Learning objective

• To appraise work measurement methods for effective utilization of human personnel in services
4.6 Work Measurement

In the last two lectures we discussed the importance and role of people in services. We also discussed that service organizations should devise HR strategies which motivate, retain and reward employees. To devise these initiatives it is important to develop performance measures to ensure that the employees are performing up to the set standards. It is equally important for any organization to utilize the employees or personnel effectively.

Work measurement gives answers to the following questions typically faced by service organization.

- How many people are required to meet specific demand or job requirement?
- How much work employees are doing?
- How effectively employees are working?
- How to design an appropriate incentive system?
- What are the fair productivity expectations of supervisors or top management?

Work measurement is defined as establishing time for a given task that would take when the task is performed by a qualified or skilled employee at a defined level of performance. Work measurement in services is gaining attention as most of the services are labor intensive and are of repetitive nature. In services customer's waiting time is very crucial hence it is important to know how much time it takes to do or to complete a given job or task. It helps in improving planning, scheduling, performance appraisal and decision making.
4.6.1 Work measurement methods

- The methods adopted to measure work done by employees vary from one workplace to another and from one industry to another. **Example:** A call center may measure the work in terms of number of calls an executive answers. Whereas, a typist might be evaluated on the basis of time it takes to type a letter.

- The basic procedure for work measurement, regardless of a particular technique is comprised of analyzing work, measuring and synthesizing the work.

- In analysis, the job is divided into discrete components called elements. In measurement, a specific technique is adopted to establish time required by each element of task. Finally, elemental times are synthesized and added together with appropriate allowances to construct the standard time to complete task.

4.6.2 Allowances

During the work shift or working day, workers suffer from fatigue or may like to attend personal needs. The fatigues in workers are imposed by:

- Type of work undertaken
- Duration of work
- Working environment

The time required by the worker to recover from fatigue and to attend to the personal needs is referred to as an 'allowance'. It is also termed as relaxation time, contingency time or unoccupied time of worker.

There are three mostly used techniques of work measurement presented in Figure 4.8.
4.6.3 Work Measurement Techniques

1. **Time Study**
   Involves timing a sample of a worker's performance and using it to set a standard.

2. **Predetermined Time Standards**
   Divide manual work or task into small basic elements that have established times, and then add the time factors for each element to estimate time for a particular task.

3. **Work Sampling**
   Determines the proportion of time a worker spends on activities.

4.7 Time Study

- The time study is a classical stopwatch study involves timing a sample of a worker's performance and using it to set a standard. The standard time is the time required by an average worker to perform a job once.
• Time study was proposed by Frederick W. Taylor in 1881.
• It requires trained and experienced observers to measure the time because the standard time cannot be set before the work is performed.
• More appropriate when the task is repetitive in nature.

4.7.1 Applications of Time Study

Example 1: When we give car to a repair shop, we always like to know how much time it will take to get the car serviced. The estimate of time taken to service a car is provided by the service personnel based on the standard set after performing time study on various instances of car repair and servicing.

Example 2: In services, time study is performed to measure and simplify work which can help in reducing cost. For example, customers seeking standard queries from banks can be directed to customer service representative or a call center executive in place of entertaining these customers in the bank branches. It will help in saving the branch employee's time.

4.7.2 Steps to perform Time Study

1. Define the task or objective to be studied
2. Decide how many times to measure the task. Time study is a sampling process. It is important to decide the number of cycles or samples needed and the required level of confidence in the estimated time standards to set standard time
3. Divide the task into precise elements
4. Time and record each element time a worker would take to complete the task element. Rate the performance of worker. Let the experienced analyst record the time.
5. Complete the average cycle time for each task element as given below:
Average Cycle Time = \[ \frac{\text{Sum of the times recorded to perform each element}}{\text{Number of cycles observed}} \]

6. Determine the performance rating and normal time for each task element as given below:

   Normal time = [Average observed time] \times [Performance rating factor]

   **Performance rating factor**

   Rating is the process during which the time study observer or analyst compares the performance of the worker observed with analyst’s own concept of normal performance. The performance in terms of speed of the worker is rated as a percentage with normal performance equal to 100 percent which is adjusted to the observed time.

7. Add the normal times for each element to develop a total time for the job.

8. Compute the standard time as given below.

   \[
   \text{Standard Time} = \frac{\text{Total normal Time}}{1 - \text{allowance factor}}
   \]

**Exercise:** An office worker wants to set standard time to complete a task K comprised of three job elements. He clocked work elements and chose to take 6 cycles as shown in table 4.4. The allowance for the task is 12% and performance rating for each element is also given in the table 4.4. Find the normal time and standard time to complete the task.
### TABLE 4.4: OBSERVED CYCLES AND PERFORMANCE RATING TO COMPLETE TASK K

<table>
<thead>
<tr>
<th>Job Element</th>
<th>Cycles observed (minutes)</th>
<th>Performance rating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3  4  5  6</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>15 10 13 17 45 14</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>30 20 26 72 25 23</td>
<td>110%</td>
</tr>
<tr>
<td>3</td>
<td>4 3 2 3 5 4</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Solution**

We can see from the data that some of the observations are unusual like fifth observation for job element 1 and fourth observation for job element 2. These are non-recurring observation which might be result of some disturbance during time study performance. So, delete these unusual observations and compute the average time for all three job elements for rest of the observation.

