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Productivity Improvement in Manufacturing Industry Using Work Study Technique

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Abstract- Work study is the systematic examination of the methods of carrying out activities so as to improve the effective use of resources and to set-up standards of performance for the activities being carried out. It is one of the most powerful tools that management can use to improve productivity. 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. In this study, The prime objective of this study are to Reduced machine idle time, Increase productivity, Reduce worker's fatigue. Establish the standard performance methods and standard cycle time involved, Optimally use equipment and manpower, and Eliminate wasteful efforts, as well as useless handling material. The study area include production lines of Gear manufacturing. This production lines includes 5 machining centers, and 1 CMM machine for inspection. The line production is lagging behind the target due to line imbalance. So time study technique has been decided to measure the work. Present study was done at MGM industry Bhopal on application of time and work study technique, because of its high non value added time in an operation. . After implementing the suggested improvement ideas the firm is able to increase its productivity by 27.77%. With the help of recorded observation and discussion with manager of the company, improved flow process chart are suggested.

Keywords:- Work study, idle time, productivity, worker's fatigue, CMM machine, method study.

I. INTRODUCTION

Work study was widely known for years as "time and motion study", but with the development of the technique and its application to a very wide range of activities it was felt by many people that the older title was both too narrow and insufficiently descriptive.

Productivity is the ratio between output and input. It is quantitative relationship between what we produce and what we have spent to produce. 70 Productivity is nothing but reduction in wastage of resources like men, material, machine, time, space, capital etc. It can be expressed as human efforts to produce more and more with less and less inputs of resources so that there will be maximum distribution vity Council states that „Productivity is an attitude of mind. It is a mentality of progress of the constant improvement of that which exists. It is certainty of being able to do better than yesterday and continuously. It is constant adoption of economic and social life to changing conditions. It is continual effort to apply new techniques and methods. It is faith in human progress". In the words of Peter Drucker productivity means a balance between all factors of production that will give the maximum output with the smallest effort.

On the other hand, according to International Labour Organization productivity is the ratio between the volume of output as measured by production indicates and the corresponding volume of labour input' as measured by production indices and the

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corresponding volume of labour input as measured by employment indices2 . This definition applies to an enterprise, industry or an economy as a whole.

II. LITERATURE REVIEW

Chouhan (2019) Productivity is the most important and popular thing in the manufacturing world. This paper highlights a methodology developed for enhancing the worker productivity & efficiency and also minimization of fatigue in manufacturing line by using Time Study techniques revealed the excessive movements of operators and workers. Work study in productivity improvement could be done in time study.

Gujar and Sahare (2018) Productivity increase by means of a work study in a manufacturing industry is the area of interest in this project. The project was conducted live, where in numerous types of tools and techniques were employed to improve the efficiency and productivity of industry.

Nagaich (2017) Productivity improvement is an important aspect for any organization to survive and to achieve competitive edge. This study deals with improving the productivity in an automobile industry.

Singh and Yadav (2016) the globalization of the Indian economy has faced a great challenge to the Indian small industries in respect of productivity, quality, cost, delivery etc. To achieve success in the global market it is required fundamental improvement in the way of production in small process industries.

Patil (2016) Market trends and consumer requirements get modernize in relatively fast comportment. Globalization developed trade opportunities to fulfill consumer needs, but along also resulted in competition, improved quality and increased productivity.

Mishra (2015) Productivity improvement is the very important factor for a firm to survive and to achieve breakthroughs the work carried out deals with enhancing productivity in an automobile industry.

Centindere (2015) used to implement work and time study technique for earth energy glass Manufacture Company they worked upon the location of mold room subject to the work and time study forces the molder walk for meters during the days and this applies also to the machine operator who comes and collects the ready molds.

III. PROBLEM STATEMENT

The study area includes production lines of Gear manufacturing. This production line includes 5 machining centers, and 1 CMM machine for inspection. The line production is lagging behind the target due to line imbalance. So time study technique has been decided to measure the work. Cycle times of all machines measured with element and their breakpoints wise. This work illustrates one such example of eliminating non value added time in an operation. It shows the flow of counterstriking the problem and suggests the productive way to be carried out for work measurement.

IV. OBJECTIVE OF STUDY

Objectives are as follows:-

- Reduced machine idle time.
- Increase productivity.
- Reduce worker's fatigue.
- Establish the standard performance methods and standard cycle time involved
- Optimally use equipment and manpower.
- Eliminate wasteful efforts, as well as useless handling material.

