Time Study is a Crucial Factor for Enhancing the Productivity in Manufacturing Organization: A Case Study in ABC Industry

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Abstract
The Indian manufacturing industries are experiencing a competitive environment and struggling to find methods for increasing productivity. The ultimate goal to enhance the productivity is to speed up the process and proper utilization of man and machine. The present research work has been carried out as a case study in an forging industry with an objective to reduce the idle time in various operations. Efforts are made to study the idle time so that it can be reduced. The paper highlights the different shortcomings of the forging case industry. Finally, it reflects the enhancement of productivity.

Keywords
Productivity, Forging Industry, Time Study Analysis

I. Introduction

The manufacturing industries are continuously facing the challenge of operating their manufacturing processes and systems in order to deliver the required production rates of high quality products with minimum use of resources. The removal of bottlenecks and the reduction of WIP is a priority for Indian manufacturing industries. India will now have to work on the challenges that are before it for strengthening the manufacturing industries which are its backbone. The liberalization of the economy has opened new windows of opportunity for manufacturing sector. Increasingly the success of manufacturing industries is dependent on innovations, research and development. The performance of the organizations need to concentrate on the following challenges which includes power and transport, skilled man power shortage, investing in R&D and strategic planning, increasing the scale of operations, deliver based on globally accepted quality levels, commitment to skills development , knowledge enhancement, benchmarking their performance against the best in class and adopting best manufacturing/production techniques.

If these problems are overcomed then the growth of the manufacturing industries will increase rapidly with increase in demand of production. Therefore, to compete in an ever growing manufacturing environment, companies have to improve their productivity. There are so many ways to solve the problems concerning and improving the productivity such as Standardize work (SDW), Setup reduction (SUR), Cycle time reduction, Waste elimination etc.

The manufacturing sector is diverse, dispersed and significantly unorganized. The challenges includes insufficient access to credit, unavailability of quality raw materials, design capabilities, technology obsolescence, unsatisfactory market research, competition due to opening up of the economy and need for management / leadership development.

Now-a-days "Time study" is the crucial factor in manufacturing organization. Frederick W Taylor is known as the father of time study using stop watch. According to him stop watch time study method is a technique of establishing an allowed time standard to perform a given task with the help of stop watch along with due allowance [1]. Lean Tools is an excellent way to enhance productivity by eliminating time consuming actions or wastes that generally do not add value to the actual production. It is a way by which one can reduce the cost of manufacturing & increase productivity, which also increases annual profitability of the industry [2]. Time standards can be defined as the time required to produce a product at work station with three conditions such as: a skilled and well trained operator, working at a suitable environment and doing a specific task [3].

Idle time can be defined as the unproductive time on the part of employees or machines as a result of factors which is beyond their control. Idle time is associated with waiting time or when a piece of machinery is not being utilized but could be. Reducing idle time is a critical action needed to promote competitiveness and increase production thus securing a larger share of global business. Thus, time management is extremely important in any business which includes timing the completion of one project to match with the beginning of another thus reducing idle time. The purpose of this research is to increase the productivity of the ABC manufacturing industry through a time study analysis using stop watch method. For this the idle time of various operations in a forging unit of ABC company has been studied.

II. Literature Review

A number of researchers provide a knowledge based on various advancements done in the field of improving productivity.

Table 1: Productivity Improvement From Different Research Works

Sources	Key Findings
Kulkarni et al. (2014)	Lean manufacturing tools and work study principles have been used to improve the productivity. Setup time reduction (SUR) is an excellent method to increase the overall efficiency of the industry and improving profitability.
Surekha et al. (2013)	They discussed about the standardized work in manufacturing industry which creates a transparency in the work flow and provides the continuous improvement process. Here, the steps used for standardized work has been discussed.
Mohmad et al. (2012)	They proposed an improving the productivity of assembly line of ABC company using simulation methods by focusing on a material handling operator solution.

Naveen kumar et al. (2013)	Assembly line balancing method has been used for minimizing the number of work stations and maximizing the production rate. Group technology was used to minimize the total production cost.
Hemanand et al. (2012)	A case study in an automotive industry was carried out with the objective of waste reduction. A new material handling system was designed and developed with an objective to reduce the motion wastes and unwanted transportation for improving the productivity.
Paul et al.(2006)	Subjective assessment through questionnaire and direct observation methods were used to improve the productivity, quality and reducing rejection cost of the manual component.
Lim et al. (1997)	It was found that with improved layout of workplace the productivity of the workers was increased.
Brown et al.(1988)	An investigation was done to determine the work environment parameters taking the operators, engineers and managers of PCA factories into consideration. The authors recommended opportunities to improve the productivity and quality.

