

An improvement of productivity in Manufacturing system

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ABSTRACT: Productivity may be defined as the ratio of the output produced to the input resources utilized in the production. It can be defined in another way "total productivity is the ratio of the aggregate output to the aggregate input. Basic objectives behind the productivity measurement are - (A) To study the performance of a system overtime (B) To attain the relative comparison of different systems for a given level (C) To compare the actual productivity of a system with its planned productivity, 1.1 Purpose of increasing productivity – (A) For Management- To produce good earnings ,To stand better in the market,To clear debts or loans acquired, To sell more, (B) For Workers- (i) Higher ages, (ii) Better working condition ,Higher standard of living, Job security and satisfaction, For Customers - Reduced price of the article. Better quality, It can be ensured by three ways- (a) More output is produced with the same or lesser input (b) Same output is produced with lesser input (c) More output is produced with more input. The proportional increase in output being more than the increase in input Techniques for productivity Improvement- There are two different techniques of productivity enhancement (A) Improving productivity by reducing work content (B) Improving productivity by reducing ineffective time.

I. INTRODUCTION

Definition of Work Study- 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 the investigation of all the factors which affect the efficiency and economy of the situation being reviewed, in or to effect improvement. While the linkage between work study and productivity is apparent from the above, it is not exactly clear as to that makes it different from other productivity raising techniques. It is thus necessary to know the definition of the method study and the work measurement, the two major techniques of work study.

Definition of Method Study Method study is a 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.

Definition of Work Measurement - Work Measurement is the applications of techniques designed to establish the time for a qualified worker to carry out a specified job at a defined level of performance. Thus methods study is concerned with the reduction of work content of a job or operation, while work measurement is mostly concerned and with a subsequent establishment of time standards for operation when carried out in the improved fashion as determined by the method study.

Basic Procedure for Work Study – Select, Record, Examine, Develop, Measure, Define, Install, Maintain

Prerequisites of conducting a Work Study Work study is not a substitute for good management and never can be. It is one of the tools in the manager's tool kit. By itself it will not make bad industrial relations good, although, wisely applied, it many often improve them. If work study is to contribute seriously to the improvement of productivity, relations between the management and the workers must be reasonably good, and the worker must have confidence in the sincerity of the management towards them. The type of relationship is often determined by the working conditions and the environment provided by the management over time. Good human relations and working conditions are thus the important prerequisites for successful application of work study.

The Work Study Man The job requirements of a work study man can be translated into certain qualities –

Education (b) Experience (c) Personal Qualities

Sincerity and honesty

Enthusiasm

Interest in and sympathy with people.

Tact

Good appearance

Self confidence.

Influence of working conditions on work study – The interaction between working condition and work study has been one of the factor the critically of which has been excepted rather late. The influence can be broadly categorized into two groups; the first being of immediate nature leading to reduction of production raise or increase in no of rejections as increase in costs while the other being of long drawn nature like casing disability varying from purely temporary to more permanent nature. The set of elements constituting the working conditions primarily consists of the following –

Occupational safety and health elements.

Fire prevention and precaution elements

Layout and house keeping elements.

Lighting and ventilation elements.

Ergonomics elements.

Arrangement of working time.



Method study

Method study involves the breakdown of an operation or procedure into its component elements and there subsequent sub analysis. Hence those elements which cannot withstand the tests of interrogation are eliminated or improved. In applying method study the governing consideration are economy of operation and maintenance of expected good practice as laid down by management (Eg Safety and quality standard).In carrying out a method study investigation, the right attitude of mind is as important as knowledge of the techniques. It is essential that responsible for method study should posses-(1) The desire and determination to produce results.(2) Ability to produce results.(3) AN understanding of human factors involved.When considering the desirability of method study investigation of a particular job; it is essential to keep certain factors in mind. These are:(a) Economic considerations.(b) Technical Considerations.(c) Human reactions

Basic Procedure of Method Study –The basic procedure consists of following seven essential stages in the application of method study, none can be excluded, strict adherence to there sequence as well as to the content is essential for the success of an investigation.(1) Select(2) Record(3) Examine(4) Develop(5) Define(6) Install(7) Maintain

