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Development and implementation of Kaizen activities in an Automobile manufacturing firm

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Abstract— Today in a highly competitive and globalized market, to cater to increase in market demand, the objective of a manufacturing firm will be to deliver its products to its customers with zero defects and within target date. To compete successfully in the market, adoption of lean manufacturing techniques will help the manufacturing firms to stay at the top. This study focuses on reducing the cycle time of a manual assembly line for the first two stations, manufacturing four variants of light commercial vehicle at XYZ firm. Results showed that with introduction of fastener tray and two kitting trolleys as counter measures, there was significant reduction in cycle time. This study also highlights that with successful and proper implementation of kaizen applications has reduced ambiguity, overburdens on the operator and unevenness in the workplace.

Keywords—Continuous improvement, Fastener tray, Kitting trolley, Ishikawa diagram and cycle time

I. INTRODUCTION

Continuous improvement (Kaizen) a philosophy of never ending improvement is a concept of striving to be better every time through problem identification and solving. The Japanese believe that best and most lasting improvements come from gradual improvements. A firm can improve its productivity with minimal investment using kaizen philosophies. Kaizen deals with the change in mindset of people and improves manufacturing operations if implemented in the best possible manner. The practice of visual management as a tool to identify problems is promoted in kaizen for quick solving of problems. The basic benefit of kaizen is that, it will reduce the time and effort needed for the process to be carried out.

[1] Aasheet kumar et al., through their study found that kaizen is an effective approach to improve the productivity of an assembly line. [2] Naveen kumar and Dalgobind Mahto found that in order to improve productivity, balancing the operations at various workstations is the key factor. According to [3] Sandip K. Kumbhar et al., kaizen plays a chief role in optimization of cycle time. According to[4] M. Mohammad Hafizuddin et al., redesigning of layouts may not be the only way to improve productivity, but can also be done by changing operators work sequence and minimizing idle time. Gundeep singh and R.M Belokar [5] through their work at a tractor assembly shop found that reduction in cycle time can be achieved by implementation of lean manufacturing and kaizen techniques.

As the customer demand for different products increases, firms equip themselves to manufacture different variants to cater to customer needs, resulting in high number of parts to be delivered to assembly line. Storage of parts at line side leads to high operator walk time and search time for different parts. More number of parts at line side requires large storage space and increases ambiguity in operators mind to pick the right part for the right model (variant). [6] Raghavendra Ramappa et al., through his study at Caterpillar found that without any additional investments, kitting concept gave a great amount of flexibility to introduce five more variants to the existing assembly line. Successful implementation of kitting concept has a considerable potential to improve production operations in manufacturing industry. Furthermore kitting reduces the motion of operators on shopfloor leading to reduction in cycle time.

According to [7] Puvanasvaran et al., implementation of Poka-Yoke concept for foolproof system will restrict the flow of defects to pass from operator and reach end user. Gheorghe Dulhai[8] found that implementation of 5S on shopfloor has a positive influencing impact on performance of the processes. According to J.Michalska and D. Szewieczek [9] 5S methodology must be adopted for the workplace to be highly effective.

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II. PROBLEM IDENTIFICATION AND ANALYSIS

This study is done at XYZ firm, manufacturing four variants of Light commercial vehicle namely LP 912-49 WB, LP 712-42 WB, LP 407-34 WB, and LP 407-31 WB. The main objective of this study is to reduce cycle time for first two stations of the assembly line.

A. Cycle time reduction for stations 1 & 2 of assembly line

Currently four operators (two at right and two at left hand side of frame of the Chassis) have been assigned to do the fitments in these stations and one kitting trolley is being used for retrieval of parts. These operators are independent of each other to carry out the operations for all four variants. Operators have been trained to work according to the Work Instruction Sheet displayed in the ladder board of the corresponding stations. The operations done by four operators here are assembly of Antiroll bar and its Bracket, Quick release valve, Radiator side bracket, Engine mounting pad, Shock absorber bracket, Purge tank, Drying distributor unit, Bump stopper, Spare wheel carrier.

