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Optimization Of Vehicle Manufacturer Customer Acceptance Line Assembly

K.P. Devakaran,
Assistant Professor
Department of Automobile Engineering, PSG College of Technology, Coimbatore-641 004

Abstract

The optimization of vehicle manufacturer customer acceptance line helps in minimizing installation cost and workstations in the ford assembly. The literature survey depicts that the minimization of the workstations can be achieved by DMAIC six-sigma tool to increase the production rate. The optimization of ford assembly have various problems such as cost-oriented, assembly line balancing and cancellation of repetitive workstations. The assembly line balancing includes assigning of workstation check points in order to create a work flow for the ford assembly in the conveyor.

The present Customer Acceptance Line (CAL) conveyor consists of seventeen workstation for the ford assembly in checking the electrical, electronic and mechanical accessories malfunctioning which involves more consumption of time and repetitive human works. The proposed optimization of the Ford customer acceptance line enhances the work flow by reducing cycle time using time and motion analysis to appropriate work time limits and equal work load distribution in the workstation. Out of the seventeen workstation in Customer Acceptance Line, the repetitive stations such as manual electrical checkout and machine electrical checkout systems are optimized to improve the production rate in less time.

Thus the optimization of ford customer acceptance line helps in eliminating labour cost, current consumption charge with reduction of workstation and also improves the production line efficiency with minimal work space.

Keywords: *CAL,*DMAIC,TimeStudy,MotionStudy,WorkStation, Assembly Line .

I. INTRODUCTION

Assembly lines, which have evolved from rigorously timed and straight single-model lines to more flexible systems, remain an appealing method of mass and large-scale serial production by re-structuring the assembly line. While re-configuring the line the work load must be evenly distributed and work flow must not be disturbed among the work stations. Assembly lines are flow-oriented manufacturing systems in which line balancing is crucial for production scheduling. An assembly line is made up of numerous stations that are positioned along a conveyor belt and where operations are done, and cycle time is recorded at each station. The basic goal of line balancing is to distribute jobs evenly across the workstation so that man or machine idle time is reduced and repetitive processes are eliminated. The industrial management systems have different types of assemblies and also invest a huge cost for planning, controlling and measuring performance for different types of products. The fundamental goal of line balance is to reduce waste caused by excess production, inventories, faults, transportation,

workstation motion, and waiting.This work aims to implement assembly line balancing method to streamline the work station process by removing repetitive tasks.

The customer acceptance line shown in Figure.1. also called as CAL is a conveyor operated Team-production Straight Automated line in which workers used to work in one- or two-person work stations and execute repetitive tasks. The finished cars goes through the customer acceptance line. CAL has different stations, in each work stations the electrical system and mechanical accessories-parts over the car is checked. Each work station has various check points which is checked by manual associates.

Figure.1. Customer Acceptance Line Figure

The manual associate store the status of checked car in QLS. Quality Leadership System shown in Figure.2 is a storing application. It has line issues, repair and other checks regarding the car. The associate types vehical identification number(VIN) and feeds the result of various checks. Each work station has a QLS. Input is in terms of data entry and output in term of data extraction. Production report can be generated with help of QLS. The production analysis is done by

- c\1000= Concern Per 1000 cars.
- FTT=First Time Through.

$$FTT = \frac{\text{Number of car produced - Number of car defectice}}{\text{Number of car producced}}$$

VIN extraction, Six month to one year failure report, Pareto analysis, Production report, Line issues in a single day etc can be furnished with help of QLS.

Figure.2. Quality Leadership System

In CAL there are totally seventeen workstations they are 1. CBT AC 2. CBT Audio 3. CBT-Manual ECOS 4. Trim Interior-Rear 5. Trim Interior-RH 6. Trim Interior-LH 7. Sniffer 8. Door Interior-RH 9. Door Interior-LH 10. Tail Gate 11. Hood Interior and Exterior 12. RH Exterior 13. LH Exterior 14. Machine ECOS 15. Door Effort 16. Online Buyoff 17. Offline Buyoff. In this seventeen work stations there are totally 128 check points. In each work station there is a check sheet shown in Figure.3. which has customized check points to be checked.

