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Productivity Improvement using Time Study Analysis in a Small-Scale Import-Export Industry

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Abstract: ***The pattern of economic aggressiveness has exchanged worldwide. Many countries have joined the worldwide economic competition to capture the worldwide market to remain moneymaking and competitive by increasing their production. There are so many factors that influence the efficiency of a manufacturing system. The most widely addressed issue is how to increase production. Motion and time study approach are one of the productivities increasing techniques assist in many manufacturing industries. Productivity plays a significant or significant role in a company. There are many reasons for which productivity decreases, and there are various methods to improve productivity. However, choosing which method to use according to the situation is a wise decision. This study was done in an industry engaged in manufacturing Desk Accessories, Bag, Industrial Tool Kit, Leather Product and Home Furnishing products. The time study data for making the U bag process faster decreases the time taken for making bags and increases the production rate to increase productivity. The data was collected, and significant improvement in changeover time was observed.***
Keywords: Work Study, Time Study, Motion Study, Productivity, Time Analysis

I. INTRODUCTION

The market's competitiveness develops a continuous search for improvement on processes, products and services in all organizations. If a company does not focus on reducing costs and assuring the quality of what it provides, its survival on the market is compromised. In this context, lean manufacturing and its tools, which aim to reduce all types of waste within a company, are highlighted. Lean manufacturing emerged within the Toyota Production System to eliminate the seven wastes: overproduction, waiting, transportation, incorrect processing, inventory, motion and defects. Through this philosophy, companies started classifying operations as value-added or non-value-added, always looking for process optimization. To achieve this goal, additional tools were developed, such as the time and motion study. This research is dedicated to implementing a time and motion study employing the classification of value-added, non-value-added and waste in a production of the tool kit.[1] Productivity is the ratio of the amount of output produced to the number of input resources. Productivity =Output/Input. 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 person-hour, human resources efficiency. Various factors can influence productivity. The factors are divided into two viz. controllable factors and non-controllable factors. Controllable factors are focused on 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.[2] The present study comprises an introduction, theoretical foundation, methodology, case study and final considerations. Emphasizing the demonstration of the case study results after applying the time and motion study shows differentiation between the previous and future situations to show the effectiveness of the studied methodology.[1]

II. LITERATURE SURVEY

Paul and Rabindra (2006) used internal assessment through questionnaire, direct observation method, and archival data to improve productivity, quality, increase revenue, and reduce rejection cost of the manual component. Brown and Mitchell (1998) investigated operators, engineers and managers of PCA (Printed circuit assembly) factories to determine the work environment parameters that inhibited their performance. They recommended opportunities to improve production and quality.[3] Houts (2016) corroborates, emphasizing that the wastes are traditionally classified in seven: overproduction, waiting, transport, non-value-added processing, excess inventory, motion and defects. Excessive production is considered the worst of the seven wastes, leading to most other types of loss. Producing sooner or in larger quantities than needed leads to the formation of inventory later in the process, and the material waits to be processed in the next operation. According to Houts (2016), the seven wastes and eighth waste can be added: underutilized people.