Total number of operations done at these stations for the above four variants are 14,13,11 and 9 respectively. The current cycle time of these respective stations is exceeding the takt time, hence it becomes imperative to reduce the cycle time in order to meet customer demand. Ishikawa diagrams have been employed to determine the factors causing undesired effect i.e. time loss.

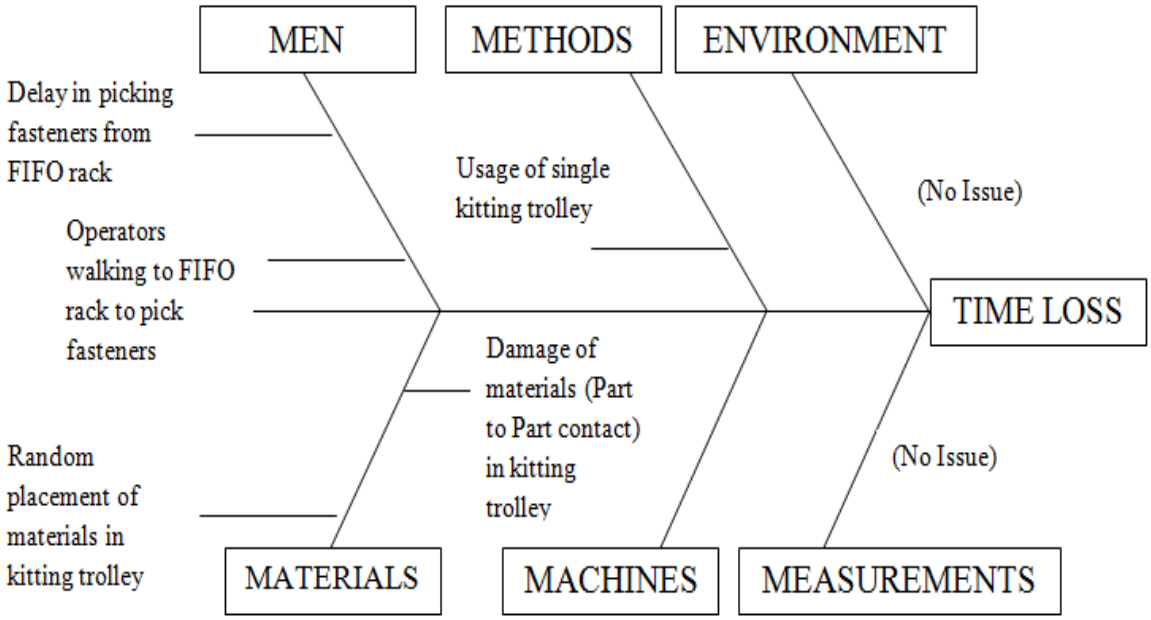


Fig 1 Ishikawa diagram for Time loss of stations 1 & 2

III. IMPLEMENTATION OF COUNTERMEASURES

A. Actions initiated to minimize Time loss for stations 1 & 2 of assembly line

1) Kaizen theme: Cycle time reduction

Problem/Present status:

1. Operator is losing significant amount of time while walking down to aisle of assembly line resulting in overburdening.
2. Operator fatigue

Countermeasure: Introduction of fastener tray.

Fig 2 Assembly line (Before kaizen)

Fig 3 Assembly line (After kaizen)

2) Kaizen theme: Implementation of foolproof concept
Problem/Present status:
1. New operators find it difficult to identify different parts, as there are four variants, it creates ambiguity in operators mind to pick the right part.
2. Material are being arranged randomly
3. Metal to metal contact of neighbouring parts .
Countermeasure: Introduction of two kitting trolley's (left hand and right hand), introducing photographs of different parts with their part numbers of all four variants on kitting trolley.