From the above table, it has been seen that for improving the productivity different researchers used different type of principles. The present paper aims that the idle time of operator and machine is a target approach to improve the productivity.

III. Work Done & Data Analysis

ABC is an auto expo manufacturing company. It has Forging Unit which is equipped with two forging lines, supported by on-line heat treatment facility, state-of-the-art metallurgical laboratory and a tool room. The forging unit produces forged parts with 2500 Ton forging press and 1500 Ton trimming press. The industry manufactures all kind of forged components like Flange Yoke, Short Fork, Long Fork , Axle Components and Steering knuckles.

The entire forging process can be divided into seven sections given as follows:

- Band Saw
- Heating
- Forging press
- Trimming
- Hardening
- Quenching
- Shot blasting

Twenty number of observations of idle time in each section are recorded using a stop watch. A particular die has been taken into consideration which is Die No. 1303 i.e., Bottom saddle (Rear Benjo Axle). The raw material is first inspected for crack detection and then goes to the cutting section. Here, there is a shearing machining and a band saw for cutting materials into required dimensions. In this present study band saw is taken into consideration.

A. Band Saw

It is the first operation where raw materials are cut into billets in required dimensions. The observations of idle time in this section have been taken for one hour and is shown in Table 2. The percentage idle time of operator is represented in Figure 1.

Table 2: Idle time in Band Saw

M/C Time, X (in min)	Operator Idle time, Y (in min)	W=Y/X	W%
4	3.68	0.92	92
4	3.82	0.955	95.5
4	2.79	0.6975	69.75
4	3.27	0.8175	81.75
4	2.8	0.7	70
4	3.48	0.87	87
4	3.02	0.755	75.5
4	3.91	0.9775	97.75
4	3.70	0.925	92.5
4	3.87	0.9675	96.75
4	3.68	0.92	92
4	3.91	0.9775	97.75
4	3.65	0.9125	91.25
4	2.93	0.7325	73.25
4	3.07	0.7675	76.75
4	3.94	0.985	98.5
4	3.11	0.7775	77.75
4	3.81	0.9525	95.25
4	2.88	0.72	72
4	2.86	0.715	71.5

For twenty observations,

Total idle time of operator =68.18 mins

In one hour,

Total idle time of operator=51.58 mins

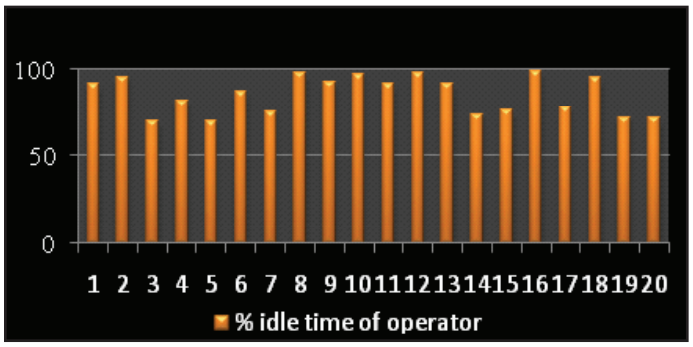

Fig. 1: Idle Time of Operator in Band Saw Section

B. Heating

The billets are stacked to line up and enter the heating chamber which is an induction heater and approximately 3000 mm long and 1000 KW capacity. In this section the billets are stacked manually. The idle time of the operator is given as follows:

Table 3: Idle time in Heating section in mins

Operator Idle Time										
	0.52	1.32	1.28	1.22	0.57	1.38	1.45	1.37	1.55	0.43
	0.39	0.52	1.11	1.1	0.54	1.07	0.55	1.01	1.11	1.1

Total idle time of operator=19.59 for 75 jobs in 60 mins

Idle time of Operator for 1 job = 19.59/75=0.2612 min

Idle time of operator for 20 jobs= 0.2612×20=5.224 mins
Average idle time by Operator = 19.59/20 = 0.9795
Percentage (%) idle time of operator=0.9795/5.224=0.1875=18.75%

Time taken from Heating chamber outlet to forging press (in secs) is represented in fig. 2.

