



Management Science

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Management Science in the 1980s

A plenary session of the TIMS XXIV International Meeting held in Hawaii (June 18–22, 1979) was designed to discuss (from a world-wide perspective) probable and possible directions of the management sciences in the 1980s. The ultimate intent of this panel meeting was to publish a set of proposals for serious consideration by the members and officers of all OR/MS related societies.

To emphasize our interest in comparative management science, Roger Layton from Australia, Bill Matsuda from Japan, and Bertil Näslund from Sweden agreed to present their opinions. Herewith is the beginning of our effort to formulate a management sciences charter. *MANAGEMENT SCIENCE* welcomes other viewpoints, and especially those that reflect national perspectives from all over the world. To start such a body of comparative management science was a primary purpose of the first plenary session. At that time we agreed to encourage similar sessions at future international meetings of TIMS.

MARTIN K. STARR
*Moderator of the
Plenary Panel*

Management Science in the 1980s—from Roger A. Layton, Australia

1. The primary thrust of management science over the next decade should be to contribute to the knowledge needed to manage large, often loosely coupled, social systems operating in a turbulent, complex environment, one in which change is frequently characterized by major discontinuities. For the most part management science has been primarily concerned with the problems of managing organizations in a static or at least a statistically stable environment. This past emphasis was a valid response to the perception that many managers had of the nature of the important problems to be solved, and generated a considerable literature on normative decision

making. However, during the last few years, managers in both the private and the public sectors began to see that the social systems they were concerned with were entering a more turbulent and complex environment, one in which substantial limits, environmental, political, social, or economic were perceived as emerging to channel or modify future systems growth.

An increasing awareness of the possible existence of these limits on the part of many of the participants or stakeholders in organizations or social systems tended to change the distribution of power within such systems and also within their immediate environment. These and related changes have in turn created a deeper interest amongst management scientists in behaviorally based concepts of optimization, multiple objective decision procedures, the handling of fuzzy information flows, the impact of added dimensions of information needs and interactive capacity on data management and decision networks, and in the implications of a much increased interdependence amongst system components.

2. Turning now to the future, it seems clear that while the normative optimization models that have characterized much of OR/MS in the past will remain important and deserve greater development, the real need will be for a deeper, richer conceptualization of the management challenges arising from the organization—environment confrontation, one that integrates and develops the currently diverse themes of optimization, multiple objective decision making, fuzzy information and system interdependence. Such an approach will combine an analytical theory of complex systems behavior in turbulent environments (a theory that goes beyond the comparatively trivial in its concepts) with a well integrated blend of behavioral and normative insights into individual and group decision processes. Developing such a conceptualization and winning acceptance of its validity as a basis for informed managerial decision must be the major step if OR/MS is to remain relevant to the manager of the 1980s. And the goal of relevance must be one of the primary goals that our societies should pursue.

3. The need for an analytically based understanding of the behavior of large, loosely coupled systems operating in a turbulent complex environment has never been greater. At the level of the nation, the challenge to the democratic process offered by the emergence of distinctive and powerful minority groups, coupled with the disappearance of a social consensus as to overall goals, the increased difficulties of data management, the increasing need to integrate expert judgment and knowledge into the process of social choice, have all combined to create a need for new theoretical insights and an awareness of the limits of social organization. The challenge can be seen in the management problems of cities such as New York, and in the search for an optimal (or perhaps satisficing) path towards economic growth on the part of the managers of underdeveloped economies.

At another level, similar challenges to the effective management of social systems arise in the design and operation of such inter-organizational systems as are found in distribution channel networks, health delivery systems, and industry groupings (such as airlines) that, while inherently competitive, are nevertheless linked by a great deal of common interest. Not only must the participants in such systems have a much better understanding of the systemic setting in which they take decisions, but so also must the public managers who would regulate the workings of these systems. The adoption of a narrow perspective by public managers has on occasion led to regulatory interventions

that are counter productive, not only in failing to control the activities that are causing concern, but also in adding cost burdens that would not otherwise arise.

At yet another level, that of the single, large organization (public or private) the task of managing has become much more complex for the kinds of reasons suggested above. The pressures for participation, for example, on the part of internal or external stakeholders (e.g., employees, public directors, etc.) have generated new stresses that have to be modeled if they are to be understood. Decision making less and less approximates the traditional, normative model and becomes multiple objective, and multi-person, with a much increased emphasis on the design of information and decision networks to cope with marked discontinuities in the environment. The interaction between organization and environment becomes a central concern of management.

