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Handbook of Systems Analysis: Volume 1. Overview. Chapter 9. Implementation

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HANDBOOK OF SYSTEMS ANALYSIS

VOLUME 1. OVERVIEW

CHAPTER 9. IMPLEMENTATION

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FOREWORD

The International Institute for Applied Systems Analysis is preparing a Handbook of Systems Analysis, which will appear in three volumes:

- Volume 1: Overview is aimed at a widely varied audience of producers and users of systems analysis studies.

- Volume 2: Methods is aimed at systems analysts and other members of systems analysis teams who need basic knowledge of methods in which they are not expert; this volume contains introductory overviews of such methods.

- Volume 3: Cases contains descriptions of actual systems analyses that illustrate the diversity of the contexts and methods of systems analysis.

Drafts of the material for Volume 1 are being widely circulated for comment and suggested improvement. This Working Paper is the current draft of Chapter 9. Correspondence is invited.

Volume 1 will consist of the following ten chapters:

1. The context, nature, and use of systems analysis
2. The genesis of applied systems analysis
3. Examples of applied systems analysis
4. The methods of applied systems analysis: An introduction and overview
5. Formulating problems for systems analysis
6. Objectives, constraints, and alternatives
7. Predicting the consequences: Models and modeling
8. Guidance for decision
9. Implementation
10. The practice of applied systems analysis

To these ten chapters will be added a glossary of systems analysis terms and a bibliography of basic works in the field.

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CHAPTER 9. IMPLEMENTATION

Edward S. Quade and Rolfe Tomlinson

> If to do were as easy as to know what were good to do, chapels had been churches, and poor men's cottages princes' palaces.
>
> W. Shakespeare

> ... the most important... results... come in the form of a vision felt by researchers as an outcome of deep, concentrated analysis... The process of transferring this vision is difficult, lengthy, and delicate. There is no assurance that it will grow simpler as our vision comes closer to perfection.
>
> J.M. Gvishiani, World Problems: Interrelations and Interdependence, *IIASA Reports*, Vol 3, No 1, 1981.

Although both Shakespeare and Gvishiani may have taken some poetic license, to do what has been decided were best to do or to bring vision to reality is a problem in many decisionmaking contexts, particularly those involving public policy. Systems analysis is not simply an academic exercise; its goal is to help bring about change for the better, to see what is done is what was decided. Change requires more than the words expressing a decision or policy mandate;

it requires the expenditure of energy, time, and resources. This change is implementation: the process of rearranging patterns of conduct so as to honor the prescriptions set forth in a decision.

When a systems analysis is commissioned, the sponsor usually has a goal in mind. He would like to discover a course of action that will accomplish something he wants at an acceptable cost, a course of action that he can adopt and can convince others with whom he shares authority to adopt. Moreover, he hopes the action, if chosen, can be successfully implemented, namely, that it not be so modified by the organization that carries it out, or by rival agencies, or constrained by the courts, or repudiated by the public, or resisted by those who must change their patterns of behavior, or otherwise frustrated, that it does not accomplish what was intended.

For certain kinds of problems and contexts full implementation is a dream. The aim of this chapter is to suggest ways for the analyst to help make it less so. Unfortunately, beside pointing out some of the many reasons why implementation can go wrong and suggesting a number of rather obvious general precautions, we have little practical advice to offer. Implementation is currently an active topic of concern of systems analysts and others; there are numerous papers pointing out where implementation has failed, but many fewer that tell what to do during the study before the decision is taken to make failure less likely.

1. BACKGROUND

The term implementation can have several meanings. Bardach (1980) identifies four:

(a) *Adoption* of a policy recommendation by an authoritative individual or institution, as in "The client has endorsed our analysis of airport landing fees and will soon promulgate regulations to implement it." This is typically an operations researcher's or planner's usage (Huysmans 1970).

(b) The *empirical details* that reflect, or represent, the application of a policy principle, as in "Effluent taxes are fine in principle, but when it comes to implementing them we see that they are often set too low." (It should be noted that "implementation" in this sense is bound to be somewhat imperfect, for the same logical reason that there is always a slippage between a theoretical construct and the operations that are used to measure it empirically.)

(c) The *operating routines* of an organization, or a network of organizations, that have been brought into being or have been modified by some policy mandate, as in "Over the years we have found it necessary to shift our implementation methods away from a reliance on regular audits to voluntary compliance and self-reporting."

