A PROJECT REPORT

ON

"PRODUCTIVITY IMPROVEMENT USING INDUSTRIAL ENGINEERING TECHNIQUES"

Submitted by

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In partial fulfillment for the award of the Degree

Of

BACHELOR OF ENGINEERING

IN

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UNDER THE GUIDANCE

Of

Prof. AFAQAHMED M. JAMADAR

DEPARTMENT OF MECHANICAL ENGINEERING

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KALSEKAR TECHNICAL CAMPUS NEW PANVEL,

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CERTIFICATE

This is to certify that the thesis entitled **"PRODUCTIVITY IMPROVEMENT USING INDUSTRIAL ENGINEERING TECHNIQUES"**

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To the Kalsekar Technical Campus, New Panvel is a record of bonafide work carried out by them under our supervision and guidance, for partial fulfillment of the requirements for the award of the Degree of Bachelor of Engineering in Mechanical Engineering as prescribed by **University of Mumbai**, is approved.

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(Dr. Abdul Razak Honnutagi)

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APPROVAL OF DISSERTATION

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Date: _____

DECLARATION

We declare that this written submission represents our ideas in our own words and where others ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Abstract

Productivity plays an important or major role in a company. There are many reasons for which the productivity decreases and there are various methods to improve productivity. But, choosing which method to use according to the situation is a wise decision. For this project work, thermocole manufacturing plant is considered and analyzed. After analysing the plant it was found that there was delay between tasks. The delay between the tasks affecting the production and causing low productivity rate. In order to improve productivity time study and motion study were found to be effective. Time study and motion study are the techniques of work study. Work study is known as highly effective productivity improvement method. Time study means to determine the standard time for doing an operation. Motion study means to simplify job and to develop more economical method of doing work. Determination of standard work cycle times is one of the important step used in work study, which provides critical inputs for improvement activities. After analysis and calculation of the time study and method study data it was found that there were no proper standards maintained and followed in the premises, the tasks were not evenly distributed between the workers, the space was not properly utilized, there were lack of safety measures, lack of performance standards, improper communication, unnecessary wastage of time. After successfully analyzing, proper time standards were considered in the industry which increased the production rate by 48 pieces extra per month in one machine.

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CHAPTER 1: INTRODUCTION

1.1 Introduction

Industrial engineering is an engineering profession that is concerned with the optimization of complex processes, systems, or organizations by developing, improving and implementing integrated systems of people, money, knowledge, information, equipment, energy and materials. Industrial engineers in a factory. Industrial engineers use specialized knowledge and skills in the mathematical, physical and social sciences, together with the principles and methods of engineering analysis and design, to specify, predict, and evaluate the results obtained from systems and processes. From these results, they are able to create new systems, processes or situations for the useful coordination of labour, materials and machines and also improve the quality and productivity of systems, physical or social. Depending on the sub-specialties involved, industrial engineering may also overlap with, operations research, systems engineering, manufacturing engineering, production engineering, supply chain engineering, management science, management engineering, financial engineering, ergonomics or human factors engineering, safety engineering, or others, depending on the viewpoint or motives of the user.

Industrial engineering dates back all the way to the industrial revolution, initiated in 1700s by Sir Adam Smith, Henry Ford, Eli Whitney, Frank Gilbreth and Lilian Gilbreth, Henry Gantt, F.W. Taylor, etc. After the 1970s, industrial and production engineering developed worldwide and started to widely use automation and robotics.

For this project work a thermocole manufacturing company is considered and analysed. Industrial engineering techniques are used for many reasons in an industry but, in this project the main aim of using industrial engineering techniques is to increase production rate of the industry by following proper standards. Various industrial engineering techniques are value analysis, time study, method study, motion economy, production planning and control, inventory control, ergonomics, material handling analysis, operation research, etc. There are different procedures and standards to carry out the techniques. Selecting the proper industrial engineering techniques for improvement in productivity is a difficult task.

Productivity is ratio of amount of output produced to the amount of input resources. Productivity = Output/Input. The European Productivity Agency (EPA) has defined productivity as, Productivity is an attitude of mind. It is mentality of the progress, of the constant improvements of what which exists. It is the certainty of being able to do better today than yesterday and continuously. It is the constant adaption of economic and social life to changing conditions. Economists define productivity as, Ratio of output to input. Accountants

define productivity as, financial ratios or budgetary variances. Behavioural scientists define productivity as, labour utilization. Engineers define productivity as, capacity utilization or production per man hour, manpower efficiency. There are various factors that can influence productivity. The factors are divided into two viz. controllable factors and non-controllable factors. Controllable factors are focused in this work. There are various controllable factors viz. product, plant and equipment, technology, materials, work methods, management, financial, etc. The factors that are concentrated in this work are technology, human factors, work methods. There are diverse methods to increase productivity. But, choosing the proper and appropriate method according to the scenario is very crucial. Choosing the proper method/s is dependent on the problem statement of the project.

1.2 Problem Statement

A thermocole manufacturing industry was analysed in this work. The work is concentrated on the mould machines. There are total 7 mould machines and each mould machine manufactures different product. Each mould machine takes different time as the products are different. Some mould machine makes 2 pieces per cycle. The following are the problem statements.

1. Less production every day than the estimated value.
2. Workforce management
3. Operating Standards
4. Reduce operating cost

The problem statement delay in the operation cycle. The problem statement in the work can be controlled by proper method study and time study. Method study or time study are the categories of work study. Work study is known as highly effective productivity improvement method. British Standard Institution defines work study as a generic term for those techniques particularly "Method Study" and "Work Measurement" which are used in the examination of work in all its contexts and which leads systematically to the investigation of all the factors which affect the efficiency and economy of the situation being reviewed in order to incorporate improvements at various levels.

