International Journal of Research in Engineering, Science and Management
Volume-2, Issue-4, April-2019
www.ijresm.com | ISSN (Online): 2581-5792

Manpower optimization using Lean Tools

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***Abstract*: The purpose of this paper is to improve the productivity of a power cord manufacturer company in India. It analyzes the production process based on work study principles and identifies the bottleneck operation. First, analyze the current production system by collecting the cycle time of all operations in the production process based on work study principles. Then, design the production network and identify the bottleneck operation. After that, based on line balancing (LB), ECRS (eliminate, combine, rearrange and simplify) – are proposed and implemented in the actual production line. With the ECRS concept, two stations are combined into one station, such as tie fitting and lock fitment on power cord. This method improves the cycle time and reduces the number of employees. Reduce the number of employees by 6 persons, and reduce the labor cost by 744000 Rs./year.**

***Keywords*: Work study, Line balancing, ECRS concept, Process improvement**

1. Introduction

The objective of Lean Manufacturing is to reduce waste and highly responsive to customer demand while producing quality products in the most efficient and economical manner [6]. The core idea behind lean manufacturing is maximizing customer value while minimizing waste, thereby achieving manufacturing excellence through the creation of more value with fewer resources [1]. A lean organization understands customer value and focuses its key processes to continuously increase it. The ultimate goal is to provide perfect value to the customer through a perfect value creation process that has zero waste [3]. Lean can be applicable to any process not only to the manufacturing. There are various tools which is used widely for implementation of Lean in industry. SWCT is a kaizen tool, which means standardized work combination table. ECRS is a tool which is used to eliminate, combine, rearrange and simplify the process, so that the productivity can be improved [6].

2. Literature Review

Sindhuja. D (2012) presented the procedure of ECRS and also explained where to apply it. By applying ECRS, many non-value-added activities can be reduced. The main aim of using ECRS tool in horn assembly is to eliminate the goal to combine or reset the place, time and person and to simplify the method provides better effect and process flow method. D. O. Fakorede (2014) presented briefly how to compare the utilization of men and machines on Nigeria mills. By using this paper, the productivity also improved in that particular organization. The analysis also shows that increase in manpower can also give rise to increase in productivity, although it has been observed that increase in production may or may not affect increase in productivity ratio. Rohana Abdullah (2014) explained the improvements on man to machine ratio suggested through work study which leads to an improved number of workers in a production line. By reducing workers and optimizing sources, the operation cost can be improved and helps the semiconductor manufacturing company towards achieving competitive advantage over other competitors. In this paper, the implementation of ECRS leads to optimal unitization of manpower without affecting productivity.

3. Methodology

A. Data collection

Data are collected using stopwatch and recorded for the actual production on a shift basis. It helps to find out the major time-consuming operations, cyclic and non-cyclic activities. It also helps to visualize the root causes and possible solutions for the problems.

1) Cyclic and Non-Cyclic activities

The activities which are repeatedly done at regular cycle of time is known as cyclic activities. The activities which are randomly done without regular cycle of time is known as non-cyclic activities. The cyclic activities include loading, unloading of job and getting job from previous machine. The non-cyclic activities include inspection, adjustments, packing, walking.

Takt time-Takt time is defined as the time required for completely transforming the raw material to finished product based on the customer demand.

$$\text{Takt time} = \frac{\text{Time available for a shift or a day}}{\text{Demand per shift or day}}$$

$$\text{Demand per shift} = 2000$$

$$= \frac{28800}{2000}$$

$$\boxed{\text{Takt time} = 14.4\text{sec}}$$

$$\text{Require output/hr.} = \frac{3600}{14.4}$$

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Volume-2, Issue-4, April-2019
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Require output/hr.=250

According to the takt time, required output of line is 250/hr.