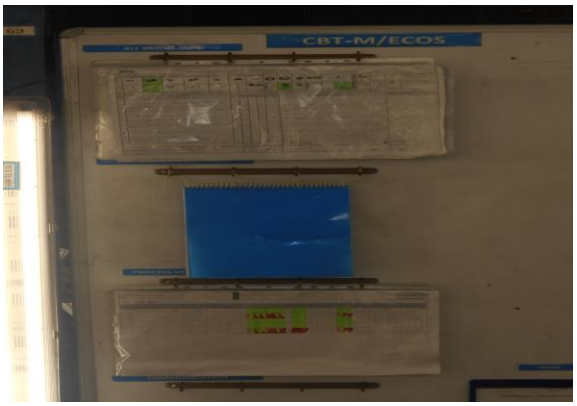

Figure.3. Check Sheet Figure

This work eliminates the repetitive task done by associates and improve production capabilities and optimize assembly line. The seventeen work station in CAL is briefly studied and also their respective check points. In studying the work stations we can conclude that two stations are doing repetitive works ,they are manual electrical check out system and machine electrical check out system.

The Manual ECOS is third work station in customer acceptance line. ECOS stands for electrical check out system. In this work station the manual associate gets inside the car and operates the electrical system in car, the working is visually verified by the associate. Four mirror are present between work station 2 and work station 5 shown in Figure.4. The associate must see over the mirror for working of electrical system and in case of any issue it must be reported in QLS.

Figure.4 Manual Inspection

Figure.5. Check Points

The check points of manual inspection are shown in Figure.5, and its consist of 1. Door 2. Door Entry Lamp Function 3. Power Mirror Function 4.Reverse Lamp Function 5. Brake Lamp Function 6. Parking Lamp Function 7. Head Lamp Low Beam Function 8. Head Lamp High Beam Function 9.Indicator Function 10. Fog Lamp Function 11. Auto Head Lamp Function.

The Machine ECOS is fourteenth work station in customer acceptance line. In this work station the manual associate checks the electrical system of car with help of a machine shown in Figure.6. This Machine ECOS setup has Genetic Network Analyser(GNA), Hand Held Unit(HHU) and a Snake. The GNA has programmed data in it which is connected to the Electronic Control Unit. With help of HHU the

asssociate scans the VIN and follows instruction given by the machine. Snake is connected to battery. The issues are automatically fed in QBAY which is a computer generated software.

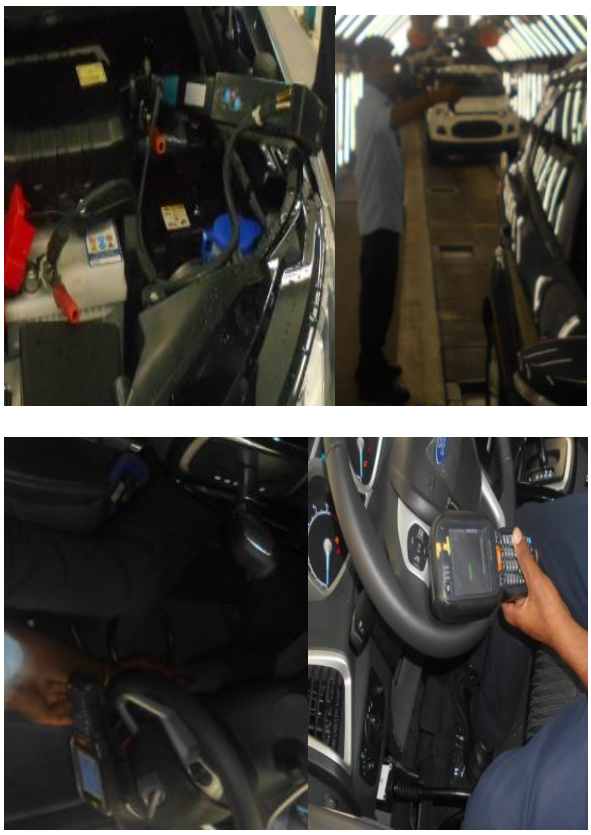

Figure.6. Machine Inspection

The check points of machine inspection and it includes the points are 1. Hand Brake 2. Flash Brake Lamp 3. Reverse Lamp 4. Hazardous light 5. Central Lock 6. Courtesy Lamp 7. Power Window 8. Horn

II. RESEARCH METHOD

Amen (2000) reported on a cost-oriented assembly line balancing precise technique druing experimental investigation and the results shows the new method for finding optimal solutions for small and medium-sized problem instances in acceptable time. Patange Vidyut Chandra (2013) used a systematic productivity strategy as well as a time study method to minimise costs and increase revenues. Dr. Ashok G. Matani, Dr. S. K. Doifode, Ankush D. Bhishnurkar (2015) applied time and motion methods to minimize delay in production and to improve manufacturing productivity for existing system. The manufacturing process was improved by eliminating and consolidating work processes, which reduced production time, transportation time, the number of processes, and the amount of space used. Niebel, B. W (1962) despicted the time study as the methodology of defining an acceptable time standard to execute a particular activity, based on measurement of work content of the required manner, with due tolerance for fatigue and personal and unavoidable delays. Meyers (2002) specified

time standards as the amount of time required to produce a product at a workstation depends on skilled worker.

