MOST- Significance in Productivity and Customer Satisfaction

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Abstract:

Customer Satisfaction is most important in today's cut-throat competition. Customer Satisfaction is closely associated with quality of the product, cost of product and customer service. The cost of the product largely depends on the time taken in producing the product and the cost of labour required to complete the work, which in turn depends on the work method, machines used for production and working conditions.

The managers devote thinking and energy to the various issues involved in improving productivity. The main function of management has been recognized as "plan, provide and control" the "resources" necessary to achieve the desired results. Out of all resources, human resource is the most difficult to control. Main stumbling block has been quantification of work- how much time to accomplish on given task due to difference in skills, knowledge, attitudes, etc. of the employees.

In the engineering industry, the first serious effort taken in this regard was by F.W.Taylor, refined over the years by many practitioners. New methods were introduced over a period of time. Some had limited applications, and some had almost universal applications. Each system had its own philosophy of looking at work, work content and work element. **"MOST"** is one of the latest additions with its own philosophy. MOST is a powerful analytical tool that helps increase productivity, improve methods, facilitate planning, establish workloads, estimate labour costs, improve safety, maximize resources and establish a baseline for continuous improvement. An attempt is made in this paper to introduce MOST in detail with its concept, types, methodology, applications, advantages & limitations along with practical examples.

Keywords: Productivity, Work study, Work Measurement, MOST, Customer Satisfaction

INTRODUCTION

In the era of globalization and cut-throat competition, there is enough pressure on cost, to keep it as low as possible. Effective utilization of Human Resource is one of the key elements to ensure optimum cost. There have been many scientific efforts, like method study and work measurement, to formulate standard time and optimal process for various activities, against which actual day to day activities can be compared and measured. MOST is the advanced technique combining motion and time study which comes handy to modern industrial engineering. **MOST** is an acronym for **M**aynard **O**peration **S**equence **T**echnique. It was developed by Kjell Jandin at H.B. Maynard & Co., Inc, USA in 1970's. Further it has become as important tool to identify unnecessary or uneconomical activities, i.e. waste, for elimination and thus making the process 'LEAN'.

Key contributions to management thought made by Lillian M. Gilbreth are linked to her biographical events, including the multiple roles she played as daughter, student, wife, mother, author, engineer, psychologist, breadwinner, domestic scientist and teacher. Key societal factors that influenced Gilbreth's contributions were the growing interest in scientific management, the status of women and the increased interest in domestic science. This paper provides a critical biography of Lillian M. Gilbreth and her work within the context of her life and times. (Gibson & el.al, 2015)

Lean production not only successfully challenged the accepted mass production practices in the automotive industry, significantly shifting the trade-off between productivity and quality, but it also led to a rethinking of a wide range of manufacturing and service operations beyond the high-volume repetitive manufacturing environment. (Holweg, 2007)

Development of innovative products requires companies to make a lot of effort. The creation of an appropriate strategy development, climate, protection of resources and preparing a launch system is a major challenge. Uncertainties and risks that accompany innovation require the use of such methods and tools to design innovation is designed precisely and will guarantee of success. Achieving success is largely dependent on the effectiveness of the decisions in the implementation of the deployment process. Among relevant criteria which influence decisions making are costs. This paper shows an approach to estimate the cost in the new products development. (Chwastyk & Kolosowski, 2014)

Activities for the development of new products are essential for most companies, and investments in such activities can be substantial. Estimating the costs for new product development projects is a challenging process as uncertainty is usually high and comparable data is scarce. While manifold work is available about general cost estimation methods, the estimation of NPD is still underrepresented in the literature. The adjustments of input data account for macroeconomic circumstances and intercompany differences in accounting standards and development processes. (Disch, 2024)

One of the main aspects that must be considered while developing any industrial project is its cost. Design to Cost (DtC) processes allow the design team to manage any kind of project based on the costs of each of the phases and of the elements, by applying a number of methodologies, techniques, cost models and tools. In this paper, a DtC framework is proposed, taking other DtC centered research as references and focusing on a probabilistic approach, in order to lead the early design stages of large industrial products, where most of the information is unclear or is still being defined. (Retolaza & el.al., 2021)

