Work Standards Setting Based on Work Sampling

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Abstract: Work sampling in the study of machine efficiency has made great achievements, but there are only very few researches taking this method into enterprise staff efficiency study, especially practical cases. In this paper, I took a trade enterprise as a case, to describe how to determine the number of sampling tests, how to control the sampling process and how to analyze the result to set reasonable work standards, which is expected to raise the staff efficiency, by determining the time standards of the samples, combined with work sampling. At last, I concluded the advantages and disadvantages of this method, in order to promote the application.

Keywords: work sampling; work standards; efficiency

1 The setting of work standards

1.1 Work standards

Work standards means Standards set for the work needed to be coordinated in the field of enterprise standardization. Work Standards refers to the time required for a well-trained employee to complete a certain amount of work, and he should be using the specified method with his normal level of effort and normal skills (non-extraordinary performance), which is also referred to as Time Standard. The A broad definition of standard is a kind of a basis or a scale used to measure and is accepted by people.

The key of work standards setting is to define a "normal working speed"[1]as well as the normal performance of skills. For example, to build a production line, or start a new transactional business, you need to design production capacity according to market demand, and hire an appropriate number of workers. Let's assume the production of one day should reach 1500, and then we can determine how many workers are needed, according to how much a worker can produce per day. However, the output of each worker is different, some workers are energetic, agile, and their working speed is high, while some other workers don't. Therefore, we must find a standard that reflects the working ability of most workers.

The setting of this kind of standards, depending on the time of observing only one person producing one product is clearly not enough. We must observe a certain number of workers producing a certain amount of products, within a certain period of time, and then we can use statistical method to calculate the time standards. Moreover, even after such a number of steps to set the work standards, when the actual work begins, it still needs timely correction by constant observation and keeping recording statistics.

1.2 The significance of work standards in study

Researches of Frederick Taylor, Frank and Lillian Gilbreth in the early 20th century laid the foundation of modern work standards setting. Researches in this field have changed the situation that manager knows very little about the appropriate workload of workers. Work standards setting is very important and plays an important role in the service industry and

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manufacturing industry. Meanwhile, work standards are also the basis for enterprise to determine the demand of human resource, enterprises would typically set up employee performance incentives system, and having appropriate work standards is a necessary condition for the establishment of employee incentive system.[2–5]

Effective operation management needs efficient work standards in order to help the company determine:

1. The amount of labor needed in production; (labor costs)

2. Demand of human resource (how many people needed to meet production requirements);

3. Cost and time prediction before production (to help with a variety of decisions, from cost prediction to self-manufacturing or outsourcing);

4. The staff size and work allocation(the assignment in a group work or a production line);

5. The expected production (so managers and workers know the content of a normal working day);

6. The basis of the wage incentive plan (how to provide reasonable incentives);

7. Employee's efficiency and the supervision of employees (there must be a standard to determine the efficiency).

1.3   Setting of reasonable work standards

Reasonable work standards, represents the time required for an ordinary worker to complete a certain amount of work under normal working conditions.

2   The principle of work sampling

Work sampling method can be used to estimate the percentage of time workers spent on different work.[6–8] It records the activities workers engaged in through random observation. The results are primarily used to determine how employees should allocate time between different works. The knowledge of time allocation helps enterprises to reconfigure staff and reassign work duties, estimate the cost of activities, set the delay and allowance time for work standards. When work sampling is used to determine the delay and allowance time, it is also known as study of proportional delay.

Work sampling process can be summarized in five steps:

1. Using the initial sample to run the test to obtain the estimated values of the parameters from the study (for example, the percentage of busy time).

2. Calculate the required sample size.

3. Prepare the observation schedule. Decide the time of random observation based on the number randomly selected. For example, we selected the following five random numbers from a random number table: 07,12,22,25 and 49. These numbers can be used to generate an observation schedule: 9:00; 09:07; 09:12; 09:22; 09:25; 09:49 (24-hour clock time).