Table 4: Time taken from heating chamber outlet to forging press

0.18	0.16	0.34	0.18	0.31	0.31	0.21	0.35	0.14	0.25
0.21	0.34	0.25	0.31	0.18	0.14	0.18	0.31	0.16	0.35

Total Time= 4.86 secs
Average Time = 0.243 secs

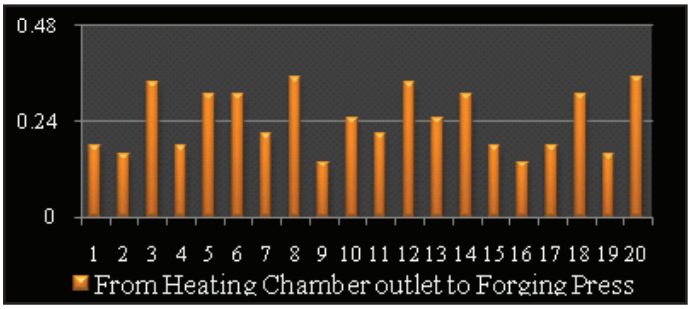

Fig. 2: Time Taken From Heating Chamber Outlet to Forging Press

C. Forging Press

Forging press is a machine tool that changes the shape of a work piece by application of localized compressive force. It can be grouped into three sub-sections i.e., Upsetting, Blocker and Finisher. The forging press is a 2500 Ton press. There is no idle time here.

Time taken from Forging press to Trimming section (in secs) is shown in Fig. 3. Here, a 1500 Ton press is used for trimming.

Table 5: Time taken from Forging section to Trimming Press

8	7	7	7	7	8	9	9	9	9
9	8	9	7	9	8	7	8	7	7

Total Time=1 min 59 secs for 20 jobs
Average Time= 8 secs for 1 job

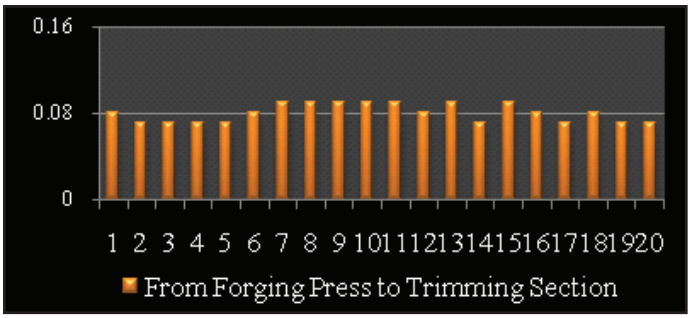

Fig. 3: Time Taken From Forging Press to Trimming Section

D. Hardening and Tempering

Hardening is a metal working and metallurgical process which is used to increase the hardness of metal. In this case, hardening is done in three temperature zones i.e., 750℃, 870℃ and 870℃. The travel time in case of hardening is 180 ± 30 mins. Tempering is a low temperature heat treatment process which is used increase the toughness while reducing some of the excess hardness. It also significantly reduces the brittleness of the material. Tempering is done is three temperature zones i.e., 530℃, 600℃ and 600℃. The travel time for tempering is 210 ± 30 mins. The idle time observed in the hardening section is given in Table 6.

Table 6: Idle time in Hardening

Operator idle time(X)	Loading time (Y)	Z = X+Y	W = X/Z	W(%)
2.41	0.24	2.65	0.909434	90.94
2.22	0.33	2.55	0.870588	87.06
1.28	0.41	1.69	0.757396	75.74
2.49	1.11	3.6	0.691667	69.16
1.1	0.42	1.52	0.723684	72.37
2.13	0.5	2.63	0.809886	80.99
1.41	0.19	1.6	0.88125	88.12
1.54	0.34	1.88	0.819149	81.91
3.01	1.14	4.15	0.725301	72.53
5.54	1.09	6.63	0.835596	83.56
2.13	0.5	2.63	0.809886	80.99
2.41	0.24	2.65	0.909434	90.94
5.54	1.09	6.63	0.835596	83.56
2.22	0.33	2.55	0.870588	87.06
1.54	0.34	1.88	0.819149	81.91
1.1	0.42	1.52	0.723684	72.36
3.01	1.14	4.15	0.725301	72.53
1.28	0.41	1.69	0.757396	75.74
1.41	0.19	1.6	0.88125	88.12
2.49	1.11	3.6	0.691667	69.16

Total idle time of operator in one hour= 46.26 mins
X= Operator idle time, Y= Loading time,
Z= Total time, W=% of operator idle time

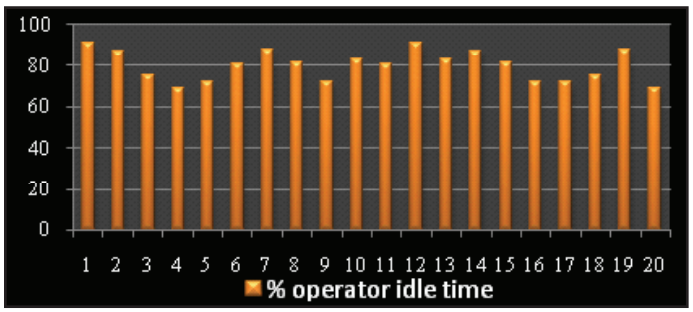

Fig. 4: The Percentage Idle Time During Hardening

E. Shot Blasting

Shot blasting is a method used to clean and polish a metal thereby removing the scales. This operation takes nearly 7 mins with a batch quantity of 150-300 kg. Here, the idle time of the operator been taken into consideration. The idle time of the operator during shot blasting operation is shown in fig. 5.