(d) The *process* of rearranging patterns of social conduct so as to honor the prescriptions set forth in some policy mandate, as in "We are implementing the new workmen's compensation law just as fast as we can."

For this Handbook, implementation is the process suggested by statement (d). It starts after the decision to adopt a particular course of action is made. Implementation ends successfully provided the goals defined by the decision are achieved and the financial costs and the delay in reaching these goals are held to a reasonable level.

Lack of success, however, should not necessarily be charged as a failure against the implementing organization . The circumstances under which the policy was designed to operate may have changed following the decision, the estimated costs in time and money may have been deliberately biased downward by the sponsor in order to secure the approval of other decisionmakers, or the policy design itself may have been defective and ill-conceived.

The importance of giving thought to implementation has long been recognized, as well as the analyst's responsibility to do so. Witness Aesop's Fable "The Mice in Council:"

> A certain Cat that lived in a large countryhouse was so vigilant and active, that the Mice, finding their numbers grievously thinned, held a council, with closed doors, to consider what they had best do. Many plans had been started and dismissed, when a young Mouse, rising and catching the eye of the president, said that he had a proposal to make, that he was sure must meet with the approval of all. 'If,' said he, 'the Cat wore around her neck a bell, every step she took would make it tinkle; then, ever forewarned of her approach, we should have time to reach our holes. By this simple means we should live in safety, and defy her power.' The speaker resumed his seat with a complacent air, and a murmur of applause arose from the audience. An old grey Mouse, with a merry twinkle in his eye, now got up, and said that the plan of the last speaker was an admirable one; but he feared it had one drawback. He had not told them who should put the bell around the Cat's neck.

One reason that, until fairly recently, analysts did not make implementation of their proposed solutions a subject of investigation during their study was the context in which they worked. Early operational researchers worked for the military and were themselves essentially embedded within the implementing organization, often vetting their ideas on the staff before they reached the commanders. Early systems analysts worked with military and industrial organizations, both of which have a strong line of authority that can usually insure that decisions made at the top will be carried out by the organization below, although not always efficiently and without modification. In fact, acceptance by decision-makers of analytic methods and results was more the problem at first and operational researchers began to equate implementation with adoption and use of their work. If the output of analysis influenced a manager's decision in some way, it was then said to have been implemented (Schultz and Slevin 1975, p. 6).

Later, when systems and policy analysts began to work on the social issues associated with housing, health, education, welfare, and other public affairs, implementation was found to be a much more serious problem. Indeed, so much so, that for social application, systems analysis came to be regarded in some quarters as a worthless approach that produced solutions only on paper (Hoos 1972).

Analysts then turned their attention to implementation, the so-called "missing link" in analysis. Archibald (1970), one of the earlier analysts to mention implementation in the sense used in this chapter, stressed that it did not follow automatically and offered suggestions for handling it:

> ...even if the policy alternative recommended by the analyst is accepted by top decisionmakers, the program that comes out of the organization may have little resemblance to the alternative originally envisaged by the analyst and the top decisionmakers. I am not merely saying that an alternative when implemented may not produce the consequences expected. Rather I am saying that the policy alternative actually executed is quite likely to have undergone radical revisions at the hands of (the) operating levels. And since a policy is no better than its implementation, this suggests that analysts need to pay attention to the feasibility of a policy alternative at operating levels as well as to its acceptability at the top decisionmaking level.

Indeed, it may be argued that in many organizations decisions are really made from the bottom up. The policymakers may suggest, but it is the lower echelons who really decide.

Most early discussions of implementation were retrospective and contained more descriptive than prescriptive material. (For instance, Pressman and Wildavsky 1973; other material may be found in Bardach 1977 and 1980, Williams and McElmore 1976, Rabinovitz, Pressman and Rein 1976, Bermen 1978, Van Meter and Van Horn 1974, and Hargrove 1975). The last two references contain major reviews of the literature. Wolf (1978) ties the reasons for the implementation shortfalls in public policies to the predictable inadequacies of nonmarket organizations such as government itself.

The major responsibility for managing the implementation process lies with the decisionmaker, but, as it is the analyst's proposal and design that is being implemented, he must share responsibility for any failure of implementation. This means the analyst needs to be supported so that he can give explicit attention to how particular policy alternatives are to be implemented.

