STAFFING METHODS IN OPERATION AND PRODUCTION

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ABSTRACT

This paper describes five methods used by firms to establish the size of the staff required for an operation, either in manufacture or in service: work measurement; adoption of legal rules and standards; copying the current best or good practices; using previous experience; managing with rules of thumb, through trials and errors. A survey conducted in Brazil, interviewing executives of various economic segments, showed that the five methods are all used, with a pronounced bias toward the last ones. The factors and constraints which influence the staffing decisions are addressed. Much ability is required from the manager in order to take all these elements into account.

KEY WORDS:

Staff dimension
Operation manpower
Workforce size
1. **INTRODUCTION**

At some times, in some industries, in some countries, the size of the workforce deserved the major attention. Since the end of the XVIII Century, at the dawn of the Industrial Revolution, till the half of the XX Century, manpower, its efficiency, its cost, attracted the attention of management theorists and practitioners. Science, the one that gave its name to the Scientific School of Management, was the science of man at work. It aimed at the most efficient use of this resource. Motion and time study, the restless search for the unique best way to do the job, the quest for the standard time, were inspired by the need to quantify the number of workers.

The growing mechanization, automation and robotization of the productive processes steered the productivity studies in a new direction, focusing materials and equipment, and exacting more qualification from the employee.

It is more difficult to set the right dimension in services than in manufacture, but one has to remember that many manufactures have administrative sectors which are “internal services” and that many services – hospitals, hotels, banks, offices – have “internal manufactures”, like laundries, cafeterias, house keeping, maintenance, transportation and the like.

Table 1 shows a classification of manufactures and services in five categories, according to a staffing viewpoint. It is more difficult to compute the necessary quantum of workers for one-time projects, for discontinuous and for intermittent operations, as opposed to continuous, standardized production.
Table 1

Classification of operations according to a staffing viewpoint

<table>
<thead>
<tr>
<th>Categories</th>
<th>Manufacture</th>
<th>Service</th>
<th>Staffing Easiness or Difficulty</th>
</tr>
</thead>
</table>
| 1. Continuous operation, without regular interruption | - Plant-made high volume standardized products  
- Oil refinery  
- Steel mill, Cement, glass  
- Chemical plants | - Railway carrier  
- Maritime transport  
- Hospital  
- Telephone, Mail  
- Internet provider  
- Convenience shop | Rather easy for manufacture  
Rather difficult for most services |
| 2. Continuous operation with regular interruption | - Factory-made high volume products  
- Automobile and appliances assembly line | - Retail shop  
- Commercial bank  
- Gas station | Rather easy |
| 3. Intermittent recurrent operation | - Batch production  
- Closed job shop  
- Automobile parts  
- Repair parts  
- Pharmaceuticals | - Accounting reports  
- Accounting audits  
- Physical inventory  
- Periodical appraisal and certification | Fairly easy |
| 4. Intermittent one-time operation | - Make-to-order production  
- Open job-shop  
- Special machinery  
- Ship building | - Medical appointments  
- Laboratory analyses | Rather difficult |
| 5. Project | - One time venture  
- Research and development  
- Construction project  
- Restoration project | - Business plan  
- Market research  
- Consulting  
- Software creation  
- Software implementation  
- Promotional sale | Very difficult |

2. FIVE METHODS FOR COMPUTING THE STAFF SIZE

One can identify five distinctive methods used to compute the size of the necessary work team.
2.1. Scientific measurement of work

The first method is based on concepts created by the Scientific School of Management. Its pioneers were Frederick W. Taylor (1911), Frank B. Gilbreth (1914) and Lillian M. Gilbreth (1945). Techniques used include studying and filming the operation, in order to eliminate useless motions and correct inefficient ones; constructing flowcharts and graphs so as to better analyze the process; times measuring and recording; making frequent observations of service workers. These techniques allow finding the one best way to do the job and the standard time to perform the operation.

Fatigue and working conditions (temperature, noise, risk) are duly taken into consideration.

