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PURPOSES AND QUALITY OF GRADUATE EDUCATION IN THE MANAGEMENT SCIENCES*

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Preface

The questions asked in Professor Churchman's letter of November 17, 1969, sound simple enough, but it would take a book to answer them fully. They are questions fundamental to the future of the management sciences. The statement below attempts to summarize the purpose and aims of the OR/Systems Section of the Department of Industrial Administration in the University of Aston in Birmingham, and to relate these to present and planned graduate courses. Since the present courses commenced less than two years ago and planned courses are some way off, most of our aims have yet to be achieved.

1. Introduction

The phrase "graduate education in the management sciences" might be taken to refer to graduate studies in any one of the many sciences relevant to management. This would seem too wide a field to discuss coherently and we are limiting ourselves to the collective term "applied management science," which draws on all those sciences to solve management problems and to design management systems. Thus, we exclude at the one end the specialist in particular academic disciplines, such as economics or psychology; at the other end we exclude management technicians, i.e. those concerned with routine or standard applications of techniques on behalf of operating management. This leaves us with a group that is more or less synonymous with the broadest interpretation of interdisciplinary operational research and systems analysis.

2. Purposes

At Aston we see the broad purpose of our educational activities in the management sciences as being the improvement of the management process, building especially on experience of operational research in larger industrial organisations over the past 20 years and of systems over the past 5 to 10 years. More specifically, we are concerned with British management (thus being concerned with the management and management science cultures we know best), and with industry more than public administration, because the former is where we have the greatest accumulated experience so far. We are very much concerned with the marriage of theory and action, which we see as the key to improvement, and we are concerned with short and medium term rather than long term results, because we hope to some extent to be able to see the end effects of our activities and modify them accordingly. In the main, we are concerned with improvement through the scientific use of knowledge and ability already existing or being created.

3. The Resources Involved in Improving Management

We see four main groups of human resources in this task:

(a) The Managers. } Working mainly within
(b) The Applied Management Scientists. } industrial organisations

* Received May 1970.

(c) The Management Teachers. } Working mainly within
(d) The Management Researchers. } academic institutions.

We believe that each member of the quartet has a key role in the task of improving ways of managing, but that they do not understand each other very well and seldom play in complete harmony. The views they hold of each others roles seldom match, and in particular, the management scientists, who surely have a central role, are often overlooked by the other three, although they pay much lip service to the management sciences and especially to quantitative techniques.

4. More Specific Aims

One aim of our activity is therefore to increase the understanding within each member of the quartet of the relevance, scope and methods of each of the other three, to give a better insight into the nature of partnerships possible between them and to show the importance of such partnerships. This is reflected in our teaching to management courses and in staff seminars and joint research ventures with our management teaching and research colleagues.

A second aim is to study the application of the management sciences in organisations and to find which ways are most effective, looking at such variables as organisation structure, role definitions, management styles, career patterns, and levels of education and training for management scientists and managers.

These two aims are concerned with trying to improve the environment within which the management scientist works, and do not impinge *especially* on the education of the management scientists.

Our third and major aim is to provide education for the applied management scientists such that they can live up to the demands of their role as we see it.

Our fourth aim is to study career patterns for management scientists, so as to show how they can best plan for useful and satisfying work over their whole careers, making full use of experience gained at each stage; and to provide appropriate post-experience educational facilities for them to aid their career development.

The last two aims concern directly graduate education for applied management scientists and are discussed further below.

5. The Applied Management Scientists

Our concept of the role of the applied management scientists was defined in §1. We see it as based on the original concept of the interdisciplinary OR team, armed with appropriate OR and systems techniques, but broadened further to include others who do not regard themselves as primarily operational researchers or systems analysts. The task is to solve management problems and to design or redesign management systems, and this calls for a coherent and comprehensive grouping of people with a wide range of backgrounds but a common ethos. We see five main components of knowledge and skill needed to do the job.

(i) "Classical OR"—problem solving from fundamentals using the scientific method; emphasises the research approach in an action context; a skill often derived from research in depth in a particular discipline, but developed also in the best OR training; embraces problem formulation, model building and validation, solution and implementation.