2. DIFFICULTIES IN IMPLEMENTATION

Consider a study to improve public transportation for a city. Suppose the primary alternatives considered are:

(i) improvement of the current bus and expressway systems;

(ii) introduction of a streetcar system (surface);

(iii) introduction of a rapid transit elevated system;

(iv) introduction of a subway system;

Additional alternatives are formed by various combinations of the primary alternatives.

Suppose a decision is made to introduce a subway to supplement the current bus and road system. What are some of the difficulties with implementation that may arise?

For one thing, the current city transport authority, having handled only automobile and bus traffic, will have had no experience with subway construction or with the operation of an underground electric railway. Consequently, the authority will have to be augmented and possibly reorganized. Managers with seniority and political connections may have to be passed over. New staff with special experience and thus higher salaries will have to be added. The known difficulties with organizational decisionmaking will arise (March 1965, March and Simon 1958, Cyert and March 1963, and Allison 1971).

For another, the systems study on which the decision to introduce a subway was partially based, while it may have been detailed enough to enable the decisionmakers to discriminate among the surface, elevated, and subway supplements to the current system, was very likely not detailed enough to answer many questions regarding implementation. For instance, for comparison purposes, it was probably not necessary to investigate whether the subway station nearest city hall should be on the corner of First and Main or Second and Market streets. For implementation purposes this has to be investigated and decided; after the decision the merchants at one location will profit and the losers will protest. Bus routes and schedules will have to be rearranged to connect with those of the subway; people who lose service will fight to regain it. Parking lots will need to be set up in the vicinity of stations in the suburbs at which commuters can leave their cars; some neighborhoods may object to these lots; some people will be glad to sell the required land, some of the property may have to be acquired through legal proceedings. Thus the transit authority, in addition to being concerned with management, financial control, regulations, inspection and surveillance during construction, providing permits and clearances, and relations with other agencies, will be beset with people (i.e., political) problems. No potential supplier of any of the necessary services is likely to cooperate unless it is to his (or his organization's) interest to do so. Some who interact with the program will not be clear where their interests lie; this can add to the confusion and delay.

By examining a number of attempts to implement social policy decisions in the United States—policies striving to do such things as creating jobs for the hard-core unemployed, building new towns, getting teachers to act in a different mode, or protecting the civil liberties of persons alleged to be mentally ill—researchers have found such programs to be characterized by underachievement of objectives, delay, and excessive financial cost. Bardach (1977) attributes many of the difficulties to the domination of the implementation process "by many actors all maneuvering with and against each other both for end results and for strategic advantages." He terms these maneuvers "games."

One such maneuver is the attempt to divert resources, especially money, which ought to be used to enhance the program's objectives, to other purposes, often equally worthy. Another "game" or maneuver is to deflect the goals of the effort, for instance, by what Bardach (1980, p. 238) calls "Piling On:"

> If a new program enjoys certain initial successes, it naturally expands its political support. It then becomes a target for interests who may have only minimal commitment to the program's objectives but who wish to capitalize on its growing political assets. Such a program is vulnerable to Piling On in much the same way that a cash-rich corporation is vulnerable to being taken over by another firm through a merger or a tender offer to shareholders. By the time the Piling On process is over, the original program goal may have become greatly submerged and/or the supporting coalition may have collapsed under the weight of the new interests. For example, the concept of "affirmative action" in the United States once meant a commitment to give preferential treatment to job applicants from racial minorities when in other respects they were "equal" to applicants from non-minority backgrounds. Over the course of the last ten or fifteen years, however, the concept has come to mean quotas and a deemphasis on the "equality-in-other-respects" criterion. Many traditional liberals who supported the more restricted "affirmative action" concept have become resentful and frightened at its maximalist redefinition and, in effect, have withdrawn energy and attention even from the initial goals.

Other maneuvers attempt to negate the effect of a new policy by installing non-sympathizers high up in the enforcement agency, or by writing regulations and rules that condone existing practices and lighten the penalty for violations, or by setting a high threshold for violations and then putting the entire burden of proof on the implementing agency. Still another maneuver is to resist efforts to control behavior administratively by tokenism or procrastination. For others, see Bardach (1977).