In an issue of the International Economic Review, J. Richmond discussed the problem of estimating a production function in a manner which recognizes that the production function is a frontier representing the maximum output that may be obtained from given inputs when the inputs are being used in the most efficient manner possible, given the state of the knowledge. (Richmond, 1974)

The production of culture perspective focuses on how the symbolic elements of culture are shaped by the systems within which they are created, distributed, evaluated, taught, and preserved. After tracing the consolidation of the perspective in the late 1970s, we introduce six facets of production (technology, law and regulation, industry structure, organization structure, occupational careers, and market) and use them to theorize within the production perspective a wide range of research. Third, we show the utility of the facet model in coherently theorizing a research study based in a quite different perspective. Fourth, we explore the recent application of the production perspective in organizational research. Fifth, we outline the recent extension of the production perspective to auto production, the study of identity formation, and meaning in informal relations. Finally, we discuss criticisms of the perspective and suggest opportunities for research. (Peterson & Anand, 2004)

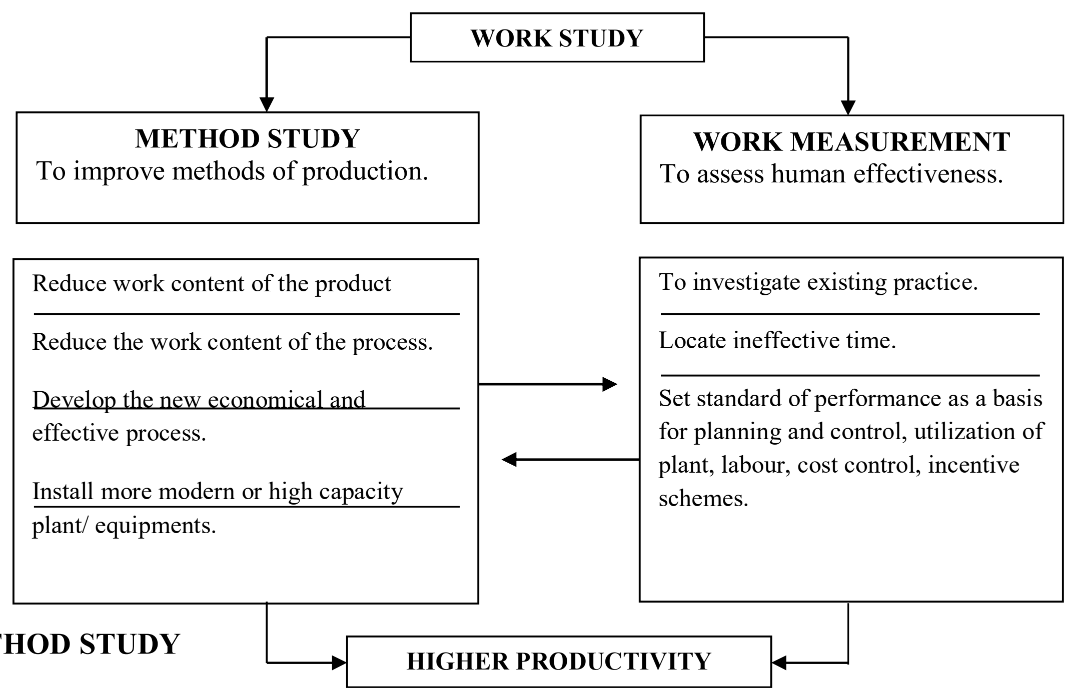
The paper reviews the scientific production of renewable energies, namely, solar, wind, biomass, hydropower and geothermal, from 1979 to 2009. The production of all the countries in the world is analysed, paying particular attention to renewable energies and research institutions. The production of scientific research for each type of energy is represented on world maps to show the degree of relationship between this research and the resources of these energies. (Manzano-Agugliaro & et.al., 2013)

The main function of management has been recognized as ‘plan, provide and control’ the ‘resources’ necessary to achieve the desired results. Out of all resources human resources is the most difficult to control. Main stumbling block has been quantification of work- how much time to accomplish on given task due to difference in skills, knowledge, attitudes, etc of the employees. Managers must be able to correctly plan the work and time required in completing the work. All these issues are linked with Work study. Work study is one of the most important management techniques which are employed to improve the activities in the production. The main objective of work study is to the optimum use of the human resources.