V. METHODOLOGY

The study illustrated in this work does measure the work content and cycle times but also helps in analyzing the different elements consuming non value aided time in the whole operation. Initially the whole production line is studied for machine wise cycle times.

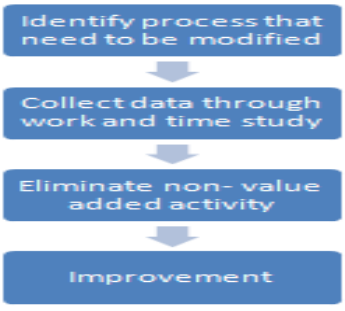

Fig 1. Flow chart of study.

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Then the bottleneck stations were treated under elemental study using time study technique. Then the work cycles were broken into operations and operations were divided into measurable elements. For each elements cycle time has been noted down on observation sheets.

1. Data Collection:

1.1 Existing Process: The process flow of existing process for the Gear Cutter product is mentioned as follows:

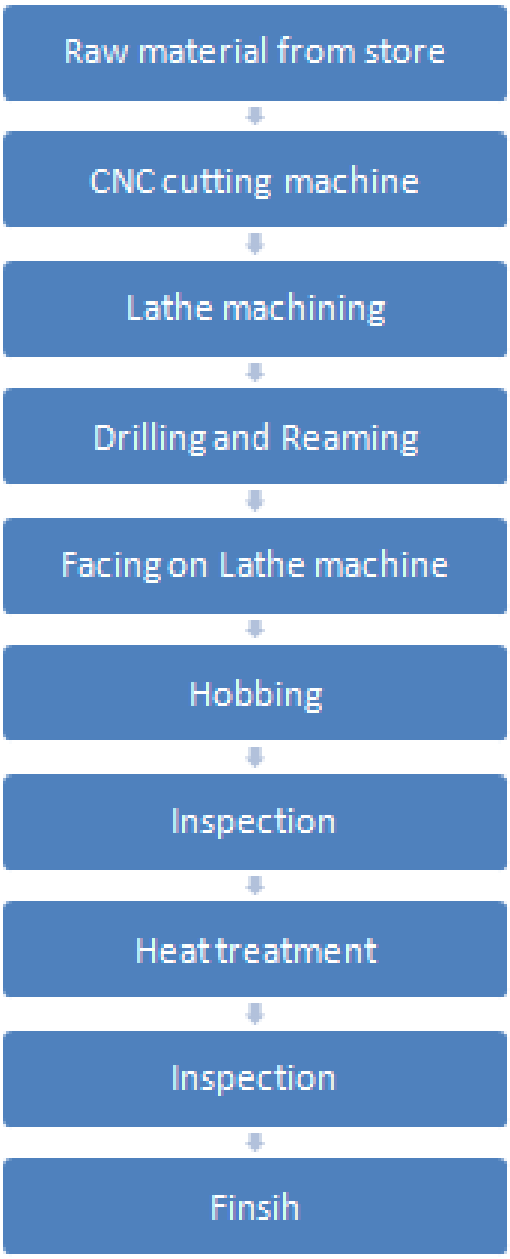

Fig 2. Process flow of Gear Manufacturing (existing process).

As per the existing process flow, the product gear need standard processes and 25.5 min to produce complete component, which is in actual a time consuming process. To find out actual standard time of existing process, need to calculate it in details, following table shows the standard time calculations.

Table 1. Time calculations for existing process.

S.No.	Process	Basic time (min)	Allowance (min)	Std Time (min)
1	Pick bars from stores	1	0.5	1.5
2	Sent to cutting machine	1.5	0.7	1.2
3	Cut to size	2.0	0.5	1.2
4	Sent to Lathe	1.5	0.5	1
5	Wait	1.5	0.3	1.2
6	Facing drilling and reaming	1.5	0.5	1
7	Send to Lathe	1.5	0.5	1
8	Facing of other side	1.3	1.5	1.5
9	Send to Gear hobbing machine	1.2	0.3	1.5
10	Wait	1.5	0.7	1.2
11	Machine the gear	2.3	2.2	1.5
12	Send to inspection	1	0.5	1.5
13	Wait	1	0.5	1.5
14	Inspection for size	1.5	1.0	1.5
15	Send to heat treatment deptt.	1.0	0.5	1.5
16	Wait	1.0	1.0	1
17	Hardening	1.5	1.0	1.5
18	Send to inspection	1.1	1.1	1.2
19	Wait	1.0	0.5	1
20	Inspection for hardness	1.2	1.3	1
Finish				
Total = 25.5 min				

1.2 Flow Process Chart:

Operation: Gear manufacturing.