It is not only the lower, operating, levels that cause difficulties with implementation. The higher, policymaking, levels can cause problems. No manager, good or bad, will forget that these levels exist or be unaware of their possible reactions to a decision that he may make. The same applies to committee chairmen and to the members of committees who may be reporting to superiors whose objectives are by no means in agreement with those of the committee. Of course, if a proposal has been well worked out and its implementation adheres completely to plan, the decisionmaker need have no fears—but in real life things seldom happen this way. There is always something that does not work according to plan—conditions may not be precisely those predicted, other changes may occur to alter how the proposal is put into practice. Almost invariably some part of the objective will not be achieved, or achieved in a different way from the proposal. This is where the difficulty arises. More often than not those at higher levels in the hierarchy are more aware of departures from plan than they are of its overall successes. If these shortcomings are in areas in which they have particular interests, they are apt to react strongly. Consequently, most managers are sensitive to any departure from plan. They adopt a fail-safe policy. They are either looking for something with no risk, or something that avoids certain areas of risk. This makes it essential for the systems analyst to have not only a good idea of the robustness of his solution but also of the entire "political" situation, including all the actors involved, and the pressure falling on the decisionmaker from higher levels of control.

3. THE ANALYST AND IMPLEMENTATION

There is a story that exists in different forms in many countries about a man from the big city who stayed for a few weeks in a small village. He did not like the life; he thought the villagers fools, and said so. Near the end of his stay he decided he ought to visit a friend who lived nearby and he asked a villager how to get there. "Oh, you want to go there," said the man, seeing his chance to get his own back. "Well, no one but a fool would start from here."

The story applies to systems analysts considering implementation. Here is the analyst, having completed his investigation, wondering how to ensure that his results are implemented. "If you want to implement your results," he might well be told, "no one but a fool would start thinking about it now." Strange as it may seem, there are still foolish systems analysts about.

Why foolish? In the first place, because to talk about implementation in this way indicates a fundamental ignorance of the processes by which change is achieved. In the second, because such an action is contrary to the nature of systems analysis, and thus betrays an inconsistency that discredits the professional standards of the systems analyst.

Organizational decisionmaking. Implementation must be investigated early in the analysis. To understand why this is so, it is necessary to examine how decisions are taken in organizations. Descriptions of systems analysis, for instance, often make it appear that the problem under consideration, and the decisions that must be taken with regard to it, exist in isolation. This is not the case. One problem facing a decisionmaker is a small part of a time-space continuum of problems that he has to deal with, and his problems are part of a larger continuum of problems faced by his organization. The decisions taken with regard to his problem create new problems and affect others; similarly the decisions taken with regard to these other problems affect his. Furthermore, managers rarely take decisions at a given time in a dispassionate manner, using only the information provided at this time, without reference to other information acquired in the past, even though this other information may be hearsay, and discredited by what is available at the time of decision.

In any organization there is a gradual development of opinion as to how a decision should be structured. Even where this is not so, it is generally true that the final form of the information fed to the decisionmaker will have been influenced by arbitrary decisions taken earlier, often by people outside the apparent power structure relating to this decision. The shop stewards, the unions, even the rank and file all have their influence. Thus, even a one-time decision to deal with a unique situation appears on analysis to be the end point of a systems process. Moreover, it soon appears that the systems analyst is himself part of this process. Indeed, from the start of the investigation—by the questions he asks, the information he collects, and the dialogue in which he engages—he becomes part of the decisionmaking system by virtue of his very existence. To be effective, he must design his actions to be in tune with the behavior of the system, involving, or at least informing, others of what he is doing. If he merely makes his input at the time of decisions, he may affect the response of the system, but only in minor ways. The consequence is likely to be a perturbation in systems performance rather than the major improvement sought.

A further point needs making here. We have said that the systems analyst is, whether he likes it or not, part of the decisionmaking process. The implied interactions work, however, in both directions. Not only does he affect the decisionmaking process from the start of the investigation, but the system is also having its effect on his investigation. It is as much a learning process for the systems analyst as for the system; in this way, and only in this way, he is able to tune his proposals finely to the requirements of the system. We shall discuss the practical implications later, but it is important to emphasize again the adaptive nature of good systems analysis.

The role of the analyst. The program for implementation depends, of course, on the type of problem under investigation. Preparation for the implementation of a decision by the managers of an industrial organization to install a computer program to expedite its operations can be vastly different from preparation for implementing a social program established by a legislature and having the force of law. Yet in the long run the successful implementation of either decision may depend on the flexibility and robustness of the associated program for implementation in coping with varying circumstances that cannot be predicted in advance and its ability to withstand human error and deliberate misuse.

To illustrate the role of the analyst in implementation, two cases involving the use of computers are presented. These illustrations might apply either to the public or the private sector.