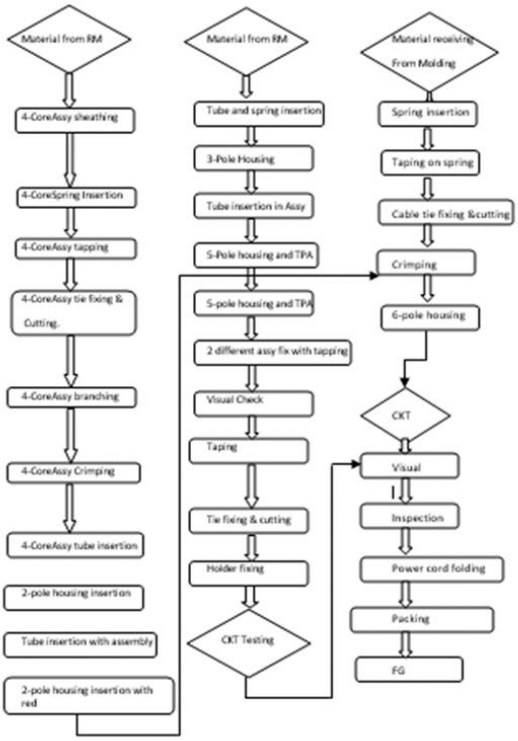

Fig. 1. Process flow diagram

Table 1
Cycle time of main line

S. No.	Process Name	M/P	CT
1	Length checking	1	7.2
2	H.V Testing	1	8
3	Insertion of spring	1	6.3
4	Taping	1	6
5	Double tie fitting &cutting	1	12.3
6	crimping	1	7
7	Insertion of 4wire in a housing with a cap	2	9
8	TPA insertion	1	10
9	Blackout checking	1	7
11	Taping	2	8.2
12	Sleeve insertion	1	9.8
13	CKT	2	9
14	Checking	2	9
15	Folding &packing	1	11.5

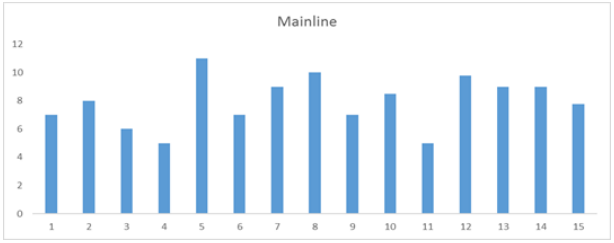

Fig. 2. Cycle time of main line

Table 2
Cycle time sub-Assembly 1

S. No.	Process Name	M/P	Per Hr.	C.T
1	Housing Insertion	1	273	13.2
2	Housing Insertion	4	332	11
3	Tube Insertion	1	581	6.2
4	Taping	1	493	7.3
5	Crimping	1	514	7
6	visual inspection	1	400	9
7	Taping	1	500	7.2
8	Lock Fitment	1	514	7
9	Tie Band Fitment	1	514	7
10	CKT	1	360	10

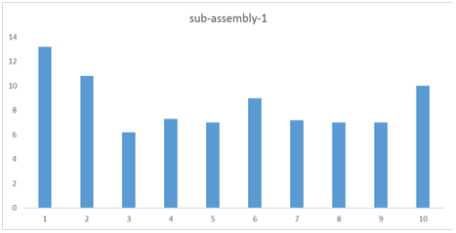

Fig. 3. Cycle time of sub-assembly 1

Table 3
Cycle time sub-Assembly 2

S. No.	Process Name	M/P	Per hr.	CT
1	Sheathing	1	529	6.8
2	Spring insertion	1	383	9.4
3	Taping	1	545	6.6
4	Tie fitting	1	400	9
5	Stripping	1	404	8.9
6	crimping	2	414	4.35
7	Tube &housing insertion with TPA	1	379	9.5
8	Tube & housing insertion with TPA	1	450	8

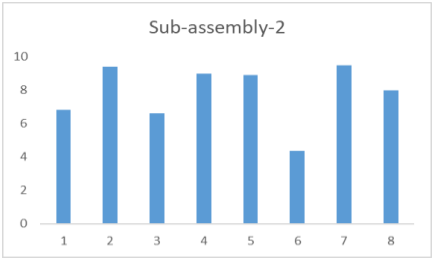

Fig. 4. Cycle time of sub assembly 2

Table 4
Line output and manpower

Line	output/hr.	manpower
Mainline	293	18
subassembly-1	273	13
subassembly-2	375	7
	Total	38

