# Research management by objectives*

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**SYNOPSIS**

Scientific and technical research is becoming an expensive business, and needs to be managed as well as directed. Regardless of whether it operates under public or private auspices, a research-and-development organization should not tolerate inefficiency or irrelevance. Its true worth is ultimately decided by the impact it makes on its environment. Doing the right things is preferable to merely doing things in the right way.

Clear definition and the setting of goals form the crux of the Management by Objectives (MBO) system. This system provides the research establishment with a profound sense of purpose and direction, which is essential for effective planning and control.

Performance standards, in association with costs and manpower, value assessment, feedback, and improvement, tend to follow naturally once the principle of a results-oriented management system is adopted.

MBO is a participative management system, leading to decentralization and self-control of the individual rather than imposed control. If wisely implemented with the necessary respect for creative work, it can enhance the job satisfaction of the research worker as well as the overall productivity of the research establishment.

**SAMEVATTING**

Wetenskaplike en tegniese navorsing word 'n duur onderneming en moet nie net bestuur nie, maar ook gerig word. 'n Navorsing-en-ontwikkelingsorganisasie behoort nie ondoeltreffendheid of irrelevansie te duld nie, ongeag of dit onder openbare of private beskerming optree. Sy werklike waarde word uiteindelik bepaal deur die indruk wat hy op sy omgewing maak. Om die regte dinge te doen is beter as om bloot net dinge op die regte manier te doen.

Duidelike omskrywing en die daarstelling van doelwitte vorm die kern van die doelwitbestuurstelsel. Hierdie stelsel gee aan die navorsingsinrigting 'n diepgaande sin van doelgerigtheid wat noodsaaklik is vir doeltreffende beplanning en beheer.

Prestasiestandaarde, gekoppel aan koste en mannekrag, waardebepaling, terugvoer en verbetering is geneig om vanself te volg as die beginsel van resultate-georiënteerde bestuur eers aanvaar is.

Doelwitbestuur is 'n deelnemingsbestuurstelsel wat tot desentralisasie en selfbeheer van die individu eerder as bestuur van bo lei. As dit verstandig en met die nodige respek vir skeppingswerk toegepas word, kan dit die arbeidsvreugde van die navorser en die totale produktiwiteit van die navorsingsinrigting verhoog.

Research in the context of this paper is defined as the creative activity that provides solutions, hitherto unavailable, to problems. The direction given to research insofar as methods and facilities are concerned is generally accepted, but that it should be managed like an industry or other business enterprise is anathema to many. The management of research is even looked upon as counter-productive. Many scientists still regard the T'FAT syndrome (Total Freedom of Action and Thought) as essential for successful creative work. They usually claim that truly great scientists like Newton, Faraday, Maxwell, Kelvin, Einstein, and Heisenberg were under very little or no management constraints.

I am not going to comment on the degree of freedom that an Einstein should enjoy; in any case, there are not many Einsteins around. For the average research worker, intelligent planning need not reduce creativity, and, to illustrate this, I consider a typical research establishment with a programme related to a particular activity in this country.

## Costs of Research

Table I indicates the rising costs of the research financed by the State.

As salaries have remained roughly constant in real terms, it is somewhat perplexing why real costs have nearly doubled over one decade. Presumably scientists use more-sophisticated, expensive equipment these days. The burning question is: Has the research productivity gone up proportionately for the country as a whole? Moreover, will productivity go up concomitantly with the future rise in costs as anticipated by the figures shown? The answers to such important questions can be given only if science leaders are prepared to accept the necessity of introducing sound management principles into their organizations. If research is to become a high-priced activity, then inefficiency or ineffectiveness cannot be tolerated. There rests a moral responsibility on a research establishment to give the taxpayer or shareholder his money's worth.

## Manpower

Far more important than finances is the responsibility of a research establishment to make optimal use of the manpower resources entrusted to it. I deliberately use the word *entrusted* because technically trained manpower has become the scarcest of all our resources.

The crucial question that laboratory inmates have to ask themselves is simply this: How much worse off would our particular industry, agricultural activity, health scene, state enterprise, etc. have been if our research programme had not been around for, say, the past decade? What real measurable or estimated impact have we made on our environment? It should be noted that the answers to such questions would relate to *real* achievements and not necessarily to what had been written in the motivation for increased budgets.