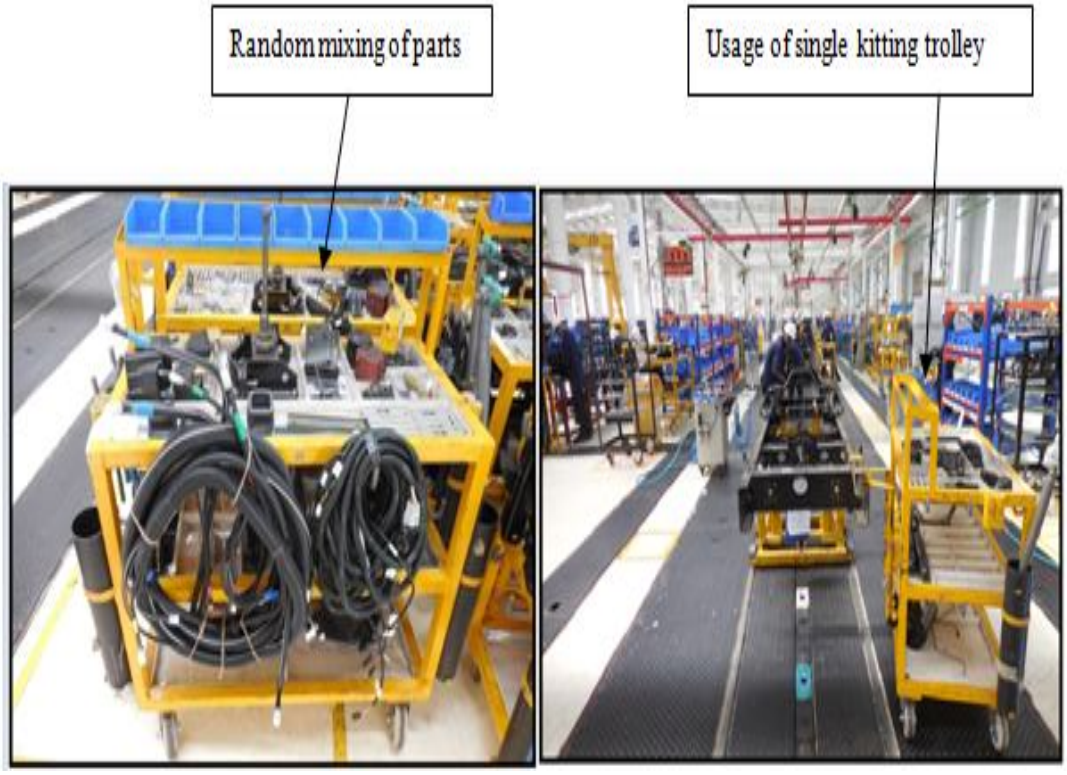


Fig 4 Kitting trolley (Before kaizen)