Table 7: Idle time in Shot Blasting Section

Operator idle time(X)	Total time(Z)	W=X/Z	Operator idle time (W) in %
3.5	7	0.5	50
3.17	7	0.45	45

4.15	7	0.6	60
2.2	7	0.31	31
6.37	7	0.91	91
3.27	7	0.47	47
5.03	7	0.72	72
6.57	7	0.94	94
3.15	7	0.45	45
4.25	7	0.61	61
3.27	7	0.47	47
3.17	7	0.45	45
4.25	7	0.61	61
3.5	7	0.5	50
5.03	7	0.72	72
4.15	7	0.59	59
3.15	7	0.45	45
2.2	7	0.31	31
6.37	7	0.91	91
6.57	7	0.94	94

For twenty observations,

Total idle time of operator =83.32 mins

In one hour,

Total idle time of operator=34.26 mins

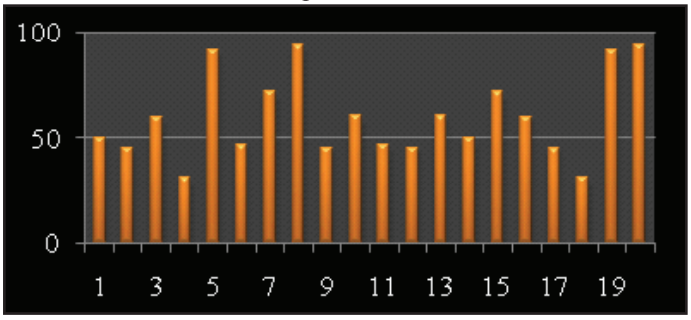

Fig. 5: Idle Time of Operator During Shot Blasting

IV. Results and Discussion

In this study, twenty observations of idle time were recorded for each section. The percentage idle time of operator in Band saw section has been shown in Figure 1. In one hour the idle time of Band saw is 51.58 mins. In heating section the idle time consumed by the operator is 19.59 mins per hour. Fig. 2 shows the time taken from heating chamber outlet to forging press. It can be seen from the graph that out of 20 observations that were taken, 10 number of observations lie above the average value 0.243. Figure 3 shows the time taken from forging press to trimming section. The graph shows that out of 20 observations, 8 number of observations lie above the average value 0.08. The idle time in case of hardening was observed during manually loading of materials. The percentage of operator idle time during hardening and shot blasting has been shown in fig. 4 and fig. 5 respectively. The idle time of operator in hardening and shot blasting is 46.26 mins and 34.26 mins in one hour. There are three shifts (8×3=24 hrs) available in ABC industry where the utilization time was seven hours (60×7=420 mins). From the above analysis it has been found that 37.92 mins was the average idle time in various sections. Therefore, in one shift the total idle time was 4 hrs 42 mins (37.92×7). The result determined that 63% (4.42/7) is the total idle time of the above said ABC forging industry.

V. Conclusion and Future Scope

The productivity in Indian manufacturing industries are not up to the mark. In the competition era, it is highly needed to produce right quantity within the right time. Therefore, idle time in the manufacturing process is a critical factor. The research has been carried out in ABC forging industry and the different results have been highlighted. In forging and trimming section, unusual observations has been found. The idle time in this section arises due to job sticking in the die and blocking in the heating chamber. It was also observed that three operators are required in this section whereas four operators were appointed. Thus, one operator is completely found to remain idle. Here, the manpower can be reduced or properly utilized. In shot blasting section, the operator after setting the machine can be instructed to conduct testing of job in the laboratory or can be a helping hand in quality inspection. Sometimes no material is available due to shearing breakdown. Major problems that affect the productivity are breakdown in the main press, power failure and die set up. A major drawback has been noticed i.e., the work-in-process inventory or stock in the material cutting section. The carrying of these stocks can tie up huge amounts of capital and result in an accumulation of obsolete unusable stock. The company must store it to perform other additional handling which increases the total cost of its operations.

More observations are highly needed for a better and transparent analysis. More similar type of industries should be added for accurate results. Longitudinal research may also considered for comparison of the above result. This research work will be a guideline for the decision makers to enhance the manufacturing productivity.

VI. Acknowledgement

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