Most researchers worthy of the name will perform their tasks as best they can. Formulating the problem, setting up the correct experimental and theoretical machinery, honestly recording the observations and applying logical reasoning are natural to a good investigator, but these activities are not enough. Of over-riding impor-

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TABLE I

THE COSTS OF RESEARCH AND DEVELOPMENT IN SOUTH AFRICA*

| Year | Cost R × $10^6$ | Cost 1970 R |
|---|---|---|
| 1966–67 | 36,8 | 42,1 |
| 1968–69 | 45,2 | 48,9 |
| 1969–70 | 59,2 | 61,5 |
| 1970–71 | 62,9 | 62,9 |
| 1971–72 | 75,3 | 71,1 |
| 1973–74 | 94,5 | 69,6 |
| 1975–76 | 141,9 | 84,6 |
| 1977–78 | 203,7 | 94,2 |
| 1979–80 | 276,8 | 101,0 |

* Figures supplied by the Division of Science Planning, Department of the Prime Minister.
For the period 1969 to 1979:
Real growth rate in research and development = 5,1 %
Real growth rate in gross national product = 3,9 %
Scientist man-years in 1969 = 4118
Scientist man-years in 1979 = 4603
Cost per scientist man-year:
1969 = R14 383 (R14 942 in 1970-rands)
1979 = R60 145 (R21 946 in 1970-rands)

tance is the selection of the right problem in the context of the environmental need and the available resources. Doing the right thing is more important than merely doing things in the right way. The *what* of research is more important that the *how*. Of course, the two concepts are mutually inclusive – it is the priorities that are important.

## Management by Objectives

Good organizational structures do not merely happen, or evolve. In fact, when left to themselves, the only things that do seem to evolve are disorder, friction, inefficiency, and eventually irrelevance. The right management system is not produced intuitively, but demands ruthless analysis of the prevalent weaknesses, creative thinking, and a systematic approach. I do not want to give the impression in the course of this talk that Mintek has a perfected cut-and-dried management system, but I do think we have identified what we want to achieve and how to set about it. Much remains to be done, and the constraints imposed by the remuneration system in the public sector are real.

In discussing Management by Objectives (MBO), one recognizes many elements in the system that have been adopted or tacitly assumed in research establishments. The formal adoption of such a management approach can be regarded as a means of introducing systematic thought to such elements. In a research laboratory, MBO is not a mere organizational technique but also an attitude of mind.

## Key Objective

The starting point in MBO is the identification of one's mission, which implies that an institution is not a thing in itself but a means to an end. It has to formulate a key objective describing its reason for existence. The key objective is the departure point for the structure, programme, planning, and ultimate estimate of the success of the institution. It must be formulated as clearly as possible. It is not an eternally fixed entity, but ought to change with its environment.

The key objective of Mintek will serve as an illustration:

> To promote the Republic of South Africa's gross national product, national security, and scientific and technological infrastructure and image through research, development, effective technology transfer, and information dissemination in the field of extraction metallurgy and allied disciplines.

This implies that Mintek's activities must be organized and managed in such a way that the work of each of its employees helps the country to make more money out of its minerals, to become more firmly entrenched as a world leader in the area of mineral technology, and to develop an immunity in the field of mineral products to possible boycotts.

The various divisions within Mintek obvoiusly have to set their unit objectives in similar fashion. For instance, the key objective of the Measurement and Control Division is as follows:

> To promote the Republic of South Africa's gross national product, national security, and scientific and technological infrastructure and image through research, development, effective technology transfer, and information dissemination in the field of measurement and process control of mineral-processing operations;

and in the Administrative Division it reads as follows:

> To promote the Republic of South Africa's gross national product, national security, and scientific and technological infrastructure and image through support of the work conducted by the research divisions of Mintek, by the provision of the necessary administrative supporting services and facilities.

From such a statement there emanate the various commitments and critical objectives, such as planning, organizing, and control, within the respective divisions. The paper* by James and Steenkamp on project management at Mintek illustrates more fully how MBO operates in one aspect of that establishment.

