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Comparisons of Standard Time and MOST for Mill and Skive Housing Operation

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Abstract— **The purpose of this study was to compare time study and motion study for mill and skive housing operation and to recommend the improvement methodologies for the productivity of the operation. The original time study and the MOST were used to evaluate this operation. The results showed that MOST resulted in 0.372 minutes and the time study resulted in 0.55minutes.**

Index Terms—**Time Study, MOST, Motion Study, Cycle, Operation.**

I. INTRODUCTION

Time Study is defined as the systematic investigation and analysis of the motions and the time required to perform a specific operation or task (Zandin, 2001; Payne et al., 2006). Time study is a direct and continuous observation of a job or task to record the time taken to accomplish a task using a stopwatch. It is often used 1) when there are repetitive work cycles, 2) when a different sub-task is performed (Groover, 2007; Krenn, 2011; Salvency, 2001).Managerial Operation Sequencing Technique or better known as MOST, is an activity based predetermined motion time system where body motions are organized into 'Sequence Models' which describe activities. MOST is more accurate, efficient, and consistent than the traditional time study. There are four types of systems of MOST: MaxiMOST is typically used with maintenance or utilities where activities are non-repetitive, with cycle times ranging from two minutes to more than several hours. MiniMOST is generally used for highly repetitive operations, where cycle times range from 20 seconds to less. AdminMOST deals with clerical activities. BasicMOST, which is the most commonly used form of MOST, is the method that we chose for our study. For the present study, a video of a male worker performing a Mill and skive housing operation were analyzed.

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II. PROCEDURE

This video showed a man performing part of an assembly line process for a Mill and skive housing. The operator tends a battery of two identical machines which perform finishing machining operations on a die cast metal housing. The operator loads each machine with two parts, closes a protective sliding door, and activates the cycle with palm buttons. When the cycle finishes and the operator opens the sliding door, he wipes oil from the edge with a hand cloth. Two parts are removed and placed to a conveyor, and two new parts are loaded. Indicator lamps on the machine panels show when the machines stop and start.

These elements will be shown later in this report. After establishing elements for this task, the groups watched the video many more times to establish good break points. These break points are defined by specific things such as when a sound starts or stops or when the worker touches something. The students were instructed not to use actions like reach because it is not a "point" in time. And the key to a good break point is a clearly defined "point" during the task. The elemental break points that the group established will be covered later in this report. After establishing very specific break points each group watched the video again and timed the elements using the breakpoints they had agreed upon. Since, the cycle time for the operation was so low, we calculated ten cycles. The students used our data to calculate standard deviation and x-bar for each element. After doing so, the students assumed a confidence level of 90% and calculated the amount of observations needed for an accurate set of data. After establishing that they had done enough observations to have an accurate time study they began putting their information into a report.

III. RESULTS

A. *Description of Elements*

For the task that the worker executed, the operation was divided into four distinct elements to be timed. For this cap milling operation four elements, which create the work cycle, were identified. See below for descriptions:

1. Load two Mill and skive housing in Machine 1
2. Unload two Mill and skive housing from Machine 2
3. Load two Mill and skive housing in Machine 2
4. Unload two Mill and skive housing from Machine 1

B. Description of Break Point

Similarly, in order to execute the time study correctly, effective break points were established. An effective breakpoint is a point in a work cycle readily distinguished by sight or sound which is selected as the boundary between two elements in time study.

These were used to indicate when the timer would start and stop per element. See below for descriptions:

1. Touch two Mill and skive housing caps
2. Touch start button on Machine 1
3. Touch two Mill and skive housing
4. Touch start button on Machine 2
5. Touch two Mill and skive housing

C. Diagram of Elements and Breakpoints associated with Each Element

Table 1: Elements and Breakpoints associated with Each Element

Element	Starting point of Element	Stopping point of Element
1. Load two Mill and skive housing in Machine 1	Touch two un-milled Mill and skive housing	Touch start button on Machine 1
2. Unload two Mill and skive housing from	Touch start button on Machine 1	Touch two un-milled Mill and skive housing
3. Load two Mill and skive housing in Machine 2	Touch two un-milled Mill and skive housing	Touch start button on Machine 2
4. Unload two Mill and skive housing from	Touch start button on Machine 2	Touch two un-milled Mill and skive housing

D. Time Study Form

Table 2: Time Study Form

		Elements	(minutes)	
Cycles	**1**	**2**	**3**	**4**
1	0.08	0.15	0.08	0.14
2	0.09	0.14	0.08	0.16
3	0.08	0.15	0.09	0.15
4	0.09	0.13	0.08	0.14
5	0.09	0.15	0.1	0.14
6	0.1	0.16	0.08	0.15
7	0.09	0.15	0.09	0.14
8	0.08	0.14	0.09	0.17
9	0.09	0.16	0.08	0.15
10	0.08	0.15	0.09	0.16
Total OT	0.87	1.48	0.86	1.5
Rating	100	100	100	100
Total NT	0.87	1.48	0.86	1.5
# observations	10	10	10	10
Average NT	0.087	0.148	0.086	0.15
% Allowance	17	17	17	17
Elemental	0.1	0.173	0.101	0.176
# occurrences	1	1	1	1
Standard Time	0.1	0.173	0.101	0.176
Standard Cycle Time	**0.55 min**			