Russell (2005) developed two groups such a group of method studies and group of work measurements used to simplify the work , and to find the time required to carry out the operational activity respecivley. Song, Wong, Fan, Chan (2006) proposed optimization method to balance production line through optimal operator allocation that takes into account the lowest standard deviation of operation efficiency, highest production line efficiency, inorder to find out the optimal solution of operator allocation. C Merengo, F Nava, A Pozzetti (1999) proposed novel method to minimise the rate of incomplete work or the probability of blockage inorder to to reduce the number of stations along the line, and also ensures uniform part consumption in just in time manufacturing systems. Waldemar Grzechca (2011) discussed about assembly line balancing based on cycle time. Cycle time is directly proportional to output efficiency of system and needs be balanced for good production rate in the assembly line.

The purpose of this research is to eliminate the repetitive task done by the manual associate in work station. As research methods, systematic observation, process charts, stop watch time study, and motion study were used in this study.A survey has been done to propose a new balanced assembely line without repetitive works.

III. SOLUTION METHODOLOGY

At present the Customer Acceptance Line assembly has seventeen work stations. Breifly studying over the check points in individual work stations we can conclude Manual and Machining Electrical Check out System are doing repetitive work. By eliminating a work station and implementing new assembly line flow, man power is reduced, additional work flow time is achieved, electricity power and space over concerned work station is saved.

The work station cannot be eliminated without proper justification. In eliminating work station we need to study the failure trend , the check points must be properly distributed and issues must be detected in other work station. DMAIC is implemented with time and motion study technique. Process charts and graphs are furnished to compare and show the test results.