An important Brazilian sugarcane agricultural cooperative, in the São Paulo State, in the seventies, used this technique to raise production. Formerly, a worker, using a machete (cutlass) was able, on the average, to cut six metric tons of sugarcane in an eight hours working day. The best workers harvested almost 20 tons a day. The cutting technique, the motions used by the champions were filmed and shown to all. About two thirds of the half million existing sugarcane cutters learned the best method and raised their output to 10 tons a day. The remaining one-third was dismissed. On the base of 10 tons per day per worker, working 5 days per week and 35 weeks (the crop season lasts 8 months) a year, Brazil would need, in order to harvest 500 million tons of sugarcane a year,

\[
\frac{500,000,000}{35 \times 5 \times 10} = 285,714 \text{ workers.}
\]

In the last twenty years, mechanization of this operation has grown. A machine, tended by three men, cuts 600 tons in an 8 hours shift. It works two shifts, six days a week. One would need, in 35 weeks,

\[
\frac{500,000,000}{35 \times 6 \times 2 \times 600} = 1,984 \text{ mechanical harvesters, handled by } 1,984 \times 6 = 11,905 \text{ workers.}
\]
Quantitative models were developed by operation researchers in the fifties (HOLT et al., 1955; BUFFA and Miller, 1979) to optimize aggregate production programs in seasonal factories, like the paint and beer industries. The relevant costs of these models are, aside from inventory holding costs, the costs of manpower hiring and dismissing.

2.2. Adaptation to legal regulations and standards

The second method used to establish the dimension of the working force consists in adapting to legal regulations and standards.

For instance, the World Health Organization has established an average 15 minutes duration for a general medical appointment (including returns). If a health institution forecasts 10 thousand appointments per year, and if a physician works there 4 hours a day, 5 days a week, 48 weeks a year, one would need, to take care of all the appointments:

\[
\frac{10,000}{5 \times 16 \times 48} = \frac{10,000}{3,840} \approx 3 \text{ physicians.}
\]

Recently, Brazilian authorities have determined that no client should wait for more than one minute when on the phone to a call center without going attended. Let us assume that calls arrive at the average frequency of \( \lambda = 1 \) call per minute and that the attendant solves the client’s problem at the rate of \( \mu = 0,25 \) client per minute. Assuming random arrival and processing times and making the usual assumptions of the classic queueing theory (FRY, 1928; SAATY, 1959; LEE, 1968) the expected waiting time, for one service channel, is:

\[
E(W) = \frac{\lambda}{\mu (\mu - \lambda)} \quad (1)
\]
Let us modify the classic theory assuming that the calls can be evenly distributed among \( n \) parallel service channels. The new \( \lambda \) becomes \( \lambda / \mu \) and the new expected waiting time \( E'(W) \) becomes:

\[
E'(W) = \frac{\lambda}{\mu \left( n \mu - \lambda \right)} \quad (2)
\]

Considering now that the frequency distribution of the waiting time is negative exponential and that its standard deviation is equal to its mean \( E'(W) \), the expected waiting time \( E'(W) \) is one third of the maximum allowed waiting time \( W_{\text{max}} \), at a 95% confidence level.

From (2), one gets the number \( n \) of parallel service channels necessary to maintain the desired average expected waiting time \( E'(W) \):

\[
n = \frac{\lambda}{\mu^2 E'(W)} + \frac{\lambda}{\mu} \quad (3)
\]

But, as \( E'(W) \) is one third of the maximum allowed waiting time \( W_{\text{max}} \), formula (3) becomes:

\[
n = \frac{3 \lambda}{\mu^2 W_{\text{max}}} + \frac{\lambda}{\mu} \quad (4)
\]

Table 2 shows the number \( n \) of parallel service channels necessary to maintain the waiting time at the maximum allowed \( W_{\text{max}} \), according to (4).
Table 2

Number \( n \) of service channels necessary to limit the maximum waiting time to the specified \( W_{\text{max}} \), assuming \( \lambda = 1 \) per minute and \( \mu = 0.25 \) per minute

<table>
<thead>
<tr>
<th>Maximum specified waiting time ( W_{\text{max}} ) (minutes)</th>
<th>Number ( n ) of service channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td>6</td>
</tr>
<tr>
<td>16</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>1</td>
<td>52</td>
</tr>
</tbody>
</table>

The number of service channels grows exponentially when the maximum waiting time is very small.

Corporative rules dictated by headquarters might often determine the headcount of local branches or franchised units, and, when enforced, must be complied with. Or they can be negotiated so as to take into account local conditions. In this case, one comes very close to the third method.

2.3. Adoption of good or best current practices

A third method for determining the size of a working unit is the use of data obtained from available good or best practices in the same economic segment.

