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Optimization of Scorpio front suspension (W105) assembly line by using ECRS Principles

Shubham Kothavade[1], S.P. Deshpande[2]

Student, Department of Mechanical Engineering, GES's R.H. Sapat COE, Nashik, India[1]

Associate Professor, Department of Mechanical Engineering, GES's R.H. Sapat COE, Nashik, India[2]

Abstract: In today's competitive manufacturing environment, companies are constantly looking for ways to improve in their production process. A new flow of assembly line is proposed for suspension assembly line. An assembly line of a Front Suspension of Mahindra Scorpio is to be optimized to increase the productivity. This paper presents the improvement of production rate and balance loss ratio of the manual assembly line. Using ECRS four principles (Eliminate, Combine, Rearrange and Simplify) minimize the idle time or the percentage of line balance loss. The result shows that cycle time of the assembly line is reduced from 56 seconds to 48 seconds and Production rate increased from 250 to 293 pieces per hour.

Keywords: Assemble line, ECRS, work-study, balancing, optimization.

I. INTRODUCTION

Modern assembly lines are used in automobile industries in order to produce high quality and very complex products. These industries involve large number of input parameters which may affect cost and quality of final product. Selection of optimum parameters and process is very important objective in the present work.The mathematical models of assembly line of Scorpio (W105) considered for the optimization of respective assembly line. Assembly lines have been widely used in various production systems to produce high-volume standardized products. This kind of production lines includes a series of workstations arranged along a material handling system. The components are processed as specified by a set of tasks, for a given cycle time. Tasks are assigned to an ordered sequence of workstations in accordance with given precedence relationships among them. To increase the production rate, different techniques have been developed to solve problems from different areas such as work measurement, line balancing, method improvement, and quality improvement tools. In this paper the major focus is on balancing the line and reduce the ideal time. In order to do it, ECRS (Eliminate, Combine, Rearrange and Simplify) principle is used.

II. WORK STUDY

Work study may be defined as the analysis of a job for the purpose of finding the preferred method of doing it and also determining the standard time to perform it by the preferred (or given) method. Work study, therefore, comprises of two areas of study: method study (motion study) and time study (work measurement). In order to understand the role of work study, we need to understand the role of method study and that of time study. Method study (also sometimes called Work Method Design) is mostly used to improve the method of doing work. It is equally applicable to new jobs. When applied to existing jobs and existing jobs, method study aims to find better methods of doing the jobs that are economical and safe, require less human effort, and need shorter make-ready / put-away time. The better method involves the optimum use of best materials and appropriate manpower so that work is performed in well organized manner leading to increased resource utilization, better quality and lower costs.It can therefore be stated that through method study we have a systematic way of developing human resource effectiveness, providing high machine and equipment utilization, and making economical use of materials.Time study, on the other hand, provides the standard time, that is the time needed by worker to complete a job by the standard method. Standard times for different jobs are necessary for proper estimation of

- Manpower, machinery and equipment requirements
- Daily, weekly or monthly requirement of materials
- Production cost per unit as an input to better make or buy decision
- Labor budgets
- Worker's efficiency and make incentive wage payments.

By the application of method study and time study in any organization, we can thus achieve greater output at less cost and of better quality, and hence achieve higher productivity.

Work Study and Ergonomics: The work study and the ergonomics are the two areas of study having the same objective: design the work system so that for the operator it is safe, and the work is less fatiguing and less time taking.

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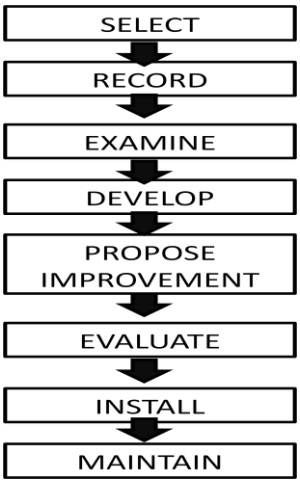

Figure 1 Standard Procedure of Work study

. To optimize any process, we have to first study the present process in detail. For that purpose we have visited the industry weekly in order to collect the data. Number of stations and number of activities for each stations were observed. All small actions of each worker where noted. At the same time, cycle time, time taken for each station, ideal time of the stations, lead time for one assembly etc. where recorded.

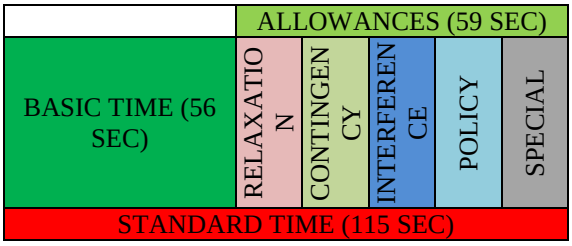

Figure 2 Standard time calculation

III. ECRS

1. Eliminate: Eliminate is a consider how the current work and eliminate waste of seven was found in manufacture such as the delay, Removing unnecessary, functions that are not beneficial, and waste.
2. Combine: It works by reducing the unnecessary step bunching together, reduce process down and production is faster. The movement during the process down.
3. Rearrange: What is the process to reduce unnecessary movement or delay between process. For the example, we swap step 2 and step 3 for reducing distance moving.
4. Simplify: For improving the work easier, more convenient. Sometime we design jig and fixture to help for the convenience and accuracy.