It has three aspects:

1. More effective use of plant and equipment.
2. More effective use of human effort.
3. Evaluation of human work.

Work study embraces the techniques of method study and work measurement employed to ensure the effective utilization of human resources in carrying out a specific task.



METHOD STUDY

Method study is an important area in production planning to plan various elements of production, deciding on the type of machine to be used for a specific task, establishing the capacity of the machine and planning the number of people to be deployed to complete the task. In method study, an attempt is made to look for alternate actions to complete the task in an efficient and economical way.

Method study is the process by which a method is developed to do a work in the best possible way in a given situation. The work is subjected to systematic and critical scrutiny to make it more effective and/or more efficient. Method study examines whether two or more actions could be done simultaneously to complete the task without affecting the quantity and quality of the work. There is a tradeoff between the benefits of arriving at an improved method and saving additional cost and time.

Method study was originally designed for the analysis and improvement of repetitive and manual works. However, its applications are many as it could be used for all types of activities at all levels of an organization. For example: processing files in the office, issuing the material from stores, carrying out the repairs and maintenance jobs. It could also be applied in service sectors such as handling patients in the hospitals, receiving passengers at the airport, etc.

WORK MEASUREMENT

Work Measurement is the application of techniques designed to establish the time for a qualified worker to carry out a specific job at a defined level of performance. A qualified worker is one who is accepted as having the necessary physical attributes. Who possesses the required intelligence and education and who has acquired the necessary skill and knowledge to carry out the work in hand to satisfactory standards of safety, quantity and quality.

The commonly used techniques for work measurement are as follows:

A] Time study:

Time study is a work measurement technique for recording the time and rate of working for the elements of a specified job carried out under specified conditions and for analyzing the data so as to obtain the time necessary for carrying out the job at a defined level of performance. The purpose of time study is to set normal times and then standard time to carry out the specified work.

B] Predetermined motion time systems (PMTS):

PMTS is a work measurement technique whereby time 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 defined level of performance. If an operation is analyzed into basic motions and each of these motions is evaluated, it is possible to determine the time values for the whole of the operation. This is the basis for PMTS.

C] Method – Time Measurement (MTM):

It is a procedure which analyses any manual operation or method into the basic motions required to perform it and assigns to each motion a predetermined time value by the nature of motion and the conditions under which it is made.

MTM was developed from motion picture studies on industrial operations and the time standards were established in 1948, the time unit is known as Time Measurement Unit (T.M.U). For a particular job when all motions have been identified, classified and recorded, the time value for each is determined from the MTM data. The sum of these motion times is the time an operator of average skill would take to perform the task if worked with average effort under normal conditions.

C] Maynard Operation Sequence Technique (MOST):

MOST is an acronym for **M**aynard **O**peration **S**equence **T**echnique. It was developed by Kjell Jandin at H.B. Maynard & Co., Inc, USA in 1970's.

MOST is a high-level predetermined motion time system (PMTS) that is based on MTM. MOST work measurement systems help measure and track productivity by providing the means to determine the time it takes to perform a task. It's a powerful analytical tool that helps increase productivity, improve methods, facilitate planning, establish workloads, estimate labor costs, improve safety, maximize resources and establish a baseline for continuous improvement. It can be applied to any type of work for which a method can be defined and described. Further MOST analysis will clearly indicate the most economical and least fatigue method.

TIME UNITS

The units used in MOST are identical to those used in the basic MTM (Method – Time Measurement) system and are based on hours and parts of hours called Time Measurement Units (TMU). The following conversion table is as follows:

1 TMU = 0.00001 hour

1 TMU = 0.0006 minute

1 TMU = 0.036 second

1 hour = 100,000 TMU

1 minute = 1,667 TMU

1 second = 27.8 TMU

The time value in TMU for each sequence model is calculated by adding the index numbers and multiplying the sum by 10.

