

**Thoughts on the Use (and Abuse) of O.R./M.S.
in the Planning and Management of Development
(Or: Can O.R./M.S. Help in the Planning and
Management of Revolutions)**

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Thoughts on the Use (and Abuse) of OR/MS in the Planning and Management of Development (Or: Can OR/MS Help in the Planning and Management of Revolutions?)

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The promises of OR/MS for the planning and management of development have been heralded by many. However, there are also many pitfalls and problems involved in the use of these techniques in less developed countries. This essay examines these dangers and suggests some avenues for research in order to make OR/MS more amenable to the needs of the underdeveloped countries.

INTRODUCTION

THIS PAPER presents some ideas on the possible use of Operational Research (OR) and the Management Sciences (MS) in the planning and management of development. It points out some of the problems involved and suggests research areas which would make OR/MS more effective in development planning and management.

It is written primarily for the OR/MS practitioner in underdeveloped countries, and for those OR/MS professionals in the industrialised countries who are concerned about development. It does not try to review the field thoroughly, it is based on personal experience, and follows two earlier papers.^{1,2} The interested reader will find a review of applications and a bibliography in a monograph by Valqui Vidal.³

The process of development implies major structural changes in the organization of productive activities, in the role and operation of the state machinery, in the educational system, in the established procedures for generating and allocating the economic surplus (capital accumulation), and in most other areas of socioeconomic activities (see 4–13). These changes must take place at an accelerated pace in order to achieve results in a moderate period of time. The process of accelerated socioeconomic transformation—with the concomitant political and cultural changes—may be appropriately called a revolution. Depending on the specific conditions prevailing in the underdeveloped country, it may or may not be preceded by violence or armed insurrection. In any case, once power has been seized the demands on planning

and management capabilities will be very large, and will probably exceed the existing level (both in quality and quantity) of administrative skills found in the underdeveloped country (see Wu,¹⁴ Gross,¹⁵ INTERPLAN,¹⁶ Trist,¹⁷ Sagasti).¹

If high social and economic costs are to be avoided during these transformations, the country must have—or acquire rapidly—a high capacity in development planning and management. This does not imply wholesale transfer of “modern” management techniques from developed areas, either East or West, where the state of the art is more “advanced”. Instead, it is necessary to examine critically what would constitute the appropriate planning and management approaches, taking into account the characteristics of the particular underdeveloped country (See Rice¹⁸ for an example from India).

Although OR/MS originated in the industrialized countries, some aspects might be used with advantage by underdeveloped countries, provided that OR/MS approaches, methods, and procedures are first adapted to the specific demands of a development process, particularly by defining a framework within which the use of OR/MS techniques can be better interpreted.

Developed countries have also something to learn from the underdeveloped, and there should be a two-way flow of planning and management “know-how”. As developed countries move into the post-industrial age, many complex problems and a new sense of instability are beginning to emerge, arising partly out of increased interdependencies which they had been able to ignore. Underdeveloped countries have a long tradition in handling unstable, critical situations and of coping with external influences. If this experience were systematized and formalized it may be of use to managers and planners in developed countries.

PITFALLS IN THE USE OF OR/MS IN UNDERDEVELOPED COUNTRIES

The use of OR/MS in underdeveloped countries has been spreading unevenly during the past twenty years. There are a few outstanding examples of the use of OR/MS methods,³ but there are many more instances where conceptual mistakes were made, projects were abandoned, and OR/MS workers produced reports only to run away from the responsibility of implementing the results. This has created a “credibility gap” for the OR/MS profession. Some of the pitfalls associated with the misuse of OR/MS are:

Escapism in figures

Government officials usually want to put everything into figures, indices, cost-benefit ratios, and similar devices. This is often done to avoid confronting real social and political choices, and to ignore the value judgements involved. OR/MS methods may provide a “scientific” justification for the fear of taking a position. In doing the analysis of an important investment

project for an Asian country, government officials were hesitant to take any stand on its merits. As the report moved up the government hierarchy, many discussions were held on the methodology of project evaluation and on cost-benefit analysis. The arguments centered on how to produce figures of merit for each variant, rather than on their substantive merits. The final decision was pushed all the way up to the minister, who received a list of variants for the project with cost-benefit ratios attached to each. In the absence of effective advice from his staff, the minister had to ask several times for additional information and to make the final decision on the basis of his subjective evaluation of the merits of each variant. In this case cost-benefit methods were used by government officials to avoid taking a clear stand.

