RESEARCH WORKERS: PRODUCE OR PERISH

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ABSTRACT

To produce research results or perish is today a continual threat to the research worker who in the boom days of the past was only sometimes subjected to the threat of publish or perish. Research management must become more effective to ensure higher productivity and continued funding. We live in an age of change, and successful technological innovation is essential for survival. The selection, motivation, and continuing education of people can contribute much to successful R & D. The systems approach and the use of industrial economics and engineering concepts can contribute to optimum utilization of research workers and facilities.

Keywords: Research management, research and development, management, productivity, administration, systems engineering, research funds, planning, project selection, research application, formulating objectives, personnel selection, education.

INTRODUCTION

The non-industrial research worker of the past was sometimes threatened to "publish or perish," but he lived in a time of a research boom where money was plentiful and controls minimal. In addition a publication is not always proof of successful research and even less proof of successful application of research results.

Things have changed and now all research workers are continually threatened to "produce or perish." Unless copious applicable research results leading to economic advantages are forthcoming, funds will dry up. More and more rigorous controls are set up to ensure high returns on research investments. It is of great importance to research workers to know about this change—what caused it and how their future is likely to be influenced by it.

THE RESEARCH BOOM

The research boom started early in this century, gathered momentum after the Second World War, and reached a peak in the midsixties. It was a time during which research funds were readily available, and successful or effective research was seldom a prerequisite for further financing.

This does not mean that no results were forthcoming—in fact, spectacular results were achieved. The question, however, is: Would the results not have been much better if there had been proper selection of projects, stringent planning and management of projects, and a concentration of effort on applying results as speedily as possible?

Now the boom is over and top-rate performance in research and its management will be a prerequisite to ensure that the supply of funds will be maintained. Unless the productivity of research is going to be sufficiently high to convince the sponsors that its output is worth more (in terms of money and other factors) than the input, it will be very difficult to obtain funds for research projects.

In the peak of the boom period from 1950 to 1965, the man-years spent annually on research and development (R & D) by scientists and engineers in the USA increased fourfold. Clearly this growth could not continue. When the end of the boom in the USA came, however, it was followed not by slower growth but by a levelling-off. There was a total growth of approximately 10 per cent in the man-years spent on R & D from 1965 to 1969; by 1972 the total research expenditure was back to the 1965 level. Obviously the situation varies from country to country, but there are indications in most developed countries that the boom has come to an end. Even if it is not evident in a slower growth in research activities, it is evident in a demand for a continued high level of performance even though available funds may have decreased.

MANAGING CHANGE

This hardening in the conditions influencing research, where effective results requiring a high standard of performance are going to be the rule, will require a very high level of research management. Certainly a *laissez-faire* or even a research-for-the-sake-of-research management attitude is going to be disastrous for any organization.

While this major change has been taking place, there has also been a change of attitude in people—the main resource required to conduct research once the finances have been procured. On the whole, people are now thinking in terms of a future with less pollution or a cleaner environment, less work or more leisure and complete freedom in deciding how they earn and spend money. This obviously contains a serious contradiction. On the one hand the population expects more and more for less and less effort, but on the other hand each of these new expectations and demands requires massive economic efforts.

It is under such difficult conditions that the research manager of the smallest to the largest projects in future will have to manage for results to achieve the performance required to ensure continuity for his sponsor, his staff, and himself.

Drucker (1974) says "in an age of rapid change (as we are in now) a technological strategy (a plan for all the efforts known in industry under the name of R & D) is essential for the success and indeed for the survival of a business and perhaps even of an industrial nation." In Canada it is estimated that 85 per cent of the increase in productivity at present is due to technological development, which again depends to a very large extent on R & D.

MANAGING FOR RESULTS

In future, managing R & D for results can therefore be expected to become a most important factor—not only to the research manager, the research scientist, and the research engineer as well as their supporting staff, but to the industries and governments of all countries. Future economic development will come to depend more and more on R & D, which is one of the main tasks in technological innovation, i.e. the all-embracing field from initiating research to the commercially successful application of the research results.