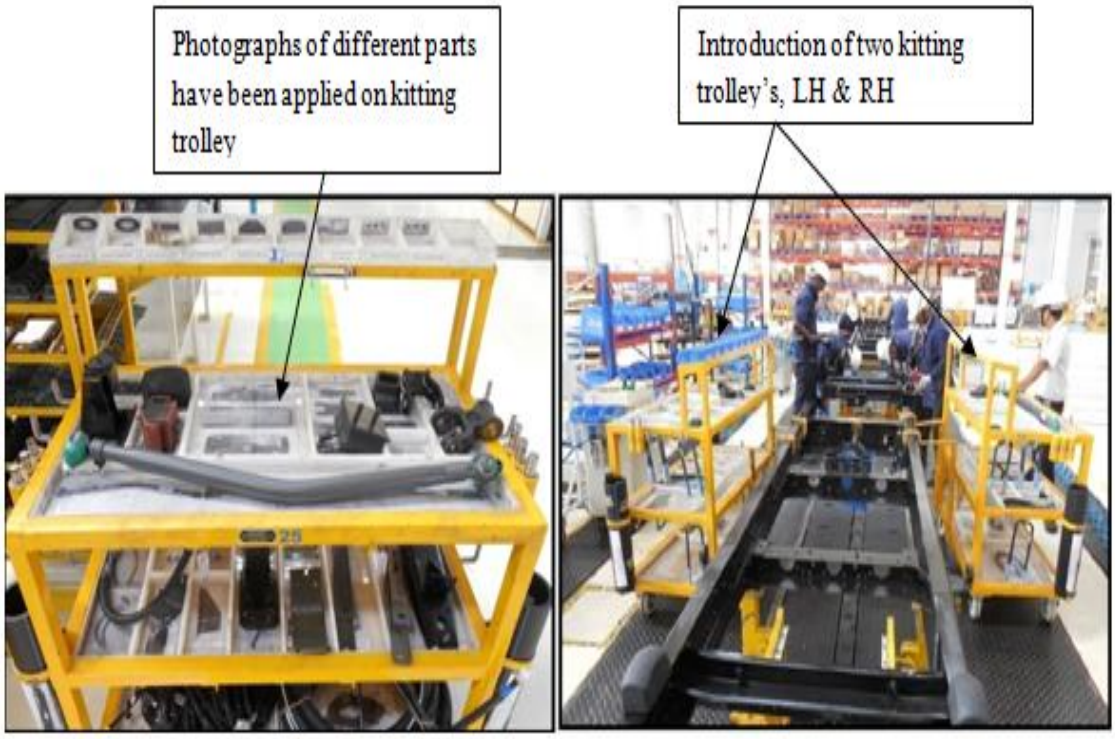
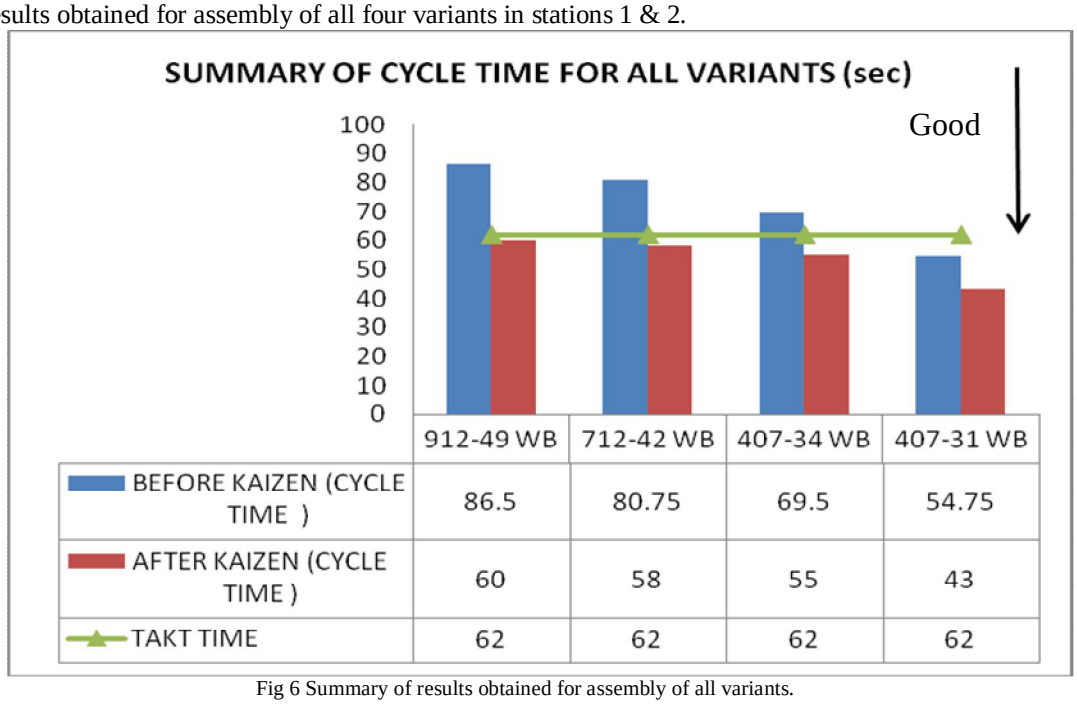


Fig 5 Kitting trolley (After kaizen)

IV. RESULTS AND DISCUSSION

1) Results obtained for assembly of all four variants in stations 1 & 2.



