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Productivity Improvement By Maynard Operation Sequence Technique

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Abstract— To sustain in business under the current global situation of fierce competition a company needs to reduce or eliminate the idle and/or down time of operations in addition to improvement of the current working methods. The problems and challenges of an auto company engaged in assembling car rear floor assembly are attributable to non-optimal operations with inefficient capacity planning. This study is conducted through application of Maynard Operation Sequence Technique (MOST) in the rear floor assembly section to capture the workflow activities using systematic and descriptive workflow data block for the value adding, value engineering and methods engineering analysis. Thus through the process redesign and process flow analysis, material handling and workflow are improved. Consequently, it has been possible to reduce the production cycle time to cater the higher level of demand with shorter Takt time reducing the current level of manpower.

Keywords— Maynard Operation Sequence Technique (MOST), Bottlenecks, Takt Time, Existing Time, Proposed Time, Increment of Production Rate, Amount of Investment.

1 INTRODUCTION

MOST is a work measurement technique that concentrates on the movement of objects. It is used to analyze work and to determine the normal time that it would take to perform a particular process/operation. MOST is a powerful analytical tool to measure every minute spent on a task. It makes the analysis of work a practical, manageable and cost effective task. It was originally developed by H. B. Maynard & Company Inc. and has three versions- Basic MOST (for the activities between 20 s to 2 min.), Mini MOST (for the activities shorter than 20 s) and Maxi MOST (for the activities above 2 min.). MOST is used primarily in industrial setting to set the standard time in which a worker should perform a task. MOST analysis is a complete study of an operation or sub-operation typically consisting of several method steps and corresponding sequence model. MOST is comprised of Work study, method study, and work measurement. In the organization under study, the excess time in operator's activity and fatigue of worker. Therefore, the real work was to identify the NVA activities and finding the reasons of fatigue in workers and reduce or minimize them. The highly practical, efficient and cost effective time estimation technique - MOST is used for this purpose. The Basic MOST System satisfies the most work measurement situations in the manufacturing arena. Every company very likely has some operations for which Basic MOST is the logical and most practical work measurement tool. Consequently, only three activity sequences are needed for describing manual work.

2 METHODOLOGY

The Basic MOST work measurement technique therefore comprises the following sequence models:
General Move Sequence- For the spatial movement of an object freely through the air.

A B G   A B P   A
Get   Put   Return

Where A = Action Distance
B = Body Motion
G = Gain Control

P = Placement

These sub-activities are arranged in a sequence model, consisting of a series of parameters organized in a logical sequence. The sequence model defines the event or actions that always take place in a prescribed order when an object is being moved from one location to another. The common scale of index numbers for all MOST sequence models is 0, 1, 3, 6, 10, 16, 24, 32, 42 and 54. The time value for a sequence model in basic MOST is obtained by simply adding the index numbers for individual sub-activity and multiplying the sum by 10.

Controlled Move Sequence- For the movement of an object when it remains in contact with a surface or is attached to another object during the movement. The controlled move sequence model is A B G M X I A, in which A B G – Get, M X I – Move or Actuate, A – Return

Where M – Move Controlled
X – Process Time
I – Alignment

Tool Use Sequence- For the use of common hand tools. However, the Tool Use sequence model does not define a third basic activity normally it is a combination of General Move and Controlled Move activities. The tool use sequence model is ABG ABP *ABP A, in which ABG – Get Tool, ABP – Put Tool, * - Use Tool, ABP –Aside Tool, A – Return

MOST is a predetermined motion time system that is used primarily in industrial settings to set the standard time in which a worker should perform a task. The time units used in MOST are based on hours & parts of hours called TMU (Time Measurement Unit). The following conversion is provided for calculating standard times:

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

3 EXPERIMENTATION

The existing assembly line consists of six workstations. The assembly is done by spot welding process with the help of movable spot welding guns. Time measurement for existing production line carried out by applying MOST technique. Time measured individually for each workstation. Existing time required for each workstation determined as below.