(ii) Technical OR—the skilled application of any of the recognized OR techniques

appropriate to the problem; requires basic mathematical knowledge plus skill based on experience; becomes dominant in "well-researched" problem areas where relatively standard solutions are applicable; may be valuable in unstructured problems in solving parts of the problem and reducing the complexity of the main unstructured area.

(iii) Contextual knowledge—knowledge of theory and practice relevant to the context of the particular problem under study; may be obtained in part by including suitable operating managers in the team, or by intensive study by one or more of the management scientists concerned (this emphasises the need for management scientists to have the ability to learn new subject matter, i.e. the need for the quality of *scholarship* in professional management scientists. But the nature of the management scientist's task is becoming too advanced for these methods alone to be adequate and he needs increasingly to have some basic knowledge relevant to the general area in which he is working, so that he may effectively seek out and use relevant, detailed knowledge. In the industrial management context, this may cover any of the theory or practice of management as taught in graduate schools of business.

(iv) Dynamics of Social Change—application of social skills and relevant knowledge to the process of organisational change involved in implementing results or installing new systems; this used to be considered a separate management problem, but it is increasingly difficult to disentangle from problem solution and system design.

(v) Integration—combining the above four components through good project management to obtain results economically and effectively and to appropriate deadlines. Encompasses the spectrum from research through development, design and installation to final operational testing; analogous to project engineering.

Our view is that a management science group in which all senior members had a good basic appreciation of each of the five component areas, and in which each individual had knowledge and experience in depth of one or more of the areas, could be most effective in carrying out the task we have described. Further, we think that it could and should be able to carry executive responsibility for "managerial innovation" in appropriate situations, as does an engineering design or product development team in the fields of "technological innovation."

6. The Concept of "Innovational Management"

It is necessary here to introduce briefly a tentative hypothesis which affects our approach to education for management scientists. This suggests some division of function between two parts of line management—into the "operational" and the "innovational" management. Operational managers would be highly skilled at running existing management systems; they would also be trained to adapt readily from running one system to running another as the jet airliner pilot adapts to different planes and different routes. The innovational manager would be the man responsible for the development and design of new systems and for their installation and "commissioning"—by analogy with the plant engineers for example. These two kinds of managers both with full decision-making and entrepreneurial powers would be able to develop the rather different groups of skills needed for the two kinds of situation. Each kind would be given some experience in the other area but could not usually be expected to be really proficient at both; there would of course be exceptions to this.

As one went higher up the organisation, posts would require a greater combination of operational and innovational skills, there would be scope for people from either side to move to the top.

Thus, the present two groups, managers and management scientists, would be regrouped into three:

Operational managers—drawn from the present line management.

Innovational managers—drawn from the more innovation minded of present line managers, and from the more entrepreneurial and action-oriented management scientists.

Advisory staffs and specialists—these would be drawn from the less action-oriented management scientists, who would provide advice and service, mainly to innovational management but occasionally to operational management undertaking minor innovation.

Such a system would seem to allow for various kinds of partnership between management and management science in managerial innovation. We can think of four off-hand:

(a) Manager as superior, management scientist as subordinate.
(b) Manager as decision-maker, management scientist as staff adviser—equal status but no decision-making authority or responsibility.
(c) Partnership in innovation—the "change agent" role described, e.g. by Bennis.
(d) Operating manager stands aside while management scientist as innovation manager carries full executive responsibility for installing and commissioning new system (as described in previous section).

We feel this new look at management roles could lead to more effective innovation and also to more satisfying career patterns for both managers and management scientists. It would however require recognition that the management scientist would need certain kinds of training and of experience at appropriate stages in his development to suit him for his future career. With this in mind we can now extend our list of five components of applied management science—which took us as far as project management, but not necessarily to the commissioning of the new system, i.e. the initial operational management of the new system.