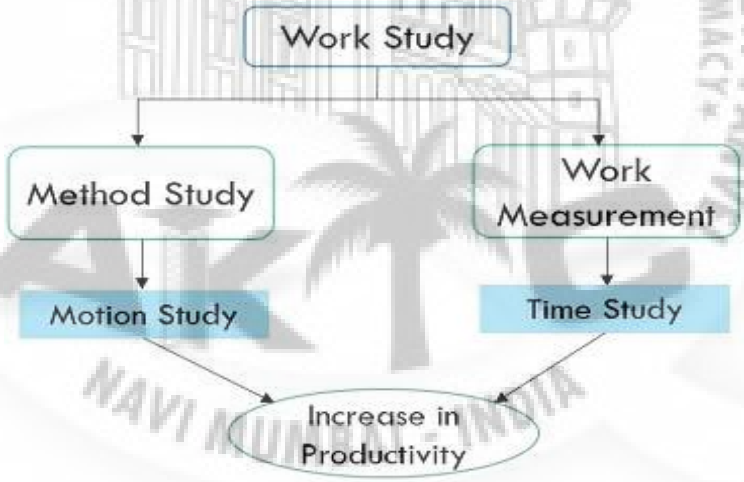


Fig 1: Work study

Method Study is the systematic recording and critical examination of existing and proposed ways of doing work, as a means of developing and applying easier and more effective methods and reducing costs. Work measurement/Time study is the application of techniques designed to establish the time for a qualified worker to carry out a specified job at a defined level of performance.

1.3 Scope of Work

1. Understanding the concept
2. Research of similar concepts in the world
3. Factory layout analysis
4. Process analysis
5. Analysis of current standards
6. Identification of Problem Statement
7. Method/Motion study
8. Time study
9. Analysis of new possible standards
10. Implementation of new standards

1.4 Method Study

Method study is the systematic recording and critical examination of existing and proposed ways of doing work as a means of developing and applying easier and more effective methods and reduce cost. Fundamentally method study involves the breakdown of an operation or procedure into its component elements and their systematic analysis. Method study adds value and increases the efficiency by eliminating unnecessary operations, avoidable delays and other forms of waste.

Steps involved in method study –

1. Select – The job to be analyzed
2. Record – All relevant facts about present method
3. Examine – The recorded facts critically
4. Develop – Most efficient and feasible method
5. Define – New Method
6. Install – Method as standard practice
7. Maintain – Standard the Practice

1.5 Time Study

Time study has been defined by British standard Institution such as The application of techniques designed to establish the time for a qualified worker to carry out a specified job at a defined level of performance. Time study is one of the techniques of scientific management which involves observation and recording of the time taken in performing a particular task. Tracking of the time consumed in carrying each part of the operation. To carry out time study stop watch technique is used.

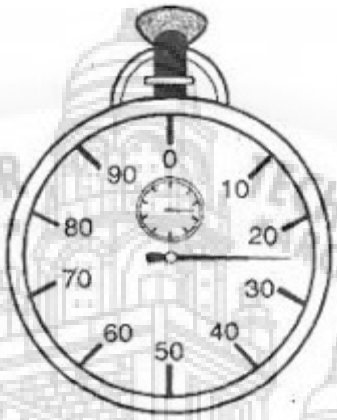


Fig 2: Stop watch used in time study

Steps involved in method study –

1. Select – The job to be timed
2. Obtain & Record – details regarding method, operator, job, working conditions.
3. Define – Elements
4. Measure – Time duration for each element
5. Extend – observed time into normal time
6. Determine – Allowances
7. Compute – Standard time

1.6 Difference between Time & Motion Study

Parameters	Time Study	Motion Study
Meaning	Time study is one of the techniques of scientific management which involves observation and recording of the time taken in performing a particular task.	Motion study involves the observation of the movement of men, machine, materials and supplies, to find out the wasteful actions and eliminate them.
Involves	Tracking of the time consumed in carrying each part of the operation.	Ascertainment of total movements of workers while performing a task.
Purpose	To identify the standard time required to perform a task.	To reduce wastage of time and energy in unnecessary movements.
Tool Used	Stopwatch	Surveillance Camera
Focuses on	Increase in productivity of labour.	Minimization of movement of workers.
Objective	To determine a fair day's work.	To find out the best method of doing a job.

Table 1: Difference between time & motion study

1.7 Productivity Standards

The two principal considerations affecting the classification of standards are:

(i) Attainability of standards, that is, the ease with which it is possible to achieve the standards, and
(ii) Frequency with which the standards are revised.

On the basis of these two factors, it is possible to classify standards as ideal, normal, basic, current or expected actual standards.

1. Ideal, Perfect, Maximum Efficiency or Theoretic Standards:

Ideal standards (costs) are the standards which can be attained under the most favourable conditions possible. The level of performance under ideal standards would be achieved through the best possible combination of factors — the most favourable prices for materials and labour, highest output with best equipment and layout, and maximum efficiency in the utilisation of the production resources—in other words, maximum output at minimum cost. Such standards reflect only goals or targets without any hope of performance being currently achieved. These standards are extremely tight and do not provide for waste and inefficiency in any form; no material is wasted; no units are spoiled; there are no idle hours; operators work at predetermined speeds; the available capacity is fully utilised. The ideal standard represents the ultimate goal to strive for, but its attainment is impossible over sustained periods. It sets its sights on the stars.

2. Normal Standards:

Normal standards are the average standards which (it is anticipated) can be attained during a future period of time, preferably long enough to cover one business cycle. Standards are set on a normal capacity basis which represent a volume that averages out the company's peak and slack periods. Constant unit costs are employed throughout the cycle, regardless of changes in current costs or selling prices. These standards are not revised until the cycle has run its full course. This generally results in an incorrect valuation of inventories and consequent errors in the profit disclosed as the inventories are understated in periods of high prices, and overstated when prices are low. Since these standards do not reflect the goals to be attained, they are not often used.