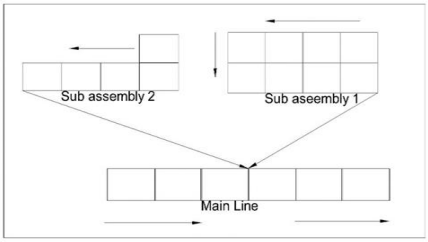

Fig. 5. Layout of assembly line

The Fig. 5 shows the arrangement of assembly line and material flow.

B. Analysis

The collected data are analyzed using lean tools such as SWCT, ECRS. ECRS tool is used for combining the workers, eliminating the unnecessary activities, rearranging the position and simplifying the process. Here ECRS is used for all workers and identified the problems.

1) Elimination of operation

In this stage the unwanted operation or additional manpower is eliminated.

Table 5
Eliminated operations

S. No.	Process Before		Process After
1	a) Length checking	b) HV testing	Length checking +HV testing
2	a) Spring insertion	b) Taping	Spring insertion +Taping

2) Rearrange

Rearrangement of sub assembly line 2 is carried out to reduce the motion.

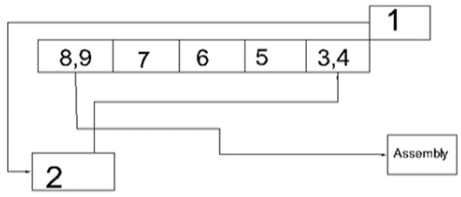

Fig. 6. Layout before rearrangement

Here 1, 2, 3, 4 in fig. 6 are the sequence of operation carried out on the part.

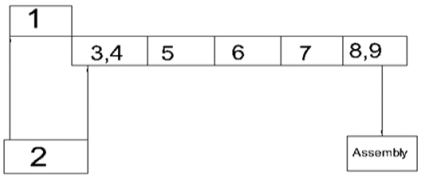

Fig. 7. Layout after rearrangement

Here 1, 2, 3, 4 are the operations carried out on the part after rearrangement of workstations.

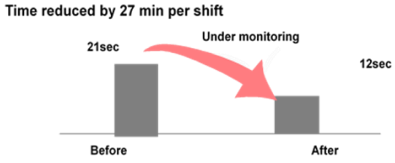

Fig. 8. Time reduction

Rearranging the workstation has saved up to 27 mins per shift.

Time study after implementation of ECRS.

Table 6
Mainline cycle time

S. No.	Process Name	M/P	Per hr.	CT
1	Length checking + H.V Testing	1	400	9
2	Insertion of spring +Tapping	1	400	9
4	Double tie fitting &cutting	1	257	14
5	crimping	1	514	7
6	Insertion of 4wire in a housing with a cap	2	450	8
7	TPA insertion	1	327	11
9	Taping	1	254	14.2
10	Taping	1	387	9.3
11	Sleeve insertion	1	300	12
12	CKT	1.5	386	9.3
13	VI	1.5	360	10.0
14	Folding &packing	1	254	14.2

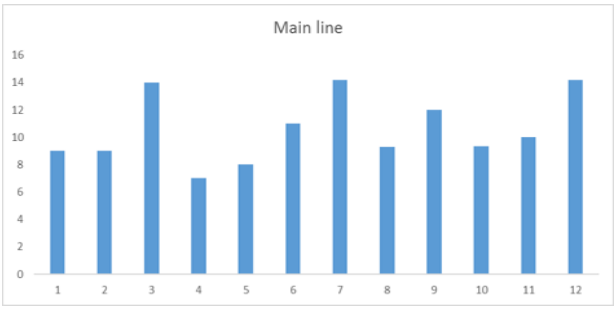

Fig. 9. Main line cycle time

Table 7
Subassembly 1 cycle time

S. No.	Process Name	M/P	Per hr.	C.T
1	Spring insertion	1	387	9.3
2	Housing	1	444	8.1
3	Insertion	1	434	8.3
4	Housing	1	300	12
5	Insertion	1	450	8
6	Housing	1	293	12.3
7	Length checking	1	257	14
8	visual inspection	1	655	5.5
9	Tapping	1	327	11
10	Tie fitment	1	360	10
11	Lock fitment	1	327	11
12	CKT	1	300	12

