Improving Productivity In Machine Shop Using Work Study

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Abstract- *Productivity improvement is a critical goal for machine shops to enhance efficiency, reduce costs, and optimize their operations. In this study, the Maynard Operation Sequencing Technique (MOST) is investigated as a productivity-boosting technique for machine shops. The main advantages and uses of the MOST approach in a machine shop setting are highlighted in this paper. Increased productivity, shorter cycle times, better worker efficiency, better machine utilization, and shorter setup times are just a few of these advantages. Machine shops can improve efficiency, streamline their operations, and get rid of bottlenecks by using the MOST technique. This study also covers the requirement for data gathering, analysis, and ongoing improvement in order to maintain the productivity increases made possible by the MOST technique. This presentation offers a general description of how. In a machine shop, the Maynard Operation Sequencing Techniquecan be used to improve production. Machine shops might aim for greater performance, increased throughput, and improved marketplace competitiveness by optimizing task sequences and equipping staff with effective procedures.*

Keywords- Productivity, MOST (Maynord's operation sequencing technique), Time study.

I. INTRODUCTION

The project study is carried out in the Machine shop called shri Lakshmi engineers, which is located in Coimbatore, Tamil Nadu Shri lakshmi engineers come from experts who have been manufacturing all type of pattern and Die . Shri lakshmi engineers was incorporated in 2018. As a contract manufacturer they are engaged mainly in the manufacture of machining component. This component and equipment are mainly for machine tools, fabrication spare parts and others. The company has been able to gain the confidence of its customers through its commitment to high quality, reliability and with our timely delivery .They go out of their way to satisfy each and every of their customers, because they aspire to stay ahead .They practice working hard and strategically re-investing our profit to acquire better equipment. A Quick observation in production department indicated ineffective operational processTo produce a single product it takes more than usual time because of current process layout, production time is higher than usual ,so productivity decreases the efficiency of an industry is low**,**only6 numbers of product is finished out of 10numbers of raw material. so conversion rate is low when compared to other suppliers the focus of this work is on The Maynard Operation Sequence Technique (MOST), a revolutionary improvement over Pre- Determined Motion and Time Study (PMTS), is the subject of this study. It also focuses on why MOST is preferred over other work measuring techniques like time study. The standard time, utilization, and suggestion for manpower planning could all be determined from this study. The machine shop's cycle time could be optimiszed using these results. Today, a preset motion time system is used to systematically analyze work For highly repetitive, short-cycle processes, attention to detail is important and useful in producing valuable technique improvements. Work is broken down into extremely small, unique pieces termed basic motions.

II. LITERATURE REVIEW

Literature review from the existing body of knowledge has provided the following:

The thorough analysis of prior studies on the subject of increasing productivity through work study. An appropriate solution is generated for the process at hand by identifying and analyzing the issues and flaws in the process.

.Abdullah R et al., (2011) in their study "The Maynard Operation Sequence Technique (MOST) was used in the " Labor Utilization and Man to Machine Ratio Study at a Semiconductor Facility" to increase productivity and lower operating costs in the MNC semiconductor sector. Results showed that cell 1 and cell 2 had operator utilization as low as 47.43% and 41.22%, respectively, whereas management had set a target of 75%. In order to achieve a 75% operator utilization, it was advised to increase the man to machine ratio from 1 man to 3 machines to 1 man to 5. Operator productivity increased by 22% as a result of the elimination of non-value-added activities and enhanced machineperformance. Thus, the study's findings are that by strengthening man's ability to

Machine ratio can be enhanced by work research and by developing a standard operating procedure, which increases productivity and, as a result, efficiency by 53 percent.

Bondhare et al., (2016), MOST technique was used on the cable production line to increase productivity. Prior to implementing the MOST increase, output was determined to be 750 units with 20 workers, but after it was discovered to be 900 units with 14 workers, a decrease of 6 workers resulted in an annual savings of INR 8, 64, 000. By altering the workplace layout, 22.1 m2 less space was required, which assists with efficient space utilization. The standard time of 160 seconds was established with the help of MOST, which could save 11 seconds each part.

