

ENHANCEMENT OF WORKERS EFFICIENCY AND VALUE ADDED ACTIVITIES BY TIME STUDY TECHNIQUES IN AN EDIBLE OIL INDUSTRY

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ABSTRACT: 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. All this initiated by performing work study on the manual operation of operator and workers activities in working area. This case study was conducted at a Edible refined oil manufacture company. From this study, Value Added activities, performance rating, the standard time, utilization and recommendation for man power planning could be established. The necessary changes and action were suggested in workplace to minimize the stress creating unproductive and ineffective movements. Brainstorming sessions have been conducted to identify all issues that are causing the loss in worker efficiency. These brainstorming sessions are done within different departments and different level of employees to study all issues. These results could be used for optimization of worker efficiency and time at the company. So, the paper, it is believed, would be great help to those working in the area of efficiency and working environment improvement in manufacturing industry. The main objective of the project is to enhance the productivity of the plant by evaluating the non-value added activities of Workers. Various Value adding & Non-Value adding activities are identified using above methods and solutions were recommended. The recommended solutions were implemented by the company and the results obtained were encouraging. There is an increase in labor productivity of the company. The cost of production is also lowered. Reducing and elimination of unproductive & unnecessary activities in company.

Keywords: Time study, Value added, Work content, Standard time, Stop watch.

I. INTRODUCTION

The project is accomplished in the area of Edible refined oil & Tin jar manufacturing at Ruchi Soya Industries Limited, Mumbai. The company manufactures different types of refined oil like a soybean, sunflower, palm. The plant has different sections of edible oil manufacturing which is supplied to the customers. The project identified the improvement of value added activity and reduction of NVA activity in edible oil Tin jar manufacturing/process and Dispatch area. The present line has less automation & most of the operations are done manually. That causes excess work content & variability at each station of manufacturing line. The requirement of the edible oil depends on the demand of the customers. Usually, the marketing immigrates convey the requirement of the edible refined oil to the production planning and

control department. Time study is the most widely used work measurement technique that employs a decimal minute stopwatch to record and determine the time required by a qualified and well-trained person working at a normal pace to do a specific task under specified conditions. Time Study system that is used primarily in industrial setting to set the standard time in which a worker should perform a task. Value-added management is powerful tool which can help businesses reduce costs. The amount paid by a customer for the activities of the worker during the assembly is known as VA. This techniques is based on measuring the work content of the task when performed by the prescribed method with the allowance for fatigue and for personal and avoidable delays. Systematic observation, analysis, and measurement of the separate steps in the performance of a specified job for the purpose of establishing a

standard time for each performance, improving procedures, and increasing productivity. It is the most versatile and the most widely used techniques of work measurement. Using a value-added management approach, non-value-added activities are identified and programs implemented to eliminate them. Thus, the Industrial Engineering technique is used to achieve:

1. The optimization of Physical arrangements.
2. The minimization of cycle time of process.
3. The maximization of workload smoothness.
4. The minimization of the number of the workstation point.
5. The optimization of worker efficiency.

Time Study work of Frederick Winslow Taylor with the Motion Study work of Frank and Lillian Gilbreth work gave rise to industrial engineering, time studies, and incentive standards, and a continuous pursuit of efficiency, not only in the plants but in the offices as well. A time study is a business efficiency technique.

II. LITERATURE REVIEW

2.1 Introduction

Value-added management is powerful tool which can help businesses reduce costs. Evidence from the US and from Europe suggests that in many organizations at least 40% of costs can be eliminated without any deterioration in the value provided to customers. Using a value-added management approach, non-value-added activities are identified and programs implemented to eliminate them. "Manual manufacturing lines technology has made a significant contribution to the development of American industry in the twentieth century". This phrase emphasizes the importance of manufacturing line especially in several sectors such as Automobiles, FMCG, Consumer appliances and those sectors that produced product in large quantity. Business conditions are changing rapidly and continuously. Markets are affected by diverse customer needs, which demand higher quality, shorter delivery time, higher customer service level and lower prices. At the same time, product life cycles are becoming shorter and shorter. This indicates the success factors depend on the efficiency of manpower and manufacturing line. Along manufacturing lines, various operations can be done either manually, automatically or in an integrated manner. Automation operations are done for high volume quantities with edition features on the workstation. However, manufacturing line and manpower utilization suffered one major problem,