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Underutilized people are resources that have their time spent with inefficient processes or unnecessary waiting times.[1] Mayank Dev Singh said they are working on "To improve productivity by using work-study & design an installation in small scale industry". This research aims to improve production capabilities for small scale industry, and this research focused on the company, which produce Stay vane of Francis turbine.[4]. Research on the implementation of lean thinking in support functions indicates that the lean philosophy is not restricted to the manufacturing industry alone and can be applied to any business domain. It is the awareness of the external and internal developments which enables a company to incorporate changes and survive. Lockheed Martin Aeronautics Company (LMAC) recognised the advancements in the computer and information technology areas, which eventually led to the improvement of the fighter jet, F-16, via the implementation of the Lean Effects in Aerospace Programs (LEAP) project (Ferdowsi and Stanke, 2002).[5] This definition put in an enterprise, a sector of economic activity or the economy as a whole. The term "productivity" can be used to ingress or measure the area to which a particular outcome can be extracted from a given input (Kanawaty, 1992). *Productivity* has been generally defined as the ratio of an extent of output to the unit of all of the resources used to produce this output.[6] The phrase Time and Motion Study refers to a broad branch of expertise dealing with the systematic willpower of preferable work methods, with the resolution of the time required for the use of human or machine to execute the work by the specified method, and with the development of resource required to make practical use of these data.[7] Motion and time study offers real-time challenges. Industries with competent engineers, business administrators, industrial relations personnel, specially trained supervisors, and psychologists carrying out motion and time study techniques are inevitably better able to meet competition and better equipped to operate profitably (Niebel, 1988).[8] World-class manufacturing or lean manufacturing operations require flexible manufacturing systems to cope with changes in external competitive environments. One of the benefits of just in-time (JIT) is the ability to adjust to changes in the firm's external environment (Miltenburg, 1998). Research suggests that there are several reasons JIT is able to cope with the changes in the external environment, including multi-functional workers and efficient facility layouts (Scholl and Klein, 1999b; Hall, 1983; Monden, 1983; Schonberger, 1982).[9]

III. INTRODUCTION TO WORK-STUDY

A. *Work-study*

Work-study is the look over, through a compatible system of the work done in a company to attain the best application of assets. All the high tech and administration structure are connected with productivity. Work-study is the fundamental techniques of increasing productivity. work-study is a technique of management involving the analytical study of a job or operation." Work-study helps to increase productivity. Better production with less effort, so goods/products are available at cheaper rates.

The primary aims of work-study are:

1) To analyse the work to achieve work simplification and thereby improve the system's productivity.
2) To have optimum utilization of resources, Move the object a distance to the point of placement, either directly or in conjunction with body motions or steps.
3) To evaluate the work content through work measurement.
4) To set time standards for various job.

B. *Importance of Work Study in Industries*

In industries, work-study is considered as equipment of improving productivity by way of:

1) Resource utilization to a satisfactory level.
2) Capital investment to introduce the latest technology.
3) Better management of the system.

C. *Need for Work-Study*

Work-study is the most essential tool of management because:

1) It is a direct means of improving the system's productivity involving very little or no cost.
2) No factor affecting the efficiency of operation is overlooked in this approach.
3) It provides the most accurate means of setting standards of performance which are helpful in the process of production planning and control.
4) Application of work-study result in immediate savings.
5) It is a universal tool for management.
6) It is the most competent tool of investigation available to the management of the industrial unit.

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D. Techniques of Work-Study

The subsequent order of the correct procedure to be adopted for having effective results of method study include the following:

1) Select the work/procedure to be analyzed.
2) Record all the relevant information related to the existing work system with the help of various recording devices or techniques.
3) Make a critical examination of collected data/facts.
4) Develop and improve the economical and practical method after giving due consideration to the alternative method possible.
5) Install the new selected method with proper instructions.
6) Similarly, the correct procedure to be adopted for having effective results of work measurement includes the followings:

Similarly, the correct procedure to be adopted for having effective results of work measurement includes the followings:

a) Divide the selected procedure into small work elements.
b) By direct observations, record the relevant information regarding the various work elements.
c) In the light of relevant information, examine the work critically.
d) Measure the work contained in terms of the work elements involved in the method being adopted.
e) Define and design the new selected method.
f) Finally, convert the work content time to standard time.