4. While the need for the theoretical analysis described above exists, and will become more critical, our understanding of the behaviour of such systems is still limited, and it is in this area that OR/MS must encourage fresh and insightful work. Some of the threads that must be drawn together are likely to come from work in the following areas:

- a. The concept of environmental texture; initiating a search for a richer taxonomy of system environments; the exploration of entropy based models of environment.
- b. Modeling of the organization environment interface in greater richness; drawing on the contingency approach that has characterized much recent work in organizational theory; exploration of interface design in other cultures (e.g., China, Japan).
- c. Dynamic modeling of the distribution of power/influence in complex systems (e.g., marketing channel models); analysis of bargaining and negotiation situations.
- d. The design of decision networks that will handle strategic as well as tactical decisions in a turbulent, discontinuous environment.
- e. The theory of fuzzy sets as a way of handling the imprecision characteristic of many elements in the decision making process.
- f. An exploration of catastrophe theory in the search for an understanding of social system discontinuities.
- g. The development of operational concepts for large systems such as connectivity, variety, stability, and self regulation.

5. The challenge to our Societies offered by this marked shift in emphasis in our discipline will be multi-dimensional:

- a. For each of us the instinctive desire to draw on experience for quick assessments of new ideas will have to be resisted. This will be especially true for those concerned with the professional journals in the field, where an active rather than reactive set of policies will be needed.
- b. Just as we search for organizational forms that are quickly and purposefully responsive to environmental changes on behalf of external clients, so we must look to the organizational forms most appropriate to a discipline that has to be at the cutting edge of change. This will not always be easy to do, or to introduce, for few of us are really comfortable with continuous change. Nevertheless, since the OR/MS Societies play a vital role in the generation and dissemination of new knowledge, we cannot allow organizational rigidities in our own structure to impede performance in this area.
- c. To the extent that we succeed in focussing on the macro issues that I have highlighted, the gap between the scientists and the managers may well become much

greater. Our Societies must initiate educational developments that will match the emerging insights. This too will require the creation of a loosely coupled social system embracing the Societies, Governments, Universities, and Business Organizations. In a real sense, then, we are searching for the design of a learning, self regulatory system in which we can play an integral part. It would be temptingly easy to see this simply as an intellectual challenge. To do this would be to deny our Societies a future in the real world of the manager. Instead, we should take the initiative, using the insights developed to bring managers and management scientists closer together within the setting of a genuine learning system.

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Management Science in the 1980s—from Takehiko Matsuda, Japan

More and more interactions, of both a technological and social nature, among intra- and inter-organizational decision-making agents are likely to characterize the human activities in the 1980s. Some forms of such interactions are considered in the following, and some possible ways for management scientists to cope with the problems arising from such interactions are suggested. The presentation is largely based upon a projection into the 1980s of the managerial problems experienced in the Japanese settings in the private as well as public sectors, but some part of it could be generalized in such a way that fits any area of the world and any time in the future.

1. Careful temporal sequencing in consuming scarce resources should be planned in terms of the long-sighted strategy. It is essentially a matter of trade-offs between the immediate goals and the long-range objectives within the framework of the dynamic sequence of decisions. However, setting of the long-range objectives is dependent upon our foresight into the distant future, and such foresight in turn is dependent upon our capability in predicting the remote future events. Thus, development of effective means of predicting the technological advances and the social changes in the reasonably distant future should be one of the central concerns of management scientists in the 1980s.

2. Role of factual information in organizational goal-structuring should be examined. The conventional management science models usually take the organizational goals as exogenous to the system; that is, the goals are supposed to be provided from outside of the system. However, in the real world problem some goals, especially the strategic ones, tend to be endogenous; namely the strategic goals are quite often generated within the system. And what goals are generated is likely to be strongly contingent upon the type and amount of factual information which the decision-making agent has on hand. Therefore, such an effective management information system that would provide the decision-maker with reliable "outside" information through scrupulous environmental scanning is necessary. Management scientists could be useful in interpretation of such external information in addition to thorough processing of the internal information.

3. Resolution of conflicts among multiple decision-making agents should be impartially executed. That is, group decision-making problems should be tactfully dealt with.

Careful study of such interactions among the agents concerned will indicate that there exists a spectrum of mutual relationships among the group members, ranging from outright conflict to strong coalition. Furthermore, dynamic change is likely to be observed in the coalition structure of the group. Such change may result from delicate shifts in the coalition formation which, in turn, may be due to changes in coalition members as interactive situations develop along the time axis. Thus, management scientists may have to grapple with such a dynamic sequence of group decision-making problems.