not improving the Value added activities (VA) and not reducing the Non value added activities (NVA). This phenomenon is defined as the stage which causes the entire process to slow down and wastage of time for productivity. This can be due to improper scheduling, improper work balancing for example is defined as distribution of workload and workers are not equal along the working place. Machine breakdown sometimes contributes to bottleneck problems since the products are moving and suddenly have to stop and they start accumulating at a certain workstation. Due to this problem, there will be one station that has maximum time to perform a task. This station is called bottle neck station. The analysis will be performed to identify the location of bottlenecks. Furthermore, the product will start to accumulate hence slow down the process yet reduce the line efficiency.

2.2 Work Study

The definition of Work Study as given in the British Standard Glossary is as follows; "Work Study is a generic term for those techniques, particularly method study and work measurement, which are used in the examination of human work in all its contexts, 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'. This has to do with Productivity Improvement, but also improvement of Quality and Safety.

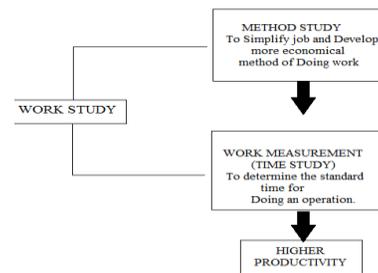


Figure: 1

2.2.1 Objectives of work study

1. It helps in the evaluation and examine of human work.
2. It helps in synchronizing various resources like human and machine.
3. It helps in efforts towards productivity improvement
4. It helps in the elimination of wasteful efforts, useless material handling etc.

5. It helps in job-simplification and work standardization.
6. It helps in the optimum use of plant, equipment, manpower and material.
7. It helps in establishing the standard of performance.
8. It helps in developing efficient work methods.
9. It helps in establishing the most efficient and effective utilization of human effort.

2.3 Method Study

Method Study is concerned with “the way in which work is done (i.e., method)”. It is used to simplify the way to accomplish a work and to improve the method of production. Method-study results in a more effective use of material, plant, equipment and manpower. It employs a systematic approach involving:

Select – Record – Examine – Develop – Install-Maintain.

“Method Study is the systematic recording and critical examination of existing and proposed ways of doing work, as a means of developing and applying an easier and more effective method & reducing cost.”

2.3.1 Purpose of method study

The main purpose (objective) of method-study is as follows:

1. Better utilization of manpower and other tangible resources
2. Elimination of unnecessary work
3. Improvement in layouts and methods of material handling
4. Improvement in working conditions
5. Improvement and simplification in design
6. Improvement and maintenance of quality
7. Improvement in the flow of production and processes
8. Economy in human effort and reduction of fatigue in work
9. Establishing the standardization in methods
10. Improvement in safety standards
11. Establishing a better physical work environment.

2.3.2 Factors consideration in Method Study

Three important factors, which govern the selection process, are:

1. Economic Considerations
2. Technical Considerations
3. Human Reactions

2.4 Work Measurement

Work Measurement Study is a general term used to describe the systematic application of industrial engineering techniques to establish the work content and time it should take to complete a task or series of tasks. Work measurement is a productivity improvement tool. Work measurement helps to uncover non-value added areas of waste, inconsistency, and non-standardization that exist in the workplace. Work measurement studies uncover ways to make work easier, and to produce products or services more quickly and economically.

2.4.1 Work is measured for four reasons

1. To discover and eliminate lost or ineffective time.
2. To set operating goals and objectives
3. To measure performance against realistic expectations.
4. To establish standard times for performance measurement.

2.4.2 Work Measurement Techniques

The following are the principal techniques by which work measurement is carried out:

1. Time study
2. Activity sampling
3. Predetermined motion time systems
4. Synthesis from standard data
5. Estimating
6. Analytical estimating
7. Comparative estimating
8. MOST (Maynard Operation Sequence Technique)

2.5 Value Added & Non-value Added Activities

In manufacturing line, there are only two types of activities that exist, which are termed as the Value Added Activities and Non-Value Activities.

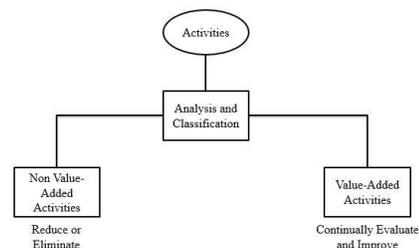


Figure: 2

2.5.1 Value Added:

The amount paid by a customer for the activities of the worker during the assembly is known as VA.