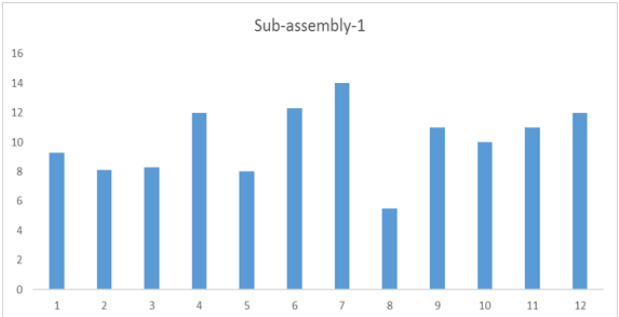

Fig. 10. Subassembly 1 cycle time

Table 8
Subassembly 2 cycle time

S. No.	Process Name	M/P	Per hr.	CT
1	Sheathing	1	632	5.7
2	Spring insertion	1	383	11
3	Tie fitting	1	400	10
4	Stripping	1	404	9.8
5	crimping	1	300	12
6	Tube &housing insertion with TPA	1	379	9.5
7	Tube & housing insertion with TPA	1	450	9.8

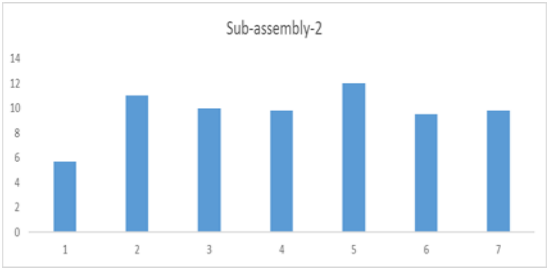

Fig. 11. Subassembly 2 cycle time

Table 9
Line output and manpower

line	output/hr.	manpower
Mainline	254	14
subassembly-1	257	12
subassembly-2	300	7
	Total	33

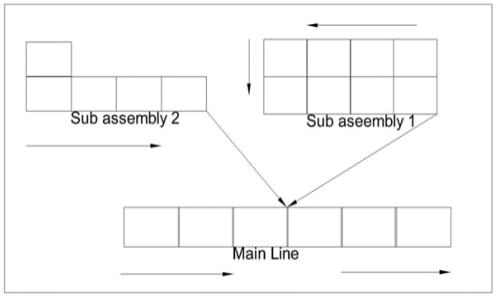

Fig. 12. Layout of assembly line after implementing ECRS

4. Result

Payment of operator is 496 Rs./day. The cost of operators for one day, one month and 1 year are shown in table. after reduction of manpower the amount saved by company is mention in table.

Table 10
Results

	MP 38	MP 33	saving
one day	18848	16368	2480
1 month	471200	409200	62000
1 year	5654400	4190400	744000

From table, it is observed that there is saving of 744000 Rs. per year.

5. Conclusion

This paper includes the method of implementing ECRS System in a Plant situated in Pune India and also the result after Implementing ECRS System. Implementing ECRS System on assembly line helped to reduce the unwanted process, unwanted motion. It helped to reduce manpower required for assembly line, with help of time study and line balancing. Saving in manpower has reduced the financial expenditure by 13.16% of company by without affecting the productivity.

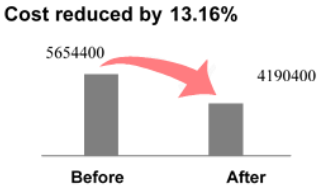

Fig. 13. Cost reduced before and after

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