E. Objectives of Work-Study

1) A good outline of plant tools and structure.
2) Less fatigue.
3) Good working conditions and environment for workers/employees. 4. To have more effective utilization of materials, machines and workforce and money.
4) Better Product quality.
5) Efficient and fast material handling equipment.
6) Leads to standardization, rationalization, simplification and specialization.
7) Efficient planning of the section.
8) Streamlined working procedures.\

Other aims of work-measurement are given below:

a) When two different procedures are equally superior, one of which needs a shorter time for accomplishing the job can be accepted.
b) The workforce need for a job can rule on the precise quantity of work to be done, assisting in workforce saving.
c) Work measurement facts come up with a reliable foundation to choose the tool.
d) Give necessary details for effective product design and increasing productivity of the set-up.
e) Gives fundamental for fair and reliable incentive schemes.
f) Decides realistic labour budgeting and provides a basis for a standard costing system.[10]

F. Advantages of Work-Study

1) It is directly proportional to increasing productivity.
2) Its consequences in the constant and best production process.
3) It decreases the manufacturing cost.
4) With the help of work-study quick and precise dispatch is achievable.
5) With the help of work-study, we can give more satisfactory service and purchaser fulfilment.
6) It upgrades the employee-employer connection.
7) It gives job satisfaction and job security to workers.
8) Better working conditions are possible for workers.
9) It is the most critical analysis tool and can help provide better wages to workers on a scientific basis.
10) Most accurate method and yet provides a sound basis for production planning, control and incentives for the workforce.
11) Everyone concerned with industries benefits from it, such as worker, consumer and management of the unit.

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IV. METHODOLOGY

1) *Step 1:* Interpret the purpose of the analysis.
2) *Step 2:* Ensure whether the standard method and conditions exist for the operation, and the operator is adequately trained.
3) *Step 3:* Select the operator to observe when more than one worker is doing the same work.
4) *Step 4:* Recording the information on the standard method, operation, operator, product, tool, and conditions on the Time Study monitoring sheet.
5) *Step 5:* Dividing the operations into small rational elements and record them on the Time Study monitoring sheet.
6) *Step 6:* Gather and record the required number of cycles by timing and rating the worker.
7) *Step 7:* Calculating the typical watch time for each element of the operation. Normal time is obtained by multiplying the typical watch time with the rating factor. Normal time is the multiplication of Observed time and rating factor. Calculate the normal time for the total operation by adding the normal time of its various elements.
8) *Step 8:* Add suitable allowances for fatigue and various delays.
9) *Step 9:* Determining the standard time of operation. Standard time = Normal time + allowances.[11]

TABLE I
Symbols and Operations

Symbol	Name	Activity
	Operation	Modification of object at one workplace. The object may be changed in any of its physical or chemical characteristics, assembled or dissembled, or arranged for another operation, transportation, inspection or storage.
	Transportation	Change in location of the object from one place to another
	Inspection	Examination of the object on check on quality or quantity characteristics.
	Delay	Retention of an object in a location awaiting the next activity. No authorization is required to perform the next activity.
	Storage	Retention of the object in a location in which it is protected against unauthorized removal.

A. *Data Collection*

The data gathering is done by recording a video multiple time because we have to do thetime study for the existing process and then for the calculation of standard time estimation same method is used for the improved process and its calculation of standard time estimation.