4. Observe and record the activities of the workers.

5. Determine how workers allocate time (usually expressed in percentage).

Managers must determine the number of observations based on the confidence level and accuracy. First, however, the analysts must choose the initial value of parameter study (step 1), which is a certain number of test observations of small samples (about 50 times).

The following formula is to calculate the required sample size under the given confidence level and accuracy, which determine the final number of observations.

In this formula:

$$n = \frac{z^2 p(1-p)}{h^2};$$

n——The required sample size;

z——The required confidence level corresponding to the difference between the standard number (when confidence level is 68%, Z=1; when confidence level is 95.45%, z=2; corresponding to 99.73% confidence level, we can get these values from the Gaussian distribution table.) ;

p——estimated percentage of time when the workers in the sample are observed to be occupied or idle;

h——Acceptable error level, expressed as a percentage.

3 Determination of standard working time

It is quite similar to manufacturing enterprises that, business enterprises, retail and service enterprises also need to set precise work standards.[9, 10] Many enterprises are beginning to use the work standards to carry on the management. Business trading enterprises are very concerned about labor cost, because labor cost is usually the second largest expense after procurement cost. It is necessary to establish work standards from customer communication, commodities quantities check (inventory check?), to checkout scanning, which can economize labor time and improve production efficiency. Since retailers often provide customers commodities with low prices to gain a competitive advantage, therefore they found that good working standards can not only cut by 5% to 15% of labor cost, but also provide more accurate data for the schedule.[11–15]

Traditional work standards are generally determined based on previous experience, which is the last work-hours needed to complete a work. Data thus obtained are often not objective, numerically inaccurate, we can not be sure whether such data is measured at a reasonable work pace, for which we need to correct the standard observation time.[16–18] Proceed as follows:

1. Determine the work or task needed to be studied.

2. Break the work up into small action unit (completion time of each action after decomposition is usually several seconds or so).

3. Determine the number of measurements (the needed work cycle and sample size) for this work.

4. Do the timing, recording performance assessment and time of each action units.

5. Calculate the average observed time (actual time). Average observed time is the arithmetic averages of time each action units measured. Wherein the time of each action units has been adjusted under any unconventional situation.

$$Average\ Observed\ Time = \frac{The\ Sum\ of\ The\ Recorded\ Time\ of\ Each\ Operation}{The\ Number\ of\ Cycles\ Observed}$$

6. Determine the performance evaluation factors (work rate), and then calculate the normal time for each action unit.

$$Normal\ Time = Average\ Observed\ Time \times\ Performance\ Evaluation\ Factor$$

Performance evaluation factor will adjust observation time to normal operation speed, which is what a trained worker expected to achieve. For example, a normal worker should be expected to walk 3 miles per hour, or to divide 52 cards equally into four parts within 30 seconds. Operation performance evaluation factor of 1.05 indicates that the working speed of the worker is slightly higher than average speed.

7. The total normal time for the work can be obtained by summing up the normal time of every action unit.

8. Calculate the time standard.

We need to rise appropriate allowance time to adjust the total normal time to compensate for individual needs, the unavoidable delay as well as reduced efficiency due to fatigue.

$$Time\ Standard = \frac{Total\ Normal\ Time}{1 - Allowance\ Time\ Rate}$$

Based on working environment, for example, the distance to lounge, water dispenser and other facilities, allowance time of individual needs is usually in the range of normal time overall 4% to 7%. Delay and allowance time rate is

generally determined after the actual study of the delay. Fatigue allowance time is determined based on the deepening of our ordinary understanding of energy consumption under different physical and environmental conditions.