Clouding the issues to make them unintelligible

When decisions have to be made on sensitive problems, government officials often tend to obscure them through the use of complex OR/MS techniques, which hide the basic issues at hand and tend to support the *status quo* based on piecemeal decisions already made by the bureaucracy. If decision makers are not well versed in OR/MS they may not be willing to contest staff recommendations, either because they are afraid of showing their ignorance or because they genuinely believe in OR/MS. A staff planning group in a ministry was passing faulty information to a committee taking politically sensitive decisions. They used plenty of jargon, invoked the name of the "holy computer", and presented their advice surrounded by theoretical paraphernalia that only made the basic issues look more complex than they really were. When an outside consulting team arrived, the planning group refused to explain the methods used in deriving their recommendations, claiming that they were a professional secret. After lengthy discussions it was clear that they had been using a combination of sophisticated techniques with poor data, and that they did not understand the limitations of the models they were applying. Nevertheless, because of the apparent complexity of the problem they were able to push their recommendations to the committee.

Giving a scientific backing to predefined policies

This consists in using OR/MS models in order to justify, as derived from scientific reasoning, some predefined policies on which decision makers have already agreed. In some cases it is the decision maker who instructs the technical staff to manipulate the models to provide the answers he is looking for; in other cases it is the technical staff who on their own initiative "show" that OR/MS methods "prove" that the decision maker was right from the beginning. A variant of this consists of the decision maker requesting a study from the technical staff and using it only if it agrees with his own policies and decisions.

Using a cannon to kill a fly

In this case high-powered OR/MS models are used to deal with simple problems which could have been solved by the systematic use of (possibly quantitative) common sense. The story of the linear programming expert who sees the simplest allocation problem in terms of linear equations, linear constraints and objective functions is all too familiar. In underdeveloped countries the younger professionals who return after studying abroad are prone to do this, particularly when they attempt to show what they have learnt and insist on looking for the problems that fit their tool box. A recent example is given by experts from an international organization who used a sophisticated matrix analysis technique to derive research priorities in several underdeveloped countries. The results obtained clearly did not justify the investment in time, effort, and money, for they could have been prepared in a few hours by a group of scientists knowledgeable with the situation in each country.

Wasting time and effort in building useless models and gathering irrelevant data

This consists in putting great effort in the construction of mathematical models and the gathering of data that may either have limited applicability or become obsolete by the time they are ready for use. Due to the rapid and uneven pace of change in underdeveloped countries, decisions must be taken in the face of high uncertainties regarding objectives, courses of action, and consequences, and although there is a need for improving decision making by introducing the systems approach, this should not be done at the expense of postponing decision making until the models and data are ready. There are many examples of the OR/MS professional arriving late to help in a decision that was already taken. Furthermore, time consuming model-building tasks are often carried out when the model will be used once for a decision without consequences.

Similar remarks apply to data gathering activities which are often seen as important for their own sake. As a result, time is wasted in refining decimal points of figures whose value is not clear for decision making purposes.