Improved methods of calculation. Consider developing a set of computer programs to assist in designing transport systems in coal mines conveying material from the coal face to the pit bottom. A typical colliery contains a number of productive faces from which the coal is transported to the shaft by means of conveyor belts. At each junction in the underground roadway system the coal is transferred from one conveyor to another and, since it is a converging system, a trunk belt may receive coal from a number of faces. The flow of coal from each face is variable, the big output being several times the average output and there are a number of occasions during the shift when there is no coal forthcoming from the face at all. It is essential that no part of the system be overloaded, for this causes a belt stoppage, which is transferred backwards to the face itself, with the consequence that production is lost. Moreover, if a loaded belt stops, it may be difficult, if not impossible, to restart it in the loaded condition. It is, therefore, essential to uncouple the various parts of the system, so bunkers are introduced.

The extractive nature of coal mining means that faces at a colliery are always advancing. Moreover, their average life is about one to two years, so that, in effect, the entire conveying system has to be redesigned at relatively frequent intervals. The problem is to decide on belt capacities, bunker sizes, and the control rules for deciding when to load and unload the bunkers.

From a systems-analysis point of view, this is clearly a simulation problem. However, because the problem is common to many collieries and, indeed, reoccurs from time to time at the same colliery, it was desirable to develop a general method of calculation to be used by planning engineers and work-study staff in any situation. It was, moreover, the first planned exercise of this kind to be undertaken within the organization concerned, so that it was essential for the system to be seen as effective and easy to use. A serious mistake in the early stages of its introduction could easily mean the failure of the whole project.

The first stage of the analysis was, therefore, to tackle the local design problem at two collieries. This meant developing computer programs for the local situation while observing the difficulties occurring in the process. The results of the work and how the method might be extended were also discussed in detail with the people concerned. These preparatory studies had two important consequences. In the first place, they made it possible to identify the major technical problems that would be involved in preparing a universal simulation program. Secondly, the successful use of the techniques reached the management teams, who were enthusiastic about the results and were able to talk to their professional colleagues about their potential use in a way that the systems analysts never could have. On the basis of the discussions held after this first study, the analysts resolved to go ahead and devise a more general program to be used at any colliery.

This work, however, led to a new difficulty. When working at a single colliery, the main contacts were the colliery planners, who provided the data on which the simulation was based, and who then used the completed computer program. When it came to developing a more general program, the managers responsible for the work were no longer those who would be using it personally. Nevertheless, it was essential that responsibility for developing the program and implementing it lie with the management. Accordingly, a joint committee was established consisting of three main elements: The chairman of the committee was a management representative and he had engineers on the committee whose joint task was to observe progress and advise on practical problems when they arose. The second element consisted of the systems team members, who advised on the methods to be used and undertook to develop the main part of the program. Finally, the team included staff from the computer service, who were to ensure that the proposals made were compatible with the available computer system and that the whole was effectively systematized, so that the programs, once developed, would run quickly and economically using relatively inexperienced staff.

This committee followed progress and arranged trials of the program.

Once a program had been developed, it was necessary to test it for basic errors and then pass it to the management staff for training. The analysts developed a series of courses, and, over a period of 12 months, some 100 planning and work-study engineers were trained in its use. These courses also included some of the operations research personnel who would have to advise on the program's use and ensure its effective application in nonstandard situations. The important thing to remember with all simulation programs is that the mechanics of using them are often easy to explain, but it is not at all easy to describe how to use them efficiently. In inexperienced hands, simulation can prove to be an expensive way of undertaking calculations that are unnecessary.

Each person attending a course was able to run one simulation while there. However, it was usually found that some assistance was required back at the colliery from whence he came before he was completely at home with the technique. Therefore, the presence of local operations research personnel who could advise him was invaluable. After about a year the systems-analysis team found that the technique had been used at over 100 collieries, mostly without the need for professional advisers. The programs, which have, of course, been continually improved and modified, have remained in use for many years.

The importance of this procedure is best illustrated by the fact that, when a major program improvement was developed three or four years later without such a careful process of introduction, all the first management users experienced major difficulties in using it. The rumor quickly spread that the program was unreliable and management staff refused to try it out. A lengthy trial under unusually rigid conditions was necessary before confidence began to be restored.

What, then, are the main lessons to be learned from this example?

- It is essential to have strong management support if a system like this is to be widely accepted.

- There must be joint responsibility for development and testing.

• Particular care must be paid to train the staff to use the new method of calculation.