MOST has proved to be an effective technique to estimate manufacturing time of new products, since in addition to imposing the deep analysis of the manufacturing method, the technique allows the analyst, only knowing the product and the means by which it will be manufactured can apply the indices according to each Sequential Model and at the end, after applying the tolerances, obtain the standard time. (da Silva & Leite, 2019)

CONCEPT OF MOST

1. **Method Description**

- Documents the action performed
- Clear, concise and easily understood
- Comprised of recommended words
- Example: Grasp screw driver located five steps away on the floor and put in tray.

2. Sequence Models

- Sequence models represent the sequence of events that occur when an object is moved or a tool is used.
- Predefined sequence models represent different types of activities.
- Three standard sequence models form the basis of the MOST system:

a) The **General move sequence** for moving unconstrained objects through the air

- **Grouped into 3 phases:**
    - Get – reach and gain control of object
    - Put – move object to new location
    - Return – distance walked back to workstation, not for hands

Get	Put	Return
A B G	A B P	A

Where, A = Action distance (mainly horizontal)

B = Body motion (mainly vertical)

G = Gain control

P = Placement

ABG Get ABP Put A Return **General Move**

Index x 10	A Action Distance	B Body Motion	G Gain Control	P Placement	Index x 10
0	≤ 2 in. (5 cm.)	No Body Motion	No Gain Control Hold	No Placement Hold Toss	0
1	Within Reach		Grasp Light Object Grasp Light Objects Simo	Lay Aside Loose Fit	1
3	1 - 2 Steps	Sit without adjustments Stand without adjustments Bend and Arise 50% occ.	Get Non-simo Get Heavy/Bulky Get Blind Get Obstructed Free Interlocked Disengage Collect	Loose Fit Blind Place with Adjustments Place with Light Pressure Place with Double Placement	3
6	3 - 4 Steps	Bend and Arise		Position with Care Position with Precision Position Blind Position Obstructed Position with Heavy Pressure Position with Intermediate Moves	6
10	5 - 7 Steps	Sit Stand			10
16	8 - 10 Steps	Bend and Sit Climb on Climb off Stand and Bend Through Door			16

Example:

Walk 2 steps and pick up a book from a table, then walk 6 steps to a bookshelf and bend to lay the book on the bottom shelf and arise and return to the table.

A3 B0 G1 (A10 B6 P1) A10

The time calculations are as follows:

I] (A10 B6 P1) = (10+6+1) = 17

II] 3+0+1+17+10 = 31

III] 31 X 10 = **310 TMU = 11.2 seconds**

b) The **Controlled move sequence** for moving objects constrained in some way

- **Grouped into 3 phases:**
  - Get and Return as before
  - Move over controlled path or actuate device

Get	Move/Actuate	Return
A B G	**M X I**	**A**

Where, A = Action distance

B = Body motion

G = Gain control

M = Move controlled

X = Process Time

I = Alignment

ABG Get **MXI** Move/Actuate **A** Return — **Controlled Move**

Index x 10	M Move Controlled: Push/Pull/Pivot	M Move Controlled: Crank	X Process Time: Seconds	X Process Time: Minutes	X Process Time: Hours	I Alignment	Index x 10
0	No Action	No Action	No Process Time			No Alignment	0
1	Push/Pull/Pivot ≤ 12 in. (30 cm.) Push Button Push or Pull Switch Rotate Knob		.5 sec.	.01 min.	.0001hr.	Align to 1 Point	1
3	Push/Pull/Pivot > 12 in. (30 cm.) Push/Pull with Resistance Seat Unseat Push/Pull with High Control Push/Pull 2 Stages ≤ 12 in.(30 cm.) Push/Pull 2 Stages ≤ 24 in. Total	1 Rev.	1.5 sec.	.02 min.	.0004 hr.	Align to 2 Points ≤ 4 in. (10 cm.)	3
6	Push/Pull 2 Stages > 12 in. (30 cm.) Push/Pull 2 Stages > 24 in. Total Push with 1 - 2 Steps	2 - 3 Revs.	2.5 sec.	.04 min.	.0007 hr.	Align to 2 Points > 4 in. (10 cm.)	6
10	Push/Pull 3 - 4 Stages Push with 3 - 5 Steps	4 - 6 Revs.	4.5 sec.	.07 min.	.0012 hr.		10
16	Push with 6 - 9 Steps	7 - 11 Revs.	7.0 sec.	.11 min.	.0019 hr.	Align with Precision	16

Example:

The operator takes 2 steps to the cutting machine, turns a hand-wheel 2 revolution, and sets the cutting tool by aligning the hand-wheel dial to a scale mark.

