STANDARDIZATION OF WORK AND TIME USING SEGMENTAL WORKMEN FOR ENGINEERING APPLICATIONS

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ABSTRACT

The research paper presents an elusive outcome of study, analysis and summary of work measurement using time and method principles for the engineering workshop trades using the segmental workmen. Usually the workmen are three types viz skilled, semi skilled and unskilled. Out of the above three the analysis of best performance for the given task is to be identified in order to make the work more reachable and deliverable. At the outset of the paper the trades such carpentry, tin smithy, welding and fitting are used. After study and analysis of various processes that are carried out in laboratories of engineering college, the most encouraging results have been obtained. The Standardized time of different skill levels of labor for various mechanical operations are identified.

KEY WORDS: *standardization, workshop trades, segmental workmen, work measurement.*

1. INTRODUCTION

Work measurement is very difficult owing to diversified set of reasons. Perhaps the measurement of human factors is the most difficult factors of all. The human measurement particulars with a balance between work content and labor time is beyond the scope of scientific methods due to various physiological factors such as frustrations, monotony, boredom, anxiety, willingness to work, skill, willpower, confidence, attitude and many more. A part from these there will be the influence of physical and environmental factors like temperature, dust, noise, vibrations, pressure, humidity etc. keeping all these in normal or acceptable conditions some methods have already been laid down for measurement of any type of work [1,2,3]. The work measurement is generally followed by method study by which a clearly defined and developed method is laid down. All that credit goes to the pioneering work of Fredrick Winslow Taylor for his methods of work measurement and time study. He suggests splitting the activity into elements and assigning the time to each element by repeated experimentation. Thus time study provides a reliable data for establishing consistent standard performance and elimination of the ineffective time from the production cycle time.

2. METHODOLOGY

The methodology is given as follows.

Step1: Record all the necessary information about the job such as product information (name of the product, material, quantity, quality requirements), process information (location of work place, process description, tooling, jigs and fixtures, layout, speeds & feeds, settings, rate of productions), information about operator (name, competence, skill, education, experience etc), information regarding working conditions (temperature, pressure, humidity, economical factors, human factors, lighting etc [4,5].

Step2: Record the method by breaking down the operation into elements to ensure most effective method and sequence of the motions.

Step3: Record the skill and competence of the operator to ensure that 'qualified' worker is allowed to work that is to be timed. A 'qualified worker' is one who is neither very skilled nor unskilled but an average; neither highly experienced nor inexperienced, and so on, so that the measurement is made at any normal level.

Step4: Record the time for each element of the operation with the help of stopwatch or by any other time measuring device or formula. The process of time taking of the same element may be repeated for pre-determined times and the rate of the worker to compare with preconceived concept of standard rating [6,7].

Step 5: Compute the basic time for each element by taking the average and then compute the normal time with the formula.

Normal time = Basic time X rating factor

Step 6: Determine the allowances to be added to the normal time to determine the standard time by using the formula;

Standard time = Normal time +Allowances

2.1 Determination of Rating Factor
The time taken for a job varies from person to person attributed to various reasons such as environmental factors and human factors. Sometimes, we come across some complaints also such as the worker is intentionally doing delay or the observer's judgment is prejudiced [8,9,10]. To overcome such disputes, Basic (avg) time is multiplied with a fraction so that it is Normalized. This fraction is commonly known as *"Rating factor"*.

Various systems of performance rating are as follows
1. Westinghouse System of rating
2. Synthetic Rating
3. Objective Rating
4. Skill & Effort Rating
5. Physiological Evaluation of Performance Level.

In this project, we prefer Westinghouse system of rating because of its high proficiency.