Managing R & D for results is a process of identifying and formulating objectives, and then planning and controlling the research to achieve these objectives. This can only be accomplished by the application of human talents and by supplying the required facilitating resources. It entails the conscious application of the following management processes:

(a) Forecasting technological change.
(b) Selecting and formulating objectives.
(c) Planning for the achievement of desired results.
(d) Organizing the R & D effort for maximum productivity. This includes initial staff requirements, directing by motivation and control; ensuring that staff is at all times adequate; and training.
(e) Continuous communication between management, project leaders and R & D staff, and between the R & D organization and the user of the research results.

(f) Implementing the results so that there is maximum benefit to the sponsor.

When R & D is undertaken, with or without conscious managing for results, a situation similar to that of a business venture develops, whether the consumer of the R & D service is the same organization, a private person, or the taxpayer. Costs are incurred in supplying the service, which if it is successful, will be worth more than its cost to the consumer, i.e. the service can be passed on at a profit. In the process of managing for results, cost and other economic information is therefore required to guide the research and keep the costs within economic limits.

PRIORITIES IN FOREST PRODUCTS RESEARCH

The selection of objectives and evaluation of results will form the cornerstones of the tasks of future research managers. In the forest products industry the objectives will vary greatly depending on conditions pertaining to time and place, but whatever these may be, it is certain that the low factor of conversion from tree to final product that existed in the past cannot be continued. Since material and labour costs have risen drastically because large areas are being used for roads, power lines, dams, farms and homes, or for aesthetic purposes and recreation, the available wood will have to be utilized more fully in future. Among our biggest challenges will therefore be to grow more wood per hectare and to produce more end-products per cubic metre of standing tree and in both cases to do so at reduced cost.

When a national research programme is drawn up for the forestry and forest products industry, it should be done against the background of the factors influencing the short- and long-term development of this industry. To do this, it is necessary to relate the present state and the growth and development of each sector in the industry to the technological, economic, and social changes that will influence the industry. This knowledge defines the strengths and weaknesses of the industry, and it will facilitate making the best decisions as to the fields in which research should be done, the products or processes that should be developed, or even the basic information that should be obtained from research efforts.

Once a programme is under way, evaluation of progress or results becomes a crucial factor—both in the sense of the value of the results in terms of effective application in practice and in terms of the productivity of the research staff. This is a complicated matter since effective results and staff productivity, although related, are not always synonymous. Even the most outstanding scientists and engineers are sometimes involved in unsuccessful projects. A certain amount of work has already been done in this field and publications ranging from a simple checklist of project evaluation criteria to more complicated cost/benefit systems are available. It is felt, however, that considerable effort will have to be expended to develop and implement effective methods of evaluation.

SELECTING RESEARCHERS

The future success of research depends on people not only as managers, but as research scientists and engineers and as support staff. In fact, apart from funds, people are the main resource in research. The ideas that form the basis of all research, development, or innovation originate in the minds of people. The initiative, drive, and determination required to develop ideas into successful economic application can come only from people who are motivated to achieve a particular goal.

To find such people, proper selection is most important. University or other academic or technical qualifications form the basis of such selection. Qualifications alone are, however, not enough and it is recommended that aptitude tests should also be used in selecting personnel. In many parts of the world test facilities exist that can evaluate the following:

- Mental alertness, which is a gauge of adaptability to general problems and situation.
- Abstract intelligence, which indicates the ability to detect scientific laws and to reason on an abstract level (an aptitude which correlates with creativity and formulation of ideas).
- Arithmetic ability, which correlates with later achievements in the practical working situation.
- Administrative ability.
- Personality in terms of temperament and character, and possible deviations. Valuable indications as to leadership abilities, adaptability to team work, and motivation can be obtained from this last evaluation.

Evaluations of this nature have been carried out with great success at the Council for Scientific and Industrial Research for nearly thirty years.