We think it particularly important that applied management scientists should be able if necessary to demonstrate in practice that their new systems work as predicted. This means that innovational management must have sufficient skills at operational management to survive a short commissioning period, if necessary. Thus, the management scientist wanting to move on through innovational management to perhaps general management needs three further sets of skills and knowledge:

(vi) Sufficient management ability for the commissioning period, as described above. This may be derived from earlier periods of operational management plus some basic training in operational management skills then, perhaps later on,
(vii) Ability to manage programmes of innovation, e.g. as director of management sciences and systems. Derived partly from experience gained in managing progressively larger numbers of management scientists and working with operational managers at various levels; supplemented by appropriate advanced management and technical courses and, at a later stage again,
(viii) General management abilities—derived from experience as member of the top management team plus further advanced courses in general management.

7. Careers for Management Scientists

We come at last to the three questions raised in the original request for this statement. We take them in reverse order, careers first.

As we see it, an education in applied management sciences is intended to assist a man in due course to be a senior innovational manager and ultimately a general manager, if he makes the grade and if he wishes to go in this direction. Similarly an education in management should enable a man to move through operational management to senior operational positions and ultimately to general management. Both paths allow a wide variety of specialisations and both allow alternative career patterns, e.g. into teaching or consultancy or, for the management scientist anyway, into research. In both cases the small fish in big pool versus big fish in small pool alternative is available. For the management scientist, the main difference from present practice is that he can see himself carrying increased responsibility as his technical ability increases, rather than working towards a high status but purely advisory role. We believe this is likely to lead to greater job satisfaction and also to attracting into management science people more likely to make an impact on the practice of management. We also feel that recognition of the innovational management role will enable many management scientists to experience both innovational and operational management at various levels and choose the mix they prefer—which in some cases may mean a move to operational management after the first flush of enthusiasm for innovation.

There has been discussion in recent years of starting new careers at 45 (Peter Drucker). We feel that many management scientists making their initial careers in industry as innovational managers may want to transfer to the more difficult areas of social administration, and for that matter that the operational managers in industry may wish to do the same. Educational programmes would again need to be available to aid these transfers.

8. Educational Programmes for Management Scientists

A first basic point is that society must become convinced of the need to invest as heavily in developing its applied management scientists as it does, for example in training its nuclear or space scientists. The problems of social and managerial innovation appear to be more difficult and more urgent than the problems of technological innovation, but we are not giving our applied management scientists a doctoral training, let alone a post-doctoral training typical of the natural scientists. We need to press for financial support for two or three years of academic training for the average management scientist.

The second point is that for applied management science the organisation is the laboratory and the research training needs access to the laboratory. This means that advanced training must be planned collaboratively between sources of finance, academic institutions and the organisations which *constitute* the laboratory.

The third point is that, even more so than in technological science, the academic training needs to be spaced through the career of the individual and not concentrated at one point right at the beginning.

In Britain government agencies support this thinking to a fair extent and advantage can be taken of, for example, deferred industrial studentships. Many problems remain however.

At Aston, we do not mount the typical one year full time Master's course in OR for new entrants. This is for two reasons. First, we believe the only material readily assimilated, before the student has experience of tackling real problems in a real management context, are the quantitative techniques, and we believe it is almost impossible to teach the techniques at this stage without giving the student a built in feeling that the main job of management scientists is to apply such techniques rather than to solve problems as they arise in all shapes and sizes. Secondly, where such courses attempt to provide realistic problem-solving situations through undertaking industrial projects on a consultancy basis, we believe the problem-solving experience to be rather less realistic and valuable than similar experience gained as a junior member of an internal OR group in a company. We consider the ideal early development of an OR scientist to be one or two years in such a group, with access to such techniques as are found necessary by the individual during this period, after which the individual should have a full time course of say one year duration in which as far as possible he may select subjects of study from the very broad list of materials under our headings (i) to (v) in §5. This selection would be based on his experience so far plus guidance from his industrial supervisor and from the university.

Such a course requires very broad and high standard facilities, since the entrants would be "high fliers" with very good experience. We do not yet have facilities for such a course. Meanwhile, we have started with a part time course in OR (one day a week for two years) for new entrants to OR groups within a 50 mile radius of the university. This course sets out to provide an elementary understanding of the main techniques, background knowledge in economics, accountancy and other management topics, and some formal understanding of the methods of OR. Half the time, however, is spent in seminar discussion in which the live projects of the course members (who must all be in full time OR employment) form the main material for discussion. Students and staff combine in groups to tackle the more difficult part of each course member's live problem.

