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Correcting Work Standards and Work Practices on Tractor Assembly Line

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Abstract: ***Manufacturing Engineering is a branch of professional engineering concerned with the understanding and application of Engineering Procedures in Manufacturing Processes and Production Methods. Manufacturing Engineering requires the ability to plan the practices of manufacturing; to research and to develop tools, processes, machines and equipment; and to integrate the facilities and systems for producing quality product with the optimum expenditure of capital. The aim of this project is to improve the productivity with correcting the work standards and work practices. Manufacturing engineering is an important function/ department for any manufacturing industry. An automobile is a combination of thousands of parts; hence the manufacturing engineering department of an auto industry is always complex and has lot of scope of increasing productivity. Productions of parts and assembly in the units have been studied in this project regarding the guidelines of the techniques.***

Keywords: time study, productivity, sequence of events, assembly line, process planning tool

1. Introduction

1.1 Productivity

Productivity describes various measures of the efficiency of production. A productivity measure is expressed as the ratio of output to inputs used in a production process, i.e. output per unit of input. Productivity is a crucial factor in production performance of firms and nations. Also, productivity improvement is the very important factor for a firm to survive and to achieve breakthroughs, carried out deals with enhancing productivity in an automobile industry. In production department there is some unwanted work process done which takes extra time, extra effort as well as increases the cost of product and the industry is not able to improve productivity. Thus, the purpose of this work is to propose improvement area in the industry so that industry can increase their productivity by analyzing the problem associated with it.

1.2 Productivity Improvement

Productivity improvement is one of the core strategies towards manufacturing excellence and it also is necessary to achieve good financial and operational performance. It enhances customer satisfaction and reduce time and cost to develop, produce and deliver products and service. Productivity has a positive and significant relationship to performance measurement for process utilization, process output, product costs, and work-in process inventory levels and on-time delivery. Improvement can be in the form of elimination, correction (repair) of ineffective processing, simplifying the process, optimizing the system, reducing variation, maximizing throughput, reducing cost, improving quality or responsiveness and reducing set-up time.

1.3 Concept

When considering the assembly operations, the factors of **Flow, Accessibility and Time** are to be considered. This study is performed in the tractor manufacturing plant which currently works on 100 tractors per day production. As per the forecast, there is a visibility of increase in the volume of production up to 140 tractors per day. So, in order to grab the business opportunity the current Work Standards need to be optimized and planned for 140DPR (daily production rate).

Assembly lines are designed for the sequential organization of workers, tools or machines, and parts. The motion of workers is minimized to the extent possible. All parts or assemblies are handled either by conveyors or motorized vehicles such as fork lifts, or gravity, with no manual trucking. Heavy lifting is done by machines such as overhead cranes or fork lifts. Each worker typically performs one simple operation (allowances considered).

According to Henry Ford:

The principles of assembly are these:
(1) Place the tools and the men in the sequence of the operation so that each component part shall travel the least possible distance while in the process of finishing.
(2) Use work slides or some other form of carrier so that when a workman completes his operation, hedrops the part always in the same place—which place must always be the most convenient place to his hand—and if possible have gravity carry the part to the next workman for his own.
(3) Use sliding assembling lines by which the parts to be assembled are delivered at convenient distances.

2. Research Objectives

- File to floor and floor to file verification and correction.
- To provide correct accessibility to the Software in the organization.
- To update the sequence of events in accordance with the actual operations' sequence happening on the shop floor.
- To update the work practices i.e. operator's sequence of doing the events on the Assembly Line.
- To decrease the man power and increase the productivity of assembly line by managing time.

3. Research Methodology

A very popular six sigma tool DMAIC has been used to solve this problem. DMAIC (Define-Measure-Analyze-Improve-Control) has been widely used as the method for Six Sigma implementation projects in manufacturing. Motorola developed the first Six Sigma implementation method to resolve some already known quality problems. The method was developed by Dr. Mikel Harry and was called MAIC (acronym of Measure, Analyze, Improve and Control). It was constituted by four stages:

1) *Definition:* Identification of problems and situations to improve, remarking what is critical to quality (CTQ)
2) *Measure:* Data gathering regarding the as-is picture of the process, including input variables, output and defects (out of compliance).
3) *Analyze:* Understanding of current process performance causes.
4) *Improvement:* Elaboration of improvement alternatives for process performance.
5) *Control:* Procedures and rules to maintain the obtained improvements, making them maintainable and durable.