B. *Flow Process Chart and Sample Process Chart*

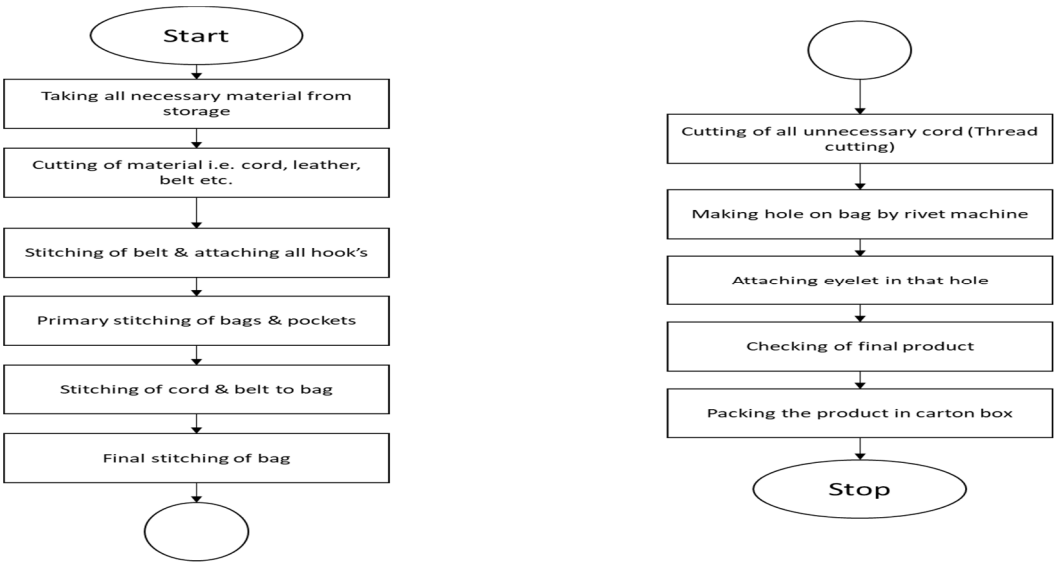

Fig.1 Flow Process Chart

Description	Distance (meter)	Time (sec)	Symbol	Remarks
Taking white rolled material form the storage	-	5		
Moving role to the rolling wheel	3	20		
Placing material on rolling wheel	-	5		
Spreading of material on long board	-	30		
Taking measurements	-	250		We can minimize these two steps
Cutting of material	-	250		
Moving of slit material to the stitching machines	2.5	5		
Taking leather material from storage for making of belts	2	5		
Moving the leather material to leather cutting machine	2	5		
Taking measurements	-	80		We can minimize these two steps
Cutting of leather material	-	120		
Moving the slit material to the stitching machine	3	5		
Taking belt material from storage and moving to the	2	10		

Fig.2 Sample Process Chart

C. Analysis of Data

1) After collecting the data for the existing process and improved process, the data analysis wasdone.

2) The data analysis was done through brainstorming activity and recording a video in which the element description is gathered for the making of the U bag.

3) After that, the feasible activities to ignore or can be minimized are listed out to minimise the time.

4) The total time of the existing flow process chart and improved flow process chart was calculated separately, and the number of activities was also calculated separately.

5) Then the total time saved was calculated because of minimizing or ignoring some activities in the existing flow process chart.

6) Then time study was done for both the existing process and the improved process, and also, the standard time estimation was done for both the methods.

7) Problems were identified, and accordingly, an action plan was developed.

V. RESULTS AND DISCUSSIONS

A. Result of Flow Process Chart

Table II
Result of flow process chart

Summary				
Subject charted:	Activity	Present	Proposed	Savings
	Operation	21	17	4
	Transport	9	9	0
Activity: Making of UBag(10 Bags)	Delay	0	0	0
	Inspection	1	1	0
	Storage	2	2	0
Method: present /Proposed	Time (sec)	2675 sec	2435 sec	240 sec

B. Result of Standard Time Estimation

Table III
Result of Standard Time Estimation

Standard TimeEstimation	ExistingProcess	ImprovedProcess	Savings
Total Time Taken	3048 sec	2760 sec	288 sec

VI. CONCLUSION

This research work focused on applying time study and motion study to reduce production time for the making of 10 U bags. The research showed thata substantial reduction in the production time possible. The experiments demonstrate that the time reduction was for the flow process chart is 240 sec and the calculation of standard time estimation was done, and the time reduction is 288 sec. Furthermore, the action plan which was suggested help in improving the overall system and reduce total time for productivity improvement.

VII. FUTURE SCOPE

The restriction of this study was that the data collection activity was carried out manually, which may have resulted in skipping some micro activities or motion. Another thingis the results achieved are an improvement over the existing process, but still, it is not saving more time for increasing productivity. It will be interesting to know if some research will be carried out to improve further.