Table 3.1- Existing Time For Work Stations

W/s No.	Name Of The Work Station	Gun No.	Men	Time In Sec.	Time In Min.
1	Fixture 1	IG14	2	80.2	1.34
2	Fixture 2	IG29	2	91.8	1.53
3	Fixture 3	SG36	2	100.08	1.67
4	Welding Table	CO_2-01	2	95.39	1.59
5	Fixture 4	SG23& SG34	3	214.80	3.58
		Total	**11**	**582.27**	**9.70**

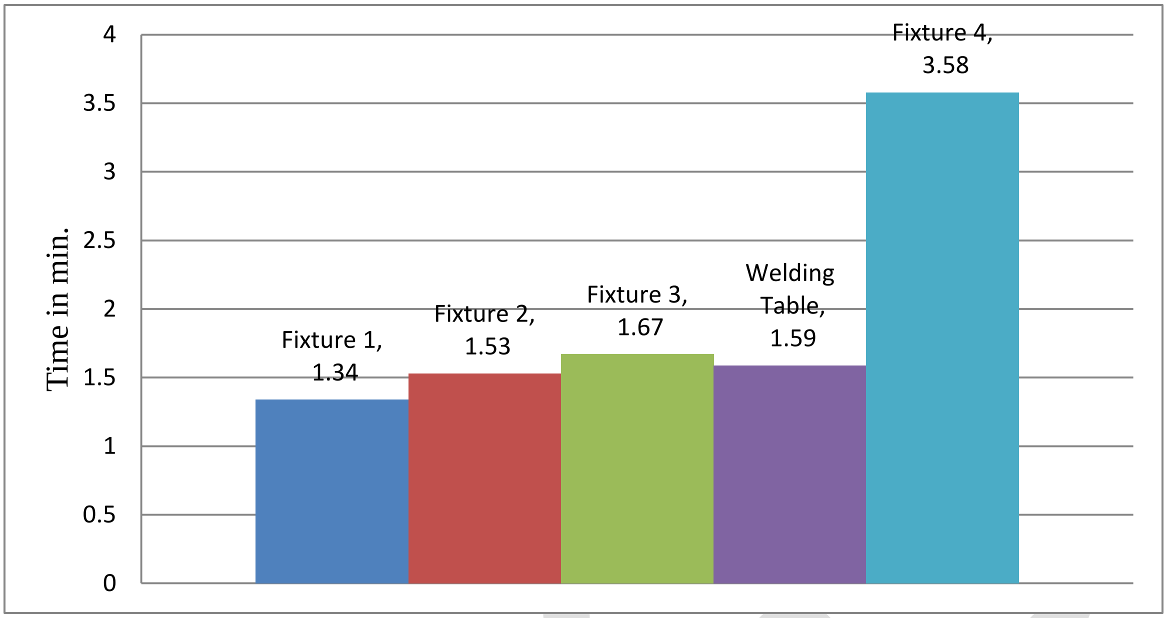

Figure 3.1- Existing Time For Work Stations

As shown in the above chart, fixture 4 required maximum time to complete work. Therefore work station 5 is identified as a bottleneck operation. For brining the competitive advantages, attempt is to be made first to reduce the cycle time through incorporation of positive changes within the bottleneck work station. By applying the MOST technique, process flow, working procedure (also called standard operation procedure (SOP)) and layout of the plant, it can be easily identified that the work station cycle time can possibly be reduced by modifying the working method. To reduce bottleneck work station time, one more work station added next to the bottleneck work station in the assembly line. The operations performed by bottleneck work station partly divided with newly added work station. Thus production flow maintain smooth. There is no fatigue and saturation of work.