3. Basic Standards:

The Chartered Institute of Management Accountants (UK) defines a basic standard as the standard which is established for use unaltered for an indefinite period which may be a long period of time. Basic standards are seldom revised or updated to reflect current operating costs

and price level changes. Basic standards representing a fixed base are used primarily to measure trends in operating performance. Although useful, basic standards must be adjusted before they can be used for performance evaluation purposes. They can be based upon any capacity level that is selected initially to develop the standards.

4. Currently Attainable or Expected Actual Standards:

Current standards are standards which are established for use over a short period of time, and are related to current conditions. They represent current costs to be expected from efficient operations. These standards do not anticipate ideal performance; they are difficult, but possible to achieve. Currently attainable standards are formulated after making allowance for the cost of normal spoilage, cost of idle time due to machine breakdowns, and the cost of other events which are unavoidable in normal efficient operations.

Productivity standards are achieved when:

1. The type and age of the property.
2. The type of surfaces involved and the degrees and type of soiling.
3. The accessibility of the work area from the service areas.
4. The frequency of cleaning.
5. The amount of traffic in the work areas.
6. The type of cleaning supplies and equipment available.
7. The function of the work area.
8. The quality of supervision and inspection.
9. The expected standards of cleaning.
10. The quality of employees.

Example of productive standard worksheet:

Total Shift Time = 9 hrs X 60 mins = 540 mins.

Beginning of Morning Shift = 20 mins

Tea Break = 10 mins

Lunch = 30 mins

Evening Tea Break = 10 mins

End of Morning Shift = 20 mins (handover)

Therefore, the room attendant is there for 450 mins in guest room (540-90) and each room takes 30 mins to clean. Therefore, the attendant can clean 15 rooms in 450 mins.

CHAPTER 2: LITERATURE REVIEW

2.1 Literature Review

Work study is used for as industrial engineering technique to improve the productivity. Work study comprises of method study and time study. In order to perform this project, literature review has been made from various sources like journals, books, articles and other sources. This chapter includes all important studies which have been done previously by other research work. It is important to do the literature review before doing the project because we can implement if there is information related to this project. The most important thing before starting the project we must clearly understand about the topic that we want to do. So, by doing the literature review we can gain knowledge to make sure we fully understand and can complete the project. A review of the article was performed to identify studies that are relevant to the topic.

Ankit P. Vekariya, Ashutosh Kumar has explained that time and motion study method is useful for simplify the operation and reduction of operation whenever possible. Using these two methods we can identify the sources which are causing delay in the operation and other unnecessary activities.

Md. Bony Amin, Adnan Islam, Syimun Hasan Mehedi,SaheaDul Bashar,Md. Ahasan Habib has explained various problems like low productivity, longer production lead time, high rework and rejection, low flexibility, lower quality product, high non-value added work etc. This paper gives information about the proper selection of industrial engineering techniques according to the problems identified in the industry.

Cengiz Duran, Aysel Cetindere, Yunus Emre Aksu has explained that Work and time study techniques is raising the efficiency of utilization of the factors of production have been used for all manufacturing and service sectors as a scientific approach. This paper gives information about productivity improvement techniques in industry. This paper has explained various consideration and standards that are required in order to conduct the time study and motion study. It also signifies various assumptions to be considered while performing the time and motion study. Various limitations, research required and various applications to improve productivity.

Mehmet Akansel, Betul Yagmahan, Erdal Emel has explained use proper methods to reduce their costs and increase productivity levels. use proper methods to reduce their costs and increase productivity levels. Various types of allowances to be considered while performing time study. Various problems that can be solved using these two techniques has been explained.

Martand Teslang in his book of industrial engineering and management has all the standard steps and procedures to conduct time study and motion study. It has brief about what standards and allowances are to be considered while performing the techniques. It has all the various methods which can improve the productivity.

CHAPTER 3: Methodology

3.1 Motion Study

Motion Study Symbols

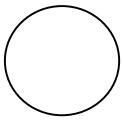
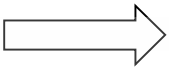
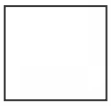
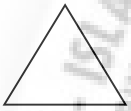
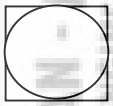
Symbol	Symbol	Explanation
	Operation	Operation means action
	Transport	Movement of travel of worker or material from one place to another
	Inspection	Checking for quality and quantity of items
	Delay	It means process has stopped due to some reason
	Storage	Finished goods are stored
	Operation & Inspection	Means inspection during an operation is going on

Table 2: Motion study symbols

3.2 Flow Process Chart

The Fig. 3 shows the process chart in which the raw material to the finished product journey is shown. The raw material enters the pre expander machine where it pre expands to the required density.

