Direct Time Study

Chapter 13

Sections:

1. Direct Time Study Procedure
2. Number of Work Cycles to be Timed
3. Performance Rating
4. Time Study Equipment

Work Systems and the Methods, Measurement, and Management of Work
by Mikell P. Groover, ISBN 0-13-140650-7.

Direct Time Study - Defined

Direct and continuous observation of a task using a stopwatch or other timekeeping device to record the time taken to accomplish the task

- While observing and recording the time, an appraisal of the worker's performance level is made to obtain the normal time for the task
- The data are then used to compute a standard time for the task

Direct Time Study Procedure

1. Define and document the standard method
2. Divide the task into work elements
3. Time the work elements to obtain the observed time T_{obs}
4. Evaluate worker's pace relative to standard performance to obtain normal time T_n
   - Called performance rating (PR)

   $$T_n = T_{obs}(PR)$$
5. Apply allowance factor to compute standard time

   $$T_{std} = T_n(1 + A_{pfd})$$

Document the Standard Method

- Determine the “one best method”
  - Seek worker’s advice if possible
- Documentation should include:
  - All of the steps in the method
  - Special tools, gauges, equipment and equipment settings (e.g., feeds and speeds) if applicable
  - Irregular elements and their frequency
- Once the standard method is defined, it should not be possible for the operator to make further improvements

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Form to document the standard method

Date	**Standard Method Description for Direct Time Study**		Page of
Operation		Dept.	Part No.
Machine		Analyst	
Methods Improvements (check if implemented)		Sketch of Workplace:	

Work Element No. and Description with Machine Parameters for Machine Cycles	Freq.	Tools and Gauges

Additional Notes

Why Documentation is Important

- Batch production – repeat orders after a significant time lapse
- Methods improvements by operator – to restudy task, must be able to prove a change has occurred
- Disputes about method – operator complains that standard is too tight
  - Is operator using the standard method?
- Data for standard data system – good documentation is essential for developing a standard data system

Divide Task into Work Elements

Guidelines:

- Each work element should consist of a logical group of motion elements
- Beginning point of one element should be the end point of the preceding element
- Each element should have a readily identifiable end point
- Work elements should not be too long nor too short
- Separate irregular elements, machine elements, internal elements

Time the Work Elements

- Each element should be timed over several work cycles to obtain a reliable average
- Stopwatch timing methods:
  1. Snapback timing method – stopwatch is reset to zero at the start of each work element
  2. Continuous timing method – stopwatch is allowed to run continuously throughout the duration of the work cycle

Advantages of Each Timing Method

- Advantages of snapback method:
  - Analyst can readily see how element times vary from cycle to cycle
  - No subtraction necessary to obtain individual element times
- Advantages of continuous method:
  - Elements cannot be omitted by mistake
  - Regular and irregular elements can be more readily distinguished
  - Manipulation and resetting of the stopwatch is reduced

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Performance Rating

Analyst judges the performance or pace of the worker relative to the definition of standard performance used by the organization

- Standard performance $PR = 100\%$
  - Slower pace than standard $PR < 100\%$
  - Faster pace than standard $PR > 100\%$
- Normal time $T_n = T_{obs}(PR)$

Direct time study form

Date	**Direct Time Study Observation Form**											Page of
Operation				Dept.				Part No.				
Machine								Tooling				
Worker								Worker No.				
Analyst		Start Time		Finish Time				Elapsed Time				

Work Elements, Machine Settings, and Observations				Cycle No. (regular elements)										
Element Number and Description	Feed	Speed		1	2	3	4	5	6	7	8	9	10	Avg T_n
1			T_{obs}											
			PR											
			T_n											
2			T_{obs}											
			PR											
			T_n											
3			T_{obs}											
			PR											
			T_n											
4			T_{obs}											
			PR											
			T_n											
5			T_{obs}											
			PR											
			T_n											
6			T_{obs}											
			PR											
			T_n											
7			T_{obs}											
			PR											
			T_n											
8			T_{obs}											
			PR											
			T_n											
Normal time = Sum of T_n (regular work elements)														