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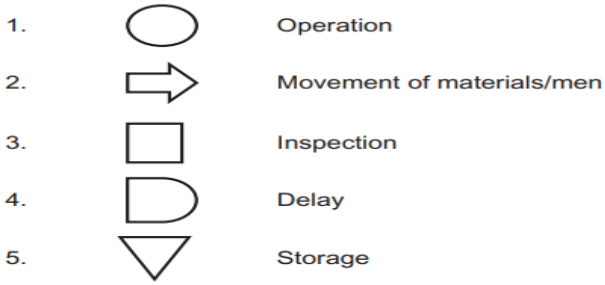
Table 2. Flow process chart.

Element description	Symbol					Time (min)
	○	⇨	□	D	∇	
Pick bars from stores						1.5
Sent to cutting machine		•				1.2
Cut to size	•					1.2
Sent to Lathe		•				1
Wait				•		1.2
Facing drilling and reaming	•					1
Send to Lathe		•				1
Facing of other side	•					1.5
Send to Gear hobbing machine		•				1.5
Wait				•		1.2
Machine the gear	•					1.5
Send to inspection		•				1.5
Wait				•		1.5
Inspection for size			•			1.5
Send to heat treatment deptt.		•				1.5
Wait				•		1
Hardening						1.5
Send to inspection			•			1.2
Wait				•		1
Inspection for hardness			•			1

Symbols for operation process chart:



2. Productivity Calculation

Table 3: Productivity Calculation.

Particular	Component produced by company		
	Per shift (8 hrs)	Per day (24 hrs)	Per week (6 days)
As per regular process	18 nos.	56 nos	336 nos.

VI. RESULTS AND DISCUSSION

1. Bottleneck Process in Gear Machining:

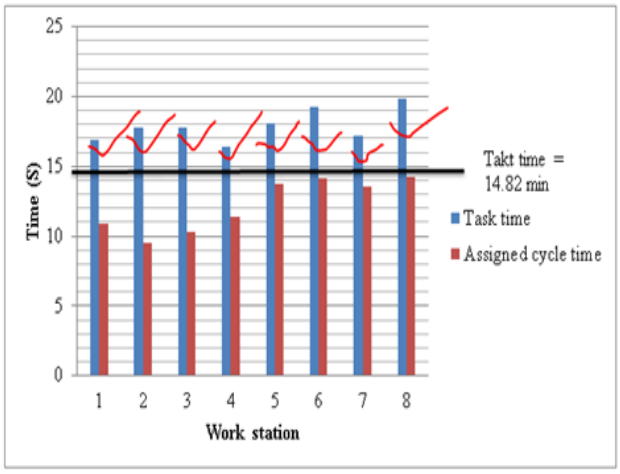


Fig 3. Bottleneck process in gear machining process.

From the above figure 5.1 it is noted that there are four bottleneck processes in which set up time can be minimize.

They are;

- Cutting process
- Gear hobbing process
- Drilling process
- Slotting process

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Table 4. Machining (value added activities) and non-machining (non-value added activities) time for bottle neck process.

S. No.	Bottleneck processes	Machining time	Non-machining time
1	Slotting	16.52	4.68
2	Gear hobbing process	15.78	2.32
3	Cutting process	13.9	3.00
4	Drilling process	13.25	3.55

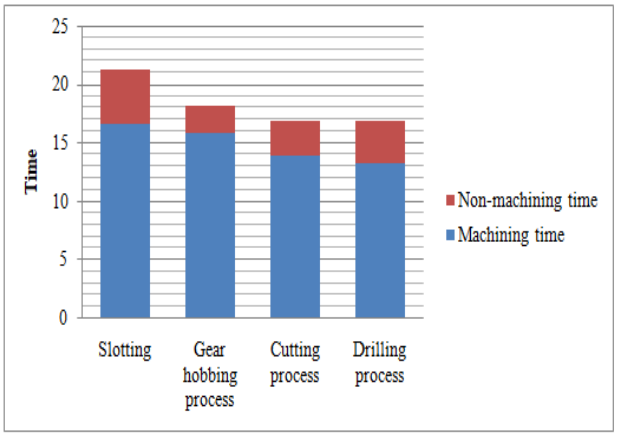

Fig 4. Machining (value added activities) and non-machining (non-value added activities) time for bottleneck process.