For instance, the American Hospital Association publishes its Annual Hospital Statistics (AHA, 2005), containing, among many other indicators, the average number of Full Time Equivalents – FTE employees per adjusted occupied bed (or adjusted inpatient day).
Other sources publish data referring to the number of employees per guest in hotels and restaurants; to the number of employees for available paying seat in commercial airlines; of teachers per students in schools; and of house keeping and maintenance personnel per square foot of office building.

2.4. Historical experience

A fourth method consists in using the historical record of the firm, adapting it, when necessary, to an increase in activities.

2.5. Rules of thumb, trials and errors

In many trades, one finds empirical rules, which are often used to estimate the size of the necessary working force.

It is well known in hotels that a room maid, provided with all the material and equipment necessary, can clean an apartment in half an hour. The standard staffing is therefore one maid for 16 rooms, in a 8 hour working day. In self service restaurants, the rule is one table waiter for 25 guests at lunch time. In fast food places it is one for 30. If one hundred guests are expected, one needs four waiters.

Other factors which bear some influence on the size of labor is the need for specialists. The list of specialists determines actually the minimum size of the team that will do the job, for instance for a research, consulting or social project.

3. AN EXPLORATORY RESEARCH

An exploratory research was conducted asking to thirty Brazilian executives in personal interviews the following open question: “Which method do you use to assign a specific dimension to your working unit ?”.
The only answer that can be ascribed to method 1 was given by the administrative director of a large service company: “I take frequent walks in my departments. If I see people idle or gossiping, I reach the conclusion that there is an excess of employees and I have to dismiss some”.

A typical answer corresponding to the second method was the following: “My hospital tries to recruit the right number of registered nurses fixed by law. But there is a shortage of nurses. Everybody knows that. You cannot comply with the law. And also it would be too expensive”.

A few answers can be attributed to the third method: “I have already worked in international companies. They have written rules in order to compute the number of people necessary. They have rules for everything. All is in the book”. This restaurant manager added: “I don’t have written rules here but I use the same ones I learnt in the past in my present business”. A similar answer was given by an information technology expert, heading an international bank project: “We have specialists for each area: IT, organization, flow charts, manuals writing. And they take monthly audits on our progress. Everything according to the book. We follow strictly the rules”.

The use of the fourth staffing method – historical tradition – was mentioned by a third of the interviewed officers. Typical answers were the following: “When I took charge, I maintained the former body of people. It actually never occurred to me to make a change. That was not the point. I had other problems. Two years later I was ordered to cut 20% of my sector. Then there was a problem.” That was a former airline executive.

The production head in charge of a Brazilian factory of a huge international manufacturing company producing electronic appliances explained: “I did not change my payroll in ten years. I inherited my team and assumed it was the right one”.

The fifth method received the largest number of answers.
A third of the managers mentioned that they experienced shortage of people and that they had to adapt themselves to a difficult situation: “I know that I am short in maintenance crew when I have some work to do and there is nobody available to do it”. “There is no staffing method. That does not exist. Only trials and errors. One must have much experience”. This was the opinion of a partner in a consulting firm.

“One cannot rely upon ready made formulas because, in a service, the relationship between client and supplier is very important and, this, you cannot quantify”. It is somewhat surprising that huge corporations, which show so much concern with costs, do not use to a larger extent rational and quantitative methods to decide on the size of their work force. In the future, when only certified enterprises will survive, all of them will have to use clearly established methods to compute the adequate size of their working people.

4. CONCLUSION

Several methods are used in business in order to establish the size of the manpower in production and operation activities. Many factors influence this size, like the nature of the task; the pressure for downsizing, for going lean; and the changes brought about by acquisitions and fusions, among many others.

It is more difficult to compute the necessary number of workers in non repetitive activities and in projects than in continuous, standardized manufacture; and in service and white collar activities than in production and blue collar jobs.

One can classify the staffing methods in five groups, ranging from science to feeling. An exploratory research conducted in Brazil through interviews with executives of various areas showed that, at the present time, the state of the art is mostly an intricate
mix of heuristics, encompassing some science, some rules, some copying and pasting,
some tradition and much feeling.

In the future, strict rules and regulations will compel all companies to compute with
more precision their manpower needs.

5. BIBLIOGRAPHICAL REFERENCES