Westinghouse System of rating
This system is based on four factors
(i) Skill
(ii) Effort
(iii) Conditions
(iv) Consistency

Factor→ Grade↓	Skill (1)	Effort (2)	Conditions (3)	Consistency (4)
Super(1)/Excessive(2)/ Ideal(3)/Perfect(4)	$A_1 = +0.15$ $A_2 = +0.13$	$A_1 = +0.13$ $A_2 = +0.12$	A = +0.06	A = +0.04
Excellent	$B_1 = +0.11$ $B_2 = +0.08$	$B_1 = +0.10$ $B_2 = +0.08$	B = +0.04	B = +0.03
Good	$C_1 = +0.06$ $C_2 = +0.03$	$C_1 = +0.05$ $C_2 = +0.02$	C = 0.02	C = 0.01
Average	D = 0.00	D = 0.00	D = 0.00	D = 0.00
Fair	$E_1 = -0.04$ $E_2 = -0.10$	$E_1 = -0.04$ $E_2 = -0.08$	E = -0.03	E = -0.02
Poor	$F_1 = -0.16$ $F_2 = -0.22$	$F_1 = -0.12$ $F_2 = -0.17$	F = -0.07	F = -0.04

Figure 1: Westinghouse System of rating

Summary Calculation

Observed Time = Sum of Ratings i.e. rating of (Skill + Effort + Conditions + Consistency) as given in Westinghouse tables.

Rating Factor = 1 ± Westinghouse Rating

Normal Time = Observed Time X Rating Factor

Standard Time = Normal Time + Allowances

Synthetic Rating

This system of rating was introduced by Morrow. The time study observer records the actual time of performance for the element as done in the previous method. Performance times for such elements have been standardized, which are known as "Predetermined Motion Time Values" or 'PMTS Values'Summarily this is expressed as

R = P/A

Where R= Performance Rating Factor

P = Pre-determined Motion Time Standard value for the element in minutes (from tables) and

A = Average Actual Time (Observed) for the same element in minutes
Similarly objective rating and skill & effort rating are considered.

Physiological Evaluation of performance level
It is known fact that there is a relation between the physical work and the amount of oxygen consumed. It has also been tried out to find the changes in heartbeat for various physical works.
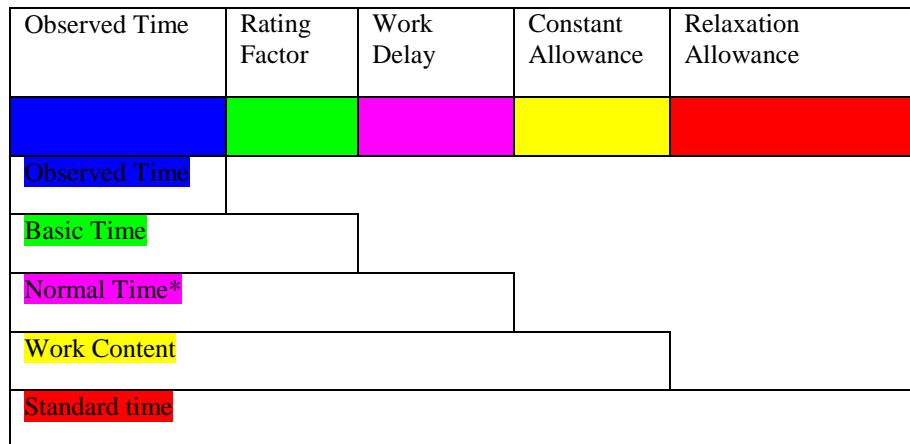
Observed Time	Rating Factor	Work Delay	Constant Allowance	Relaxation Allowance

Observed Time

Basic Time

Normal Time*

Work Content

Standard time

Figure 2: Performance level

Determination of Allowances

The determination of allowances is the most controversial part of the time study, because it varies from person to person, Situation to situation, place to place, job to job, and season to season and many more. Therefore the industrial engineer feels it most difficult job. However, certain standardized norms of allowances are in regular practice by the industrial engineers. These are narrated under five heads as follows:

1. Interference allowance
2. Relaxation allowance
3. Process allowance
4. Contingency allowance

5. Special allowance

Process Allowance

When an operator is running an automatic machine, he becomes idle after loading or if the process demands some time to go for next operation such as allowing cooling after welding operation, he becomes idle. In such cases this allowance becomes prominent.