Select Select the work studying and define the objectives to be achieved. An objective may be to reduce the manufacturing cost, or to reduce bottlenecks or to reduce fatigue incurred by the workers in order to reduce their efficiency.The factors to be considered while selecting a particular work for the purpose of method study are- (a) Economic consideration(b) Technical consideration(c) The human reaction

Record-Record all the relevant information pertaining to the existing method (if any) in details and in form of chart to obtain picture about the same, recording can be done with the help of following aids-(a) **Process Chart**-(i) Outline process chart(ii) Flow process chart; men; material and equipment type.(iii) Two handed process chart.(iv) Multiple activity chart (Time scale)(v) Simo chart (time scale)(b) **Diagrams**-(i) Flow diagram.(ii) String diagram.(iii) Cycle graph.(iv) Chronocycle raphs.(v) Travel chart.(c) **Film analysis**-(d) **Models**- **Examine**-The examination is achieved by means of two sets of detained questions, the primary question to indicate the facts are the reasons underlying them, and the secondary questions to indicate the alternatives and consequently the means of improvement. The question are asked under, five heading.

Develop-There is a right saying that to ask the right questions to be half way towards finding the right answer. This is especially true in method study From the use of questioning sequence given in the “examination” it will be seen that once the questions have been asked most of them almost answer themselves.The first step in doing is to make a record of the proposed on a flow process chart so that it can be compared with the original method and can be checked to make sure that no point has been overlooked. This also enables a record to be made in the summary of the total numbers of the activities taking place under both methods, the savings in the distance and time which may be expected accrue from the change and the possible savings in the money which will result.

Define-For all jobs other than those performed standard machine tools or specialized machines where the process and methods are virtually controlled by machine. It is desirable to prepare, a written standard practice, also known as an operative instruction sheet. This serves several purposes. The measurement of human work has always been a problem for management. As plans for the provision of goods or services to a reliable programmer and at predetermined cost are often dependent on the accuracy with which the amount and the type the human work involved can be forecasted and organized. While it has common by been the practice to make estimates and set targets base on past experience, these too frequently prove a rough and unsatisfactory guide.

Objective of Work Measurement

The following are the objectives of work measurement-

(a) To evaluate worker's performance-

This can be done by comparing actual output over a given period of time with standard output level determined from work measurement.

(b) To plan Work face needs-Work measurement can be used to determine the labour input required for any given output level.

(c) To determine available capacity-Work measurement standard can be used to estimate available capacity for a given level of work force and equipment availability.

(d) To determine price or cost of a product-Labour standard is one of the most important parameters of a costing or pricing system which is crucial to the survival and growth of the business.

(e) To compare work methods-When alternative methods for a job are being considered, work measurement can provides the basis fro economic comparison of the methods.

(f) To facilitate operation scheduling – To all scheduling system one of the data input is time estimates for work activities which are derived from work measurement.

(g) To establish wage incentive schemes – Workers receive more wage for a more output under wage incentive schemes. Underlying these schemes is a time standard which defines the reference output.

Basic procedure of work measurementThe basic procedure consists of following stages – (1) Select (2) Record (3) Examine (4) Measure (5) Complete (6) Define

Techniques of work measurement The principal techniques by which work measurement is carried out are – (a) Work sampling(b) Predetermined time (c) Standard data(d) Stop-watch time study

Work Sampling It is a work measurement technique in which a large number of instantaneous observations are made at random intervals over a specified period of time of a group of workers, machines and process. Each observation records the state of the system observed, the percentage of observations recorded for a particular activity or delay over the specified period is a measure (estimate) of the percentage of time during which that activity or delay occurs.

Pre-determined time standards (PTS) A PTS is a work measurement technique whereby times established for basic human motions (classified according to the nature of motion and the conditions under which it is made) are used to build up the time for a job at a definite level of performance

Standard DataThough the spectrum of operations carried out in any plant is rather wide, several common elements do exist in many operations. Walking in one such common examples which is found to be involved in diverse activities such as painting and handling. While timing such activities the work study man has to time, the common elements walking again and again and hence his job can be made much easier if standard time for walking is easily derivable from the set of data.

Stop watch time study

1. The equipment – required to carry out time study activity basically belongs to two groups. The first group represents those which are to be used at site i.e. is during the data collection. Such a set of equipment which is essential are

A stop watch
A study board
Time study forms.