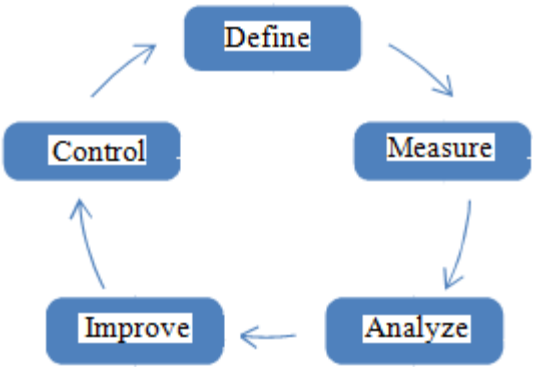


Figure 1: DMAIC process flow

Table 1: Target Dates

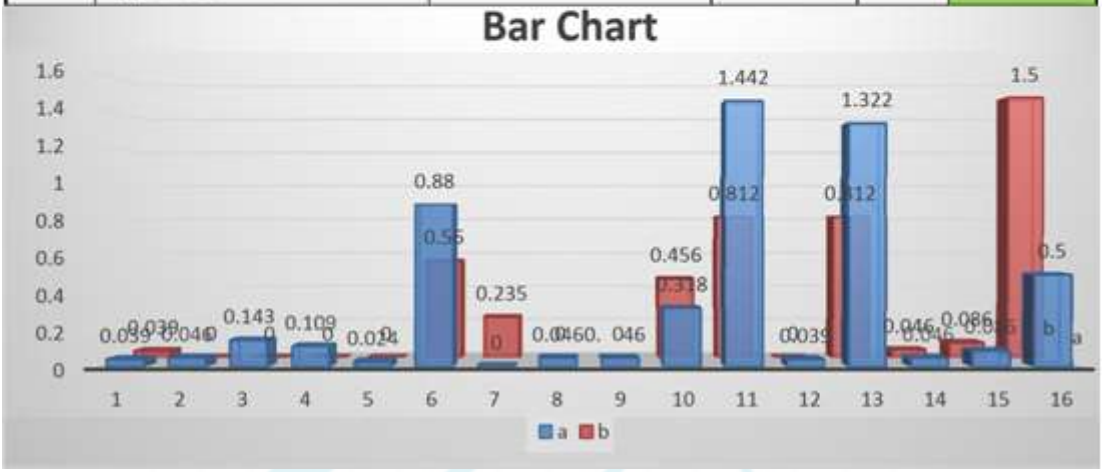
PHASES	START DATE	END DATE	PROCEDURE
DEFINE	5/3/2018	15/3/2018	Verifying sequence of events on assembly line and marking changes.
MEASURE	16/3/2018	10/4/2018	Measuring time, distance and bill of material (BOM).
ANALYZE	11/4/2018	10/5/2018	Understanding the process planning software used.
IMPROVE	11/5/2018	31/5/2018	Specifications of work practices & work standards to be improved.
CONTROL	1/6/2018	10/6/2018	Documentation and follow-up of the new updated work standards.

Data Analysis

For maintaining company's confidentiality all the data cannot be displayed. In analyzing phase I compared the sequence of events with what is happening on assembly line. And I prepared a comparative sheet mentioning things that are to be done on assembly line and things that are to be changed in the software.