Average time for job element 1 = \(\frac{15+10+13+17+14}{5} = 13.8\) minutes

Average time for job element 2 = \(\frac{30+20+26+25+23}{5} = 24.8\) minutes

Average time for job element 3 = \(\frac{4+3+2+3+5+4}{6} = 3.5\) minutes

Compute the normal time for each job element considering performance rating.

Normal time for job element 1 = \((13.8) (1.00) = 13.8\) minutes

Normal time for job element 2 = \((24.8) (1.10) = 27.28\) minutes

Normal time for job element 3 = \((3.5) (1.00) = 3.5\) minutes
Total normal time to complete the task = 13.8 + 27.28 + 3.5 = 44.58 minutes

The standard time to complete the task considering allowance of 12 %

\[ = \frac{44.58}{1 - 0.12} = 50.66 \text{ minutes} \]

### 4.7.3 Sample size for time study considering sampling error

We know that since time study is a sampling process, so sample size will affect the sampling error. What sample size or number of cycles will be appropriate to conduct time study? It depends on the desired accuracy and level of confidence. It also depends on the variation exists within each job element. We can use standard charts or tables to find the sample size at certain confidence level. The sample size, \( n \), can be determined using following formula

\[
n = \left[ \frac{Zs}{h\bar{x}} \right]^2
\]

Where

- \( Z \) = Standard normal deviate for the desired confidence coefficient (as shown in the table 4.5)
- \( s \) = Standard deviation of the initial sample
- \( h \) = Accuracy level desired in percent of the job element expressed as a decimal
- \( \bar{x} \) = Mean of the initial sample
- \( s/\bar{x} \) = Coefficient of variation
### TABLE 4.5: COMMON Z VALUES FOR DESIRED CONFIDENCE LEVELS

<table>
<thead>
<tr>
<th>Desired confidence (%)</th>
<th>Z-value (standard deviation required for desired level of confidence)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>1.65</td>
</tr>
<tr>
<td>95</td>
<td>1.96</td>
</tr>
<tr>
<td>95.45</td>
<td>2.00</td>
</tr>
<tr>
<td>99</td>
<td>2.58</td>
</tr>
<tr>
<td>99.73</td>
<td>3.00</td>
</tr>
</tbody>
</table>

#### 4.8 Predetermined Time Standards

- Analyst divides the task into small basic elements.
- The time taken to complete the basic elements is already established based on very large samples of workers.
- The time factors for all basic elements are added to estimate time for a particular task.
- The time standards can be set before a task is done & hence can be used for planning.
- There are a number of commercially available systems to set predetermined time standards such as
  - MTM: Methods Time Measurement
  - CSD: Computerized Standard Data
4.9 Work Sampling

- Estimates the percentage of time that worker spends on various activities.
- Developed by L. Tippet in 1930s.
- Used to analyze the jobs that have non-repetitive elements.
- Also used to determine ratio delay which is the percentage of time a worker is delayed or idle.
- Work sampling involves random observations to record the activity that the worker is performing.
- Work sampling helps in determining how employees allocate their time. So, the study can be utilized to set staffing levels, reassign duties, estimate various costs and set delay allowances.
- Easier approach and less expensive than time study.
- **Example:** An IT manager takes 400 instantaneous observations at random intervals on a coder over few weeks to find out that the coder was doing coding job in 270 observations whereas the coder was idle for 130 observations due to miscellaneous reasons. So, we can see that the coder remains idle for \((130/400) \times 100 = 32.5\%\) of the time. No doubt the accuracy of such results depends on the number of observations.

4.9.1 Steps of work sampling procedure

1. Take a Preliminary sample to obtain estimates of the parameter values.
2. Compute the sample size required.
3. Prepare a schedule for random observations at appropriate times.
4. Observe and record employee activities
5. Record the performance indicator like number of units produced or any other services rendered during the study.
6. Compute the normal time and standard time per service.
4.9.2 Sample size for Work Sampling

1. Parameter to be estimated can be the percentage of time a worker is busy or a worker is idle.

2. Determine the number of observations or sample size, \( n \), Considering desired confidence level and accuracy as given below:

\[
 n = \frac{z^2 P (1-P)}{h^2}
\]

Where

- \( Z \) = Standard normal deviate for the desired confidence level (derived from normal form)
- \( P \) = Estimated value of sample proportion
- \( h \) = Acceptable error level in percent

Even though the large number of observations will give more accuracy, there should be some limit beyond which accuracy is not worthwhile economically. It incurs a good percentage of cost in conducting the work sampling study with large number of observations.

Example

An office worker wants to perform work sampling for task T. It was estimated that employees are idle 20% of the time. An office worker would like to take a work sample with accuracy of 4% desired confidence level of 95.45%

Solution:

Number of Observations,

\[
 n = \frac{z^2 P (1-P)}{h^2}
\]

\( Z=2 \) for 95.45% confidence level

\( P=\text{Estimate of idle Percentage which is 0.2} \)
\[ h = \text{Desired accuracy of 4\% or 0.04} \]

\[ n = \frac{(2)^2 (0.2)(0.8)}{(0.04)^2} \]

\[ = 400 \text{ Observations} \]

In work sampling it is determined that whether the employee is busy or idle during the observation, a ratio is given to the employee, and the units produced are totaled in order to produce an average.

This data can be used to determine the normal time and standard time as mentioned below.

Normal Time = \[
\frac{\text{Total study time} \times \text{Working time percentage} \times \text{Performance Rating}}{\text{Number of units produced}}
\]

The standard time can be determined by considering allowances and the normal time as determined in Time study.