• There must be an adequate back-up service while management staff are getting used to the technique, and, indeed, to educate new management staff.

An organizational system. This second kind of computer system is different from the one considered in the previous section in that, once installed, it will be mandatory, that is, it will be part of the routine operation of the organization, and the people concerned with its operation will have no discretion as to whether they use it or not. This is equally true whether the new system replaces work previously undertaken in some other way or whether it provides some new service. It might be thought that the implementation problems of such a system are relatively easy, being confined to formal approval by the appropriate controller and the technical problems associated with the developing and debugging a computerized system. The reality is far more complex. For a system to operate successfully, the correct data must be fed into it, and the outputs must be both usable and used. All these call for control. As systems become larger, it also becomes more difficult for the people within them to have any understanding of the consequences of their actions, and the need for control increases.

But even the best control system does not ensure the organizational system's effectiveness and use, unless the system is properly matched both to the organization as a whole and to the individuals who must use it; indeed, these persons must both understand and accept it. Thus, for an organizational system, matching and control are the essence of successful implementation.

Consider the problem of implementing a centralized computer system for provisioning (ordering, stocking, and distributing) spare parts and equipment for a large, dispersed engineering organization.

While this is too large a subject to be covered here, two points of organizational behavior need to be emphasized:

• There is an innate resistance on the part of many people to undertaking work that appears to them to happen without some system, against the perceived interests of their immediate group (or even that of the organization as a whole).

• Once a working procedure has been established, it develops an internal stability of its own. Attempts to make small changes often fail, because there is a natural tendency to revert to old and previous practices that feel understandable and comfortable.

The extent to which these factors can be controlled is discussed later, but the fact is that control can never overcome the problems that arise from bad design or poor installation. There is only one way to overcome the dangers and distortions arising in most man/computer systems: to apply the principle of "inversion," which states that a proposed organizational design should be examined from the inside out, that is, the designer must explore the consequences of his design for the people in the system and analyze how they will react to the new pressures. Unless this is done, the new system will not be matched to the organization, and inefficiency and malfunction will result.

The next four subsections look at the characteristics of some of the most important human elements in the system:

(a) The operators—those involved with the detailed day-to-day operations of the stores.

(b) The managers—those who deal with complaints and take responsibility for the smooth running of the system.

(c) The maintainers—those who keep the system operational.

(d) The controllers—those responsible for the system's overall performance.

(a) *The operators*.

Human operators are not mere ciphers to be considered equivalent to the electronic units in the computer. By the standards of computer elements, they may be judged to a degree inferior in performance; they possess specific positive characteristics far outweighing so casual an assessment, yet too often ignored both in systems design and implementation. More than one badly designed system has been saved from collapse because its operators had a better understanding of its performance than the designer. Unfortunately, the larger and more computerized the system becomes, the more difficult it is for operators to have this saving sense of what is happening.

People have at least four important characteristics:

- An extraordinary, even though fallible, memory.
- An ability to relate cause to effect.
- Flexibility.
- A sense of purpose.

Not all operators possess all these values—perhaps only a minority—but a system that denies their existence will almost certainly run into serious trouble, particularly during implementation, for it is these skills that come into play then. Indeed, if the systems designer is lucky, he will find that the operators to some degree redesign the system for him. He may find that he can never get a complicated system up to full operating efficiency without their help.

These human characteristics are also important in routine operation in coping with the predictable mishaps that cannot be dealt with at the computer level. Thus, if the wrong part number is given in a requisition, the storekeeper very often remembers the right one. If the item has been misplaced in the store, he may guess where to look for it; if it still cannot be found, he may be able to identify another item that is like the one required. Efficient design demands that these human characteristics be used.

Implementing a system that denies the operator the opportunity to be human is likely to run into difficulties, for it reduces him not just to a cipher, but to a hostile and uncooperative element of the system.

Another important value of the human operator is his tendency to take short cuts. If it appears to him that effort, time, or money can be saved, he is likely to try to save it—and, furthermore, without consultation, unless there is some countervailing reason. Thus, if items are in short supply in his shop, he may do some private rationing to ensure that supplies last until the next delivery.

More importantly still, he can report on any sudden changes of conditions, and thus bring corrective procedures into action faster than the computer control system can. On the other hand, if he has to perform a detailed calculation, but thinks he knows the answer from experience, he will give his answer. If he has to record information in difficult or dirty conditions, he is very likely to try to remember the information and record it later. Information believed to be irrelevant is given less attention than facts whose value is apparent.