2.5.2 Non-value Added:

The amount doesn't paid by the customer, for the activities of the worker during the assembly is known as NVA. Facilities are constructed to produce goods that can be sold to customers, while doing so capital, energy, human, information, and raw material are acquired, transported, and consumed. Companies always aim for optimizing the resources consumed during this transformation. One way of optimum utilization is to reduce the non-value added cost associated with these resources. In a typical manufacturing industry, there are eight major wastes (Non value added costs).

2.5.3 Non Value Added Costs

1. Overproduction
2. Inventory
3. Non-value Added Processing .
4. Defects
5. Transportation
6. Motion
7. Waiting
8. People

2.6 Rating and Allowances

When someone is doing work, his/her way of working will vary throughout the working period and will be different from others doing the same work. This is due to different speeds of movement, effort, dexterity, and consistency (Kesselreg, 2000). Thus, the time taken for one person to do the work may not be the same as that for others and may or may not be 'reasonable' anyway. The purpose of rating is to adjust the actual time to a standardized basic time that is appropriate and at a defined level 16 of performance. Rating is on a scale with 100 as its standard rating. (Managers net: rating). Direct observation techniques (such as time study and analytical estimating) include process for converting the observed times to time for the qualified worker at a defined level of performance. The commonest of this process is known as rating.

"Performance rating is the process of adjusting the actual pace of an operator by comparing it with the mental picture of the pace of an operator working at normal speed". And determines a factor called Rating Factor.

2.6 Work Content

The time taken by a worker or a machine to carry out an operation or to produce a given quantity of a certain product may be considered as made up in the following manner:

Total Time of Job = Basic work content + work content added by poor product design or materials utilization + work content added by inefficient methods or operation + in-effective time resulting from human resources contribution.

2.6.1 The work content is increased by the following:

- A. Work content added by poor design or specification of product or its parts, or improper utilization of materials.
- B. Work content added by inefficient methods of manufacture or operation.
- C. Work content resulting mainly from the contribution of human resource.

III. METHODOLOGY

Methodology provides the step by step information to achieve the goal and objective. The methodology in the form of flowchart also provides the overview of the way to achieve the objective. It can be applied to any type of work for which a method can be defined and described. Time study was designed to be much easier than other work quantification techniques because of its simpler structure. It is a progressive technique. The technique is thoroughly proven, highly respected and used around the world. Time Study is a powerful analytical tool to measure every minute spent on a task. This research is a case study in which a systemic way has been followed to reach the solution of research problems. After a few primary visits an idea is generated and literature is studied accordingly. Then data is collected and analyzed from the field according to the literature.

3.1 Stopwatch Time Study Method:

Work study is divided in two groups in order to gain higher productivity. First group is a group of method studies which are used to simplify the job and develop more ergonomic methods of doing it. Second group is a group of work measurements which are used to find the time required to carry out the operation at a defined level of activity (Russell, Taylor, 2005a). Stopwatch time study measures how long it takes an average worker to complete a task at a normal pace. A "normal" operator is defined as a qualified, thoroughly experienced operator who is working under conditions as they customarily prevail at the work station, at a pace that is neither fast nor slow, but representative of an average. The actual time taken by the above-average operation must be increased, and the time taken by the below-average must be reduced to the value representative of normal performance. Performance rating is a technique for

equitably determining the time required to perform a task by the normal operator after the observed values of the operation under study have been recorded (Nakayama, 2002)5. Hence, when a work is measured with the stop watch device it is known as stop watch time study method. 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.

3.2 Importance and Uses of Stop Watch Time Study:

Generally this technique is used to determine the time required by a qualified and well trained person working at a normal pace to do a specified task. The result of time study is the time that a person suited to the job and fully trained in the specific method. The job needs to be performed if he or she works at a normal or standard tempo. This time is called the standard time for operation. This means the principle objectives of stop watch time study are to increase productivity and product reliability and lower unit cost, thus allowing more quality goods or services to be produced for more people.