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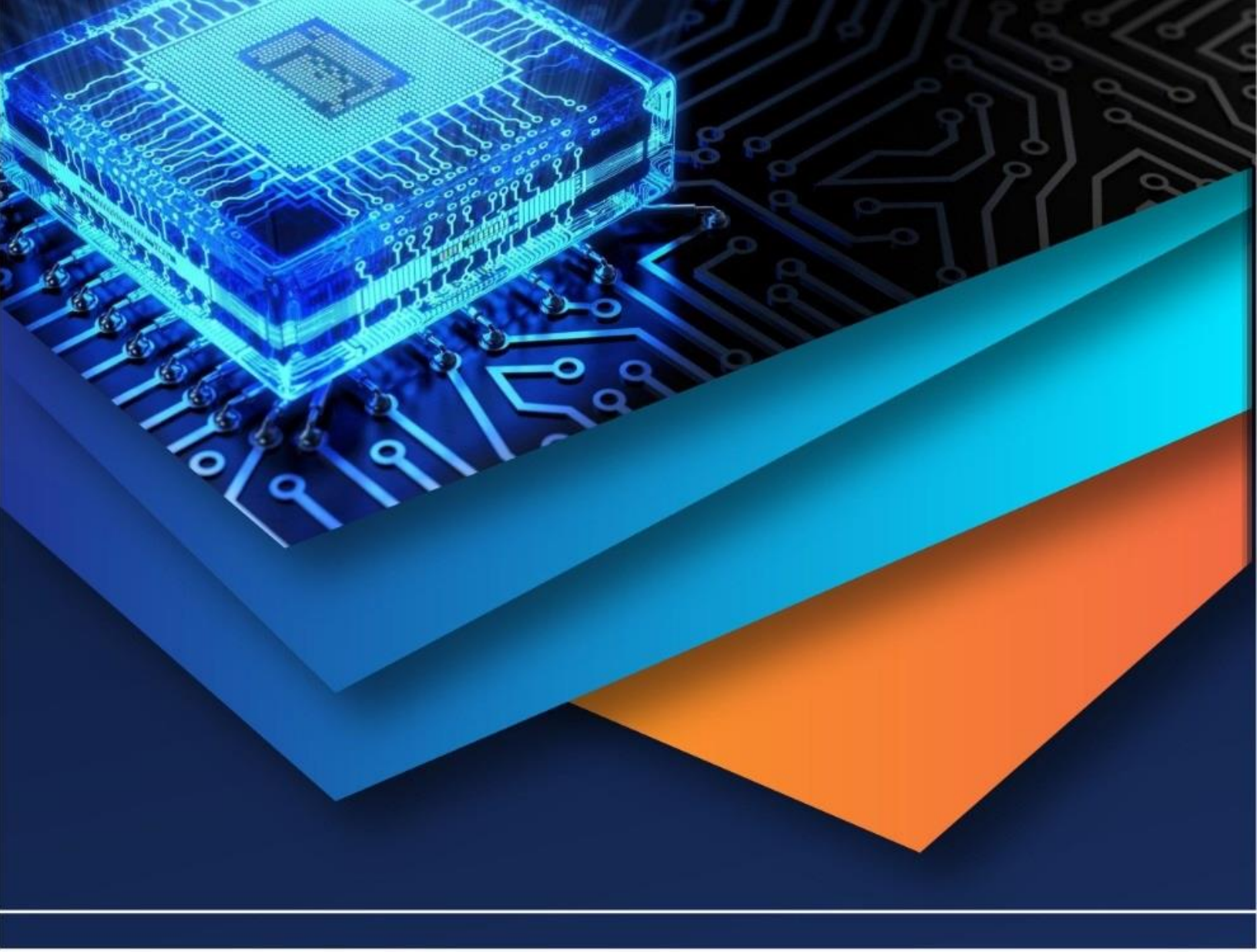

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