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## REQUIREMENTS FOR CONTRIBUTIONS

Articles in the field of agricultural economics, suitable for publication in the journal, will be welcomed.

Articles should have a maximum length of 10 folio pages (including tables, graphs, etc.), typed in double spacing. Contributions, in the language preferred by the writer, should be submitted in triplicate to the Editor, c/o Department of Agricultural Economics and Marketing, Pretoria, and should reach him at least one month prior to date of publication.

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# Contents


Page

I. PERSPECTIVE ON MANAGEMENT AND AGRICULTURE IN A DYNAMIC ENVIRONMENT : PAPERS READ AT THE TENTH ANNUAL CONFERENCE OF THE AGRICULTURAL ECONOMIC SOCIETY OF SOUTH AFRICA IN PRETORIA, 27 TO 29 OCTOBER 1971

1. Speakers ..... v, vi

2. Opening address ..... 1
   - J.A. Lombard

3. Management - perspectives, aims and approaches ..... 5
   - Allan G. Mueller

4. Farm business management - the dynamic approach ..... 12
   - S.D. Parsons

5. The management of research and development ..... 17
   - S. Meiring Naudé

6. Management in marketing ..... 21
   - A.J. van der Merwe

7. Managing agricultural extension ..... 23
   - C. Murray

8. The prerequisites of agricultural policy management ..... 26
   - W.E. Kassier

9. List of papers of introducers of group discussions during the conference ..... 32

II. STATISTICS ..... 33

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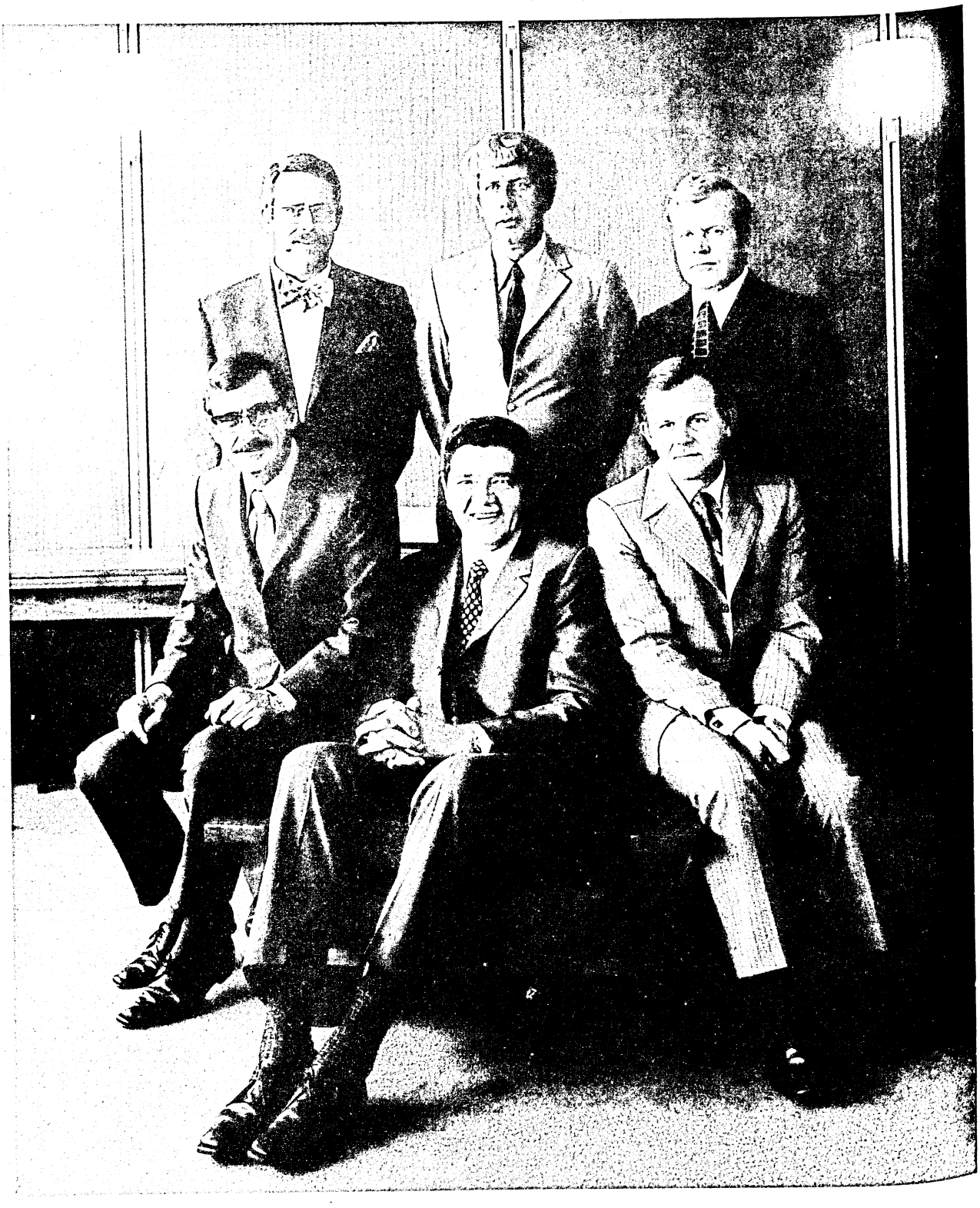
# 1971