The importance and uses of stop watch time study can be stated as under:

- (i) Determining schedules and planning work.
- (ii) Determining standard costs and as an aid in preparing budgets.
- (iii) Estimating the costs of a product before manufacturing it. Such information is of value in preparing bids and determining selling price.
- (iv) Determining machine effectiveness, the number of machines which one person can operate, and as an aid in balancing assembly lines and work done on a conveyor.
- (v) Determining time standards to be used as a basis for labor cost control.
- (vi) Helps to know the Labour productivity, Labour efficiency, Labour Performance. and overall time required to perform the task.
- (vii) Helps to improve the process of operation.

3.3 Equipments used to measure time using Stop watch:

Following equipments are used to measure time using Stop watch time study method:

- 1. Digital or electronics stop watch
- 2. Electronic data collector and computer
- 3. Observation board
- 4. Observation sheet
- 5. Stationary – Pen, Pencil, Eraser, Calculator.

3.4 Time Study Procedure

The main Process Steps of Carrying out Work Measurement are as follows:

- 1. Obtain and record all available information about the job, worker, process map, raw material and the surrounding conditions of work.
 - 2. Record the complete description of the method, break it down into elements.
 - 3. Measure with a stopwatch and record the time taken by the worker to perform each element of the operation.
 - 4. Assess the performance rating of the worker.
 - 5. Extend the observed time to "basic time" by factorizing the actual time (observed time) by the assessed rating.
 - 6. Determine the allowances (e.g. Personal allowances, relaxation allowances, allowances for the working conditions etc) to be made over and above the "basic time" for the operation.
 - 7. Apply those allowances on the "basic time".
- Basic time = (Observed time x Performance rating)
- 8. Thus, determine the "standard time" for the operation.

$$\text{Standard time} = \text{Basic time} + \text{Allowances}$$

IV. DATA ANALYSIS

After understanding the production process and manpower deployment of the plant the initial step was to collect some of the initial data that was available with the staff to understand the working of the industry. The following data has been collected and analysed to tin plant and dispatch section. The Company in which I started my project work in Edible refined oil manufacturing at Ruchi Soya Industries Limited. The plant has different sections of edible oil manufacturing which is supplied to the customers. Using Time study application and work content of each operation are calculated .Some definitions are as follows

Station 1- It is an area where a material is shifted from Stores to Tin jar manufacturing area.

Work Content of Dispatch Operator – Operator 1

Activity	Time (in min.)
Checking & Cleaning the forklift	15
Fill the Forklift check list form	10

Shift the damaged oil filled jar	26
Shift the empty plates of jar from loading point to packing stock area	38
Shift the filled tin jar from packing stock area to loading point	52
Unloading the tin jar plates	15
Total	156

Standard time calculations of Dispatch Operator 1

Observed Time = 156 Min.
 Basic Time = 156 X 0.90 = 140.4 Min.
 Standard Time = 140.4 X (1+6/100) = 148.82 Min

Operator 2

Activity	
Checking & Cleaning the forklift	15
Fill the Forklift check list form	10
Setup the empty plates of jar on other plates	11
Helping the others	8
Total	44

Standard time calculations of Dispatch Operator 2

Observed Time = 44 Min.
 Basic Time = 44 X 0.90 = 39.6 Min.
 Standard Time = 39.6 X (1+6/100) = 41.976 Min

Station 2- It is an area where a Dispatch helper is loaded the truck.

Work Content of Helpers-

Activity	helper 1(time in min.)	helper 2(time in min.)	helper 3(time in min.)
Setup the tin jar in lorry	68	72	60
Helping the Others	28	28	32
Total	96	100	92

Standard time calculations of Dispatch Helper 1

Observed Time = 96 Min.
 Basic Time = 96 X 0.90 = 86.4 Min.
 Standard Time = 86.4 X (1+6/100) = 91.584 Min

Standard time calculations of Dispatch Helper 2

Observed Time = 100 Min.
 Basic Time = 100 X 0.90 = 90 Min.
 Standard Time = 90 X (1+6/100) = 95.4 Min

Standard time calculations of Dispatch Helper 3

Observed Time = 92 Min.
 Basic Time = 92 X 0.90 = 82.8 Min.