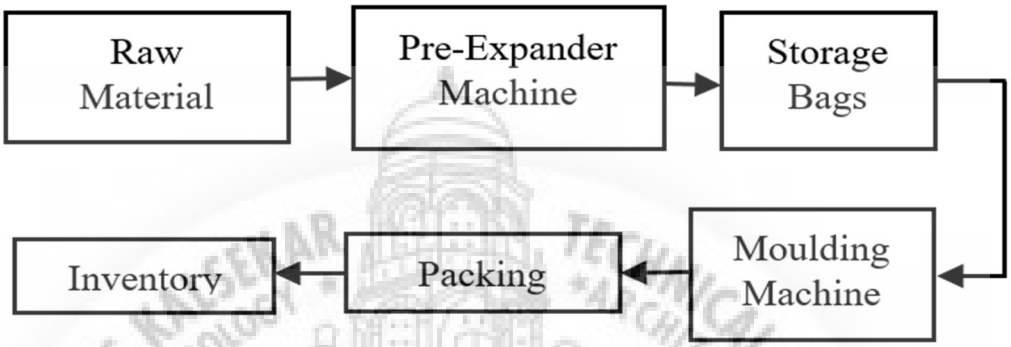


Fig 3: Process Chart

Then after proper check of density, the material is transferred and stored in the storage bags through which the machine gets the material. Moulding machine takes material from the storage bags and then the product is manufactured in the moulding machine. Once the product is done in the moulding machine it is transferred to the packaging area, where it gets packed and ready to dispatch. There are total seven moulding machines. The flow process chart is shown for one machine and is approximate to other machines. Then the material is stored in the inventory till dispatch. The detailed process flow chart is shown below with symbols and timing of operation. The flow process chart is approximately calculated. It can change from machine to machine and as well as product to product. Even if the flow process chart is slightly different of each machine the delay of every machine is nearly same.

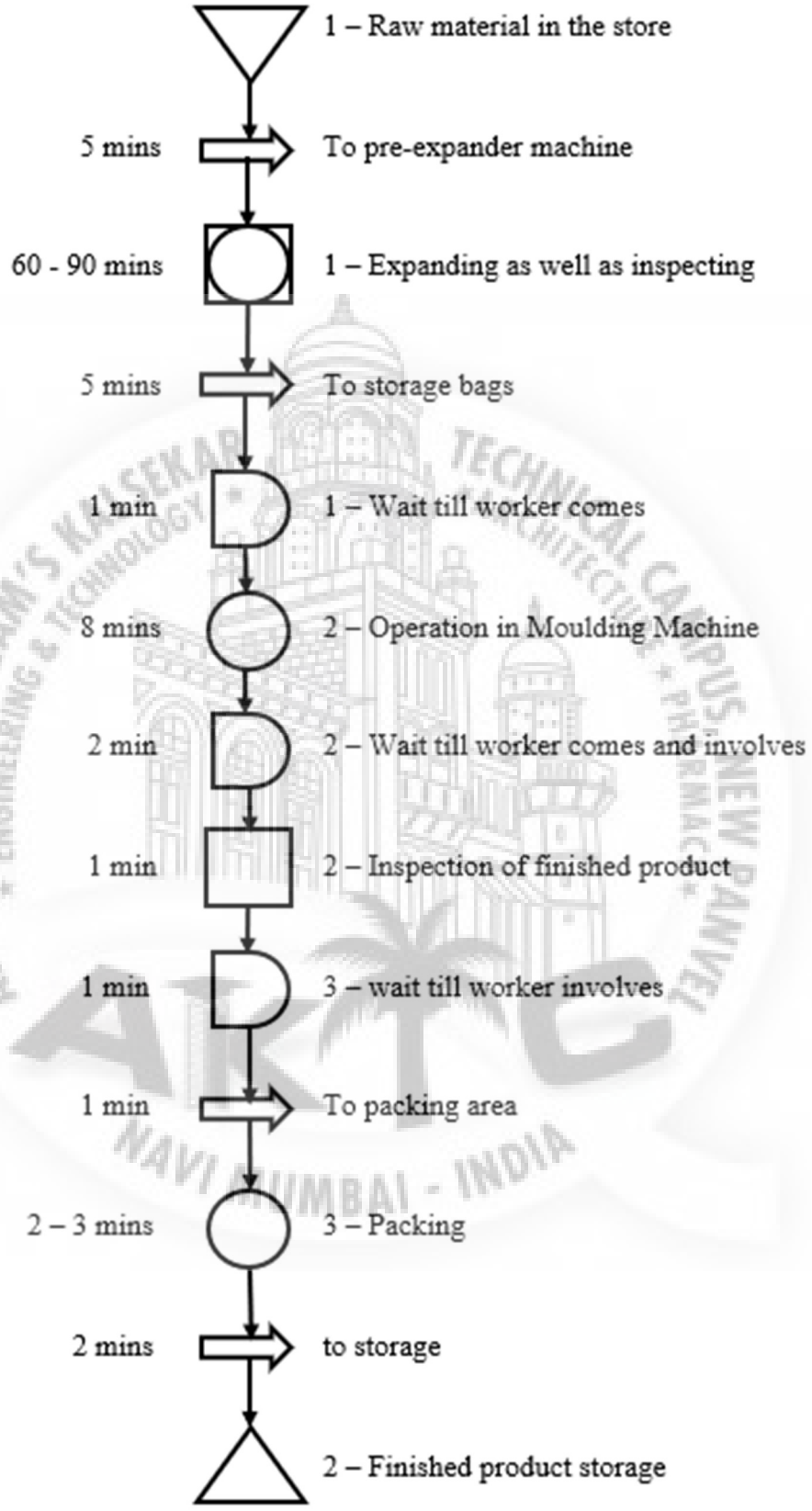


Fig 4: Flow Process chart

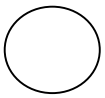
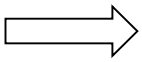
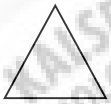
Symbol	Frequency	Time in minutes
	3	80
	4	13
	2	6
	3	4
	2	

Table 3: Summary of Flow Process Chart

3.3 Steps

There are few steps which are to be followed for doing method study. They are as follows.

1. Selection of the job – It is the first step which involves three considerations namely economic, technological and human. In this work, the focused area is on technological and human aspects.

2. Record the information – For recording step, flow process chart has been done, which gives all the information and the time taken by each operation or activity to complete it.

3. Examine the information – This is very crucial step. In this step the information from the flow process chart is examined critically. From table 3, as there is delay of total 4 minutes equals to 240 seconds. The delay is caused by various reasons which affect directly on the productivity. In this work the delay is seen more in the moulding machine area. So, for analysis and calculation delay during the mould machine operation is considered. The first delay, after storing the material in the storage bags can be neglected and which does not contribute more towards low productivity (Refer Fig -4 and Table 3).