The second group of equipment representing those which are used as supplementary ones, usually not carried to the site always, includes.

(i) Small calculator(ii) A reliable clock with a second hand(iii) A set of measuring instrument such as tape, steel rule, tachometer etc.

2. The stop watch – Usually three types of stop watches are used fro performing time study.(a) Fly back type (b) Non fly back type (c) Split hand type .All the above type may have one of the following three graduations in them – (i) Recording one minute per revolution with the smallest hand graduation of 1/5th of a second with a small hand recording 30 min.

(ii) Recording on minute per two revolution with the smallest graduation of 1/10,000th of an hour, with a small hand recording one hour.

3. Time study board – A light flat board is usually of plywood or plastic sheet having a size larger than the document i.e. the time study form that it has to hold property. It should normally have provisions for holding the stop watch in a convenient orientation and location to facilitate easy operation and clear reading.

4. Time study forms – These are pre designed printed or photocopied form of standard size which allow the observer to record the relevant observation in present in the form (Time study forms of Escorts Ltd.

Were used by the team in this project work)**5. Basic Steps in Time Study** – The following nine steps constitute the time study process.

Breaking the job into elements.After recording the information relating to the job and worker is over and the work study man is ensured that the best method is being adopted then as the next step the job should be broken down into elements.

An element being defined as distinct part of a specified job selected for convenience of observation, measurement and analysis.

Timing Elements by Stop Watch – After the elements to be timed have been identified, selected and listed as will as the number of times each of such elements to be timed is ascertained to ensure certain confidence ad accuracy level timing can start. There are two principal methods of timing with the stop watch.(a) Cumulative timing(b) Flyback timing. In first method the watch runs continuously throughout the study. **Rating**Rating and allowance are the two most controversial aspects of time study. Time study is not an exact science, although much research has been and continues to be undertaken to attempt to establish a scientific basis for it. Rating the allowances to be given for recovery from fatigue and other purposes are still, however, largely matters of Judgment and therefore of bargaining between management and labour. Definition of Rating- Rating is the assessment of the worker's rate of working relative to the observer's concept of the rate corresponding to standard pace. "Standard performance is the rate of output which qualified workers will naturally achieve without over-exertion as an average over the working day or shift, provided that they know and adhere to the specified method and provided that they are motivated to apply themselves to their work.

Scales of rating – In order that the comparison between the observed rate of working and the standard rate may be effectively, it is necessary to have a numerical scale against which to make the assessment.

Determination of Basic Time- The number 100 represents standard performance. If the study man decides that the operation he is observing is being performed with less effective speed than his concept of standard , he will use a factor of less than 100 (say 90 or 75) or else. If on the other hand, he decides that the effective rate of is above standard, he gives it a factor greater that 100 (say 110 or 115 or 120) Basic time is the time for carrying out an element of work at standard rating. Basic time is calculated by the formula – $BASIC\ TIME = OBSERVED\ TIME \times RARING / STANDARD\ RATING$

Extension is the calculation of basic time from observed time.

The newer 0-100 scale has however certain important advantages which have led to its adoption as the British Standard. In the 0-100 scale, '0' represents no activity and '100' the normal rate of working for the motivated qualified worker -i.e. The "STANDARD RATE"

Work Content- Work content of a job a operation is defined as. **Basic time + relaxation allowances + any allowance** for additional work eg. That part of contingency allowance which represents work.

Allowances - Even when most practical, economic and effective method has been developed, the job will still require the expenditure of human effort, and some allowances must therefore be made for recovery for fatigue and relaxation. The determination of allowances is probably the most controversial part of the work study it is difficult to prepare a universal accepted of precise allowances that can be applied to every working situation any where in the world due to various reasons such as –

Factors related to the individual (b) Factors related to nature of the work itself.(c)Factors related to environment etc.

Relaxation allowances – elaxation allowance is an addition to the basic time intended to provide the worker with the opportunity to recover from the physiological and psychological effects of carrying out specified work under specified conditions and to allow attention to personal needs. The amount of allowance will depend on the nature of the job.

Contingency allowances – A contingency allowances is a small allowances of time which may to included in a standard time to meet legitimate and expected items of work or delays, the precise measurement of which of uneconomical because of there infrequent or irregular occurrence.