Table 3.2- Proposed Time For Work Stations

W/s No.	Name Of The Work Station	Gun No.	Men	Time In Sec.	Time In Min.
1	Fixture 1	IG14	2	80.2	1.34
2	Fixture 2	IG29	2	91.8	1.53
3	Fixture 3	SG36	2	100.08	1.67
4	Welding Table	CO_2-01	2	95.39	1.59
5	Fixture 4	SG34	2	88.32	1.47
6	Fixture 5	SG43	1	100.32	1.67
		Total	**11**	**556.11**	**9.27**

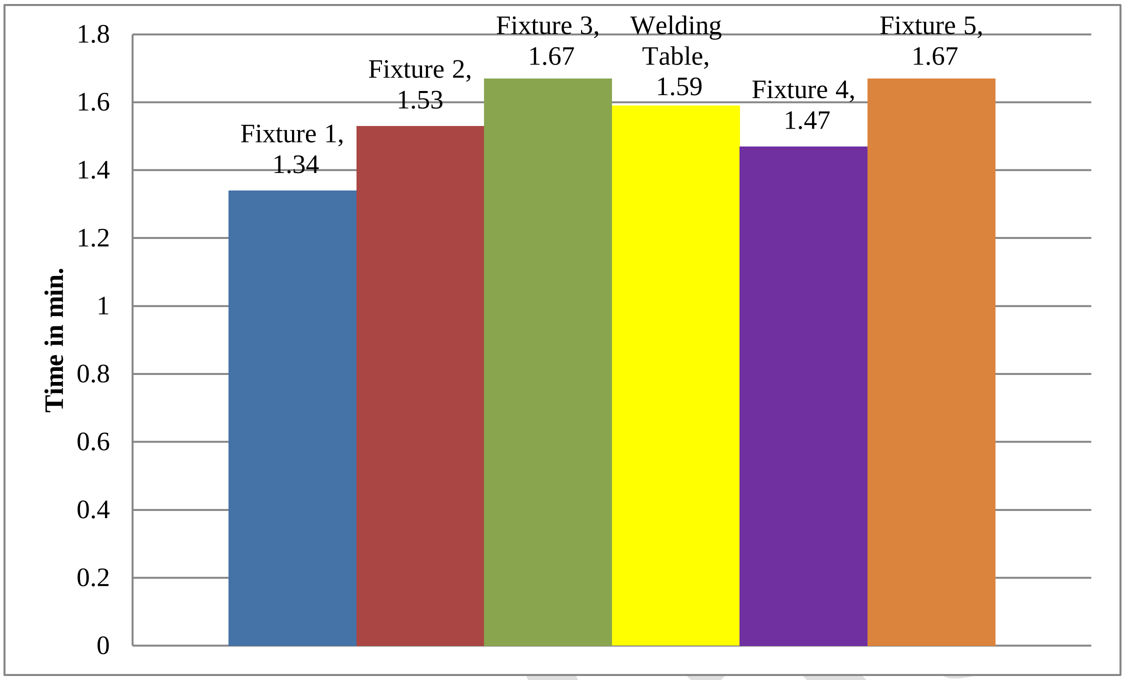

Figure 3.2- Proposed Time For Work Stations

As shown in the above chart, by adding one more work station time required by bottleneck work station is minimized. Also manpower required by work station 4 is reduced to 2 men. Manpower required by new workstation is 1 man. Minimization of time required for bottleneck work station results in to balancing of assembly line by avoiding fatigue and saturation of work.

4 RESULTS AND DISCUSSION

To assess the improvement in production rate, the Takt time of the considered assembly line is determined by dividing the total available time with the customer demand.

Table 4.1- Information Available To Work Out The Takt Time

Available Working Time (Min.)	Total Activity Time (Min.)	Highest Work Station Time (Min.)	Daily Required Quantity
480	10.694	1.67	280

Takt Time = (Available working time)/(Daily required quantity)
= 480/280
=1.71 min.