From the above table it is clear that non machining time of slotting process takes 40% of the total time so cycle time of the process increases.

In order to reduce the non-machining time we have to reduce setup time i.e. both loading and unloading time it is done by optimizing the slotting fixture.

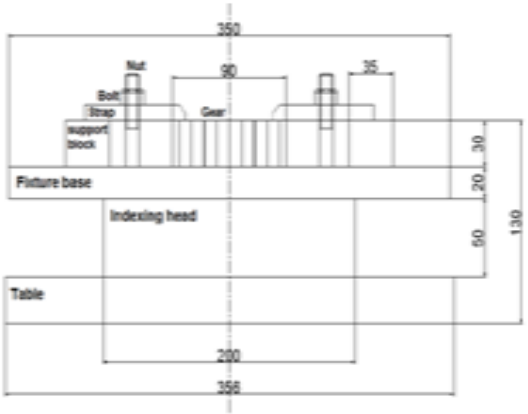

Fig 5. Orthographic view of proposed slotting fixture.

2. Comparison between Present Fixture And Proposed Fixture:

Table 5. Activities of present slotting fixture.

	Present slotting fixture		Proposed slotting fixture	
S. No.	Activities	Time	Activities	Time (sec)
1	Positioning the gear on fixture plate	20	Positioning the gear on fixture plate	15
2	Fixing the strap clamp 1	11	Rotating the strap clamp 1	5
3	Loose fastening the nut 1	10	Locking with the pin1	5
4	Fixing the strap clamp 2	13	Rotating the strap clamp 2	5
5	Loose fastening the nut 2	10	Locking with the pin 2	5
6	Tight fastening	15	Rotating the table to 180°	30
7	Adjusting the table to the tool position	20	Positioning the tool head	10
Total		99 sec		75 sec

Earlier the setup time of the gear in the fixture takes about 1.66 min it has to be reduced so to that extra running hours of the machine can be avoided and demands can be met.

After the study about the existing activities involved in fixing the gear in fixture implementation of SMED concept is done.

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With the implementation of SMED concept the setup time has been reduced to 0.5 min which stops the extra running of machine.

3. Improvement Results:

Table 6. Time calculations for existing process.

S.no.	Process	Basic time (min)	Allowance (min)	Std Time (min)
1	Pick bars from stores	1	0.5	0.5
2	Sent to cutting machine	1.5	0.7	0.5
3	Cut to size	2.0	0.5	0.23
4	Sent to Lathe	1.5	0.5	1.2
5	Wait	1.5	0.3	1
6	Facing drilling and reaming	1.5	0.5	1
7	Send to Lathe	1.5	0.5	1.5
8	Facing of other side	1.3	1.5	1.5
9	Send to Gear hobbing machine	1.2	0.3	0.5
10	Wait	1.5	0.7	1.5
11	Machine the gear	2.3	2.2	1.5
12	Send to inspection	1	0.5	1.5
13	Wait	1	0.5	1.5
14	Inspection for size	1.5	1.0	0.5
15	Send to heat treatment deptt.	1.0	0.5	1
16	Wait	1.0	1.0	0.5
17	Hardening	1.5	1.0	1.2
18	Send to inspection	1.1	1.1	1
19	Wait	1.0	0.5	1
20	Inspection for hardness	1.2	1.3	0.5
Finish				
Total = 20.63 min				

3.1 Flow process chart:

Operation: Gear manufacturing.

Table 7. Flow process chart.