4. Effective means should be developed to deal with the choice of the value systems by the relevant decision-making agents. It has so far been tabooed in scientific arguments to step into the realm of value judgment. Value has been presumed to be the object of philosophical arguments, and in conventional management science studies value is taken to be fixed and given. But consequences of choice of a specific value system from among conceivable value alternatives might be compared through the use of reliable management science models. Although the direct comparison among different value systems may be rather difficult, comparison among those consequences which result from the choice of specific objective functions based on different value systems may be somewhat easier. Such comparative information may be of great help in reaching a group decision.

5. Causal structure of the decision-making environment should properly be taken into consideration. Environment in management science studies, so far, has usually been taken in its "solid" entirety, but it may be causally structured. To elaborate, a system, in its interactions with the environment, could exert a certain impact upon an element of the environmental system, and such an element could in turn exert a further impact upon another element of the environment, and so on. Thus the initial impact may be amplified or attenuated as the impacts propagate through the causal structure of the environmental system. In some cases such propagation may take a circular route and create an unexpected counter-impact upon the original system itself. Court cases in environmental pollution may provide pertinent examples.

6. Large uncertainty of the type with probability distribution unknown should adequately be dealt with. Such uncertainty may constantly be experienced in times of environmental turbulence which may be characteristic of management in the 1980s. Sudden, drastic changes caused by certain discontinuities in the environmental system invalidate the conventional planning methods. For instance, business conditions may be directly linked with turbulent turns in the economy and politics in the international setting. Daring risk-taking may be needed in the face of such uncertainty. Generally speaking, the range of outcomes contingent upon the range of possible environmental changes and/or possible action-alternatives should be identified by means of an "experiment" with analytical and/or simulation models. Sensitivity analysis on such models or observant scenario writing may greatly help the decision-making agent in assessing the risks due to such large uncertainty.

7. Models of decision networks for crisis management should be developed. A certain amount of shocks to the system seems unavoidable in these days of environmental turbulence, and such shocks tend to produce a serious crisis in the system. So the system must have reliable decision network models in order to deal effectively with such a crisis. The information system model must be sensitive enough to properly detect the vital trigger information. The decision system model must be so sensible as

not to amplify the shocks in the course of their propagation through the causal structure of the system. And the action system model must have such stabilizing capability that makes the system restore its equilibrium state after the crisis. Such resilience that enables the system to quickly reach a new equilibrium state may also be needed in the action system model.

8. Interactions among various decision-making agents and the management science staff within an organization should be more carefully identified and more skillfully managed. Dyad models, e.g., manager-MS staff, have so far been employed in analyzing and designing these interactions. Such models, however, would seem to give only partial pictures of such interactions. Alternatively, a new set of models which might be called the triad models may be proposed so that the entire picture of such interactive situations may be represented as fully as possible. Two types of uni-triad model, namely the $\triangle$ -model and the ∇ -model may be proposed; the former may be employed to represent such a situation as the "executive-line manager-MS staff" configuration and the latter to represent the "line manager-MS staff-worker" configuration, to take a few examples. The $\triangle$ -model and the ∇ -model may be connected to form the bi-triad model ($\diamond$) and the tetra-triad model ($\blacklozenge$) as the case may be, and this hopefully takes care of the worker participation and the self-management problems [1].

9. Knowledge of behavioral sciences should be tactfully applied to the dynamic treatment of the process of organizational change as triggered by management science studies. Exchanges among the decision-making agents of role expectations and role performances should be thoroughly studied and carefully modeled on the basis of role theory. The triad models may be extremely useful in the analysis of such role exchange processes. Results of the role-theoretic analysis could be effectively incorporated into the study of the unfreezing-changing-refreezing (U-C-R) process in management science implementation [2], [3]. Thus, management-scientific and behavioral-scientific research results may be amalgamated into deeper understanding and wider acceptance of management science by more and more people.

10. Finally, more emphasis should be placed on the scientific treatment of inter-organizational systems. It is very likely that an organization as a system comes into contact with other organizational systems in its environment. Thus mutual interactions among business firms, financial organs, government agencies, labor unions, etc., play more and more significant roles in our lives in the 1980s. Inter-organizational networks should be carefully examined together with the process of formation of such networks. Particular attention should be paid to the cooperative type of interactions such as coalition and cooptation (choice into a group as a fellow member). Modeling such type of inter-organizational systems is a new task for management science. Furthermore, special consideration should be given to the interaction between organizations and "movements" such as the consumer movement, because such a movement would appear to work on considerably different principles from the conventional organization.