Standard Time = 82.8 X (1+6/100) = 87.76 Min
Working and Not Working of Dispatch Operators and Helpers

	operator1	operator2	helper 1	helper 2	helper 3
Working %	45	22	47	29	28
Not Working %	55	78	53	71	72

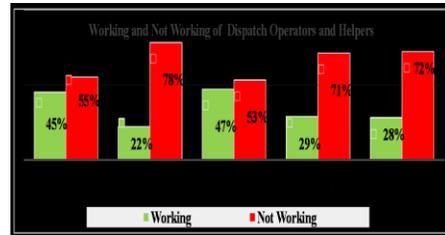


Figure: 3 Working and Not Working of Dispatch Operators and Helpers

VA & NVA of Dispatch Operator 1 –

	OPERATOR- 1 WORKING	
Activity	Time(in min.)	%
VA	156	72%
NVA	60	28%
Total	216	

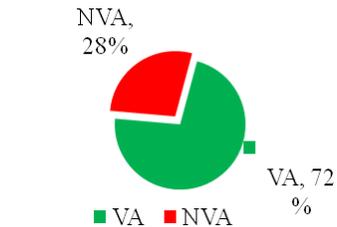


Figure: 4 Operator 1 Working Chart

	NVA	
Activity	Time(in min.)	%
Necessary	16	27%
Reducible	12	20%
Elimination	32	53%
Total	60	

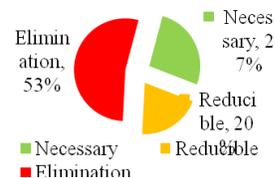


Figure: 5 Operator 1 NVA Chart

The NVA (reducible and elimination) time of dispatch operator-1 is distributed -

NVA Time (reducible and elimination) = 32+12=44min

VA time of Dispatch Operator-1 = 156+44=200min

New NVA Time of Dispatch Operator-1 = 16min

VA & NVA of Dispatch Operator 2 –

OPERATOR- 2 WORKING		
Activity	Time(in min.)	%
VA	44	50%
NVA	44	50%
Total	88	

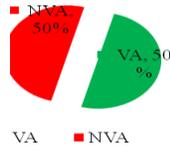


Figure 6: Operator 2 Working Chart

NVA		
Activity	Time(in min.)	%
Necessary	16	36%
Reducible	8	18%
Elimination	20	45%
Total	44	

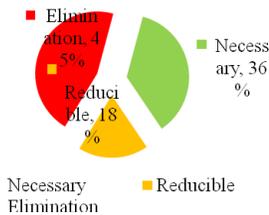


Figure 7: Operator 2 NVA Chart

The NVA (reducible and elimination) time of dispatch operator-2 is distributed-

NVA Time (reducible and elimination) = 20+8=28min

VA time of Dispatch Operator-1 = 44+28=72min

New NVA Time of Dispatch Operator-1 = 16min

VA & NVA of Dispatch Helper 1–

HELPER- 1 WORKING		
Activity	Time(in min.)	%
VA	96	73%
NVA	36	27%
Total	132	

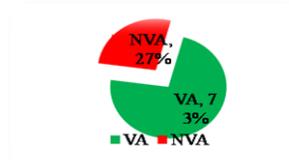


Figure: 8 Dispatch Helper 1 Working

NVA		
Activity	Time(in min.)	%
Necessary	16	45%
Reducible	12	33%
Elimination	8	22%
Total	36	

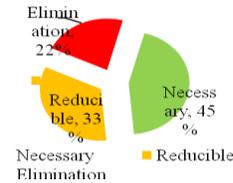


Figure: 9 Helper 1 NVA Chart

The NVA (reducible and elimination) time of dispatch Helper-1 is distributed -

NVA Time (reducible and elimination) = 12+8=20min

VA time of Dispatch Operator-1 = 96+20=116min

New NVA Time of Dispatch Operator-1 = 16min

VA & NVA of Dispatch Helper 2–

HELPER- 2 WORKING		
Activity	Time(in min.)	%
VA	100	96%
NVA	4	4%
Total	104	

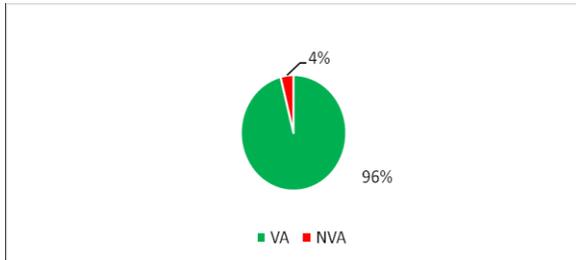


Figure: 10 Helper 2 Working chart

	NVA	
Activity	Time(in min.)	%
Necessary	0	0%
Reducible	4	100%
Elimination	0	0%
Total	4	