Seminars also cover discussion of the management science literature and attempt to relate this to the working environments of the course members. This course will lead to a postgraduate Diploma and we are considering a possible extension to Master's level for students who pass it sufficiently well. This would consist of a research project related to one of the five areas listed—for example, an evaluation of the cost effectiveness of different techniques in certain problem areas.

This would not fill the need expressed earlier for a one year full time course, across the whole applied management science range, which we believe is desirable for the good OR man with two to three years experience in a good learning environment. If we are to offer such a course it is now clear that many entrants to it will have already obtained a Diploma or a Master's Degree based largely on the OR techniques. We therefore need to be able to give a higher degree than Master's, but at present the only alternative is a Ph.D. and traditionally this is given for research rather than a very broad ranging course. The course would be something like an M.B.A. for Management Scientists—bearing in mind the level of training and experience at entry, a one year course should be able to reach at least the level generally associated with a two year M.B.A. We are still seeking solution to this general problem.

We are also considering a more advanced course of say three months duration for men with five to ten years good management science experience in industry who have risen to positions of some responsibility, such as Head of OR or Systems or Head of

Management Services. This would be an intensive course something like those run in some American Business Schools for fast rising managers approaching general management, but with an emphasis suited to those coming from the innovational management rather than the operational management side, e.g. less appreciation of quantitative and scientific methods, information systems etc. (which the innovational men have covered very thoroughly by this time) and more appreciation of political decision-making, broad policy-making etc. (in which the innovational man is likely to be relatively deficient).

We have two other courses relevant to the management sciences. First is a one year full time Master's Degree in Systems Analysis for entrants with two or three years industrial experience preferably in systems or management. This covers the psychology of man/machine systems design, business economics and accounting background, computer systems technology and Operational Research techniques. The output of this course should be able to make a useful contribution to a broad applied management sciences activity. The second is called the Interdisciplinary Higher Degrees Scheme, being a new type of Ph.D. program which involves the use of applied research methods in two or more specified disciplines to the solution of an important problem in an organisation. The program is intended to enable high quality specialists in particular disciplines to convert to a broader problem-oriented career in industrial management. It is for the man whose skills are in the research approach rather than in learning a wide range of subject matter, and it appears likely to produce men who could enter applied management science groups with a particular strength in the first component of §5—that we called "Classical OR". This scheme is being administered by us on behalf of all Faculties in the University, but there is considerable interaction between the research students on it and our own course programmes.

Our implementation so far in all the areas described is a long way behind our purposes and aims, but we feel we are moving in the right direction.

9. Individuals Entering Applied Management Science Programmes

We feel the essential requirements in applied management scientists are: the ability to bridge the theory/action gap at a fairly high intellectual level; a strong sense of curiosity coupled with the ability and desire to get things done; an interest and ability in team work both with professional colleagues and with managers and laymen; considerable drive and initiative and refusal to be beaten by difficulties. Some industrial OR groups have been very successful in recruiting this kind of person and courses based on men already recruited to OR in this way benefit from this selection process. It seems likely that academic courses which precede OR experience attract a different mix of individuals which may be less suitable for the applied management science tasks we have outlined. Our own part time programme in OR relies on industrial recruitment of OR men, and where the firms have no previous experience of OR they do not necessarily recruit the right type. We therefore offer assistance to such firms in the recruitment process.

There is pretty wide scope for a range of kinds of individual in applied management sciences, but the characteristics we mentioned earlier are probably needed in most or all of them.

10. Conclusion

Diversity in individual characteristics, in educational programmes, in career patterns, and in forms of organisation seem to be not only inevitable but desirable in the management sciences. This makes it very hard to set out a coherent statement on the subject. Simple standardised solutions seem bound to be wrong whatever their nature. It is indeed a difficult subject to pin down and discuss. Perhaps we do need a book to set out the various arguments and possibilities.