Area	Activity	Remarks	Given Time (a)	Observed Time (b)	Action
CRA	Applying oil on bearing is given in SOE but not physically done	Floor to file and file to floor is not matching	0.039	0.039	Corrected work practices
CRA	Applying grease on O ring is given in SOE but not physically done	Floor to file and file to floor is not matching	0.046	0	Corrected work standards
CRA	place the shifter with NSS connected in it and tighten with single bolt	Floor to file and file to floor is not matching	0.143	0	Corrected work standards
CRA	Mistake proofing for NSS	Floor to file and file to floor is not matching	0.109	0	Corrected work standards
CRA	Spreading loctite from roller is not done physically but is given in SOE	Floor to file and file to floor is not matching	0.024	0	Corrected work
CRA	Assembly using hoist is in SOE but it is done manually	Floor to file and file to floor is not matching	0.88	0.56	Corrected work standards
CRA	Not in SOE but is done physically	Floor to file and file to floor is not matching	0	0.235	Corrected work standards
CFA	Applying grease on the pin is mentioned in SOE but is not done physically	Floor to file and file to floor is not matching	0.046	0	Corrected work practices
CFA	Grease is not applied on the coil pin physically, but given in SOE	Floor to file and file to floor is not matching	0.046	0	Corrected work practices
RAA	procure metal seal in pair, unwrap and clean it with cloth and thinner sprayed on it	Floor to file and file to floor is not matching	0.318	0.456	Corrected work standards
RAA	In SOE cleaning of extra loctite after dowel fitting and paint mark is written but is not done physically	Floor to file and file to floor is not matching	1.442	0.812	Corrected work standards
RAA	In SOE paint mark on snap ring is to be done, physically it is not done	Floor to file and file to floor is not matching	0.039	0	Corrected work practices
RAA	In SOE applying loctite by screen and cleaning extra loctite is mentioned, physically roller is used and cleaning is not required	Floor to file and file to floor is not matching	1.322	0.812	Corrected work standards
MLA	In SOE application of grease on O ring is mentioned but is not done physically	Floor to file and file to floor is not matching	0.046	0.046	Updated in the Software

MLA	assemble 2 dowels on axle mounting is given in SOE, but is not physically done	Floor to file and file to floor is not matching	0.086	0.086	Corrected on the line
MLA	Oil filling is done from the side of the housing, previously it was done from upper side	Floor to file and file to floor is not matching	0.5	1.5	Updated in the Software



From the above table and bar chart it is clear that time given in work standards vary from the actual time. On correcting the work standards, the time saved was found to be 0.54 minutes/ transmission. For 100 DPR it is a saving of 54 minutes/day i.e. 33.75days/year are to be saved which is a huge difference.

Improve

After analysis of collected data following improvement actions are been suggested:

- Sequence of events shall be updated on the software
- Work practices to be corrected on assembly line

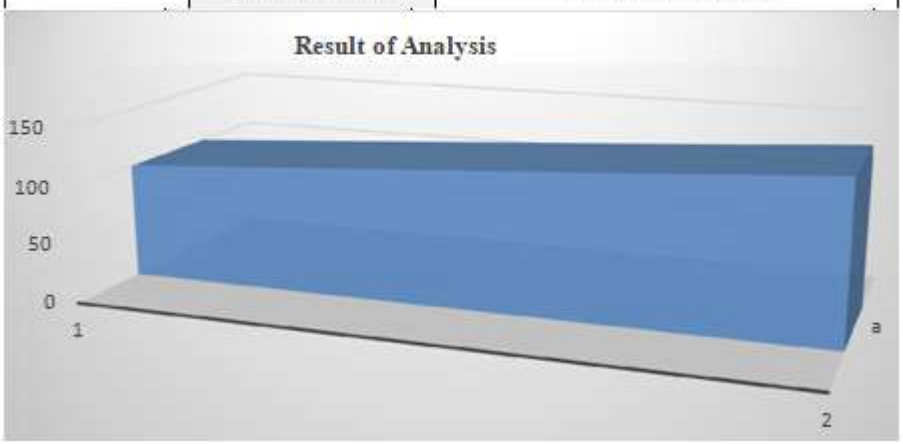
Reduction of carbon footprints:

- Number of transmissions assembled before improvement = 100/day
- Number of transmissions assembled after improvement = 138/day
- Number of days reduced per year = 16 days x Number of transmissions increased per year = 11400

4. Results and Benefits

Analysis resulted in the increment of 38 tractors/day which is displayed in a bar chart below.

Benefits	*Time saved*	*Increment in production*
	270hours/year	11400tractors/year



Control

Procedures and rules are to be maintained to obtain the improvements. Making the improvements maintainable and durable the Control step would help. Proper guiding & training of the operators is done so that they could follow the work standards and improve the work practices. Hence, the improvements done will remain in control and will lead to high production.

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6. Conclusion

By DMAIC application, in the analysis phase work standards and work practices, both varied than the actual one. By correcting the standards and practices it is concluded that there is an increment of 38% in the production on tractor assembly line.

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