E. Dixon Test

Number of Observations	Ratio to Calculate if: Largest (x_n) is Suspect	Ratio to Calculate if: Smallest (x_1) is Suspect	Alpha Risk 0.10
8	$\frac{x_n - x_{n-1}}{x_n - x_2}$	$\frac{x_2 - x_1}{x_{n-1} - x_1}$	0.479
9			0.441
10			0.409

Element Number	Variable values	Calculation Largest Suspect	Calculation Smallest Suspect	Ratio Large(top) Small(bottom)	OutLier or Not OutLier
1	$X_n = 10$ $X_{n-1} = 09$ $X_1 = 08$ $X_2 = 08$	$\frac{10-09}{10-08} = \frac{1}{2}$	$\frac{18-08}{09-08} = \frac{0}{1}$	0.5 > 0.409 0.0 < 0.441	OL NOL
2	$X_n = 16$ $X_{n-1} = 16$ $X_1 = 13$ $X_2 = 14$	$\frac{16-16}{16-14} = \frac{0}{2}$	$\frac{14-13}{16-13} = \frac{1}{3}$	0.000 < 0.409 0.333 < 0.409	NOL NOL
3	$X_n = 10$ $X_{n-1} = 09$ $X_1 = 08$ $X_2 = 08$	$\frac{10-09}{10-08} = \frac{1}{2}$	$\frac{08-08}{09-08} = \frac{0}{1}$	0.5 > 0.409 0.0 < 0.441	OL NOL
4	$X_n = 17$ $X_{n-1} = 16$ $X_1 = 14$ $X_2 = 14$	$\frac{17-16}{17-14} = \frac{1}{3}$	$\frac{14-14}{16-14} = \frac{0}{2}$	0.333 < 0.409 0.000 < 0.409	NOL NOL

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F. Sample Size Calculations

$$s = \sqrt{\left[\frac{\sum(x_i - xbar)^2}{(n-1)}\right]} \qquad n = \left[\frac{(t)(s)}{k\bar{x}}\right]^2$$

K = .05
$T_{9,\,0.10}$ = 1.833

Element	1	2	3	4
Std. Deviation	.0067	.0092	.007	.011
Mean, Xbar	0.087	0.148	0.086	0.15
N =	7.97	5.19	8.90	7.23

G. MOST Analysis

Table 3: MOST Analysis

Task Description	Task #	Move Type	MOST Sequence Model	TMU for Task
Put un-milled part into Machine 1	**1**	GM	$A_1\ B_0\ G_1\ A_3\ B_0\ P_3\ A_0$	80
Close door of Machine 1	**2**	CM	$A_1\ B_0\ G_1\ M_3\ X_0\ I_0\ A_0$	50
Close door of Machine 1	**3**	CM	$A_1\ B_0\ G_1\ M_3\ X_0\ I_0\ A_0$	50
Open door of Machine 2	**4**	CM	$A_3\ B_0\ G_1\ M_3\ X_0\ I_0\ A_0$	70
Unload milled part from Machine 2	**5**	GM	$A_1\ B_0\ G_1\ A_3\ B_0\ P_1\ A_0$	60
Put un-milled part into Machine 2	**6**	GM	$A_1\ B_0\ G_1\ A_3\ B_0\ P_3\ A_0$	80
Close door of Machine 2	**7**	CM	$A_1\ B_0\ G_1\ M_3\ X_0\ I_0\ A_0$	50
Start Machine 2	**8**	CM	$A_1\ B_0\ G_1\ M_3\ X_0\ I_0\ A_0$	50
Open door of Machine 1	**9**	CM	$A_3\ B_0\ G_1\ M_3\ X_0\ I_0\ A_0$	70
Unload milled parts from Machine 1	**10**	GM	$A_1\ B_0\ G_1\ A_3\ B_0\ P_1\ A_0$	60
			TOTAL TMU =	**620**

GM=General, CM=Controlled

MOST cycle time:

620 TMU x 0.0006 min = 0.372 minutes
Time Study Cycle Time:
0.55 minutes
Difference = 0.55-0.372= 0.178 minutes

IV. Conclusions

There were few to no variables that hindered some of the collected data. The worker performing the task worked at a very efficient pace; there was minimal error during his cycles. The worker worked at a rate were there was minimal idle time between tasks, there was a constant feed of un-milled caps, so whenever un-milled caps were placed in the machine two more filled the place of the previous caps. Instead of a critique for this particular workstation, the manufacturing company should applaud the performance of their worker, and the efficiency of their operations at this point in time.

If one, were to provide suggestions on how to improve these operations, I would suggest the company to take a more ergonomic approach when assigning these type of tasks. Provide mats for the workers to work on to help relieve stress and strain from areas such as the knees and other parts of the legs. Also, if the company would like to alleviate some of the movement of the worker, they could move the machines next to each other. Place the conveyor belts in between each machine, so movement would be strictly from the torso and up. Scheduling breaks and maybe supply a water station nearby to cut down fatigue on the workers body.

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