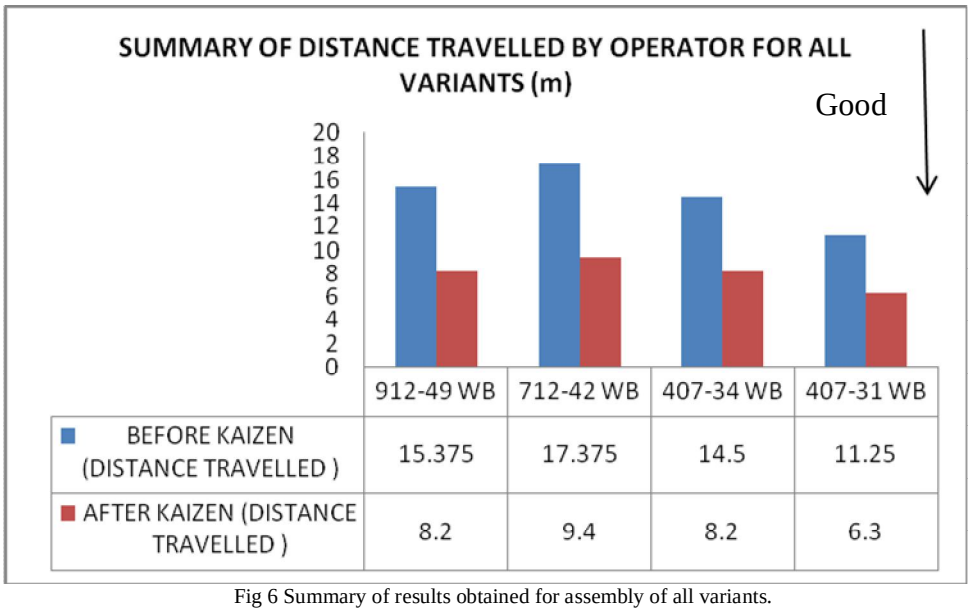
	912-49 WB	712-42 WB	407-34 WB	407-31 WB
BEFORE KAIZEN (CYCLE TIME)	86.5	80.75	69.5	54.75
AFTER KAIZEN (CYCLE TIME)	60	58	55	43
TAKT TIME	62	62	62	62

Fig 6 Summary of results obtained for assembly of all variants.

Operation time of each operator to assemble the fitments was recorded before and after implementation of kaizen activities for a period of one week, average of all data was used to calculate cycle time. From Fig 5 it is evident that cycle time of LP 912-49 WB, LP 712-42 WB and LP 407-34 WB is exceeding the Takt time whereas that of LP 407-31 WB is within the range. After implementing kaizen method as explained in Fig 3 & 5, cycle time is reduced significantly. Cycle time for LP 912-49 WB, 712-42 WB, 407-34 WB and 407-31 WB is reduced by 30.63%, 28.17%, 20,86%,and 21.46% respectively.

2) Results obtained for Distance travelled by operator during assembly of all four variants in stations 1 & 2.

From Fig 6 we can observe that amount of distance travelled by each operator was significantly reduced in assembly of all four variants. This is due to introduction of fastener tray and addition of another kitting trolley to the assembly line. This eliminates frequent motion of operator, a form of waste which is not acceptable. From Fig 6, we can see that average Distance travelled by operator for assembly of LP 912-49 WB, 712-42 WB, 407-34 WB and 407-31 WB is reduced by 46.67%, 45.89%, 43.44% and 44% respectively.



	912-49 WB	712-42 WB	407-34 WB	407-31 WB
BEFORE KAIZEN (DISTANCE TRAVELLED)	15.375	17.375	14.5	11.25
AFTER KAIZEN (DISTANCE TRAVELLED)	8.2	9.4	8.2	6.3

Fig 6 Summary of results obtained for assembly of all variants.

V. CONCLUSIONS

Kaizen process plays a vital role in boosting the productivity of the firm; it is a gradual step towards making a workplace highly effective. This study highlights the fact that, introduction of two kitting trolley's (each on left and right hand side of assembly line) and usage of fastener tray by each operator has reduced the cycle time of first two stations for manufacturing of all four variants of light commercial vehicles. Dedicated compartment for each part has removed uneven arrangement of parts in kitting trolley. Metal to metal contact of various parts is eliminated. Application of photographs of various parts with their part numbers on kitting trolley considering all four variants has eliminated ambiguity in operators' mind and has enhanced their knowledge.

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