The main analysis tools in method study are 5W1H (What, Where, When, Who, Why and How) question-asking method, the four principles of ECRS (Eliminate, Combine, Rearrange and Simplify) and the principles of motion economy.

Table 1 Elimination of work elements

Sr. No.	Work Element	Time Saved(sec)
1.	Load the knuckle in the bin	1
2.	Pick the knuckle from the bin	2
3.	Load the hub in the bin	1
4.	Pick the hub from the bin	2
5.	Turn back and move towards dustshield stand	1
6.	Turn back clockwise and towards conveyor	1
7.	Load the dustshield in the bin	1

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Table 2 Combination of work element

Sr. No.	Work Element	Time Saved(sec)
1.	Pick the dustshield along the hub	1
2.	Pick the barcode sticker in RH along with part-code sticker in LH	2

Table 3 Rearrange work elements

Sr. No.	Work Element	Time Saved(sec)
1.	Turn back and move towards knuckle box after caliper loading	1
2.	Pick the knuckle from stand after previous	1
3.	Turn back clockwise and towards conveyor after previous	1
4.	Load the knuckle on the fixture	2
5.	Clamp the knuckle after knuckle loading	2
6.	Index fixture 90 to left side after clamping knuckle	2
7.	Pick the hub after indexing	1
8.	Align hub mounting holes with dust shield mounting holes after picking up hub and dustshield	2
9.	Assemble hub sub assy(with dust sheild) on the knuckle	2
10.	Turn back clockwise and move 2 steps towards disc stand at the start of 3rd station	1
11.	Pick the disc with both hands after previous	1
12.	Turn back clockwise and move 2 steps towards conveyor after previous	1

IV. RESULTS AND DISCUSSION

We categorized the process into seven stations. We collected the current cycle time for each workstation for 30 replications from all employees in the stations and calculated average cycle time of all stations.

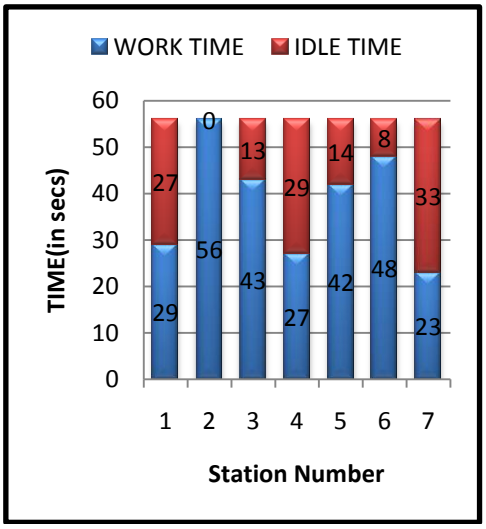

Figure 3 Present Process,

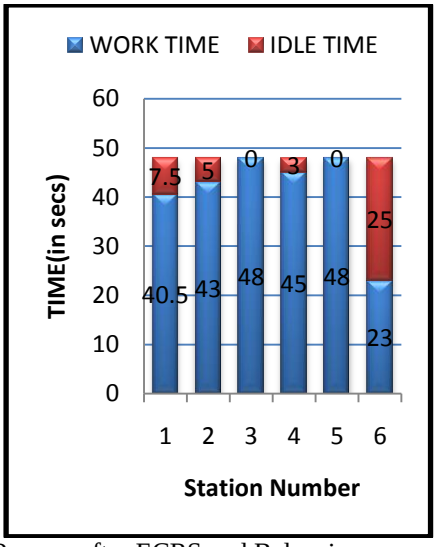

Figure 4 Improved Process after ECRS and Balancing

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Table 4 Results

	PRESENT	IMPROVED	%
Cycle time	56	48	**14.28**
Productivity	250	292	**16.8**
No. of operators	14	12	**-**

The cycle time of the assembly line is reduced by 8 secs, thus improving the productivity by 42 units per shift. Two workstations are eliminated, which made two operates available, to perform other activities. Thus the suspension assembly line for Scorpio W105 is optimized and completely balanced, resulting the increase in profit for the company.

V. CONCLUSION

The predefined goal of increasing the productivity was achieved using ECRS principles and balancing theassembly line. Total increase in the productivity was 42 pieces per shift (16.8%) which added Rs.75,600 in profit of the company. Whereas reduction in two stations, saved the cost of operators i.e. Rs. 4 lakhs annually. In this way the Scorpio Suspension Assembly line is optimized and well balanced.

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