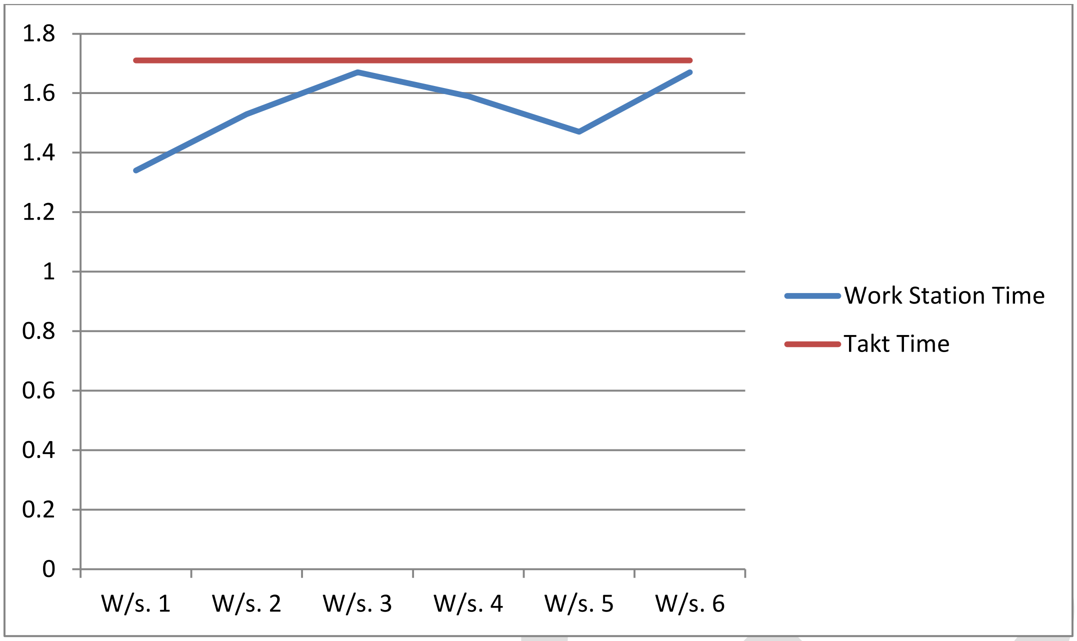

Figure 4.1- Takt Time

As the calculated Takt time for the assembly line is as 1.71 minutes per piece, the customer demand of 280 pieces per day cannot be entertained by the current practice. However, by bringing the proposed changes in assembly lines it is possible to satisfy the demand on time as well as increase the productivity.

Table 4.2- Manpower requirement

Type Of Assembly Line	Shift Time		Total Manpower	Largest W/s. Time In Min.
	Day	Night		
Current Assembly Line	11	6	17	3.58
Proposed Assembly line	11	0	11	1.67

As shown in the above table, proposed changes in the assembly line reduce manpower up to 11 men. As the daily required quantity is achieved in only day shift, manpower of 6 men work in night shift saved in proposed assembly line. The amount of investment save is given below.

Investment saved/Year = Manpower * Average salary per year
= 6 (men) * 3 (lakh)
=18 lakh

Hence we can save amount of investment up to 18 lakh per year by implementing the proposed changes in the current assembly line. The time saved to complete task in largest workstation is given below.

Time Saved/Unit Quantity = Largest W/s. Time In Current Assembly Line – Largest W/s. Time In Proposed Assembly Line
= 3.58 – 1.67 = 1.91 Min.

5 CONCLUSION

It is evident that to sustain in this competitive industrial environment, a company needs to reduce or eliminate the idle and/or down time, improve the working methods, standardize the time as well as enhance the overall capacity planning and in this respect the MOST can play a vital role. In this research, a possible way of improving the productivity of undertaken by an auto company is presented. The result shows that by modifying the methods, it is possible to bring the competitive advantages in terms of satisfying the customer demand, well balancing the process flow as well as ensuring the economic benefits. Thus the incorporation of the MOST to estimate the standard times for various elemental tasks involved in different operations, inclusion of simple tools and jigs to perform a task in shorter time with minimum effort from operators and manoeuvring the distribution of activities in different workstations to balance production lines can substantially improve the productivity of an industry from the current level. In future, a research study with the application of the MOST can be explored from a wider perspective through implementation in a single or mixed model assembly lines having large number of work stations.

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