

How U.S.A. Companies Are Using Operations Research Techniques

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MODERN management techniques are spreading at plant and divisional levels, but top management in many corporations is still puzzled over how to introduce these techniques at the corporate level. This survey of 107 of the largest U.S. corporations examined the present composition and use of operations research (OR) departments in corporate level activities.

Forty-four percent of the corporations in the study have OR departments (variously known as management science, systems, or corporate planning departments) at the corporate headquarters. On the average, the companies that have special OR departments are about 50 percent larger than those that do not. The average rate of sales growth in both groups is the same, but the growth in terms of earnings per share is higher (12.4 versus 8.7 percent) in the group without OR departments. This is probably, however, a factor of company size rather than one related to the existence of an

OR department. And, just as sick people go to a doctor, so companies with lower rates of growth in earnings per share are seeking the aid of operations research.

Another interesting difference between the groups is their technological development. The group with OR departments was producing only 65 percent of its present product mix five years ago. The group without OR departments was producing 82 percent of its present product mix five years ago. The analysis shows also that OR departments are less common among conglomerates than among industrial corporations that operate mainly in one industry. An explanation may be that most conglomerates are relatively young and still in a formative process.

Prevalence

In 1960 fewer than 10 percent of the corpora-

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tions surveyed had OR departments, and today 44 percent do. It is reasonable to predict that by the mid-1970s about two-thirds of the large U.S. corporations will have special OR departments at their corporate headquarters. In the face of this impressive growth, it is pertinent to ask why some companies do not feel the need for such a department. Only two companies surveyed had actually abolished their OR departments because they considered them unsuccessful experiments. The majority of the other companies that do not have special departments reported that they either conduct operations research at various headquarters departments or delegate such activities to the divisional level. Some companies mentioned the formation of special task forces or committees to attack specific problems; others admitted that top management is not ready for such a progressive step.

Companies that distribute OR activities among various departments of headquarters, or those that delegate them to the divisional level, try to justify this as a cost saving and claim that this arrangement makes better use of manpower. The effectiveness of such second-priority activities is questionable. If the function is delegated to a division, then corporate projects involving other divisions are probably undercut. If the function is given to a headquarters department, there is a danger of low efficiency.

Status

Top management gives high recognition and authority to the OR department. Most of the departments report directly to a vice-president, and, in some cases, the director of the department is a vice-president himself.

Apart from the largest 10 percent, OR departments are very small, with an average of five professionals and one and one-fourth persons on the clerical and secretarial staff. Even including the largest 10 percent, the average size only goes up to 10 professionals. One reason for keeping this department small is that its major objective is to increase efficiency and, as such, it should be an example of high quality with small quantity.

Personnel

The OR department is characterized by young and highly educated professional people. The average age of the department manager is 40, while the average age for the professional staff is

33. Only 4.9 percent of a department's members are not college graduates; 38.5 percent hold bachelor's degrees; 43.7 percent hold master's degrees; and 12.9 percent hold doctorates. The educational level was found to be higher in industrial corporations than in service corporations.

Operations research involves a multidisciplinary approach, so it is not surprising to find diversified backgrounds among the professional staff. These range from engineering to historical studies. Also typical is the variety in major fields of study on all levels. On the undergraduate level, mathematics and statistics, engineering, and business education are the most common. Half of those with master's degrees hold them in business administration, operations research, or management science.

On the doctoral level, one-third have a specific operations research or management science degree, and in descending order of prevalence are chemists and chemical engineers, mathematicians and statisticians, and economists.

The directors of OR departments are on an even higher educational level — 32 percent have their doctoral degrees, and 44 percent have master's degrees. Their professional backgrounds are mainly in operations research or management science (35 percent) and in engineering (29 percent).

The OR department is a young department, so it is not surprising to find that the average tenure of the professional employee is only four years. This short stay also can be attributed to the fact that some companies use the department as a training school for top-line and staff positions. About 35 percent of the professionals who leave the department are promoted to staff positions and 19 percent to line positions in the same company. To replace the manpower losses caused by the high rate of turnover, recruiting is done directly at the college level for about 46 percent of the vacancies.

Companies are reluctant to give much information about their salary structure, but OR departments seem to be competitive in regard to starting salaries. Nonetheless, about half the companies surveyed either are having trouble filling vacancies or presently have vacancies.

As the department is usually small, it often needs to use outside consultants. About 60 percent of

the companies have made use of consulting firms, and about 86 percent of these believe that the consulting costs were justified.

Costs and Savings

Many top executives would like to evaluate the OR department and its activities from a purely monetary standpoint — through a venture or investment analysis. In such an analysis, a comparison is made between expenditures and savings over any desired period. However, it is extremely difficult to calculate the expected savings. Savings may be realized only over a long period of time, and the OR unit may be only one of several influences. Only half of the OR departments attempt to compute quantitatively the savings achieved through their activities.

In contrast to savings, expenditures are predictable. The largest item is salaries, which account for about half (or about \$12,500 per professional worker) of the total budget. The average OR unit with six employees should thus cost about \$150,000 each year to run. An attempt to relate the department's budget to the total sales of a manufacturing corporation shows that the budget is, on the average, .25 percent of the company's sales (that is, \$250,000 for a company with \$100,000,000 sales). Variations are considerable. In the larger corporations, the percentage is 0.1 to .05 percent, while in the smaller corporations the budget may go up to 0.6 percent of sales.

Most of the companies that do attempt to compute the savings achieved by the OR department do it on the basis of individual projects. For example, one company in the pharmaceutical industry calculated that the OR department saved \$40,000 at a cost of \$15,000 by simulating manufacturing.

OR departments are in effect consulting units, so it is interesting to learn how their cost is charged. Only one-third of the departments make specific charges (mainly by projects) to their clients within the company. In the remaining two-thirds of the cases, the department's expenditures are regarded as a part of the company's overhead. It would appear preferable if its client departments were charged for services, allowing better control of expenditures and permitting efficiency comparisons (such as against outside consultants or against expected savings). The client department should be allowed, in certain cases, to reject

the internal consultant as being unprofitable and to hire an outside consultant.

Functions

One question that the top executive usually puts to the management scientists is, "What will the OR department do at the corporate headquarters?" The survey recorded about 500 projects, from simple inventory problems to complex projects involving the simulation of the entire industry or social systems. Companies were asked to list their past, present, and future projects. A clear trend to more sophisticated projects emerged. For example, whereas in the past one of the concerns of OR departments was internal expansion through introduction of new products, they now evaluate acquisition programs, and expect in the future to optimize expansion through growth analysis of mergers. Cost accounting now has the added dimension of developing profit centers. Corporate simulation now requires total industry simulation, and long-run forecasting is being added to short-run forecasting.

An OR department at the corporate level can carry out projects involving several divisions or plants in different divisions, as well as corporate-level projects. Of the OR projects reported, 46.4 percent were on the corporate level, 40.1 percent on the divisional level, and 13.5 percent on the plant level.

The average project lasts about ten months and involves two and a half researchers. OR personnel use the computer quite frequently. Most often they use the simplest OR techniques (such as simulation, linear programming, and statistical analysis). Only a small proportion of operations research problems are solved by other established techniques (PERT, dynamic programming, nonlinear programming, and queuing). As one management scientist said: "We use simple models since 50 percent of our job is to sell what we do in the other 50 percent."

A final problem considered by the survey was implementing the results of a project. Many OR scientists, especially at plant and divisional levels, used to complain that a large portion of their projects were never implemented. The survey shows that today about two-thirds of all projects are mostly or completely implemented. This fact reflects the high status of the department and the strong support given to it by top management.