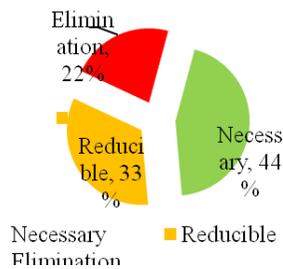


Figure: 11 Helper 2 NVA chart

The NVA (reducible and elimination) time of dispatch Helper-2 is distributed -

$$\text{NVA Time (reducible and elimination)} = 04+0=04\text{min}$$

$$\text{VA time of Dispatch Operator-1} = 100+04=104\text{min}$$

$$\text{New NVA Time of Dispatch Operator-1} = 0 \text{ min}$$

VA & NVA of Dispatch Helper 3-

HELPER- 3 WORKING		
Activity	Time(in min.)	%
VA	92	92%
NVA	8	8%
Total	100	

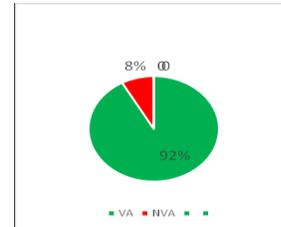


Figure: 12 Helper 3 Working Chart

	NVA	
Activity	Time(in min.)	%
Necessary	0	0%
Reducible	8	100%
Elimination	0	0%
Total	8	

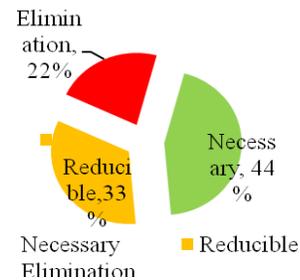


Figure: 13 Helper 3 NVA Chart

The NVA (reducible and elimination) time of dispatch Helper-3 is distributed -

$$\text{NVA Time (reducible and elimination)} = 08+0=08\text{min}$$

$$\text{VA time of Dispatch Operator-1} = 92+08=100\text{min}$$

$$\text{New NVA Time of Dispatch Operator-1} = 0 \text{ min.}$$

V. RESULTS

A lot of manpower, improved VA activities time, reduces NVA activities time and effort was saved and productivity was increased.

A New VA activities time is increased of total manpower is 592 min. and reduced the NVA activities time of total manpower is 104 min. in one shift .Therefore by this study improved working time 592 min. instead of 488 min. Improved the worker activates for other works by implementation of Time study.

VA and NVA Analysis of Manpower-

	Observed Time (in min)	Standard Time (in min)	Available Time (in min)	Idle Time (in min)	VA (in min)	NVA (in min)	New VA(in min)	New NVA(in min)
Dispatch operator 1	156	148.82	420	271	156	60	200	16
Dispatch Operator 2	44	41.9	420	378.1	44	44	72	16
Dispatch Helper 1	96	91.5	420	328.5	96	36	116	16
Dispatch Helper 2	100	95.4	420	324.6	100	4	104	0
Dispatch Helper 3	92	87.7	420	332.3	92	8	100	0

VI. CONCLUSION

The case study was successfully implemented in the industry thereby increasing the productivity and worker efforts and confirming the importance of work measuring techniques like Time study in industries. It is a simple, easy and an efficient technique without any initial investment which gives tremendous results.

By the result of this study it is clear that NVA is present in total work content, which should be minimum and the VA activity is low which should be maximum. The percentage is the ratio of total work content of VA or NVA total work content.

Thus with the help of Time Study method it is possible to achieve major times reduction in the manufacturing of the products. Time study nearly gives non-machining time reduction of 60 to 65 %. With the help of this method it is also possible to get the production time of the products before its actual manufacturing starts. This helps in the production planning.

VII. FUTURE SCOPE

The study is limited to few departments only, the other issues leading to the availability, performance and quality loss which ultimately leads to a loss in productivity. In this project, the study is done and suggestions are given which is implemented, resulting in an exact increase in production and

Efficiency of workers and Operators. Since it is a continuous running industry the work is limited to the particular departments and the calculations to the other departments are not made. Observations for individual machines and operators for other department scan be studied and overall plant cost reduction can be perform in future research work.

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