For example, a production workshop had one of the duties measured, through time study, and the result was 4 minutes operation performance evaluation factor was 85% for the worker observed, which means that during the study, operation level of this worker is 85% of a normal worker. If the allowance time rate the enterprise using was 13%. We can determine the normal time and time standard by the above method:

$Average\ Observed\ Time = 4.0\ minutes$

$Normal\ Time = Average\ Observed\ Time \times\ Operation\ Performance\ Evaluation\ Factor$

$= 4.0 \times\ 0.85 = 3.4\ (min)$

$Time\ Standard = \frac{Normal\ Time}{1 - Allowance\ Time\ Rate}$

$= \frac{3.4}{(1-0.13)} = 3.9(min)$

Thus available, because performance evaluation factors of the worker in observation is 85%, lower than the average level of an operating worker, therefore, the normal time is less than four minutes, the worker's average observed time,.

4 Specific application of work sampling

Work sampling is focused on determining how to allocate workers' time between different processes. It is determined by the percentage of time workers spent on the production activities, rather than by the specific time measured in a certain work task. Therefore, observers just randomly, objectively record every activity.

We can also refer to example of determining the number of the sample, Human Resources Manager Li wants to make sure his employees have sufficient time to provide customers with timely, helpful service. He believes that when busy rate of an employee is over 75%, the service they provide to the customers who come to visit or make phone call without reservation will deteriorate rapidly deteriorate rapidly. Therefore, to ensure a high level of efficiency and customer satisfaction, he did not want to let his employees spend over 75% of working hours on customer service.

The method is as follows:

We have to determine five points in this research: firstly, Based on the result of the example, the number of observation times required should reach 300. Secondly, in order to ensure the sample's reliability, the observation should be made randomly and objectively in two weeks. Thirdly, managers should determine the scope of "work activities". In this case, all the activities involving the customers are work activities (filing, have meetings, data input, or discuss with higher-ups). Fourthly, personal affairs time belongs to the 25% non-working hours. Fifthly, to understand the employee's work, the observers should not interfere with the normal work activities. After 300 times observation we have the following results:

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Table 1: Time study of work sampling

	Observation times	activities
	175	Make phone calls or meet with customers
	45	be idle
	21	Personal affairs
	10	Discuss with higher-up
	49	Filing, having meetings, data input
total	300	

In Summarize, except 67 times observations (observed being idle or dealing with personal affairs), others are work-related. The actual idle rate is 22% (66/300), less than what Li thinks needed to ensure high customer service level, he needs to find a method to reduce the current workload. This can be solved by reassigning duties or hiring more employees.

Through the above applications, we found that work sampling is especially suitable for human resource requirements determining or the re-division of employees (as shown below):