Policy allowances A policy allowance is an increment, other then bonus increment, applied to standard time to provide a satisfactory level of earning for a specified level of performance under exceptional circumstances.

Special allowance- Special allowance may be given for any activities which are not normally part of the operation cycle but which are essential to the satisfactory performance of the work.

the standard time -"Standard time is the total time in which a job should be completed at standard performance."

The standard time for each operation is determined by adding the various allowances to the basic time.

Standard time (ST) = Basic Time (BT) + Allowance

To determine the standard output per shift i.e. the production norms per shift the actual effective working time has to be determined taking considerations. Start up End Activities (b)Tea Break (c)Lunch Break The exact quantum of time for the above factors needs to be worked out by the concerned authority of the department. Once the actual effective working hour per shift is arrived at the production norm per shift can be computed output by the following mechanics – Standard time / 1000 pieces = S hrs. Production / hr = 1000 / S Production / Shift = 1000 / S x A

Where – A = actual effective working hours per shift (to be determined by department.)

(a) It records the improved method for true reference in as much detail as may be

necessary.(b) It can be used to explain the new method to the management, foremen and operators also advisor all concerned, including the work engineers, of any new equipment required or of changes needed in the layout of machines or work places.(c) It is an aid to training or retraining and can be used by them for reference until they are fully converted with new method.(d) It forms the basis on which time studies may be taken for setting standard, although the element breakdown will not necessarily be the same as the breakdown of motions.

Install The final stages in the basic procedure are perhaps the most difficult of all. It is at this point that the active support is required from the management and the trade union a like.(a) Gaining acceptance of the change by the department super vision.(b) Gaining approval of the change by the management.(c) Gaining acceptance of he change by the workers and their representatives.(d) Restrain the workers to operate the new methods.

The ProblemThe S & H Gears Ltd is a sister concern of Gajra Group. The major products manufactured here are crown and pinion gears, it is located in Devas city of M.P. this company came into existence in 1974. it is a about 1 km from Devas railway station.**AIM:PROPOSALS FOR PRODUCTIVITY ENHANCEMENT OS S & H CLEARS Ltd. BY CHANGING EXISTING LAYOUT WITH CONCEPT OF SINGLE PIECE FLOW.**

DRAWBACKS –(a) There is an improper Material flow in different Machines.(b) The time taken by the transport of material is more.(c) The waiting time taken by the material is more.(d) Man power allocation is not proper.(e) The Machines used for different functions are not properly selected.(f) Plant layout is not properly spaced.(g) The utilization of resources is not proper.**The effect which there drawback inculcates are** –(a) High production cost.(b) Low productivity.(c) The Delivery time to users is improper.(d) High Inventory cost.(e) Low manpower utilization.Due to these Drawbacks & the ill effects on the factory the project team on observation has decided to go fro the change in layout & whole concept of present manufacturing practice

Looking all the factor involved the type of facility available Project team has decided to go for piece flow rather than to go for batch production is going in at presents

TURNING SECT (PINION OLD)

For turning Section, S & H company purchases forged pieces. Then there forged pieces are send to inspection department, where inspection is done manually. Then these jobs are taken to LOUDEN MACHINE. Where facing & centering is done one by one. This operation takes 180 seconds. Then light facing is done on MBD-2 in 90 seconds. Lettering and punching is done on PROTOL machine in 60 seconds.Following operation are done on following machines in following time.

Rough First copy turning	-	SPILOTE -	144 Sec.
Rough Second copy turning	-	SPILOTE -	144 Sec.
Rough turning	-	SPILOTE -	144 Sec.

Now first copy turning is performed on CNC machines in 110 seconds. In copy turning master piece of same size & shape is used. Then blank turning is performed on CNC in 207 seconds Green grinding on Dia D-5 done on cylindrical grinder in 80 Seconds. Now second copy turning (circlip grinding) is performed in 90 Sec. On Herbert lathe. Now green grinding on D-8 dia is performed on cylindrical grinder which takes 88 seconds.