The next two steps will be covered in the calculation and analysis.

3.4 Time Study

The time study is done with the help of stop watch. Time study is done to calculate the time taken by each task. The time study data is given below for moulding machines from 1 to 7. Each moulding machine has different products, so the time will be different for every task.

Machine Number	Reading Number	Various time considered in seconds						Total Time
		Input	Walking	Operation	Product removal	Inspection	Cleaning	
1	1	38.07	36.24	152.98	15.13	8.12	90.45	340.99
	2	48.48	22.50	152.45	38.35	9.04	-	270.82
	3	39.67	19.78	152.23	28.71	8.67	88.32	337.38
2	1	48.81	25.57	267.12	30.47	8.79	-	380.76
	2	46.74	18.69	267.82	17.78	8.34	76.78	436.15
	3	50.45	21.15	267.06	25.56	9.15	-	373.37
3	1	61.08	21.49	394.72	24.1	8.03	71.34	580.76
	2	49.97	28	390.87	21.59	8.56	67.01	566
	3	42.36	25.04	393.45	17.99	8.29	62.75	549.88
4	1	18.95	16.79	420.93	18.01	9.97	-	484.65
	2	19.98	15.05	412.86	18.48	10.72	-	477.09
	3	17.46	17.62	417.99	19.2	8.38	-	480.65
5	1	19.21	17.78	317.82	17.89	8.95	-	381.65
	2	18.65	17.82	327.44	24.76	8.04	55.71	452.45
	3	22.34	14.56	327.78	19.87	8.16	-	392.71
6	1	38.7	18.61	435.75	27.43	10.37	70.14	601
	2	44.34	24.76	434.68	19.7	9.59	67.71	600.78
	3	42.13	22.49	432.62	19.42	10.74	-	527.4
7	1	37.72	27.10	540.29	29.32	9.68	53.86	697.97
	2	39.55	17.34	555.86	27.10	8.42	-	648.27
	3	45.67	21.02	548.72	24.99	8.10	78.23	726.73

Table 4: Time study data

Various time taken by different mould machines are shown in the table. As seen the data taken is of 7 moulding machines. For each moulding machine 3 readings are shown. As seen in the table considering machine number 4 and machine number 5 take less time in every task, which means the worker assigned to these machines are working efficiently without wasting any time. Cleaning does not occur after every cycle of machine. As seen in the table there are various time given such as input, walking, operation, product removal, inspection, cleaning. These times varies from person to person. Proper time standards were not followed due to which the task that require less time to be completed takes long time. The mould machine 1, 2, 3, 6, 7 makes 2 pieces of product per cycle.

3.5 Calculation & Analysis

By the data of motion study the following points came further.

1. There were no proper standards maintained and followed in the premises by the workers.
2. The tasks were not evenly distributed between the workers.
3. There were lack of safety measures.
4. Lack of performance standards.
5. Improper time standards
6. Unnecessary wastage of time

For analysis of time study any two machines are considered from the table. And from each machine one reading will be considered for analysis. Considering machine number 1, 2, 6 and 7. From machine number 1 considering reading number 1 and from machine number 2 considering reading number 2. Machine number 1 and 2 makes 2 pieces. Allowing only one worker to work between these two machines. From machine number 6 considering reading number 1 and from machine number 7 considering reading number 3. Machine number 6 and 7 makes 2 pieces. Allowing only one worker to work between these two machines.

The following time is calculated with the help of motion study standards and considering allowances as 15%. The time are constant for all machines except the operation time will differ.

1. Time for input to the machine – 40 seconds
2. Time for walking between machines – 20 seconds
3. Time for product removal – 22 seconds
4. Time for inspection of product – 10 seconds
5. Time for cleaning the die – 60 seconds

Calculation for Machine no. 1 and 2

Time for Operation at Machine number 1 – 153 seconds approximately
Time for Operation at Machine number 2 – 268 seconds approximately

According to the process adding standard time required for each task and adding actual operation time for machine number 1 and 2 to get the unnecessary loss of time for the cycle.

Cycle time for machine number 1 = Input time + Operation time + Product Removal Time + Inspection Time + cleaning time + Walking time
= 40+153+16+9+91+37
= 346 seconds

Standard Cycle time for machine number 1 = 346 seconds
Actual Cycle time for machine number 1 = 361 seconds
Difference = 15 seconds per cycle

In one hour, there are 9.97 cycles of machine number 1
Time saved per hour = 149.5 seconds
Considering one shift (7 hours) = 1000 seconds approx..

Cycle time for machine number 2 = Input time + Operation time + Product Removal Time + Inspection Time + cleaning time + Walking time
= 47+268+18+9+78+19
= 439 seconds

Standard Cycle time for machine number 2 = 439 seconds
Actual Cycle time for machine number 2 = 450 seconds
Difference = 11 seconds per cycle

In one hour, there are 8.2 cycles of machine number 2
Time saved per hour = 90 seconds
Considering one shift (7 hours) = 630 seconds

Calculation for Machine no. 6 and 7

Time for Operation at Machine number 6 – 436 seconds approximately
Time for Operation at Machine number 7 – 556 seconds approximately

According to the process adding standard time required for each task and adding actual operation time for machine number 6 and 7 to get the unnecessary loss of time for the cycle.

