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IMPLEMENTATION OF MAYNARD OPERATION SEQUENCE TECHNIQUE IN DRY PACK OPERATION - A CASE STUDY

Puvanasvaran A. P., Yap Y. Y. and Yoong S. S.
Faculty of Manufacturing Engineering, Universiti Teknikal Malaysia Melaka, Malaysia
E-Mail: punesh@utem.edu.my

ABSTRACT

This paper highlights the use of the Maynard Operation Sequence Technique (MOST) to reveal hidden waste on the dry pack operation in an electronic industry. Verification of current stage is done by conducting a process flowchart and workflow diagram to provide an overall picture of the current operation. Then, time study by using stopwatch is conducted to determine the actual cycle time of operation. MOST analysis is then presented to analyze each method described in a detailed way with every single motion. By comparing the actual cycle time and MOST results, the performance of the operators is calculated through an equation and presented in percentage. This paper significantly shows that MOST is an effective method to evaluate each action step of operation and standardized the operation time which leads to productivity improvement. Then, a performance measurement is generated based on MOST to track or monitor the performance of the operators in the daily operation.

Keywords: Maynard operation sequence technique (MOST), time study, productivity improvement.

INTRODUCTION

In the manufacturing industry, profitable growth is ensured by progressively increases in productivity. As stated by Zaidin [1], if a production system needed to be efficient, then its individual operations must be efficient and optimized. It is necessary to track out the potential opportunities to be improved to achieve the efficient production system [2]. The work and time measurement technique helps the manufacturer to increase the productivity by defining the proper working method, standard time and the way of maximizing the resource utilizations [3]. By knowing the time to manufacture a product, the management can achieve and maintain a high utilization of manpower, material and equipment. In addition, MOST can be used for optimized any processes that required manpower [4]. The key point of MOST concentrates on the movement of objects. The time taken from the series of operations is measured in such a way that ineffective time is shown up and can be separated from effective time [5]. In this case study, the result of time study showed that there is a variance of time among the four operators that perform their works at the dry pack operation even they are doing the same nature of work. This indicates that the absence of performance measurement allows workers to lengthen the working time and have inconsistent productivity. The management level unable to trace the inconsistency if there is absence of performance measure that can used to monitor the performance of operators in the current operation. Then, a performance measurement is developed through MOST analysis. The result of the implementation of MOST brings benefits to an operation without additional cost. With the standardized cycle time, a performance measurement can be constructed to compare with the actual cycle time performed by the operators.

LITERATURE REVIEW

Work measurement

Yadaz [6] defined work measurement as a systematic procedure to analyse work and determine the time required to perform key tasks in a process. After the time standard being established, the equipment efficiency and the manpower utilization may increase. A measurement system is introduced normally for two main reasons; get a picture of the current conditions and support decision making action (Pienkowski, 2014). In manufacturing, time study and PMTS are usually used to measure labour performance and obtain a standard data (Ostwald, 2001). The basic procedure of work measurement is select, record, examine, measure, compile and define (Kanawaty, 1992; Pandey *et al*., 2014).

Time study

According to Matias (2001), time study is a work measurement technique which measures the time needed for the elements of a studied job to carry out at a defined level of performance based on a prescribed method. It is then used to establish an accurate time standard after consider allowance for fatigue, personal needs and unavoidable delays. Time study is also known as method to establish employee productivity standards (Mishra *et al*., 2014). Generally, time study is used to compute the time required by a qualified worker to perform a specified task at a defined level of performance. The qualified worker carries out the work in a consistent and systematically way to achieve an effective rate of performance. Time study equipment: timing device - stopwatch, time study board and time study forms. According to Nuutinen at al. (2008), to obtain a reliable and accurate time study, it is important to comprehensively determine and follow a list of actual steps of the study itself.