Depending on the situations, Indian industries are using the following index of process allowance.
25% of Normal Time - Heavy Work Load (>30Kg)
20% of Normal Time - Short Cycle Load (0.2 min)
15% of Normal Time - Similar type of Work Load
10% of Normal Time - Power fed Machine operation
 5% of Normal Time - Operation on automatic machine

3. DATA ANALYSIS CARPENTRY
Material Preparation

Skill	:	Good	$C_1 = 0.06$
Effort	:	Good	$C_1 = 0.05$
Conditions	:	Good	$C = 0.02$
Consistency	:	Perfect	$A = 0.04$

Westing house Rating Factor: $= 1 + (Skill + Effort + Conditions + Consistency)$

$$= 1 + (0.06+0.05+0.02+0.04)$$

$$= 1 + (0.17)$$

$$= 1.17$$

Process Allowance   :   20% of Normal Time – Short Cycle Load

Machining Process

Skill	:	Excellent	$B_1 = 0.11$
Effort	:	Excellent	$B_1 = 0.10$
Conditions	:	Excellent	$B_1 = 0.04$
Consistency	:	Perfect	$A = 0.04$

Westing house Rating Factor: $= 1 + (Skill + Effort + Conditions + Consistency)$

$$= 1 + (0.11+0.10+0.04+0.04)$$

$$= 1 + (0.29)$$

$$= 1.29$$

Process Allowance   :   20% of Normal Time – Short Cycle Load

Finishing Process

Skill	:	Perfect B1 =0.15
Effort	:	Perfect B1 =0.10
Conditions	:	Excellent B1 =0.04
Consistency	:	Perfect A =0.04

Westing house Rating Factor: = $1 + (\text{Skill} + \text{Effort} + \text{Conditions} + \text{Consistency})$

$= 1 + (0.15+0.10+0.04+0.04)$

$= 1 + (0.36)$

$= 1.36$

Process Allowance   :   20% of Normal Time – Short Cycle Load

Inspection

Skill	:	Perfect B1 =0.15
Effort	:	Excellent B1 =0.10
Conditions	:	Perfect B1 =0.06
Consistency	:	Perfect A =0.04

Westing house Rating Factor: = $1 + (\text{Skill} + \text{Effort} + \text{Conditions} + \text{Consistency})$

$= 1 + (0.06 + 0.05 + 0.02 + 0.04)$

$= 1 + (0.35)$

$= 1.35$

Process Allowance   :   20% of Normal Time – Short Cycle Load

Similarly for the other processes the analysis is carried out.

4. RESULTS

After study and analysis of various processes that are carried out in laboratories of engineering college, the most encouraging results have been obtained. The Standardized time of different skill levels of labor for various mechanical operations as follows:

S.No	Trade Name	Standardized Time of Un-skilled labor (Min:Sec)	Standardized time of Semi-skilled labor (Min:Sec)	Standardized time of Skilled labor (Min:Sec)
1	Carpentry	52.08	44.58	32.39
2	Tin Smithy	50.25	32.09	22..06
3	Arc Welding	17.46	09.48	04.55
4	Fitting	64.15	47.54	37.40
5	Foundry	61.01	49.02	42.10
6	Injection Moulding	11.34	10.29	10.07
7	Study Of Microstructures	33.27	25.13	19.27

Table.1 Standard Time

From the above table,
- Standard Time of various operations facilitates to examine the skill level of student in examination without any prejudice and partiality.
- From this all the students are measured under same datum.
- This technique facilitate to student to work under standard methodologies.

5. FUTURE SCOPE

Application of this technique to laboratories of engineering streams like Mechanical, Civil, CSE,ECE & EEE facilitate to examine skill level of student accurately.

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