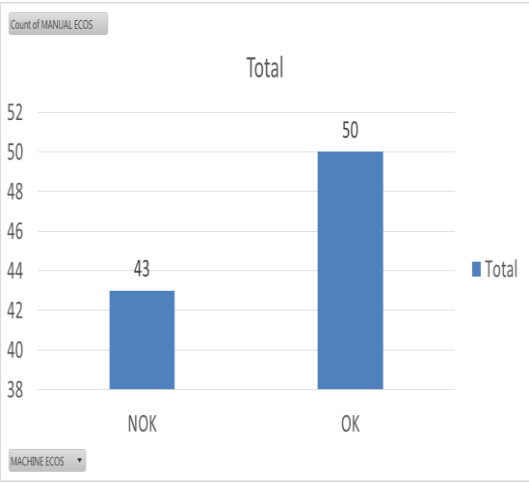

Figure.7. Machine Vs. Manual Inspection

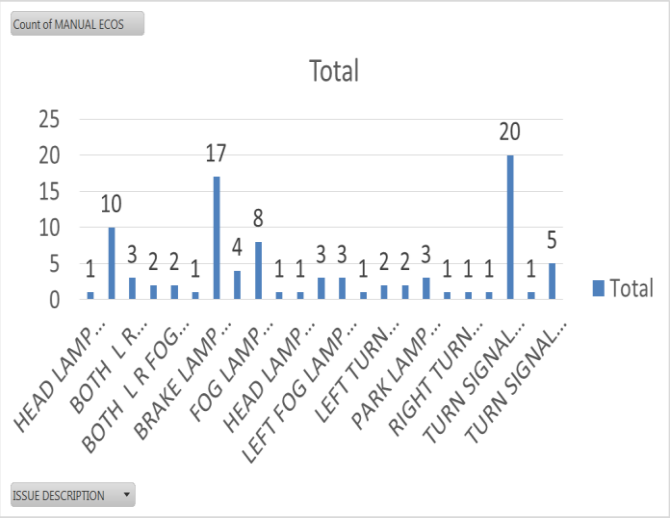

Figure.8. Manual Inspection Vs. Issues

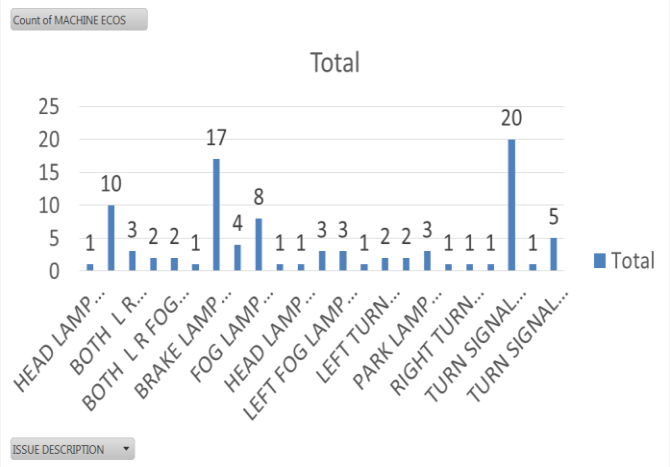

Figure.9. Machine Inspection Vs. Issues

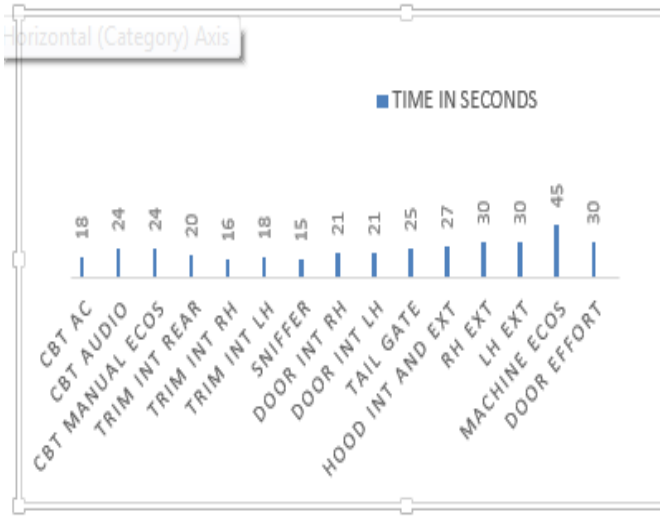

Figure.10. Time Study in Work Stations

The test results says issues which have been ploted in Manual passed in Machine inspection and vice versa, so we cannot eliminate the check points. The check points in Manual ECOS work station that is to be eliminated is allotted to other work stations. Motion study is done to allocate the check points to other work station. By studying we can conclude in Four stations labor is in driver seat(CBT AC, CBT Audio, Machine ECOS and Trim Interior) so we must allot the check points to this stations only. If the check points is allotted to other stations the time taken to finish the task will be more. The check points of eliminated work station is added to first and second work station and the line is tested.

IV. COST SAVED BY PROPOSED METHODOLOGY

❖Electricity Cost Saved

- 100 watt industrial fan is employed. Two fans are saved cancelling a work station.
- (Fan)200 watt * Number of hours working
- 100 watt * 21.5 hours= 2150 Watt-hour
- Convert Watt-hour to Kilowatt hour, since one unit of electricity consumed is equal to one Kilowatt hour.
- 1watt= .001Kw
- So we get 2.15Kwh, for per day.
- For a month(taking 31 days) = 66.65Kwh
- One unit of industrial line is equal to 6Rs, so 66.65 * 6= 400Rs
- For two fans per month= 800Rs is saved
- Tube light employed is 20 Watt.
- Hence 20 * 21.5 = 430 Watt-hour.
- Converting to Kwh we get .43 Kwh, per day.
- For a month= 13.33 Kwh
- One unit of industrial line is equal to 6Rs, so 13.33 * 6= 80Rs.
- For nine tube lights, 9 * 80= 720Rs

❖Labour Cost Saved

- Salary of associate= 8000 Rs
- Totally 3 shifts= 3 * 8000= 24000 Rs
- Per Annum= 2,88000 Rs is saved

❖Total Cost Saved

- Associate cost per annum= 2,88000Rs
- Cost saved by cancelling Fan per annum= 9600Rs
- Cost saved by cancelling lights per annum= 8640Rs
- Total Cost Saved= 3,06240Rs.

V. CONCLUSION

In this paper, the assembly line balancing and the problems faced were observed in real time. According to the findings of the assembly line balance study, repetitive production jobs are key concerns for management since they impair productivity. The assigning of work stations are implemented, to

minimize the number of workstations and maximize the production rate. The equipment costs, cycle time, the correlation between task times and the flexibility over the task needs a great attention.

The problem which occurred in CAL are related to repetitive tasks. From the observation, data collection based on time and motion study, the new proposed assembly line in CAL consist of totally sixteen work stations. The advantages of newly proposed line balancing are, from 17 stations now CAL is reduced to 16 Stations. Hence Man power is reduced. As a result of man power reduction, associate cost is eliminated. Electric power to that concerned station is saved, space is saved and QLS in concerned station is saved. The modified Customer Acceptance line with 16 stations was successfully tested and will be implemented in few months.

Further developments are needed to describe all the industrial environments situations. Nevertheless, the results obtained depicts that a general customizable solution can be achievable by small change in work flow and reducing the work station.

Abbreviations

- CAL- Customer Acceptance Line
- ECOS- Electrical Checkout Sysyem
- QLS- Quality Leadership System

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