A3 B0 G1 M6 X0 I6 A0

The time calculations are as follows:

I] (A3 B0 G1) = (3+0+1) = 4

II] (M6 X0 I6) = (6+0+6) = 12

III] 4+12+0 = 16

IV] 16 X 10 = **160 TMU = 5.8 seconds**

c) The **Tool use sequence** for use of hand tools.

- The Tool Use Sequence is a combination of the General Move and Controlled Move activities.
- **Grouped into 3 phases:**
  - Get Tool (Object)
  - Put Tool (Object) in Place
  - Use Tool

  - Put Tool (Object) Aside
  - Return
- The Tool Use Sequence model makes use of the “A”, “B”, “G”, and “P” parameters, which are all familiar to us, plus the new Tool Use parameters.

Get	Put	Use	Put	Return
A B G	**A B P**	*	**A B P**	**A**

- * consists of the “tool use” parameters F, L, C, S, M, R, & T.
  - F -- Fasten
  - L -- Loosen
  - C -- Cut
  - S -- Surface Treat
  - M -- Measure
  - R -- Record
  - T – Think

Example:

A mechanic walks 3 steps to pick up a screwdriver, return 3 steps to place it on a screw, and turn it down 8 wrist-turns, then aside tool within reach.

A6 B0 G1 A6 B0 P3 F16 A1 B0 P1 A0

The time calculations are as follows:

I] (A6 B0 G1) = (6+0+1) = 7

II] (A6 B0 P3) = (6+0+3) = 9

III] (A1 B0 P1) = (1+0+1) = 2

IV] 7+9+16+2 = 34

V] 34 X 10 = **340 TMU = 12 seconds**

3. **Phases**

- Sequence models are structured into phases used to describe the action performed.
- Each of the predefined sequence models has a different set of phases.

4. **Index Values**

- Each parameter is assigned an index value based on the motion needed to perform the activity.
- Index values are then used to generate the total time required to perform a task.

PREREQUISITES TO IMPLEMENT MOST SUCCESSFULLY

MOST work measurement system determine the time it takes to perform a task. The main stumbling block is to decide how much time to accomplish on given task due to difference in skills, knowledge, attitudes, etc of the employees. Also Mental and emotional reactions to investigations and changes of method should be anticipated; if the study of a particular job appears to be leading to unrest or ill feeling leave it alone, even though it is most economical.

MOST will be more readily accepted by the workers if the task selected for the study can improve the working conditions, reduce the effort and fatigue of the workers and help to increase their wages.

MOST METHODOLOGY

- Watch job/task.
- Determine sequence(s) to use.
- Determine index values.
- Add index values to determine Time Measurement Unit (TMU)
- Multiply TMU by 10.
- Convert TMU to seconds, minutes, and hours.

VERSIONS OF MOST

1. Basic MOST:

At the intermediate level, operations that are likely to be performed more than 150 but less than 1500 times per week should be analyzed with Basic MOST. An operation in this category may range from a few seconds to 10 minutes in length. (Operations longer than 10 minutes may be analyzed with Basic MOST, with 0.5 to 3 minutes being typical cycle time for Basic MOST).

The majority of operations in most industries fall into this category. Basic MOST index ranges readily accommodate the cycle-to-cycle variation typical at this level. The method descriptions that result from Basic MOST analysis are sufficiently detailed for use as operator instructions.

2. Mini MOST:

Mini MOST provides detailed and precise methods analysis of highly repetitive operations, such as small assembly and the packaging of small items. Operations that are likely to be performed more than 1500 times a week should be analyzed with Mini MOST. An operation in this category may have cycle times of less than 1.6 minutes, with 10 seconds or less being typical.