Md Abdul Moktadir et al., (2018) To increase productivity, the method study, a work study method, is applied. By using work measurement on the manufacturing line, the production system for the leather goods industry is improved. The procedure has a productivity increase of 12.71 percentage points.

Waghambare et al. (2016), They applied their research to the assembly task at one of the top axle manufacturing companies in India, Shard Motor Ltd., located in Nasik.

MOST with the intention of assessing production. The activity's standard time is specified using MOST in this case. As a result, by cutting the number of operations from 40 to 31, the cycle time is decreased from 10.42 minutes per unit to 4.326 minutes per unit. Productivity was 92 prior to the trial, but it increased to 220 as a result.

Kadar et al., (2014) in their study “Cycle Time Reduction using Toyota Production System" discovered that the paint shop of the toy production unit had an imbalanced paint line due to some stations being overburdened while others were under utilised. For measuring the average time for various operations, the Basic MOST System is employed. Even after combining some procedures since it is not possible to further divide the activities, it is evident that there is a significant difference in the work content from operator to operator, ranging from a minimum of 102 seconds to a maximum of 150 seconds. The bottleneck workstations were located, which led to an 18.75% reduction in personnel from 16 to 13. Thus, cycle time can be significantly decreased by implementing the Toyota Production System, increasing productivity.

Ankit et al., (2015) a research project titled "Productivity Improvement of Manufacturing Process of Diesel Engine by MOST Technique" was carried out at Topland Engines Pvt. Ltd. Following an analysis of the diesel engine production facility, it was discovered that most tasks are carried out manually by employees. There is no set time for each procedure in the industry. Time is lost as a result of improper operation sequences. There is a lot of material movement in the industry's current layout. Distance travel is inappropriate. Thus, travelling from one location to another requires extra time. The proposed configuration was created to shorten the engine's travel distance. A decrease of 27.66% in total assembly time and in the assembly department was achieved by applying the MOST approach in the sub assembly department. 18.20% less time is spent on assembly overall.

Ingale et al., (2014) in their study The technique of work measurement by utilising Basic MOST was highlighted in the paper "Improvement of Productivity by New Approach-Lean Enterprise by MOST Way". This research was done in the pump manufacturing sector. With the resources at hand, the current manufacturing line cannot satisfy client demand. A new modified technique is proposed by combining the VSM and Basic MOST applications. According to this study, synchronizing VSM with BASIC MOST results in a 40% improvement in line EWT and a 15% improvement in lead time. Lean Enterprise is the name given by MOST Way to the hybrid optimization process in which Lean and MTM are synchronized.

Belokar et al., (2012) utilized MOST to identify and reduce NonValue Added (NVA) tasks in order to boost the productivity and cost effectiveness of the work and decrease worker weariness. Because of their research, the authors were able to define a new set of reduced standards and save 18% of the working time.

Gupta and Chandrawat, (2012) used the fundamental MOST in a little Indian company. Their analysis also suggests that production may have increased significantly. For a specific goal, MOST can also be used in conjunction with various other methods.

Tarun Kumar Yadav, (2013) Choosing an appropriate assembly system is the first step in the usage approach. Next, appropriate cycle times, parallel workstation requirements,and implementation of parallel lines for the chosen assembly system type. They recommended Work measurement is a methodical approach for analyzing work and estimating the amount of time needed to complete crucial activities in processes; it is often based on time standards for manual operations.

.A. N. M. Karim, H. M. EmrulKays, A. K. M. N. Amin and M. H. Hasan, (2014) In order to remain competitive in the present global environment of intense rivalry, businesses must cut back on or completely eliminate downtime and idle time from their operations in addition to improving their current working practises.The Maynard Operation Sequence Technique (MOST) was used in the rear window assembly phase of the study to record workflow activities utilizing a systematic and descriptive workflow data block for the analysis of value engineering, value addition, and method engineering. New techniques and work standards are subsequently created in advance for manpower analysis, workplace design, and capacity planning. Thus, material handling and workflow are enhanced as a result of process redesign and process flow analysis. As a result, it has been able to shorten the manufacturing cycle time in order to accommodate the increased degree of demand while keeping the present level of labor with a quicker takt time.

