexibility and learning.

Index Terms— just in time , Kaizen , Material Handling , Part Component Kitting ,Productivity Improvement, waste reduction, 5s.

1 INTRODUCTION

In manufacturing systems, the practice of delivering components and sub assemblies to the shop floor in predetermined quantities that are to be placed together in specific containers or slots is generally known as "kitting" [1] In the context of in-plant materials supply, the principle of *kitting* is often discussed, as it has been stated to offer a number of advantages over the more traditional principle of continuous supply which is often referred to as line-stocking [2]. Nowadays, customers put a lot of pressure on the market to get timely delivery and at low prices. In addition, more and more variation in the assortment has been demanded and custom-made products are often requested. This trend leads to an increased amount of parts moving around on the shop floor. To cope well with these tendencies in the market, manufacturers need to have good control over their operations and look for improvements where possible. In this viewpoint, kitting has been introduced as a counterpart of line stocking. Whereas in line stocking supply of parts are made to the line in bulk by means of individual component containers, in kitting components are grouped together by assembly and supplied to the line in kit containers [3]. The kitting system provides the worker with a proper material handling system, thereby enabling a balance to strike between too little and very high inventory of parts which are fed into the assembly workstations through line stocking. With kitting, parts are kitted in advance (temporarily stored in store) before it can be delivered to the production assembly line. Therefore, kitting avoids inventories at the production floor.

1.1 Definition:

Kitting is the practice of putting together a kit of components and/or sub assemblies before delivery to the shop floor.
A *kit* is then a specific collection of components and/or sub-assemblies [4]

2.LITERATURE REVIEW

H Ahmad Et.Al **[5] -**The objective of this paper is to review the implementation of lean manufacturing in kitting assembly. The implementation of lean manufacturing in kitting assembly may be beneficial to the organization such as reduce in space occupancy,part shortages, lead time and manpower.With a proper understanding on what to kit, where to kit, how to kit, why to kit and who kits the material with a standardized process flow may ensure the success of kitting there by increasing the productivity. Brynzer and Johansson [6]-Their work focused on design of kitting system in terms of location of the order picking activity, work organization, picking method, information systems and equipment. Key design aspects and performance aspects like traveling time and distance, picking information, Design of picking package, picking accuracy and manual picking techniques. In the kitting system, results show that picking efficiency and accuracy can be improved by making better use of the product structure when dividing picking information. Robin Hanson Et.Al [2]-Their work focuses on parts presentation in manual assembly. Their aim was to determine how kitting affects the time spent by the assembler fetching parts and, more specifically, what is the impact of the proportion of parts included in the kit. The paper focus study on four case studies in an automobile assembly in which parts presentation by kitting is compared with parts presentation in component racks. In the case studies, kitting enabled shorter distances between parts presentation and assembly object and thereby a potential reduction in the time spent fetching parts.

3. METHODOLOGY

3.1 Assembly work sequence study

The study has been conducted on eta assembly workstation present in half-line assembly line of an Axle manufacturing industry. The study mainly focuses upon part-components, their sequence and quantity requirements. The data collected is tabulated as shown below.

Table 1: Individual Part Components

Serial Numbers	Component	Quantity requirements in numbers
1	Inner bearing Cup	1
2	Pinion Lock nut	1
3	Outer bearing Cup	1
4	Differential Cup	1
5	washer	1
6	Master Spacer	1
7	Bearing	1

3.2 Problem Identification

The part components that go into sub assemblies in various workstations were being dumped in a box type container, in random quantities and in one particular place. The worker had to leave his workstation to fetch the part components, and search out for the components associated with his assembly. Due to this condition, there was no proper balance in part components' inventory and at times part components' quantity had to face surplus and deficit availability problems. Surplus conditions resulted in Muda of Inventory that includes inventory maintenance costs, and deficit conditions resulted in Muda of Labor motion, thereby increasing the ideal time and there by affecting the productivity rate. Non value added activities were spectacle issues. Also, the number of assemblies per shift was not standardized.

3.3 Time and Motion Study

A Motion Study has been conducted and the following parameters were tabulated

Table 2: Motion and time study data

Serial number	Activity	Time taken in seconds
1	Walking from workstation to inventory place	178
2	Searching and sorting for necessary component	137
3	Arranging the components	286
Total time invested on unwanted motion		601

3.4 Action Plan

As a solution for the existing problem, the main objective of the present work is to come up with a kitting system by standardizing the number of assemblies per shift, and that eliminates Unwanted worker's movement, Inventory, wait time, delay time, Ideal time and to assure that the part components are sorted, set in order and given into respective workstations so that the workers can fetch the individual components associated with their assembly workstations in an effective manner and predefined sequence. The major principles incorporated in overcoming the existing problem in an eta assembly workstations are Lean's 5S and Just in time. The kitting system is supposed to be designed prior to Lean's 5s principle and Just in time Principle.

4. DESIGN OF KITTING SYSTEM

The number of assembles made per shift was standardized from 48 to 70. A kitting system has been designed based on the following factors.