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# The management of research and development

by

DR S. MEIRING NAUDÉ

In many of the industrially developed countries of the world which have in the past invested heavily in research and development, the criticism of late has been that too much money is being spent in this way. In many instances the reason for this critical attitude is undoubtedly the result of changed national strategies, but one begins to wonder whether, in some cases, it is not the research worker himself who is responsible for this change of heart!

In the circles where the financing of projects of this nature is decided, the question is being asked more and more often: Is the money allocated to research and development being spent effectively? - since those who supply the monies which finance research and development naturally want to know what return they can hope for on their investment and whether it is the best return they can get.

Perhaps one of the main reasons why research, as well as the financing of research has come under fire is that much of the research critisised was fundamental research and was never intended to achieve any particular practical results. Therefore, when research is of the type that achieves results which give scope for practical application, researchers must go out of their way to make these results known to those who can use them. In addition, they should welcome positive criticism from the potential users of their results since they have a knowledge of comsumer markets and of consumer demands.

I personally believe that research and development can pay high dividends, but I also realise that not everybody shares this opinion at present.

To my mind the onus is on the research worker to prove to potential users of research results that research is a tool which can be used very effectively by industry for successfully improving an industry's economic productivity.

To achieve results which can be applied in industry, both the research and its subsequent development must be directed or managed purposefully. Those concerned must tackle the job of managing research and development conscientiously, for once useful results have been achieved, it will be necessary for the researchers to sell their ideas to the manufacturer, to salesmen, to the government, to industry or to any other potential user.

In addition, they will then have to assist with the practical application of their results to ensure their ultimate successful implementation.

Although the principles of management are universal, it must be realised that the application of these principles is relative to time and place and is always influenced by the economic, social, political and technological factors of the environment, which differ from country to country. Nor do these remain static; the ideas and actions of executives of organisations which influence people's ideas and actions, change with the economic and social environment.

Management must be recognised as a separate discipline which must play its part in an atmosphere of interdisciplinary co-ordination. It is of the utmost importance that it should be biased towards research which will produce results, rather than towards research as an activity which does not necessarily lead to the right type of results. Research results of the kind required by industry are obtained only from activities which have an objective, which are well-planned, well-controlled and well-executed.

Management is partly an art and partly a science. Although the art of management is essentially inherent and can be improved upon by experience, a scientifically orientated management process can be acquired from formal studies.

Drucker[1] says "Knowledge organised in a discipline does a good deal for the merely competent; it endows him with some effectiveness. It does infinately more for the truly able; it endows him with excellence."

The following is a research and development management process which can be used as a guideline in working out a process which will serve a particular purpose. (This will be found in tabular form in the Appendix).

PHASE I

The first phase of this process, which is a prerequisite for all projects, is the formulating of objectives. If we do not know where we are going, we will not be able to reach our objective! If we aim at the second best, or even lower, the goal we are aiming at may not be worth achieving!

Our first function then will be to formulate realistic objectives which will bring the maximum advantage to the organisation concerned, taking into consideration the environment in which the organisation operates. For instance, at a university the aim of research is, justifiably, the gaining of knowledge in a particular field; also training

1) Drucker, Peter F. Managing for results, London, Pan Books Ltd., 1964

students in the art of obtaining knowledge and communicating their findings to others.

In industry, on the other hand, the aim will be to establish technical problems in their proper economic context by deciding along which lines research and development should take place to bring the maximum economic benefit. More and more, preliminary techno-economic surveys of the sphere of action are being used for this purpose.