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Management Science in the 1980s—from Bertil Näslund, Sweden

The presentation below is divided in three parts. The first deals with the role of Management Science from an organizational point of view, its role and its way of functioning. The second part deals with emerging problems which could be solved by using management science. The final part deals with some things that TIMS can do to prepare itself for the 1980s.

Part 1. The Role of Management Science

The role of management scientists will have to change due to legislation in many European countries and problems will have to be formulated from new points of view.

1.1 Part of Teams and a Teaching Role

In many countries in Europe worker participation in decision making becomes more important. This is true at all levels in organizations and it will strongly affect decision making in various ways. The major implications for management science are:

- (a) The need for impartial, objective analysis will go up. (See however 1.2(b) below.)
- (b) It will be necessary to present results such that they are more easily understood by more people (see also (c) below).
- (c) Since workers will be allowed to make decisions in more areas affecting their own work the role of experts will become different. They will have to become teachers and part of working teams.

1.2 New Perspectives in Formulating Problems

(a) Due partly to the new role as described in 1.1 and partly due to requirements for successful implementation in general, management science problems will increasingly have to be formulated from the point of view of current methods of decision making rather than from the theoretical needs of our models.

(b) Due to the increased power of labor it will often be necessary for management scientists to analyze problems from the point of view of workers, perhaps in contrast to another analysis of the same problem made on behalf of the owners by another management scientist. This should be discussed e.g., in relation to the ORSA guidelines.

Part 2. New Problem Areas

The following problem areas were suggested (among others) by top executives in Swedish companies (see also 3.4 below).

2.1 Shocks and Need for Flexibility

There seems to be a reduced faith in the possibilities to create a stable environment and to use planning in the traditional sense. Methods and solutions must provide help

when there is very large uncertainty without probability distributions. The methods used must give increased flexibility.

2.2 *Stagnating World Economy*

Many problems will arise from the fact that the world economy—at least from the point of view of highly industrial nations—is stagnating. This might increase the use of “cost saving” management science methods.

2.3 *Manpower Planning*

The importance of finding the appropriate person for a task and to plan his/her career is more important when workers and managers have more right to remain within the same organization a longer time. More refined man-power planning methods will be necessary.

2.4 *New Roles for Board of Directors*

Since different stake-holders are represented on the Board of Directors (labor, women consumers, different ethnic groups, etc.) the role of the Board of Directors might change and thus the top structure of enterprises.

Part 3. What TIMS Could Do

In order to *do* things to prepare TIMS for the 1980s I suggest the following:

3.1 Study other scientific societies; how do they serve their members: how have they evolved? Build models of the evolution of scientific fields, see e.g., Näslund, B., “The Optimal Number of Management Scientists,” *European J. Operational Res.*, Vol. 2 (1978), pp. 357–359.

3.2 The membership structure should be analyzed. A substantial part of management science in the 1980s will be done by those who are now members of TIMS and similar societies. Thus, who they are will to a large extent determine management sciences in the 1980s. As an example, a recent study of membership of the Swedish O.R. society has shown that

(a) The society is reaching a “steady state” of about 400 members after twenty years of growth.

(b) The education and professional background of members are changing. During the early days, a high proportion of members were Ph.D.’s in mathematics, statistics and economics. At present, most members have lower academic degrees and they are working in other organizations than the universities.

(c) Increasingly management scientists are brought in to solve specific problems in a function, a department, a hospital, etc. After the problem is solved, the management scientists tend to a larger extent to remain in that general problem area and fairly soon they identify themselves as professionals within the area of application and not as management scientists in general. This means that there is a very high outflow from our profession which must be met with a similarly high inflow. As management science in the 1980s becomes a more mature profession with a large body of knowledge it might be different from other professions with respect to its age distribution. This might create problems and advantages which should be dealt with in time.

3.3 Many problems and possibilities during the 1980s will arise since society and organizations will face new challenges. We should however also observe developments

in the sciences, perhaps in sciences which have not, so far, played an important role in TIMS. An example of such a science is neurology and the studies of functioning of the brain.

3.4 More systematic studies should be made of how potential users of the services of management science see e.g., the next ten years. As an example, a study was undertaken at the Stockholm School of Economics last year concerning what management problems top executives in approximately 50 large Swedish firms expected during the 1980s. At first, interviews were made with ten executives. The results were then discussed in seminars with the total group participating. Some results were presented in Part 2 above.

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