Element description	Symbol					Time (min)
	○	⇨	▭	⊃	∇	
Pick bars from stores					•	0.5
Sent to cutting machine		•				0.5
Cut to size	•					0.23
Sent to Lathe		•				1.2
Wait				•		1
Facing drilling and reaming	•					1
Send to Lathe		•				1.5
Facing of other side	•					1.5
Send to Gear hobbing machine		•				0.5
Wait				•		1.5
Machine the gear	•					1.5
Send to inspection		•				1.5
Wait				•		1.5
Inspection for size			•			0.5
Send to heat treatment deptt.		•				1
Wait				•		0.5
Hardening						1.2
Send to inspection			•			1
Wait				•		1
Inspection for hardness			•			0.5
Total						20.63 min

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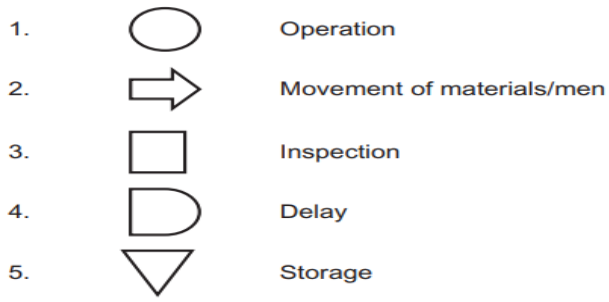
Symbols for operation process chart:

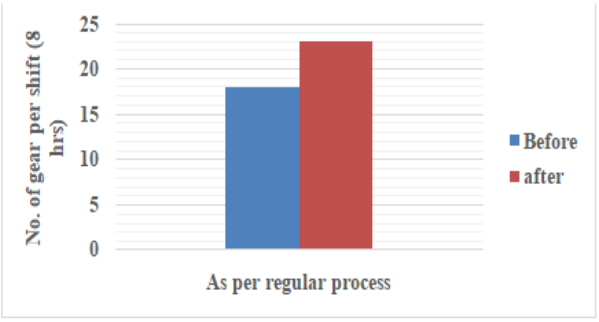


4. Productivity Calculation:

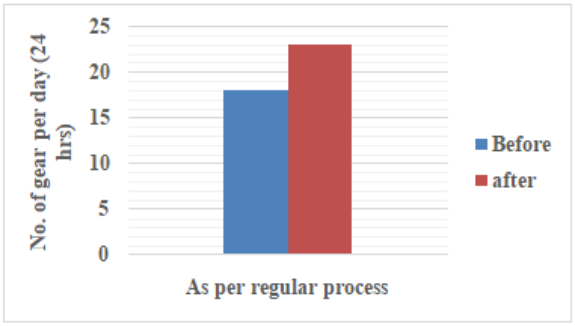
Table 8. Productivity Calculation.

Particular	Component produced by company		
	Per shift (8 hrs)	Per day (24 hrs)	Per week (6 days)
As per regular process	23 nos.	69 nos	414 nos.

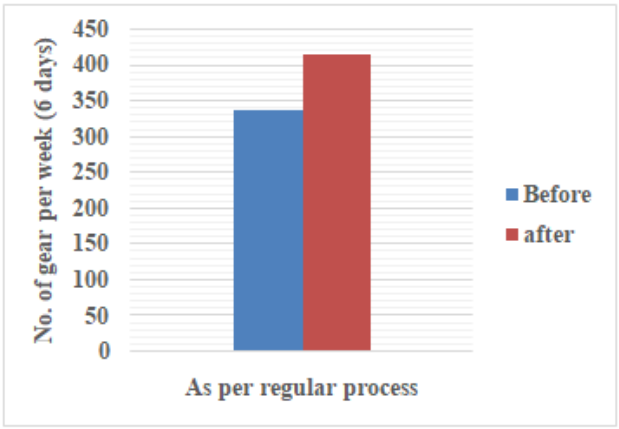
5. Overall Results:



(a)



(b)



(c)

Fig 7. Overall Productivity Comparison.

VII. CONCLUSION

Work measurement includes time study and motion study as well. Work measurement should be carried out by conducting both time and motion study in order to achieve reasonable results. Before conducting time study, it is very much necessary to consider the motion study also.

Hence motion study can be considered as a basis for time study. As discussed earlier, time study measures the required time to perform the operation as per the specified process flow. Authors studied the time study on bottleneck stations to eliminate the unnecessary time to improve the production quantity on machine. Basic time has been calculated for each element and then analyzed the obtained data for changes to be implemented on machine.

During the study of the process of the gear manufacturing plant, existing processes are examined critically with method study & layout technique.

From the above discussion it can be concluded that the process can be improved based on method study, work procedure and proper utilization of machine. It will improve the current process by reducing the process, time and the worker's fatigue. After implementing the suggested improvement ideas the firm is able to increase its productivity by 27.77%.

With the help of recorded observation and discussion with manager of the company, improved flow process chart are suggested.

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