Irregular Element and Description	Freq	T_0	T_f	PR	T_n		**Calculation of Standard Time T_{std}**
A							Sum of T_n (regular work elements)
B							Sum of freq x T_n (irregular elements)
C							Total T_n per cycle
D							PFD allowance A_{pfd}
E							Standard time $T_{std} = T_n(1 + A_{pfd})$
Additional Notes							

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Apply Allowances

- A PFD allowance is added to the normal time to compute the standard time

$$T_{std} = T_n(1 + A_{pfd})$$

where A_{pfd} = allowance factor for personal time, fatigue, and delays

- The function of the allowance factor is to inflate the value of standard time in order to account for the various reasons why the worker loses time during the shift

Example

- A direct time study was taken on a manual work element using the snapback method. The regular cycle consisted of three elements, a, b, and c. Element d is an irregular element performed every five cycles.

Work element	a	b	c	d
Observed time (min)	0.56	0.25	0.50	1.10
Performance rating	100%	80%	110%	100%

- Determine (a) normal time and (b) standard time for the cycle

Solution

(a) Normal time:

$$T_n = 0.56(1.00) + 0.25(0.80) + 0.50(1.0) + 1.10(1.0)/5 = 1.53 \text{ min}$$

(b) Standard time:

$$T_{std} = 1.53(1 + 0.15) = 1.76 \text{ min}$$

Machine Cycle in the Task

- If the work cycle includes machine-paced elements, then standard time may include a machine allowance applied to the machine time

$$T_{std} = T_{nw}(1 + A_{pfd}) + T_m(1 + A_m)$$

where T_{nw} = normal time for worker (external) elements, T_m = machine cycle time (assumed constant), and A_m = machine allowance

Cycle-to-Cycle Time Variations

Result from the following:

- Variations in hand and body motions
- Variation in the placement of parts and tools
- Variations in the quality of the starting work units
- Operator mistakes
- Variations in worker pace
- Timing errors by analyst

- The observed work element times Are normally distributed about the true value of work element time
- Te is the time required (the most critical value we are most interested.)
- The objective is to identify the true value of Te within a certain confidence interval.
- Ex: we want to be 95% confident that the true value of Te lies within ±10 of the observed average value of the element time.

- Two difficulities with this analysis:
  - The population standard deviation is not known **s.**
  - A relatively small sample size of n.

The standard deviation must be estimated from the sample itself. as the mean value

Number of Cycles to be Timed

After several cycles, calculate sample standard deviation s

$$s = \sqrt{\frac{\sum\left(x - \bar{x}\right)^2}{n-1}}$$

Using the Student t distribution, according to a small sample size(less than 30)

$$n = \left(\frac{t_{\alpha/2}s}{k\bar{x}}\right)^2$$

Performance Rating

Analyst observes and rates the worker's performance relative to the definition of standard performance

- The most difficult and controversial step in direct time study
  - Potential conflict of interest between the worker and the analyst
- Most common performance rating method is based on speed or pace