Model fetishism

Once a model is built and used successfully it acquires a life of its own. Perhaps the frequency of such happenings is so rare that the OR/MS analysts feel they must exploit the model to its fullest possible extent. This gives rise to a "model cult" which carries the obligation of keeping up, improving, and perfecting the model indefinitely. In this way a model is often refined beyond its usefulness. The most familiar example is that of econometric models for planning purposes, which often become the *raison d'être* for a

whole division in a planning agency. The ever increasing demands of the model in terms of professional inputs, more refined data, and computing facilities escalate out of proportion to its use. This disease attacks primarily statisticians and economists who are highly skilled in the use of mathematical statistics and computer programming, and who are not aware of the diminishing returns from investment in model building.

Focusing on the wrong issues

This is a natural consequence of the importance of quantitative methods in OR/MS. Analysts, and decision makers in some cases, pay more attention to the aspects of a problem situation which can be quantified and handled by a model. In consequence, they are given greater importance than they should. One example is that of models for educational planning, where a host of quantifiable issues (average permanence in school, attrition rates, attendance figures, student/teacher ratios, and costs of all types) take precedence over non-quantifiable ones (design of curricula, content of literacy training, quality of the teaching staff, differential performance of students, etc.). The emphasis on quantification in OR/MS methodology displaces the focus of attention away from the crucial messy and non-quantifiable choices to be made.

Satisfying ego trips of foreign researchers

Through technical advice missions, international research projects, academic agreements and similar means, researchers from advanced countries spend a considerable time developing OR/MS models and using other quantitative methods to "help" planners and managers in underdeveloped countries. Although good intentions must be assumed in general, often the problem situation is seen as a way of preparing another paper, getting material for a book, obtaining academic promotions, and building up the prestige of the foreign researcher. In one case the use of a model has been suggested by a professor visiting a planning agency because he was doing research with a particular model and needed an extra country for comparative purposes. In other cases consultants are sent from the country providing funds and technical assistance, who see their task as one of spreading the gospel (their models and methods) among the pagans. One consultant was advocating the use of a standard mathematical model built by his company to justify the adoption of birth control on economic grounds in several countries, having already made the decision that birth control was necessary.

This introduces serious distortions in the patterns of use of OR/MS in the planning and management of development, and often discredits OR/MS because of the negative reaction generated among decision makers and technical staff. However, this is not the fault of the foreign expert alone, for the local counterparts also bear responsibilities. They may see in this a way

of gaining access to the international intellectual community (by getting fellowships, co-authoring papers, obtaining invitations to conferences), or they may also believe in the techniques brought by the foreign expert, thinking that they represent a form of superior rationality which they should strive to attain. Whatever the case the effects are the same: a foreign researcher obtains a "problem" to try his approach, a paper or even a book might be published on the subject, a local member of the technical staff might be trained (primarily in the collection of data!), and probably nothing will happen from the point of view of improving the decision making process in the underdeveloped country. The exceptions to this case are rather rare.

Of course these risks involved in the use of OR/MS are not exclusive to the underdeveloped countries. However, they are more ominous because mistakes are felt from many years in a situation where resources are scarce and every decision counts. This places more responsibility on the OR/MS professional working in underdeveloped countries, and makes the ethical issues of the practice of OR/MS of paramount importance.

SOME SUGGESTIONS FOR GEARING OR/MS TO THE PLANNING AND MANAGING OF DEVELOPMENT

Assuming that OR/MS can contribute to the planning and management of revolutions, there are some difficulties arising out of the nature of existing OR/MS techniques and the way they have been used in underdeveloped countries. The assumption that OR/MS can be useful is based on the belief that the scientific method applied to decision making on development problems will help in bringing about socioeconomic transformations more rapidly and at less cost. This assumption may be just wishful thinking, but I remain optimistic enough to venture some suggestions that may render OR/MS more appropriate for development planning and management.

On the mismatch between OR/MS methods and development problems

Most of the available methods and techniques in OR/MS are geared towards helping decision makers in defining the structure of activities to be performed by their organization and determining the levels of resource allocations. Although these are important problems, they are conditioned by other types of decisions to which little attention is given, and which have great importance in underdeveloped countries.