Maynard operation sequence technique (MOST)

Despite the various types of job descriptions, Mishra *et al.* (2014) believed that all task is performed by using only a combination of 19 basic motions. MOST can be applied to describe the similar motion sequences for almost of all operations as stated by Bures and Pivodova (2015). Within these motion sequences, each single motion activity has its firm place in sequence. MOST employs a structured approach whereby the data developed is uniform, consistent and clear which can be identified as a progressive technique. MOST makes the work analysis becomes a practical, manageable and cost effective task [7]. There are three types of sequence models in BasicMOST system as shown in Table-1. The sequence model defines the events or actions that always take place in a prescribed order when an object is being moved from one location to another.

Table-1. Sequence Model.

Activity	General Move	Controlled Move	Tool Use
Usage	Spatial movement of an object freely through the air	Movement of object remaining contact with a surface or attached to another object	Use of common hand tools
Sequence Model	A B G A B P A	A B G M X I A	A B G A B P U A B P A
Parameters	A - Action distance B - Body motion G - Gain control P - Placement	M - Move controlled X - Process time I - Alignment	F - Fasten L - Loosen C - Cut S - Surface treat M - Measure R - Record T - Think

There are several benefits of MOST as compared to other work measurement technique [8]:

a) Reduced costs and paperwork

b) Improves productivity

c) Streamlines operations

d) Easy to learn and use

e) Quickly identifies inefficient methods

f) Provides consistent results/ standards

g) Provides accuracy to within ± 5 % with a 95 % confidence level

h) Can be applied to any method - defined manual task

i) Applicable for every type of industry

j) Encourages method development and improvement

METHODOLOGY

In this case study, direct observation is conducted to understand the process steps in the dry pack operation. It starts with observing the entire operation and then break down the operation into sub-element according to their sequences. With the result of direct observation, workflow diagram can be developed and time study can be conducted. Four operators are selected as the study subjects to perform their daily work in the operation and the time data is collected. The time data is the actual cycle time performed by each of the operators. Then, MOST analysis is conducted and the MOST result is compared with the actual cycle time of each operator in a diagram.

There are three types of sequence models in BasicMOST system as shown in Table-1. The sequence model defines the events or actions that always take place in a prescribed order when an object is being moved from one location to another. Despite the various types of job descriptions, Mishra *et al.* [9] believed that all tasks is performed by using only a combination of 19 basic motions. MOST can be applied to describe the similar motion sequences for almost of all operations [10]. MOST employs a structured approach whereby the data developed is uniform, consistent and clear which can be identified as a progressive technique. Therefore, MOST can reveal value added and non-value added activities at each sub process [11]. Then, the performance of the operators is calculated by converting MOST result and actual cycle time of the operators to the total number of lot packed.

RESULTS AND DISCUSSIONS

Direct observation is conducted to understand the process steps involved in the dry pack operation. The operation is broken down into sub elements according to their sequences. In order to visualize the general overview of the dry pack operation, a workflow diagram is drawn as shown in Figure-1.