Traits of a Good Rating System

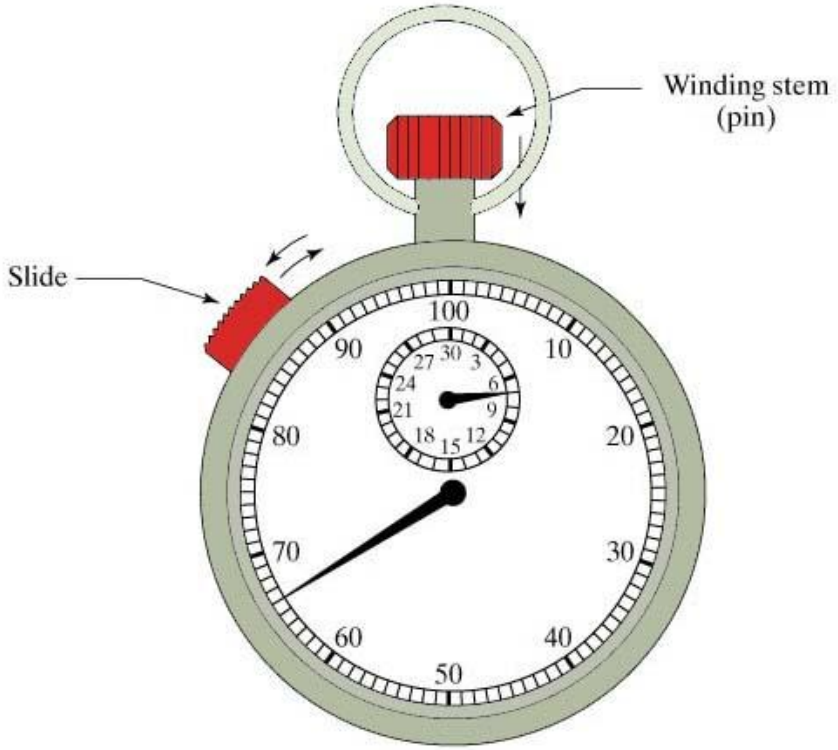
- Consistency among tasks
  - A worker who can perform at 125% on one task should be able to do the same on other tasks
- Consistency among analysts
- Easy to explain and easy to understand
- Based on a well-defined concept of standard performance
- Rate performance during the observation
- Worker notification

Time Study Equipment

1. Stopwatch
   - Mechanical stopwatches
   - Electronic stopwatches
2. Video cameras
   - Provides visual and audio record of method used by worker
3. Computerized techniques in direct time study
   - Use of PCs and PDAs

Mechanical Stopwatch

Calibrated in decimal minutes



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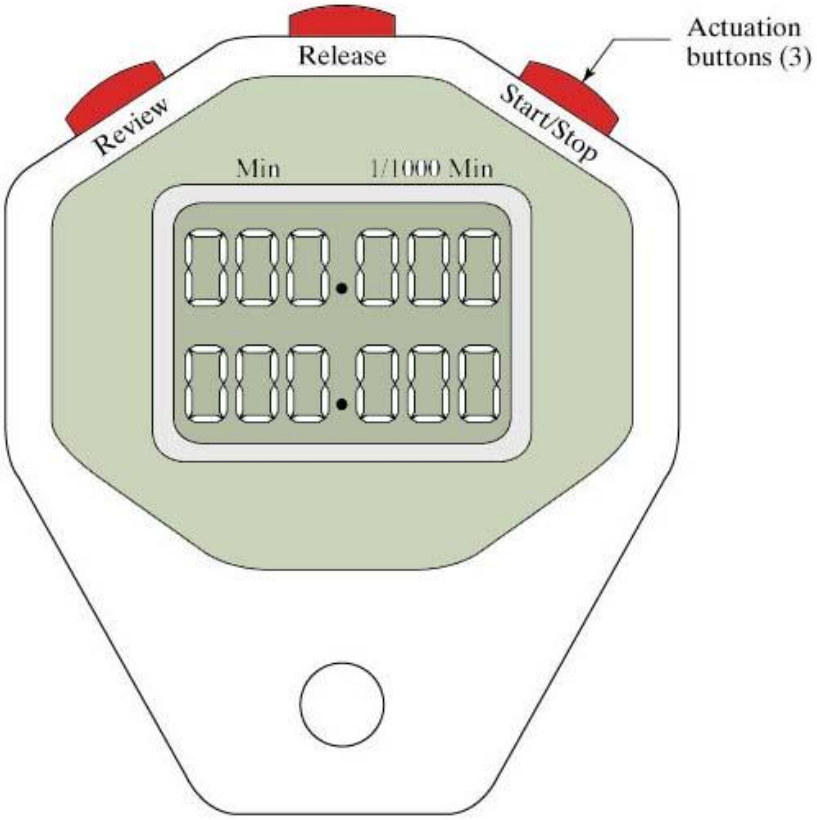
Electronic Stopwatch

LED read-out



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