Decisions with regards to the planning and management of development can be grouped into five categories.¹⁹ First, the definition of long-term ideals and the desired future image of the country and its society; second, decisions regarding the patterns of interaction among the different aspects of the process of socioeconomic development and the insertion of the country in the world system, this is, the national and international context in which the

structural transformations are to take place; third, decisions about the institutional infrastructure of the country, including the types of organizations and "rules of the game" that should be instituted to provide support to the social fabric; fourth, determining the scope and nature of the social and productive activities to be performed; and fifth, decisions on the allocation of all types of resources.

These five anticipatory decision categories are the domain of stylistic, contextual, institutional, activity and resource planning. The interactions among these categories of decisions can be summarized by saying that *resources* are allocated to *activities* through *institutions*, taking into account the *context* in order to approach the *desired future*. The five categories of decisions can be referred to national socioeconomic development objectives, in which case the unit of analysis will be the country itself, or to some aspect of the process of transformation, such as finance, industry, technology, and so on.

OR/MS methods have been mostly developed in industrialized countries where a situation of relative stability could be assumed with regard to the long-term objectives and ideals, to the structure of environmental and contextual relations, and to the institutional fabric. Therefore, the focus was on the development of methods to help decision makers on the last two categories of decisions.

If the role of OR/MS in underdeveloped countries is to provide assistance in decision making for the transformation of socioeconomic structures, then the categories of stylistic, contextual, and institutional planning acquire greater importance than is customarily given to them by OR/MS practitioners and theoreticians. Activity and resource decisions are heavily conditioned by decisions made on long-term objectives and ideals, on the patterns of interaction with the environment, and on the design and implementation of institutional structures.

In view of this mismatch between problem areas and OR/MS methods there is a need for reappraising what is available in the tool box of the OR/MS profession, the ways these tools have been used (with all the pitfalls mentioned earlier), and their possible evolution, with the aim of developing new approaches and methods that would take into account explicitly these neglected factors and thus realize the potential contribution of OR/MS to the planning and management of development.

On the conceptualization of development problems

Elsewhere²⁰ I have proposed a description of the OR/MS process in general systems terms, emphasizing the importance of the "conceptualization" which generates the conceptual model prior to the "modeling" phase that leads to the scientific model. The *conceptual model* is the image that the OR/MS professional forms in his mind about reality. It provides an orderly framework to place his perceptions pertinent to the problem situation and

allows him to identify the structure of the problem and its relevant aspects. The conceptual model represents an abstraction from reality and the problem situation and is capable of generating one or more scientific models.

The *scientific model* is the most widely studied and recognized element of the OR/MS process. It is a formalized representation of both reality and the conceptual model and its correspondence to them is critical. It usually consists of symbols together with a set of rules to manipulate them, through which the OR/MS practitioner is able to assess the internal consistency of the model, to establish its degree of correspondence with reality, and to extract a solution from it.

The conceptualization process is heavily influenced by the values of the OR/MS professional, by the objectives of the organization he is working for, and by the long term ideals of the society to which he belongs. Whereas in the more affluent countries the OR/MS professional can dissociate himself to a large extent from the political and social impacts of the decisions he is helping to shape, this is not possible in underdeveloped countries. The consequences of decisions are seen faster and more clearly, their impact is difficult to ignore, and the OR/MS man is confronted with the contradictions between individual and collective rationalities: what is good for his organization may be bad for society. Unless he is grossly insensitive he will find it impossible to ignore this fact. Under special circumstances it is possible to design situations where individual and collective rationalities converge, and this may be one of the main tasks of the OR/MS professional.²¹ In other cases such convergence is not possible and he has to choose at whose service to put his skills. This conflict, which emerges at the conceptualization phase, is not exclusive to the underdeveloped countries (e.g. the ABM and the Institute for Critical OR controversies in the US and UK respectively) but its implications are far greater there. The OR/MS man must consider questions such as: why decisions are taken by an elite? For whom is he really working? are the "client" and the "user" of his work the same?²² What will be the impact of the decisions on the different social groups of the country?