Description: These two work sampling studies are used to determine the working styles for a salesman who comes form an electronic product wholesale enterpriseand several automobile assembly line workers.
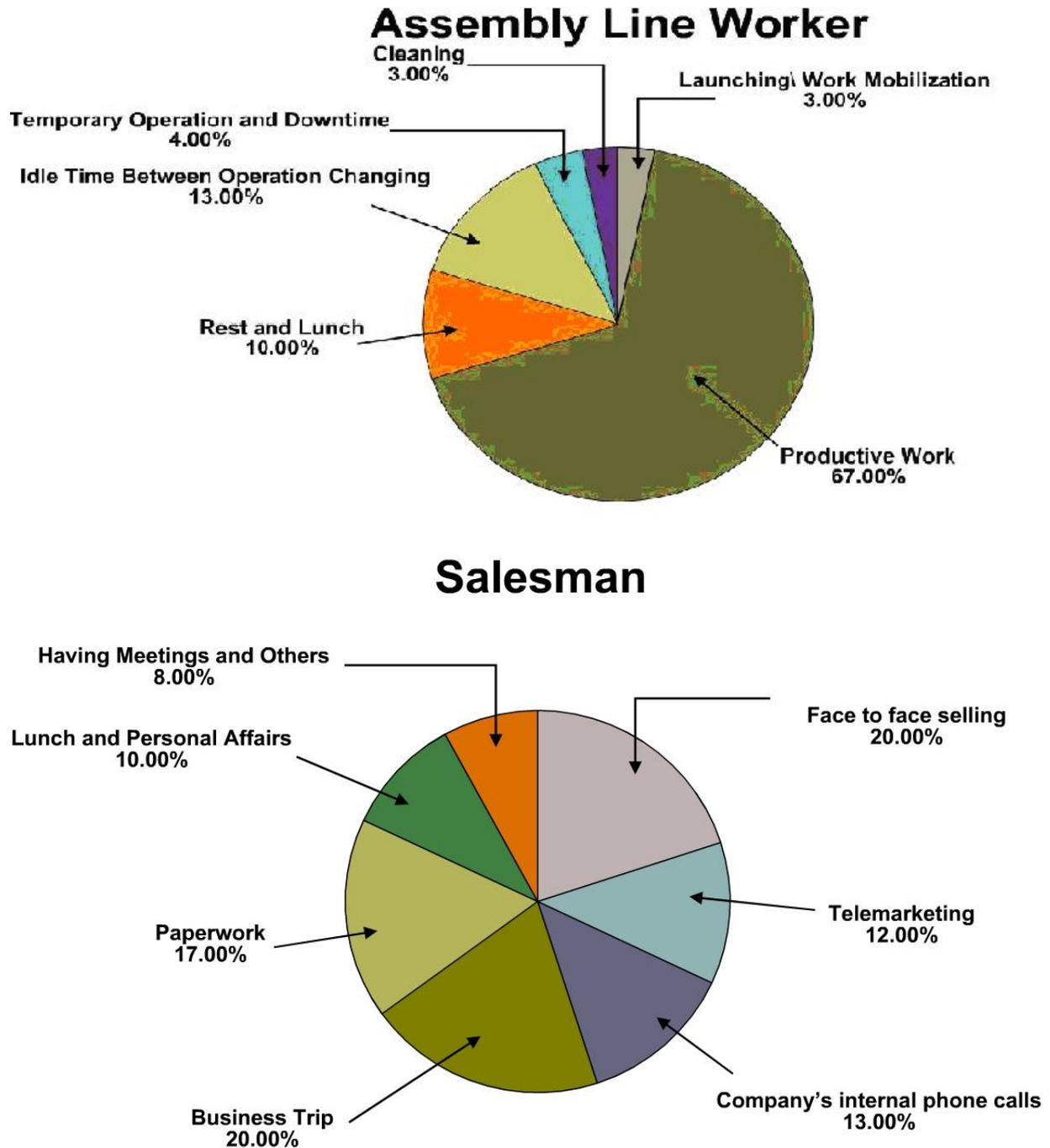
Assembly Line Worker

Salesman

Figure 1: Work samplings time study

5   The advantages and disadvantages of work sampling in the application

When we apply work sampling to do the observation, we should observe and analyze when the observation time is inconsistent. If action time is too short, it may be caused due to some mistakes during the observation, usually excluded. However, when the action time is too long, it also needs to be analyzed to determine whether the time value is correct. On the other hand, an overlong action time would be caused due to the incidental, reasonable operation in work unit (for example, machine setting) or individual needs, delay and fatigue.

Work sampling has the following advantages. At first, since an observer can simultaneously observe several workers, so the cost involved is cheap. Secondly, the observers usually are not required much training, no timing device also. Thirdly, the operation can be very flexible. You can temporarily postpone the study at any time, not affecting the accuracy of the results. In addition, work sampling makes intermittent observation over a period time (each observation time is very short). Thus, the workers can hardly make any effect on the results. Finally, impact the sampling made to the work during the process is negligible, so that the possibility of objecting the sampling from the workers will be low.

The disadvantages of work samples: initially, it did not subdivide work unit. Secondly, if the observer does not comply with the principles of random observation, it may produce biased or incorrect result. Thirdly, although it hardly interferes with the work, its accuracy could be low, especially when the work time is very short.

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