These difficulties can be overcome and the advantages exploited if the system is properly matched to the operator's actual characteristics. (Incidentally, to allow for the fact that an operation can best be done in different ways by different people in different places, there is no reason for some flexibility not to be allowed sometimes in systems design.) Failure to appreciate this has led to serious systems failures when transferring a general computer system from one context to another, from one country to another or one administrative unit to another; the principle also sometimes holds, when one person replaces another. This matching is something that needs to be examined in detail when the implementation stage is being considered, but it also needs to be reviewed continually throughout the life of a system. It is as much a problem of implementation as design.

It must not, of course, be assumed that the operators are unalterable in their abilities or their understandings: they too are capable of adapting, but they need training and teaching (the former for acquiring specific skills, the latter for developing understanding). How to proceed requires careful analysis. If there is a mismatch, it must be identified, and then analyzed. Often the best people to undertake this analysis are the operators themselves. They do not need to know the details of the whole system, which they could hardly be expected to understand, but they do need to know the consequences of their possible actions on the system as well as to be able to comment on the consequences for themselves.

Finally, there remains the question of control. Whether from direct disobedience, unconscious drift, or changing conditions, operator performance will in time become unsatisfactory, and a control system must exist to ensure that it continues to meet the objectives of the system. How can such control be instituted? What indices can be used to ensure that departures from the desired performance are detected? While the answers to such questions must be specific to a given system, they are seldom obvious. Thus, a provisioning service has to minimize costs subject to a given level of service. The costs can be measured in part, but the level of service is much more difficult to identify. Similarly, one can check that all necessary forms have been filled in, but not that they have been filled in correctly. Checks on stock levels are expensive to carry out, and are undertaken infrequently, and mistakes that may have occurred can rarely be traced to their origins. The problem of control may be one of management as much as systems design, but it is essential that such indices as the system produces be well understood and related to the real control problem, not simply to the computer's functioning.

(b) *The managers.*

In this context a manager is one who is responsible to a group of customers for a service or function, for which the computer system is intended to provide the routine operating element. Thus, his work has a highly discretionary element. For example, one of the issues on which he must rule is whether or not to make a special order for items in short supply. An analytically designed provisioning system, of course, has reordering routines applicable when there is an established pattern of use. However, what happens with spare-parts ordering when a machine has only been in use for a short time, or when the operating divisions place a large new order for some well-established piece of equipment? In order to be able to cope with such situations, the manager must have an awareness of such special actions as may be necessary when the standard routines no longer apply. It is, of course, conceivable in theory for the system to be able to cope with all occurrences, but in practice it may not be worthwhile programming rare possibilities into the system. In any case, trouble shooting when serious deviations occur provides managers with their most difficult and interesting tasks.

When an emergency occurs, the manager must be able to take action with some knowledge of what its consequences may be. Suppose, for instance, that a supplier has production problems that greatly increase the lead times on orders. What will the effect of this be on the company's stocks? What will the consequence of remedial actions be? It is unlikely for the manager to know how to handle every eventuality himself, so he must be able to get this knowledge promptly. Thus, he must have quick and easy access to people who know and who can undertake the appropriate analyses. These people are called the "maintainers."

It is also important to realize that all systems have to cope occasionally with unexpected events, and that robustness and flexibility may be more important than an optimal solution. A system that can cope with a variety of inputs is better than one that is highly efficient for a single kind of input. Again, these may be thought to be questions of design, but they are critical when it comes to implementation. The manager knows only too well the problems he has to cope with. If he feels that the system does not help, implementation will be slow. He may not be able to explain why, but his reluctance may be justified.

Although managers have powers of discretion, they are, of course, part of the overall system, and thus subject to checks and controls. Because of those powers of discretion, however, these controls need to be primarily through indices of performance rather than checks on procedure. It is essential for these indices to be true measures of performance; indices taken in isolation can often work to the overall detriment of service.

(c) *The maintainers/installers.*

What, it may be asked, has systems maintenance got to do with implementation? The answer is a good deal, simply because many of the problems that occur later in modifying the system are the same as those that occur in implementation. The basic questions are therefore those of systems design, and all that needs to be said here is that five elements are needed.

1. Close contact with the systems analysts, managers and operators involved in the plan.

2. A set of diagnostic procedures.

3. A set of predictive simulations that can forecast the effects of change.

4. A well documented basic program structured to allow for change.

5. Above all, an implementation plan that is known to all and that can be modified by those responsible for operating the system.