PatiI.S.S ,Shinde B.M., Katikar.R.S. andKavade M. V. (2004) The idea was to raise knowledge of the Maynard Operation Sequence Technique, a specific work measuring method that is crucial for organizing and managing operations. Any work measurement technique's primary goal is to cut down on work content and boost process productivity as a result. They have almost completely eradicated the unease of online workers. A MOST analysis is a comprehensive examination of an operation or a sub operation that includes one or more methodology steps, related sequence models, suitable parameter times, and the operation's or sub operation’s total normal times. They employ the MOST approach, which allows for a significant time savings in the production of the goods. MOST almost guarantees a decrease in non-machining time of 60 to 65%. Through the aid of Using this technique, it is feasible to learn how long a product will take to produce before the real manufacturing process begins.

A.P. Puvanasvaran, C.Z. Mei, V.A. Alagendran, (2013)The incorporation of time studies has been shown to increase the autoclave process's Overall Equipment Efficiency (OEE). The Maynard's Operation Sequencing is recognised. A Review of Total Operation Time Optimization The secondarytime study is subsequently carried out using the Maynard Operation Sequence Technique (MOST). They recommended using MOST to assess the amount of progress that contributes to OEE. It is trustworthy since it offers constant standards and precision with a 95% confidence level of 5%. Additionally, it has been shown that the amount of time needed for data production and standard establishment has greatly decreased.

.Mehvish Jamil, Manisha Gupta, AbhishekSaxena and VivekAgnihotri, (2013) The approach used to standardize process operations using Maynard's Operation Sequence Technique and reduce worker tiredness on the production line by applying ergonomics is highlighted in the study. Therefore, this study uses Maynard Operation Sequence Technique (MOST) as the time study technique and Like Ergonomics as the labor study method. Their primary goal is to optimize the system through the combination of MOST and ergonomics.

Ashish Thakre et al., (2010) It has been suggested that the MOST work measurement approach be utilized to reduce non- productive assembly line activities to a minimum. The MOST research found that the operators' excessive motions greatly increased the fundamental work content.

Sunil Londhe, [2016] in his study The work measuring utilized for management decisions including planning, scheduling, pricing calculation, and performance analysis is described in "Review On Work Measurement By Most (Maynard Operation Sequencing Technique)".

Gothey, (2005) in his study, Five different types of contactors have been examined for the Study of MOST D.P Contactors for Standardization. To understand and enhance the current operating processes using MOST, a two-phase research was conducted.

Sirdeshmukh, (2009) in the study Predetermined Motion Time systems (PMTS) have developed into a desirable and practical assessment tool for personnel utilization and productivity. Productivity Improvement by Application of MOST in Switch Gear Company

Zandin, (1980) is regarded as a pioneering contribution to MOST Work Measurement systems. Zandin defined work in terms of operation, sub operation, time standard, activity, method step, sequence model, sub activity, and MOST analysis in his book "MOST Work Measurement Systems." By concentrating on MOST as a productivity development technique, the notion of MOST and the fundamental MOST sequence models are thoroughly described.

III. METHODOLOGY

The method starts with defining the issue, which is the machine shop's poor production rate. Next, it identifies the steps needed to produce a cavity plate (made of CI material), and then takes time studies for each step. Then, using MOST, we determine the process' standard time, compare it to time studies, and attempt to reduce non-value-added processes in

order to increase productivity. The work has been done in three phases

Phase 1: Identifying operation involved in cavity plate production

Raw material for producing a cavity plate is supplied from customer , Most of the operation in cavity plate machining is done in Vertical machining center it is a computer control machine, the process involved cavity plate production divided into sub operation

- Drilling
- Tapping
- Loading and setting the work piece
- Facing the top surface
- Outer roughing and finishing
- Job removal
- Boring and counter boring
- Testing
- Packing

Phase 2: Cycle time of each sub operation iscalculated using time study

The operator's trip time as a result of the installation of the material and other operational equipment away from the line was recorded by the timing device as part of the overall activity time. It reflects the amount of time needed to finish one cycle of a certain action or activity. In a time study, each job in the operation is observed, timed, and the overall cycle time is calculated by adding together all the individual task times..