Contextual factors also influence the conceptualization process more directly in underdeveloped countries. They have been living in what Emery and Trist²³ call "turbulent fields" for a long time. We have become accustomed to instability, high interdependencies, strong impact of environmental factors on decision making, and an erratic and fast pace of change.¹⁴ Any conceptualization of a problem situation which restricts itself only to its immediate manifestations is likely to deal only with the symptoms of the problem, rather than with the main factors that condition it. The fragility of the societal fabric, the vulnerability of institutions which are not able to withstand the impact of environmental changes, and the frequency with which external factors modify the "rules of the game" show that the concep-

tualization of a problem situation must take into account the context. Adding the instabilities introduced by changes in the international system—and over which the majority of underdeveloped countries have little control—the nature of the environment in which development decisions have to be made becomes rather difficult to handle, and places greater demands on the conceptualization phase.

The nature of the institutional infrastructure of the country also influences the conceptualization of a problem situation. “Rules of the game” change frequently in underdeveloped countries (and this may be a result of the transformations they are undergoing), and there may be either a paucity of institutional channels (lack of relevant organizations), or an abundance of them (overflowing bureaucracy) which make the structure for policy and decision making difficult to work with. The design of appropriate institutional structures—comprising legal systems, organizations and operating procedures—should become an integral part of the OR/MS process.

The conceptualization phase of the OR/MS process deserves more attention in underdeveloped countries. Unless the values, the context, and the institutions are considered explicitly, the planning and managing of socioeconomic transformations will remain outside the reach of OR/MS.

On modeling development problems

Closely associated to the conceptualization of a problem situation is the construction of a scientific model. Because of the particular conditions encountered in underdeveloped countries, differences also emerge at this stage.

First, it appears necessary to move away from the overwhelming emphasis on quantification that has characterized the evolution of OR/MS. This does not necessarily mean losing scientific rigor. If at one extreme we place the “semantic models” consisting of verbal or written statements about a problem situation, and at the other extreme the exact optimization models of quantitative nature, there is a wide spectrum of models in between to use in development planning and management. Semantic models, used extensively by anthropologists and sociologists, can be made more systematic through the use of operational definitions and of some rules to manipulate them. Moving towards the optimization end of the spectrum, we find symbolic models of a logical nature, in which a set of symbols representing concepts, variables, and parameters is given a precise meaning and detailed rules for their handling are specified. The following stage involves a movement towards formal models in which, in addition to rules of interaction, the concept of direction is introduced, with the subsequent addition of magnitude or intensity of interaction. In this way interaction, interaction–direction, and interaction–direction–intensity models could be built before moving to the category of models

involving quantification on cardinal scales, such as simulation and optimization models.

Given the nature of the problems at hand in the planning and management of development, it appears that the intermediate range of models, involving a degree of formalization which does not reach the quantitative cardinal level, may be appropriate for model building in development planning and management. When stylistic, contextual, and institutional considerations must be taken into account, it becomes difficult to use the range of quantitative tools available in the OR/MS trade. These considerations require different modelling techniques on which very little work has been done. The development of a "social systems science" approach to replace the traditional quantitative paradigms of OR/MS appears to be an encouraging sign.

Second, it is apparent that too much emphasis has been placed on building models which reproduce and extrapolate the behaviour of the entities involved in the problem situation. This assumes that the system will continue to work more or less in the same way, which is precisely what should be challenged in underdeveloped countries. The only possible use of extrapolative models, generally based on regression techniques, is to obtain a reference projection, a view of what may happen if nothing were done. This can only serve as a starting point for designing the transformations that must take place. Extrapolative models do not help in defining the direction of transformation processes, for this requires normative models that would translate ideals, values, and objectives into viable courses of action. Except for some attempts at formalizing values and objectives in simplified problem situations, there are practically no approaches and methods suitable for normative model building. The work of Ackoff and Emery²⁴ and that of Ozbekhan²⁵ provide examples of the type of conceptual tools required for this task.