Cycle time for machine number 6 = Input time + Operation time + Product Removal Time + Inspection Time + cleaning time + Walking time
= 40+436+22+10+60+20
= 588 seconds

Standard Cycle time for machine number 6 = 588 seconds
Actual Cycle time for machine number 6 = 601 seconds
Difference = 13 seconds per cycle

In one hour, there are 5.99 cycles of machine number 6
Time saved per hour = 77.87 seconds
Considering one shift (7 hours) = 545.09 seconds

Cycle time for machine number 7 = Input time + Operation time + Product Removal Time + Inspection Time + cleaning time + Walking time
= 40+549+22+10+60+20
= 701 seconds

Standard Cycle time for machine number 7 = 701 seconds
Actual Cycle time for machine number 7 = 726.73 seconds
Difference = 25 seconds per cycle

In one hour, there are 4.95 cycles of machine number 6
Time saved per hour = 123.84 seconds
Considering one shift (7 hours) = 866 seconds

Similarly,
For all the machines.

CHAPTER 4: RESULT

4.1 Results

After analyzing and calculation of the data of time study and motion study, the following are the results.

After giving input to two machines the worker is free till the operation of the machine is done. During this free time the worker cleaned the steam pipes, keeping the previously manufactured products in the finished product section and utilize the free time perfectly. Proper standards were followed like each worker were assigned two machine, safety measures were taken like wearing gloves and mask, proper maintaining the time schedule, following proper allowances.

Previous Productivity (weekly) = Number of pieces manufactured in one machine in a week/ Number of days in a week.

= 42+47+32+41+43+52 / 6

= 257 / 6

= 42.83 pieces per day approximately

After implementation of proper standards = adding 2 pieces extra per day (According to the calculation)

= 44+49+34+43+45+54 / 6

= 269 / 6

= 44.83 pieces per day approximately

In a month = 12 pieces per week x 4 weeks = 48 pieces extra were manufactured per machine in a month.

Machine Number	Standard Time (secs)	Actual Time (secs)	Time saved per hour (secs)	Time saved per shift (secs)
1	346	361	149.5	1000
2	339	350	90	630
6	588	601	77.8	545
7	701	726.7	123.8	866

Table 5: Time saved per shift

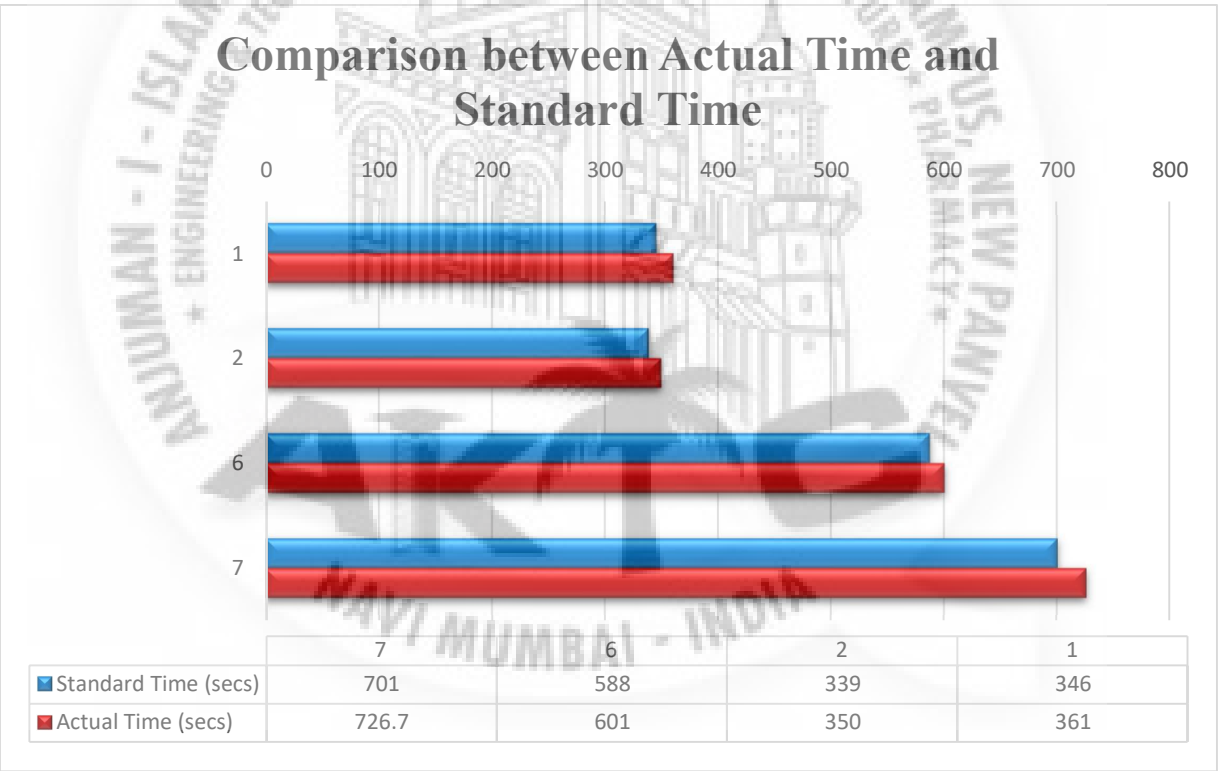


Chart 1: Comparison between Actual Time and Standard Time

Machine Number	Time saved per shift (secs)	Operation Time (secs)	Pieces made by time saved per shift
1	1000	153	6.5
2	630	268	2.3
6	545	436	1.2
7	866	556	1.55