Table.1 cycle time of sub operation

S No	Sub operation	Cycle time (minutes)
1	Drilling	2
2	Tapping	3
3	Loading and setting the work piece	10
4	Facing the top surface	10
5	Outer roughing and finishing	35
6	Job removal	5
7	Boring and counter boring	30
8	Testing	5
9	Packing	10
Total cycle time		110

Phase 3 : Standard time is calculated using Basic MOST study

Any form of task for which a method can be specified and explained can be used using MOST. Due to its more straightforward structure, it was intended to be significantly faster than existing work quantification methodologies. It brings together the fundamental motions that regularly happen into predetermined sequences. MOST is a progressive technique that employs a structured methodologyand creates structured data. The method has received extensive validation, is well regarded, and is in widespread usage. A strong analytical tool for tracking every minute spent on a job is MOST.

By far, Basic MOST is the MOST variation that is used the most frequently. Exercises that are often performed morethan 150 but fewer than 1500 times per week examined at the intermediate level. by basic MOST

Following three sequence models have been established:

i. General Move Sequence
ii. Controlled Move Sequence
iii. Tool Use Sequence

Table.2 Sequence model

Activity	SequenceModel	Parameter
General move	ABGABP A	A=Actiondistance B=Body motion G=Gain ControlP=Placement
Controlled move	ABGMXIA	M=MoveControlledX=Process TimeI=Alignment
ToolUse	A B G A B P A B PA	F= FastenL=LoosenC=CutS=Surface treatM=MeasureR=RecordT=Think

An overview of MOST procedure is as follows:

- Determine sequence(s) to use
- Determine index values

- Add index values to determine TMU
- Multiply TMU by 10
- Convert TMU to minutes

The time measurement unit (TMU) is used as a time unit for MOST study

T.M.U = 0.036 sec
= 0.0006 min
= 0.00001h

Table.3 MOST Estimation Sheet Existing Working Activity

SUBOPERATION1:DRILLINGOPERATION					
S.NO	SUBACTIVITIES	MOVE	PARAMETERSANDINDEXVALUE	TMU	TIME(Min)
1	Walk twosteps towardsthe rawmaterial	Generalmove	A3+B0+G0+A0−B0+P0+A0	30	0.018
2	Pick the rawmaterial	Generalmove	A1+B3+G0+A0−B3+P0+A0	70	0.042
3	Walk 25 stepstowards theRadial drillingmachine andplacett	Generalmove	A42+B0+G0+A0+B3+P3−A1	490	0.294
4	Pick the drillbitandclampinchuck	Tool use	A0+B3+G1+A0−B0+P1+F42+A0+B3+P3+A1	540	0.324
5	Put drill inrawmaterials(4)	Controllocimove	A0+B3+G1+M3+X16+I16+A1	1600	0.96
Totaltimetocomplete Drillingoperation				2730	1.638

Table 3 lists the fundamental activities, their respective index values, TMUs, or time measurement units, and operating times (in minutes).

Similar calculations were made for each process and calculated time for each. Table 4 shows the summary of all activities held in the production process by using MOST

Table.4 Total activity time of MOST sheet for all sub operations

SNo	Suboperation	Time(minutes)
1	Drillingoperation(5subactivities)	1.5
2	Tappingoperation(5subactvities)	2.4
3	Loadingandsettingtheworkpiece(9subactivitica)	9.0
4	Facingthetopsurface(6subactivities)	8.5
5	Outerroughingandfinishing(12 subactvities)	31.1
6	Jobremoval(6subactvities)	2.7
7	DRO operation(5 sub activities)	27.182
8	Testing(5subactivities)	2.3
9	Packing(5subactivities)	8
	Totaltime(63subacivities)	92.7

Table.5 Comparison of Time study and MOST study

S.NO	Operation	Time study	MOST study	Time saved
1	Drilling	2	1.6	0.4
2	Tapping	3	2.4	0.6
3	Loadingandsettingworkpiece	10	9.0	1.0
4	Facingthetopsurface	10	8.5	1.5
5	Outerroughingandfinishing	35	31.1	4.1
6	Jobremoval	5	2.7	2.3
7	Boringandcounterboring	30	27.1	2.9
8	Testing	5	2.3	2.7
9	Packing	10	8	2

Table-5 shows that maximum 4.1 min can be save on VMC operation through MOST and approx.30 to 50 seconds in all the operation. Through this study, it is possible to draw the conclusion that using the MOST approach may significantly cut cycle time on the process.