Third, the differences between macro and micro rationalities are of paramount importance in model building for development planning and management. The problem is not that of attaining coherence between a general objective and the objectives of particular units operating within the same framework (for which model-building tools exist), but rather that of understanding the driving force and motivation of a variety of individuals, groups, and organizations operating in an interactive way at different levels, and whose rationality cannot even be expressed in the same terms. For example, the concept of rationality for a small enterprise in a branch of industry dominated by a few oligopolistic firms, with a restricted market situation, with deformed government operational controls, with distortions introduced by measures taken by financial agencies, agencies in charge of providing foreign exchange, labour organizations, and so on, will differ from the rationality of a large enterprise in the same branch of industry. In turn, the rationality of these enterprises will differ from those of enterprises in other branches, and from the rationality of the government agency in charge

of promoting the development of industry as a whole. The rationality of this agency may also differ from that of other agencies, ministries, and private organizations, each of which functions according to its own inner logic. When social aspects are introduced, the situation becomes even more complex.

In this case no amount of elegant model building can substitute a basic understanding of the driving forces of different actors and groups. Attaining such understanding requires an effort which goes well beyond classical model building in the OR/MS profession, yet it is essential if the models built are to be of any use for the purposes of planning and managing major socio-economic transformations.

In other papers^{1,2} I have listed some features of model building for development planning and management. These include the large component of social sciences that is required during all phases of the OR/MS process, the need to avoid using simplistic models to represent complex situations, and the differences in the nature of variables and parameters to be used in model building. Furthermore, there are also differences at the model solving and implementation phases, arising out of the different conditions found between developed and underdeveloped countries.

POSTSCRIPT

This paper has examined the need and possible use of OR/MS in the planning and management of major socioeconomic transformations (revolutions) in underdeveloped countries. It has raised several issues which are usually ignored by practitioners and theoreticians both in developed and underdeveloped countries. The aim was to suggest the types of changes that are required in order to make OR/MS more appropriate for development planning and management. Much more research needs to be done on these issues, and this is a task primarily for the OR/MS professionals in underdeveloped countries, with or without help from their colleagues from the industrialized nations.

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Commentary

This paper is concerned with a fundamental examination of the possible roles for O.R./M.S. in developing countries. The author proposes that development must entail a basic shift in the balance of power between the 'haves' and the 'have-nots'. This will occur through a process of change that the author calls a 'revolution' although this is not necessarily violent. But the O.R. person will normally be part of the 'haves' so that he/she may lose out in the revolution. There is therefore a conflict of interest for the O.R. person if he/she is to work on problems of development and this conflict is something that most O.R. people in the developed countries have not had to face.

A number of pitfalls are listed which may be seen as offering retreat from the problems of revolutionary development outlined above. The author continues the paper with the most important section where he makes some suggestions for gearing O.R. to the planning and management of development. These suggestions will appear radical to someone educated in traditional O.R. Five categories of management decisions are defined to be stylistic, contextual, institutional, activity and resource planning. Traditional O.R. has dealt with the last two categories involving the scope and nature of productive activities and the allocation of resources between them. But development needs inputs from O.R. with reference to the first three categories involving the definition of long term ideals, the international context and the institutional infrastructure.

If O.R. is to cope with this wider view of problems in developing countries, new approaches and attitudes are needed. The author suggests the use of intermediate models, formalised but not entirely quantitative. He notes that extrapolative models are only useful for providing reference projections under conditions of no change. Recommendations are made to O.R. workers to obtain a basic understanding of the driving forces of different actors and groups. The author also notes that developed countries may have something to learn from developing countries in the future since the developed countries are moving into a less stable post-industrial age and instability has long been a key characteristic of developing countries.