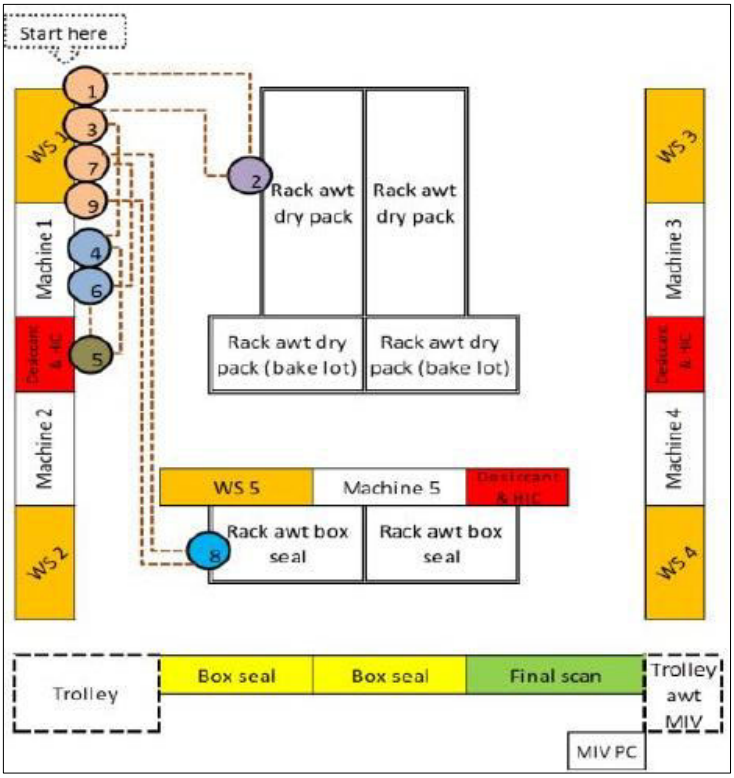

Figure-1. Workflow diagram of dry pack operation.

Time study is conducted to collect a real time data to know the total time used by operator to complete all the job elements. This stopwatch time study involved a selection of four different operators doing dry pack operation of the production line. Four qualified workers are selected to contribute to this study. They are trained and experienced worker in this operation. Prior to time study, they have been explained clearly regarding the time study procedure in order to obtain a full cooperation with them. Electronic stopwatch is used to record each unit time of job elements in snapback mode, whereby the time is initiated at the beginning of the cycle of the every element of work and be reset after each breakpoint. The time study result is shown as Table-2.

Table-2. Time study result.

Job Element		Time used (s)			
		PO1	PO2	PO3	PO4
Lot	1. Get lot from rack	16.05	11.36	11.55	10.20
	2. Untie lot. Take out traveler and label stickers Verification	62.24	44.61	67.33	45.51
Box	3. Take our reel from pizza box Stick reel label Scan reel label Stamp id	10.20	11.85	12.58	10.35
	4. Insert reel into MBB bag Stick MBB label Scan MBB label Stamp id	14.24	12.24	13.06	11.94
	5. Vacuum seal machine Insert HIC and desiccant	7.63	9.45	8.26	8.50
	6. Vacuum seal process	12.27	12.41	12.62	12.04
	7. Go to workstation Pack into pizza box	5.18	6.67	6.52	7.85
Lot	8. Stamp id Write data and time	16.30	12.29	11.02	14.09
	9. Tie whole lot Send to rack at box seal	20.88	19.86	15.71	28.29
Total		164.99	140.75	158.65	148.77

MOST is applied to analyze each of the job elements in a detail way. This approach focuses on the details down to the basic movements of action and body motions of operators. According the MOST analysis, the total TMU is 3500. While converting into seconds, its total time is 126 seconds. Figure-2 showed the comparison between time study result and MOST analysis.

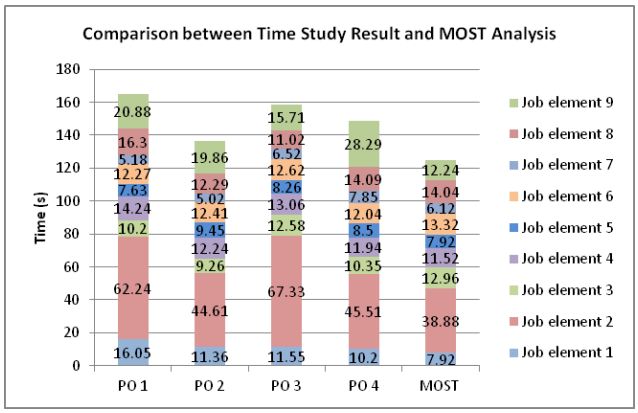

Figure-2. Comparison between time study result and MOST analysis.

Based on the job element, it is clearly seen that four different operators take different time to complete their work yet the nature of work and job sequence are similar. The operators tend to lengthen the time to complete the operation; without the standardized working time, the operators work with arbitrary [12]. These hidden wastes can be trace through the MOST analysis. As shown in the Figure-2, the MOST result is the shortest because the excessive working time is not included which mean the MOST result is the ideal cycle time of the operation. The longer time recorded in time study is due to the higher probability of NVA activities occurrence which are transportation and motion. All these wastes are hidden which cannot be seen and revealed without MOST

application. Kim [13] explained that the difference may be due to the fact of the worker is not experienced enough to be considered as an 'expert', which is what the MOST analysis is intended to model.