Table 6: Pieces manufactured by time saved per shift

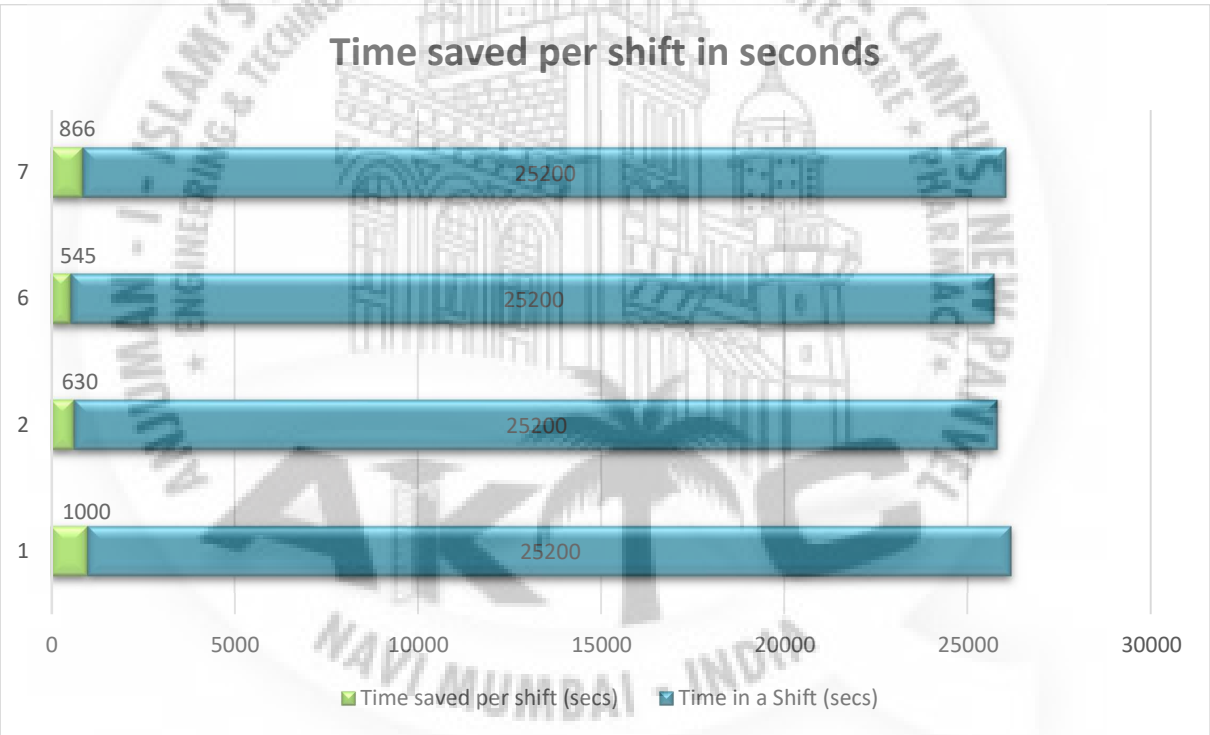


Chart 2: Time saved per shift in seconds

Machine Number	Pieces made by time saved per week (6 days)	Pieces made by time saved in a month (4 Weeks)
1	39	150
2	13	52
6	7	28
7	9	36

Table 7: Pieces manufactured by time saved in month

Machine Number	Standard Time (secs)	Actual Time (secs)	Time saved per cycle (secs)	Percentage time saved per cycle
1	346	361	15	4.15%
2	339	350	11	3.14%
6	588	601	13	2.16%
7	701	726.7	25	3.44%