PHASE II

The second phase is the management of research and the development of that research to produce results.

These can be achieved only by meticulous planning. Planning is therefore the first function of management; this is the preparation of a programme of future activity which, if followed, will fairly certainly achieve definite results.

The plan must make provision for each objective to be achieved in the correct sequence and in a limited period of time. It is probably difficult in the case of research to make an accurate estimate of the time required but it must be estimated as accurately as possible.

Obviously the time-scale cannot be left indefinite because every objective achieved has only a certain value, and if more time is spent on achieving an objective than it is worth, whatever the terms of measurement, then the results achieved are a loss rather than a gain.

Even at a university there must be a time limit for tasks, such as e.g. the completing of a Ph.D. thesis. A good Ph.D. thesis completed in two years must obviously be of more value than an equally good thesis completed in five years.

The second function of management is organisation. Organisation is the determination of the structure and allocation of jobs. It involves the grouping of those activities which are necessary for the implementation of plans, and the attainment of goals; the assignment of these activities; provision for the delegation of authority in this regard, and the co-ordination of these activities.

Great advantage can be obtained if working groups are made up of staff trained in different disciplines, as this provides the team with the maximum available knowledge.

In this regard it is important that research and development should not depend on people with a multi-disciplinary training. Those involved must have been trained as scientists and engineers in specific disciplines.

For instance, if problems involving several disciplines in the field of pollution and environmental engineering have to be tackled, use should be made of multi-disciplinary teams. No one person can receive a basic training wide enough to be able to deal with such problems on his own or to carry out research alone in such fields. The aim should not be to develop a pollution engineer out of one with a basic engineering training but to use a team of engineers, physicists, chemists, etc. to solve pollution problems.

The third function of management involves staffing. Staffing is the process by which managers select, employ, train and promote people necessary to do the work, and dismiss or retire those who are inefficient, incapable or redundant.

Research is expensive since effective research can be done only by the best brains available in the country. The training of research workers, either at a university, a research organisation or in industry costs a great deal.

The poor researcher has no ideas and is biased. Not only is his output poor and limited but at the same time he saps the energies of the good researcher who has to keep him going.

To solve problems or to develop new activities in a limited time, requires imagination. A researcher must know on what and with what he is going to work. He must be original and must be unbiased. A good research worker therefore is one who not only has good ideas, but one who can develop ideas effectively.

The fourth function of management involves directing the activities which will bring about the realisation of the set objective. Directing is the giving of authoritative instruction which will guide, regulate and bring about the purposeful action of people so that the formulated objectives are achieved.

A balanced research organisation is dependent on good contributions from all its workers. First and foremost we must realise that there is no alternative to the enthusiasm and drive which are the prerequisites of a good researcher.

But we must beware of the manager who considers himself capable of doing everything in his organisation. He is one of the biggest bugbears in research organisation. The successful research manager will realise that he requires people with better brains than himself in the specific fields involved.

The fifth and last function of management is control. Control is the process of measuring current performance and guiding it towards a predetermined goal.

Control is the appraisement of progress, i.e. measuring the quantity and quality of results in relation to the initial objectives and plans.

The good manager will foster the research worker who has the ability of looking very critically at his project. In assessing his progress, he will not hesitate to change or stop a programme should this prove necessary.

The third and last phase of research and development is the application of results. The first function in applying the results of research con-

sists of disseminating the results. The dissemination of results can be achieved by publishing, conducting symposia, replying to enquiries and incorporating research results into specifications and codes of practice.

The second function consists of assisting industry and consumers with the practical application of research results. It is considered of the utmost importance that the researcher should himself give this form of assistance to industry.

As regards the application of research results, it is important for the potential users of technical innovations to be made aware of the value of local research and development to their own organisations and to South Africa.

(1) Industrialists in South Africa often look to other countries for solutions to their technical problems. They sometimes find that the same or similar problems have already been solved in some other country, but by seeking the answers elsewhere, they perpetuate the gap which often exists between local scientists and industry.

This leads to a vicious circle. The scientist lacks experience in applying his findings in the industrial sphere and is frustrated because he is not recognised by industry.

The industrialist, on the other hand, has no confidence in the scientist who lacks experience.[2]

"Know-how" and licence agreements with overseas organisations often have very real disadvantages - they are sometimes extremely costly and, what is even more important, they usually contain some very restrictive clauses. It is customary, for example, for these agreements to restrict the operations of the licensee to a certain geographical area and to deny him the right to export.