Motivation of staff requires specific attention, especially in view of the high expectations outlined in this paper. Well-educated people are motivated first by their own achievements, recognition, responsibility, and advancement, and second by their need for challenging work and for participation in their own management. It is therefore imperative that the goals of the individual scientists, engineers, and technicians working in R & D must be matched closely to the goals of the organization.

CONTINUING EDUCATION

One of the most important aspects in this respect is continuing education. Napoleon Hill (1960) said that "universities usually specialize in teaching knowledge—but what is really required from graduates is specialization in organizing and using knowledge. They have to direct knowledge intelligently, through practical plans of action, to achieve a definite purpose." The first step in continuing education is therefore to teach the young scientist and engineer how to achieve results through R & D. Some of this knowledge can be obtained through acquiring a higher degree at a university, but how to achieve results of practical value and how to apply these results in practice must be taught by senior research staff with experience of successful applied research.

Learning and teaching are going to be more deeply affected by the new availability of information than any other area in human life, according to Drucker (1974). He also feels that there is a great need for a new approach, new methods, and new tools in teaching. If we consider that it is estimated that more than three-quarters of all the scientists that ever lived are alive today and that the growth in research has levelled off, the average age of research scientists and engineers will rise drastically from now onwards. This will make continuing education even more important than in the past since young graduates with an up-to-date education will form a smaller part of the total staff.

An important example of continuing education is communication with other research staff, as for example international meetings where people meet to exchange information, experiences, and ideas.

Project failures and their causes should also be one of the subjects of discussion between researchers of different organizations or countries. People seldom are prepared to deliver papers of this nature at international meetings, but are quite prepared to discuss failures with individuals. If the value of such discussions can be accepted more widely, a wealth of additional research information would become available to researchers.

SYSTEMS APPROACH

Future development will be based on the perception of systems, says Drucker (1974). Biologists, for example, work in the total system they call ecology. In the sawmill a new, faster machine may be installed to do a particular task better or quicker. But unless the total system (i.e. the sawmill) gains in total capacity, efficiency or productivity, less pollution, lower production cost or in some other desirable measure, then the new, faster machine will be a disadvantage.

The total system, whether it be a manufacturing process or product application, should be investigated from the technical and the economic point of view, using a systematic, analytical approach. Recommendations should be made within this framework, bearing in mind their influence on other segments or phases of the system. The primary purpose should be to develop forests or forest products and their applications, as well as existing and new systems of manufacture, in such a way as to achieve maximum economic efficiency.

With the development of the systems approach, it has become essential to make use of industrial economics and industrial engineering concepts in feasibility, cost, and production studies aimed at lowering costs of products and raising productivity in manufacture. A systems approach is used by the techno-economic team of the National Timber Research Institute, whose aim it is to contribute, together with the purely technical research, to the most economic utilization of existing timber resources.

This team has, for example, carried out a techno-economic survey of the forest products industry aimed at defining, against an economic background, the technological problems confronting the industry and at determining how scientific research could contribute to solving these problems. They have also carried out a cost accounting and cost control study for the sawmilling industry, which formed the basis for an interfirm comparison of manufacturing standards and costs in the sawmilling industry. Industrial engineering tasks are undertaken by this team to develop manufacturing systems and to assist with their efficient economic and technical application within the forest products industry.

An example of the work in this field is the development of a sawmill output measuring device that measures the length, width, and thickness of each piece of sawn wood that comes out of a sawmill. This machine, of which one prototype has been manufactured and tested, and of which the first production model has now been completed, will be very valuable for determining the efficiency of sawmills accurately and quickly enough to allow meaningful production control to be exercised.

CONCLUSION

In conclusion, it must be stressed that we live in a period of change and that researchers, especially research managers, will have to adapt to changing conditions. It will require, from many people, a new outlook on and a different approach to management of research and the tools required for carrying out R & D. Above all, researchers need to realize that they will play a major role in the economic and social development of the future world and that they owe it to themselves, their sponsors, and their countries to meet this challenge.

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