Table-3. Actual cycle time and MOST result.

Item	Time study				MOST
	PO1	PO2	PO3	PO4	
Actual cycle time (s)	412.61	403.90	423.83	402.18	390.60
Number of lot packed in 1 shift	104	106	101	107	110

According to Senthil and Haripriya [14], MOST is the most vital and is taken at the standardized time as it leads to time saving and around 15 % profitable. This statement supported by the result gained in this study, which MOST result showed the minimal time to complete one cycle of operation. In Table 3, the number of lot packed in 1 shift which is 12 hours is computed by using the actual cycle time of each operator and also MOST result. The result showed the MOST result has the highest number of lot packed in 1 shift compared with each operator.

$$\text{Performance} = \frac{Actual\ performance}{Ideal\ performance}; \quad \text{Eq. 1}$$

The performance of the operators can be calculated through the Equation 1. The ideal performance is the number of lot packed based on MOST result while actual performance is the number of lot packed by the operators in 1 shift.

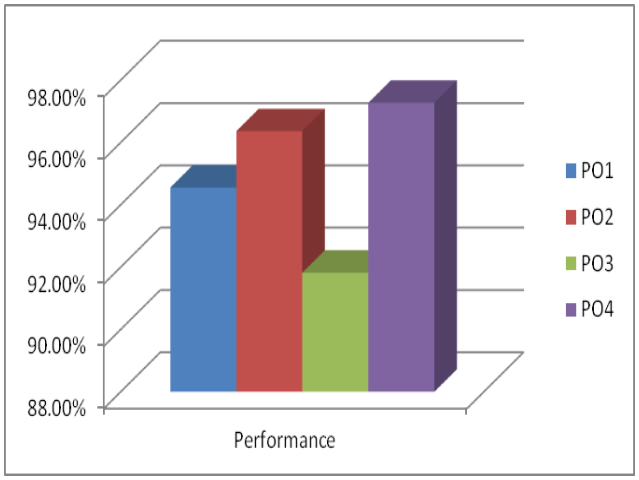

Figure-3. Performance of each operator in dry pack operation.

As shown in Figure-3, the performance of each operator is computed and it showed the PO3 has the lowest performance rate while PO4 has highest performance rate among four operators. This performance measurement can be used to monitor the performance of the operators and act as a catalyst in continuous improvement and performance improvement to achieve consistent and maximum productivity in this dry pack operation. MOST is a great tool to develop benchmark for the manual operation and visualize the hidden wastes in the production, which are unnecessary working step and excessive working time performed by the operators. Through the implementation of MOST, the performance of the operator is traceable and improvement can be made.

CONCLUSIONS

In this study, MOST is implemented to investigate the operation and analyse each activity step. Major time reduction can be achieved as the operators are not standardized and this can be solved by MOST analysis. The findings show that MOST can be implemented to improve work and work process in the industry. Moreover, it can used to reveal the hidden wastes in the operation with the standardized time and reduce the chances for workers to lengthen the working time to release time stress. This study brings multiple impacts to the company. In management aspect, the work system is being optimized in term of standardization of task time and proper operation sequence. Elimination of waste leads to the reduction of cycle time towards achieving productivity and satisfy customer demands. The significance of MOST is highlighted by providing a guidance which can motivate operators to do better and keep optimizing the operation process. Moreover, MOST helps to minimize the time wastages by mis-operation and subsequently enhances operational efficiency. The performance measurement based on the MOST analysis able to monitor the performance of the operators and encourage operators improves their productivity continuously and maintain the productivity consistency. This project shows a positive outcome which is advantageous to the employer of the company. The knowledge and experience gained in productivity enhancement can be applied in other similar industry fields for economic development of a country.

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