Furthermore, they usually stipulate that any additional innovations which the licensee brings about, become the property of the licenser.[3] There have been cases where South African industry has bought antiquated processes from overseas companies, which only worked effectively after extensive research and development had been done by local engineers and scientists.

(2) It is becoming more and more evident in many countries that the skilful use of research and development can, and should, play a leading role in a country's planning and technological development. This can be achieved by multi-disciplinary, techno-economic research teams, whose aim it is:

(a) To exploit opportunities rather than solve existing problems.

(b) These teams can be used not only in the planning and appraisal of research but they can also be of assistance with the application of research results.

(3) In Australia and Canada it was realised some years ago that it was essential to reallocate the money spent on research and that technological innovation in industry must be encouraged.[4]

In the USA a specialist committee of the Department of Commerce in 1967 carried out a detailed survey of inventions and innovations in their country.

Their most important recommendation was: "The major effort should be placed on getting more managers, executives and other key individuals - both in and out of government - to understand and appreciate how technological innovation is initiated, financed and managed into new technological business that grows, provides jobs and satisfies people."

It is interesting to note the major difference between these two approaches. While Australia and Canada depend on state contributions for the promotion of technological innovation, the American approach emphasises an understanding of the benefits of technological innovation which is independent of financial assistance from the state.

In our own case, efforts will, in the first place, have to be concentrated on educating industrial managers to realise that economic benefits can accrue to them from the successful application of research and development results. This is the only way to ensure that these managers will take the initiative in their own organisations in this respect.

(4) The economic prosperity of a country's industries, and even of individual organisations, depends on the ability of its managers to get the most out of the application of the existing means of production, i.e. the application of research and development with maximum productivity as its aim. Traditionally, the essential factors for production were considered to be capital, labour and raw material. It is obvious that higher productivity is obtained by the more effective utilisation of these production factors and in this context the use of technology, which is a creative factor, should now also be considered as a production factor.[5]

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2) Morkel, A.T. Tegnologiese innovasie, Inaugural address. School of Business Leadership, UNISA, Pretoria, 17 April 1969

3) Scientiae, Rig op Resultate, Vol. 10, no. 5, pp. 2-8, Pretoria, CSIR, May 1969

4) Visser, J.H. Die bevordering van produktiwiteit in S.A. met besondere verwysing na die ingenieursberoep. Talk delivered at the General Meeting of the Pretoria Branch of EASA, 13 August 1969

5) Bosman, D.L. Research and development - a prerequisite for economic progress in industry. Paper presented to the Second Summer School for MBL II 1969, School of Business Leadership, UNISA, 9 September 1969

I should now like to direct my final remarks specifically to an example taken from the field of agriculture. In the developed countries during the past twenty years, agriculture has shown the greatest economic growth. In the USA it is expected that agricultural productivity, which has increased almost twice as rapidly as that of manufacturing, could expand at an even greater pace in the next ten years.

In the past, success is said to have resulted from the rapid expansion of agricultural technology which made it increasingly possible for a small number of highly trained, highly equipped "commercial" farmers to produce very large outputs.

In the future, however, increasing productivity is expected to come mainly from the application of the "systems approach", i.e. considering each part in relation to the total system. Consider, for instance, the cultivation of tomatoes from the planting of seedlings to the packaging of the ripe fruit for shipment. This is being done by the parallel development of varieties of tomatoes suitable for mechanised cultivation and machines suitable for tomato planting, harvesting, sorting and packing.

I fully realise that conditions in South Africa differ vastly from those in the USA and that we cannot apply their new developments directly, but the indications are that we shall be in a better position to maximise our success if we apply the "systems approach" and combine our knowledge of science and agricultural engineering to help us to attain our objectives. These objectives will have to be very well selected and defined and will have to include the practical applications of the results of research. In your particular case, this means that you will have to improve the economic aspects of agriculture.

## APPENDIX

### THE PROCESS OF MANAGING RESEARCH AND DEVELOPMENT FOR THE ACHIEVEMENT AND APPLICATION OF RESULTS

| Phase | Functions |
|---|---|
| I<br>Formulating objectives | 1. Formulating realistic objectives of maximum advantage to organisation |
| II<br>Management of research and development projects for the achievement of results | 1. Planning<br>2. Organising<br>3. Staffing<br>4. Directing<br>5. Controlling |
| III<br>Application of results of research | 1. Disseminating results<br>2. Assisting industry and consumers with practical application of results |