3. Maxi MOST:

Maxi MOST is used for longer cycle operations such as setups, maintenance, material handling, heavy assembly, and job shop work. Operations those are likely to be performed fewer than 150 times per week should be analyzed with Maxi MOST. An operation in this category may be less then 2 minutes to more than several hours in length.

Two more Types:

1. **Clerical MOST** – It is used in clerical activities such as office and service environments.
2. **Admin MOST** – It is used to analyze administration and general activities. Admin MOST is a version of Basic MOST.

PERFORMANCE LEVEL FOR MOST

Measured times produced with MOST systems represent a performance level of 100%. They represent the performance of an "average" trained worker, working under adequate supervision and under "average" work conditions at a "normal" pace. The computation of the total time value for an activity produces a "Normal time" without allowances.

ADVANTAGES

The MOST has a family of tools. By means of these we can economically measure work dependent on type of activities (building of ships, electronic assembly, etc.) Basic MOST is used to analyze the very wide range of manual operation most common to industry. Mini MOST provides detailed analysis of highly repetitive operations (electronic assembly) and Maxi MOST is used for longer cycle operations. For selecting the appropriate MOST Work Measurement System we use a simple procedure.

MOST was designed to be much faster than other work measurements technique, as shown below:

COMPARSON OF APPLICATION SPEED

WORK MEASUREMENT TECHNIQUE	TOTAL TMU'S PRODUCED PER ANALYST HOUR
MTM – 1	300
MTM – 2	1000
MTM – 3	3000
Mini MOST	4000
Basic MOST	12000
Maxi MOST	25000

Thus the advantages are as follows:

- ✓ Universal approach.
- ✓ Fast to apply.
- ✓ Accurate.
- ✓ Easy to understand and learn.

- ✓ Multi –level system.
- ✓ Consistent results.
- ✓ Encourages method development and improvement.
- ✓ 100% performance level.
- ✓ Methods sensitive.
- ✓ Activity timings can be obtained in advanced.

DISADVANTAGES

- Requires exact job description and layout.
- Chance of omitting elements when estimating new jobs.
- Not always applicable to non-repetitive operations.

APPLICATIONS

MOST has been already introduced into the wide varieties of industries, such as aerospace, automotive, electronics, retail, banking, manufacturing, etc., in EU, US, and Asia. MOST is widely accepted with more than 30,000 certified applicators in companies. Thousands of organizations are recognizing the potential of MOST to help them achieve high performance. MOST is a work measurement system which can be easily implemented and practically maintained.

Few of the sectors were MOST is implemented successfully are as follows:

- ✓ Automobiles
- ✓ Assembly
- ✓ Metal working
- ✓ Electronics
- ✓ Aerospace
- ✓ Material handling
- ✓ Textile
- ✓ Ship building
- ✓ Maintenance
- ✓ Hospitals
- ✓ Administration

CONCLUSION

In the era of globalization and cut-throat competition, there is enough pressure on cost, to keep it as low as possible. Effective utilization of Human Resource is one of the key element to ensure optimum cost. There have been many scientific efforts, like method study and work measurement, to formulate standard time and optimal process for various activities, against which actual day to day activities can be compared and measured. MOST is the advanced technique combining motion and time study which comes handy to modern industrial engineering. Further it has become as important tool to identify unnecessary or uneconomical activities, i.e. waste, for elimination and thus making the process 'LEAN'. MOST guarantees the overall accuracy of the final time standard. It dramatically decreases applicator deviations through preprinted sequence models. During the analysis procedure, the applicator attention is focused on each sequence model parameter. Also, it solves problems with documentation.

MOST Computer System is designed to assist the industrial engineer to become more productive on the job. It is based on the concept keywords that represent type of grasping, movement and positioning the sequence. It enables greater speed, does standard calculation, sets and maintains completely the labour time. Efficient, smooth and productive work is performed when the basic motion patterns are tactically arranged and smoothly choreographed with the best methods using the principles of methods engineering. MOST when planned critically with focus on workers attitude, skills, knowledge, emotions, etc and taking workers into confidence before introducing MOST in the company effectively become a tool to improve productivity.

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