Number of Assemblies per shift - **70**
Supply kit Trolley designed – for **35** assemblies
Number of supply kit trolley needed per shift – **2**
Geometrical Shape of the Supply kit trolley – **Pentagon**
Number of Assemblies made per Face of the pentagon – **7**

Table 3: Number of Components accommodated per Face

Slot Nos.	Components	Number of Rods/slots Provided in each Face	Number of components in Each Rod	Quantity in terms of Numbers
R1	Inner bearing Cup	1	7	7
R2	Pinion Lock nut	1	7	7
R3	Outer bearing Cup	1	7	7
R4	Differential Cup	1	7	7
R5	washer	1	7	7
R6	Master Spacer	1	7	7
S1	Bearing	1	7	7

FIG1: KITTING FOR ETA ASSEMBLY

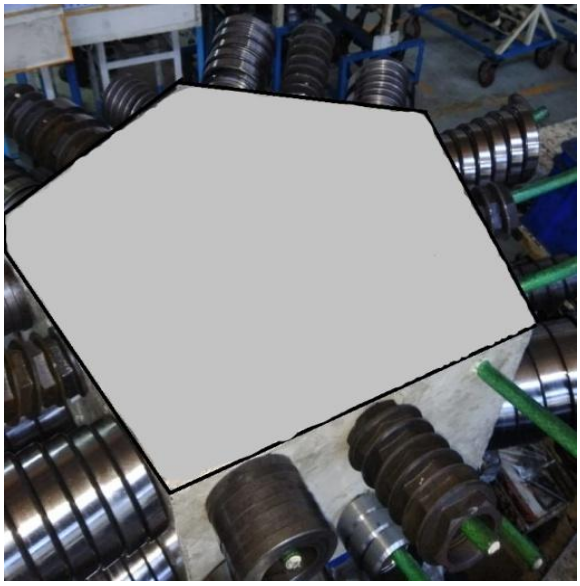

FIG2: TOP VIEW OF ETA ASSEMBLY KITTING

5. RESULTS AND DISCUSSIONS

The kitting for the eta assembly workstation has been successfully implemented and the required objectives were attained. The number of assemblies made per shift was standardized from 48 numbers to 70 numbers and the relative comparison is as shown in the fig 3. Right quantities of part components are given for the workers in the right time and in the right place thereby achieving just in time principle. The necessary part components are properly sorted, set in an organized manner, kept clean, standardized and the concept of kitting was sustained. This exemplifies the implementation of leans 5s principle. Therefore, the concept of line stocking is overtaken by kitting which stands as the change for good depicting kaizen activity. Surplus and deficit conditions of part component quantities are eliminated by striking proper inventory balance. Thus, Muda of inventory has been eliminated. Worker's movement is totally eliminated by providing kitting system right in their assembly working zone. The effect of kitting on productivity is visually analyzed by the following figures.

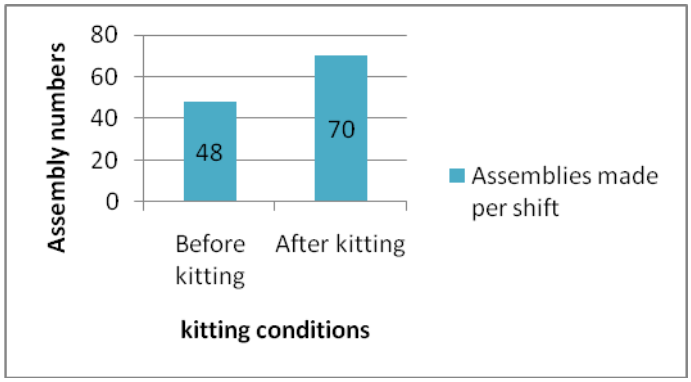

FIG 3: PRODUCTIVITY IMPROVEMENT

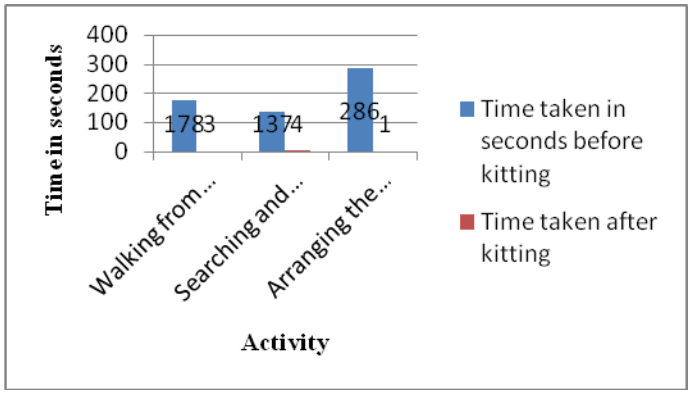

FIG 4: REDUCTION IN MOTION

FIG5: BEFORE AND AFTER KITTING SCENARIOS

6. CONCLUSION

Based on previous research, most researchers agreed that the implementation of kitting is the best way for material feeding in order to achieve a status of lean manufacturing. Factors such as inventory, floor space occupancy and operator walking distances is to be reduced and therefore, lean kitting assembly is considered the suitable method to be implemented in production area which has high variation and volume compared to line stocking [5]

This paper presents the effect of part components' kitting on the productivity rate of an axle manufacturing firm. The problem identified is provided with the appropriate solution and the same has been implemented. The tangible and intangible benefits that has been obtained as a result of kitting, reduces the non value added activities such as Muda of inventory and Muda of motion. Kitting in the present study has assessed to solve quality related issues including user-friendly material handling, achieving control over the flow of work in process materials and over viewing the complex products through training and learning.

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