## Project Selection

In project selection and management, one needs to assess the potential for technology transfer right at the start. Ultimately, the decision to proceed with a project, say one that is essentially geared to an increase in gross national product, is based on the following equation, which, although not quantifiable, forms a good basis for qualitative reasoning and decision-making:

$$M \propto \frac{P_1 \times P_2 \times P_3}{C}, \text{ where}$$

$M$ = the merit of the project,
$C$ = total costs of manpower, equipment, materials, etc.,
$P_1$ = probability of technical success,
$P_2$ = probability of successful technology transfer,
$P_3$ = probability of commercial success.

A multidisciplinary approach is invariably required to projects in mineral technology, and the optimal interaction between the research divisions must be carefully planned at the outset.

## The Effects of MBO

Once a results-oriented management system has been adopted, the setting up of a suitable structure and the planning of the work to be done with a view to the end goals become automatic. The setting of performance

*Copies are available from Mintek Library.

standards in terms of manpower, equipment, and material costs, holding to time schedules, final results, etc., is essential, and corrective measures tend to follow naturally.

Easy teamwork is a byproduct of the MBO system because an individual in the organization knows what the ultimate aims are, and personal advancement is determined by his or her contribution to the total mission.

It is a participative management system in that staff members contribute to the formulation of goals, whether it is a proposal for a specific scientific or engineering project by a research worker, or a new data-acquisition technique (to update the material required by a scientist) emanating from the library. This, in turn, leads to decentralization and a concomitant delegation of authority downwards. The common end-view provides a maximum of self-imposed control and a minimum of control imposed from above.

### Conclusion

Staff members of a research laboratory naturally want to qualify as original thinkers. The simple use of known technology to solve a problem can be anathema to some. The NIH syndrome (Not Invented Here) often leads to expensive re-invention of the wheel, the latter not necessarily being an improvement on the existing wheel. When the end result is more important than the means of achievement, people tend to invest their time and talents only in those areas where their originality can make a useful contribution — that is, useful in terms of the ideology of the organization.

One final and very important comment concerns the effect of MBO on the job satisfaction of the creative worker. After all, success in research, although determined by many factors, is primarily dependent on a thing called *a new idea*, and that does not come from machines or systems, but from people; intelligent, at times sensitive, people with normal needs such as a desire for recognition, emotional and physical security, etc. It is my firm conviction that the most important contribution to human happiness is an awareness that what one does is relevant. In the context of a research organization, an awareness that one is contributing in one way or another to the realization of the corporate goal provides a sense of personal relevance, and therefore job satisfaction and maximum productivity under the given circumstances.

# Mineral science and technology

The Council for Mineral Technology (Mintek) will be celebrating fifty years of growth in 1984 and is organizing an international conference, MINTEK 50, on its areas of special expertise.

The following subjects will be covered in a series of technical sessions and excursions:

- Pyrometallurgy
- Hydrometallurgy
- Mineral dressing
- Mineralogy
- Control of mineral-processing plants
- Analytical chemistry in mineral processing
- Mineral and process chemistry
- Physical metallurgy

A number of international authorities in mineral science and engineering will be contributing to the conference, which will be held in Johannesburg in early April, 1984.

Papers which should stress the modern trends, are invited on topics in the above subjects. Titles and synopses (200 words) must be submitted by 1st October, 1982. Contributors whose submissions are accepted will be expected to supply extended abstracts (about two typed pages) by 1st July, 1983, and their full papers by 1st December, 1983.

The organizers intend to publish the proceedings of the conference as a special publication.

Those wishing to submit papers and those wanting copies of the first circular, which will contain more information about the conference, should write to The Conference Secretary (C.25), Mintek, Private Bag X3015, Randburg, 2125 South Africa.

# Ion exchange

The International Conference on Ion Exchange IEX '84 will be held in Cambridge (England) from 15th to 20th July, 1984. It is being organized by the Solvent Extraction and Ion Exchange Group of the Society of Chemical Industry, London.

Following the organization of very successful conferences on ion exchange in 1969 (London) and 1976 (Cambridge), a further meeting is being arranged. The conference will include water treatment, special ion-exchange applications, ion-exchanger developments, fundamentals, and hydrometallurgy. The conference and accommodation will be in a Cambridge college. Industrial visits, evening events, and a social programme will be arranged.

Intending authors are asked to notify the organizers of the nature of their papers. An abstract will be required by 31st October, 1982, and the full paper by July 1983 if accepted for publication in the Proceedings.

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