TRNING SECTION (PINION NEW)

Operation Performed –

There three machines Louden, MBD & protol which take times 180”, 90” & 60” respectively. So Now only one 9 person can manage the three machines. Fixes the job 1at. He operates on Louden 180 Sec. Leaves the machine & goes to 2nd machine MBD takes 90 Sec. Fixes the job & leaves the M/c & goes to 3rd Machine Protol where it, takes 60 Sec. & fixed the job.

As he gets enough time to handle three machine so one person is enough as he can go back to 1st M/c after operating 3rd M/c.II. Spilot - M/c

ONO	-	25, 26, 27
T	-	144, 144, 144,

Here on this M/c as there are three operations are performed. So one person is enough to handle all the three operations on one machine.

III.	CNC		
	OP	-	30, 35, 60
	T	-	120, 207, 90
& V	HERBERT		
	OP	-	70
	T	-	90 Sec.

Here 2 machines Cylindrical grinder where 2 operations are performed 50 & 80 which take time 80 & 88 Sec. Respectively & Herbert OP. No. – 70 takes 90 Sec, so only one person can handle two machines at a time as the time taken by 1st ONO & i.e. 50 is 80 Sec. so he can fix the job and can move to next operation i.e. ONO – 80 & take time 88 Sec. & fix the job & then move to the meet m/c. Herbert & OP NO. – 70 & take time 90 Sec. & here also it can fix the job & again go back to 1st M/c.

IV CONCLUSION

That means here total number of persons used are four persons in this total pinion turning section, so our man power reduced. Machining time:-(i) Here our total time occurring i.e. according to the machines handled time taken by operations by one person so by person. A total handled is 33) Sec. By 1st M/cs 330 Secs. (3 m/c's).(ii) Spilote as three operations are performed by one persons. So our total time taken is 432 Secs. B – 43 Secs.(iii) Next Our CNC Cylindrical Cylinder & Herbert are all interrelated so total taken by all operations are 675 Secs. So this is our bottle neck where maximum time is taken i.e. 675 Secs.

One Shift is one 8 hrs. = 480 min New bottle neck time = 675 Sec. = 11.25 min/Job

Comparison – Jobs/Shift = $\frac{480}{11.25} = 42.66 - 43 \text{ jobs/shift.}$

Based on Manpower:-Here there in old layout where there are one person on each machine so the man power in old layout is more here we have reduced from three to one who can handle three machines i.e. Louden, MBD, Lathe Protel.

In spilote there was already one person operating on the machine.

Next CNC, Cylindrical cylinder & Herbert they are all interrelated /c's but earlier there were three persons operating on there machines. But now we have reduced from three persons to two i.e. one person can handle CNC & other person cylindrical & Herbert & also do the interrelated operations CNC machine.

Total there were before seven (7) persons operating & Now there are only four (4) persons operating. We have reduced (3) three persons.

OLD	-	NEW
7 Persons	-	4 Persons

Reduced 3 Persons

Based on time:

Earlier based on our old layout the time taken was 1437- secs.

Now as our production is based on single production system, so by rearranging the arrangement of the machines.

Here our each shift has 8 hrs that means 480 min. In our old layout operation our total time taken was 1437 Sec. to produce 1 piece that means 23.95 mins to produce 1 job. That means production per shift are 20 jobs.

Old Result - 20 Jobs / shift

Now by rearranging & introducing new techniques we have increased our productivity. Now our time is reduced to 675 Secs. so that means 11.25 mins. So by unitary method we can calculate our productivity as earlier we get in (Old)

In 23.95 Mins we get – 1 pieces .So in 480 mins we get i.e. hrs. – shift – 20 (New)

Now our productivity is increased.

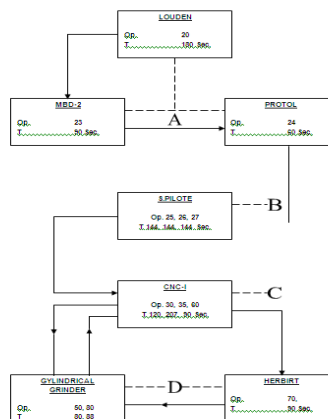
Here we get in 11.25 min – 1 piece.

Our total productivity has increased to 42 jobs / shift.

We have almost double our productivity from 20 jobs / shift to 42 jobs / shift.

Suggestion : To increase our productivity we can also introduce new machine to reduce time.

NEW TURNING OF PINION



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