Table 8: Percentage time saved per cycle

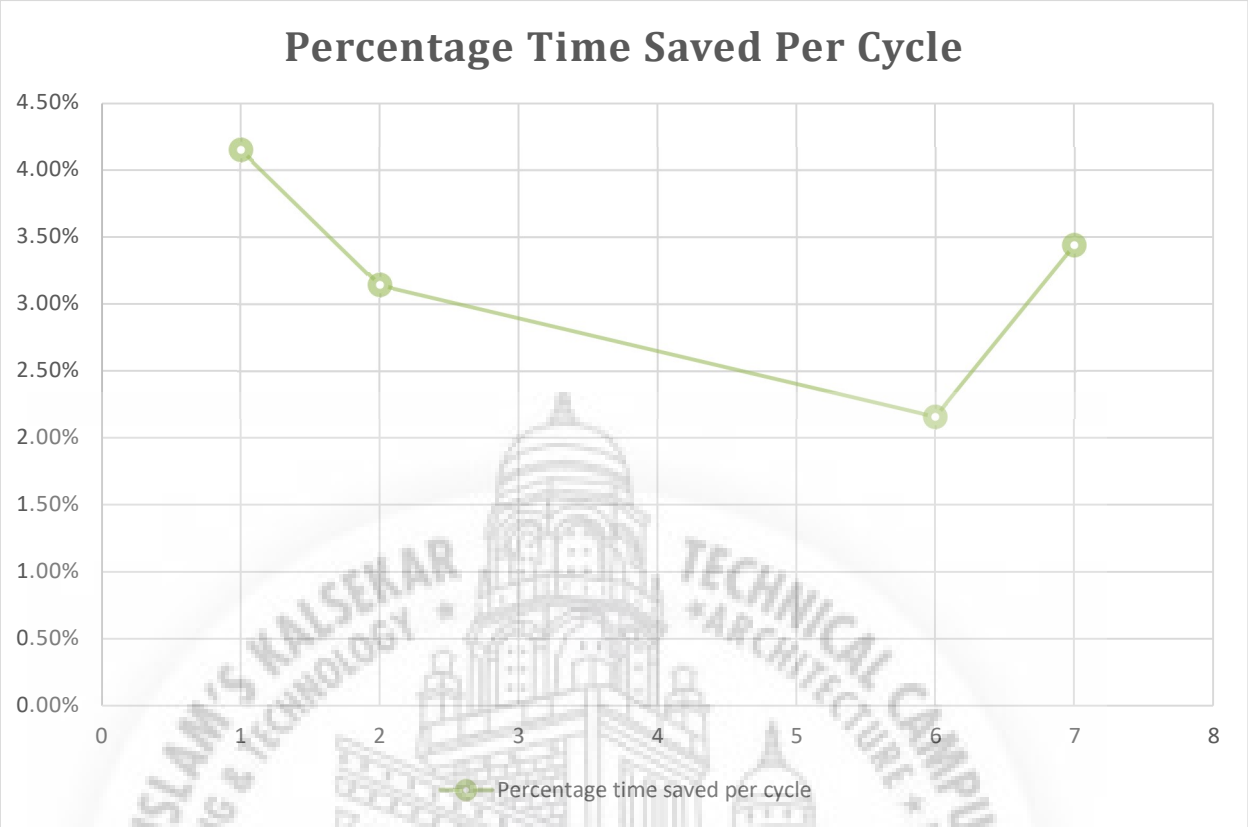


Chart 3: Percentage time saved per cycle

4.2 Conclusion

In the working premises the standards were not followed proper through which there was delay in production causing low productivity rate. Increasing motivation levels of workers, keeping the tool box which is needed during the machine breakdown or for cleaning purpose, proper safety measures, calculation of standard times and following those time standards and allowances helped in increase the production causing the productivity to increase. Time study and motion study contributed to achieve high productivity rate. By following these time standards scheduling of the required quantity of product was done and was found to be precise. After successful standardization proper routine timetable for every worker was made which included the time standards with allowances.

APPENDICES

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GLOSSARY

1. Allowance - the amount of something that is permitted, especially within a set of regulations or for a specified purpose.
2. Analyze – It is the process of breaking a complex topic or substance into smaller parts in order to gain a better understanding of it.
3. Ascertainment - the process of finding something out for certain.
4. Avoidable - able to be avoided or prevented.
5. Budgetary - Relating to or in accordance with an estimate of income and expenditure.
6. Controllable - capable of being directed or influenced.
7. Dispatch – The sending of someone or something to a destination or for a purpose. Economical - Economical means using things in the best possible way without wasting anything.
8. Ergonomics - Industrial ergonomics could be defined as the branch of science that aims at achieving an optimal fitting of the work environment and job activities to the worker.
9. Evaluate - To judge or calculate the quality, importance, amount, or value of something.
10. Financial - Financial usually refers to money matters or transactions of some size or importance.
11. Finish goods - Finished goods are goods that have completed the manufacturing process but have not yet been sold or distributed to the end user.
12. Flow chart - a diagram of the sequence of movements or actions of people or things involved in a complex system or activity.
13. Frequency - Frequency is the number of occurrences of a repeating event per unit of time.
14. Fundamentally - In a basic and important way.
15. Implementation - Implementation is the realization of an application, or execution of a plan, idea, model, design, specification, standard, algorithm, or policy.
16. Inspection - An inspection is, most generally, an organized examination or formal evaluation exercise.
17. Inventory - Inventory or stock is the goods and materials that a business holds for the ultimate goal of resale. Inventory management is a discipline primarily about specifying the shape and placement of stocked goods.
18. Lead time – A lead time is the latency between the initiation and completion of a process.

19. Man power - The number of people working or available for work or service.
20. Management - Management is a set of principles relating to the functions of planning, organizing, directing and controlling, and the application of these principles in harnessing physical, financial, human, and informational resources efficiently and effectively to achieve organizational goals.
21. Manufacturing - It is the production of products for use or sale, using labor and machines, tools, and chemical or biological processing or formulation.
22. Motion Study - It is a science of eliminating wastefulness resulting from ill-directed and inefficient motions". Motion study evolved into a technique for improving work methods.
23. Mould - MOULD is a container that you pour sift liquid or substance into which then becomes solid in the same shape as the container e.g. when it is cooled or cooked. Operating cost - Operating costs or operational costs, are the expenses which are related to the operation of a business, or to the operation of a device, component, piece of equipment or facility.
24. Optimization - The action of making the best or most effective use of a situation or resource.
25. Premises – A house or building, together with its land and outbuildings, occupied by a business or considered in an official context.
26. Productivity - It is a measure of efficiency of a person completing a task
27. Productivity rate – Productivity rate is calculated as the total output of workers divided by hours worked.
28. Raw material - A raw material, also known as a feedstock, unprocessed material, or primary commodity, is a basic material that is used to produce goods, finished products, energy, or intermediate materials that are feedstock for future finished products. Revolution – A circular movement or revolution; to cause to spin around or whirl.
29. Standards – A level of quality or attainment.
30. Storage bag – To store the goods
31. Summary – A brief statement or account of the main points of something. page 18
32. Surveillance - Surveillance is the monitoring of behavior, activities, or information for the purpose of information gathering, influencing, managing or directing.
33. Time standards - A time standard is a specification for measuring time: either the rate at which time passes; or points in time; or both.

34. Time study – Time study is a structured process of directly observing and measuring human work using a timing device to establish the time required for completion of the work by a qualified worker when working at a defined level of performance.
35. Tracking - Tracking and tracing tools automatically record all of the materials that enter or leave a plant and monitor the status of those materials while they are being consumed and/or produced throughout the manufacturing process.
36. Utilization - The action of making practical and effective use of something. page 7
37. Work Cycle - A sequence of tasks, operations, and processes, or a pattern of manual motions, elements, and activities that is repeated for each unit of work.
38. Work measurement - Work measurement is the application of techniques which is designed to establish the time for an average worker to carry out a specified manufacturing task at a defined level of performance.
39. Work study - Work study is a generic term for those techniques, particularly method study and work measurement, which are used in its entire context and which lead systematically to the investigation of all the factors, which affect the efficiency and economy of the situation being reviewed in order to effect improvement.

ACHIEVEMENT

We submitted our research in IRJET Journal Volume 7, Issue 3. The following are our certificates.

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Productivity Improvement by Time Study and Motion Study

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