IV. RESULTS

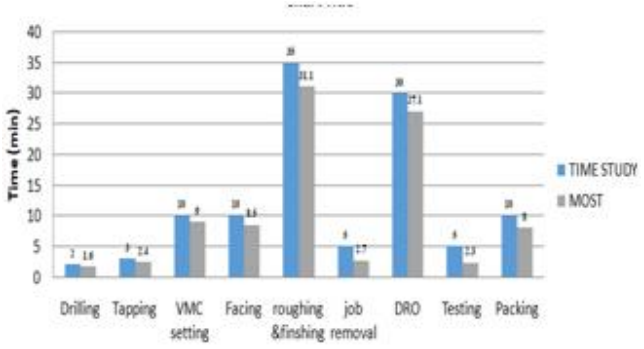

Fig.1The cycle time comparison of all operation

The figure-1 shows the comparison between time study and MOST study in which 0.40 min, 0.60 min, 1.00 min, 1.50 min,
3.90 min,2.30 min,2.90 min,2.70 and 2.00min are saved by MOST method on Drilling, Tapping, Loading, FacingOuter and inner machining, Job removal, Boring, Testing, Packing operation respectively

The total decrease in time by MOST study is

Total Work Content By Most Study Was 92.7 minutes Total Work Content By Time Study Was 110 minutes
= (110 – 92.7)/110 = 0.157

= 15.72%

This demonstrates that the MOST study is the optimum study to be used for work content calculation since it maximizes the time needed to increase productivity.

Productivity calculation By Time Study

Total time available per shift =660 min or 11 hr Total Cycle time=110 min
Total unit Produced per Shift =660/110 = 6 units per shift
Labour productivity (in terms of hours)
= Total quantity produced/ Actual man hours required to produce that quantity=6/11=0.54

By MOST Study

Total time available per shift =660 min or 11 hr Total Cycle time=110 min
Total unit Produced per Shift =660/92.7 = 7.11 units per shift
Labour productivity (in terms of hours)
=Total quantity produced/ Actual man hours required to produce that quantity=7.11/11=0.64

Increase in Labour Productivity

Labour productivity (MOST study)= 0.64 Labour productivity (Time study) =0.54
= (0.64-0.54)/0.54 =0.185
=18.5%

According to the calculations, it can be said that the MOST technique, as opposed to the Time study, is most suited for work measurement. Utilising MOST on the assembly line can contribute to a 18.5% boost in production.

V. CONCLUSION

The study was aimed to increase productivity by implementing MOST. The study was carried out by breaking down operations into basic elemental tasks and then giving those tasks index values to determine the theoretical cycle time. MOST made it simple to draw attention to the ineffective working conditions and workplace design. According to our calculations, productivity increased by 18.5%, total production time decreased by 17.3 minutes, and therefore we almost saved 15.72% of time compared to the conventional approach. Therefore, we must use MOST for the optimum outcome. Thus, the Maynard Operation Sequence Technique results in an increase in productivity that produces the most work in 12 hours, saving both energy and operator costs.

VI. SCOPE FOR FUTURE WORK

This project can be developed by finding Non value added activities in MOST method and suggesting a alternative method which adds value to the process ,and Finding some ergonomically sound solutions might help to cut down on unnecessary delays and make things approachable for the worker. The future potential of MOST in machine shops largely depends on its capacity to support leaner, more productive, and technologically sophisticated processes. Machine shops may maintain their competitiveness, boost quality, and adapt to changing market needs by using the insights from MOST analysis and fusing them with other digital technologies and automation.

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