The importance of the first and last of these cannot be overstressed. A man/computer system is a living thing that does not behave in detail as it is designed, but neither does it behave in detail in the way that those within it say it does. The maintainer needs to be able to analyze and interpret what is happening; thus, there needs to be a systems analyst, not just a computer programmer.

(d) *The controller*

The controller is centrally involved in implementing a new system. He is committed to installing it—probably more strongly than anyone else, because it does a job he sees the need for doing; however, he also has to accept responsibility for its cost, and, should it come to a bad end, for its failure. He also has the task of resolving a host of minor conflicts between his staff and the systems designers. He has to decide on where flexibility may be allowed and where new procedures are enforced in detail. He must discuss departures from the plan, and the effect they will have, not only on his staff, but also on his customers.

Above all, he must satisfy himself that he is getting what he wants; and, beyond that, whether the specification he agreed to actually meets his needs.

This last point is an important one: who can blame the system's designer for doing what was agreed upon, even if the agreement should not have been reached in the first place? In truth, there is no excuse–it is the designer's responsibility to see that what the customer says he wants is really what he needs. It is remarkable how often this point is overlooked when new organizational systems are established. In the provisioning case, for example, it is usually assumed that the prime purpose is to ensure that the stock ordering, storage, and movement activities minimize overall costs. If this is the sole purpose, the whole thing becomes a mechanical operation, the controller can go home, and the computer can take over. He knows, however, that he cannot go home. If his organization faces a severe cash shortage, he must reduce stocks even if it means that overall costs go up. If he is in conflict with suppliers, or must balance certainty of supply against average lead time, or if he is negotiating discounts, he must have a system he can control. He must know the consequences of his actions, and he must be in control.

The design of a system that enables the controller to cut overall stocks in the best way is different from one that assumes overall costs always to be minimized; it is no more difficult, just different. It becomes difficult only when one tries to use the system for something it was not designed for. Thus, care is needed at the pre-implementation phase.

The controller's next problem is control. How does he assure himself that the system is working properly and efficiently? The designer must bear in mind that several features of the new system will be new and that the controller will not have an instinctive understanding of what values new indices should take. (Do not underrate the importance of instinct to a senior manager; it is often the reason he has risen in the hierarchy.) Most of his indicators are internal–costs, quantities, staff, etc.–and he has estimates from the systems designer he can use for comparisons. However, it is necessary to make two warnings. In the first place, almost by definition no system with an external purpose can be judged adequately from internal evidence; external indicators must also be introduced, and to be effective there must be data so that comparisons can be made before and after implementation. Second, it is also necessary to ensure that no problems are being pushed to one side in the course of implementation. Neglected problems can cause backlogs that lead later to serious deterioration in performance. Indicators that some problem has been overlooked may be nervous distress in the staff, or steady or increasing overtime. At the implementation phase, no disturbance is too small for study.

Concluding remarks. As these two cases make clear, the analyst has a key role to play in implementation. His preparation for this role begins at the start of his work, when he familiarizes himself with the problem situation and the actors involved in it, as well as the subtle facts of the setting, including any unwritten traditions that may dominate it. For example, if staff reductions are permitted only under circumstances of dire distress, the analyst will not be able to presume that a new system will be manned by new personnel chosen for their qualifications; rather, he must assume that the existing staff will accept the system and be trained to use it, and he will have to accept this constraint as he develops alternatives.

Too, the conditions present where the problem exists may also affect how any proposed solution will be implemented—and therefore, what sorts of proposals may be feasible. Giauque and Woolsey (1981) tell of the well educated young analysts who were

> . . .hired to increase the productivity of a third-world steel mill. A major problem lay in the scheduling of three electric arc furnaces. The time required to process a charge depended upon the amount of power fed to the furnace, thus power scheduling was a critical decision variable. Furnace operators, who were on an incentive plan, had to work within a power capacity for each furnace, a total capacity for the plant, and had to schedule such resources as charging and pouring

cranes so as not to interfere with one another.

> The [analysts] . . . studied the problem, gathered operating and capacity data, and developed a complex model to handle furnace scheduling. A computer system, complete with video displays for each furnace operator, was procured, and massive amounts of time and money were expended in developing and debugging the code, report writers, system interfaces, and so forth. Total cost was appoximately 2.5 million US dollars. All concerned settled back, confidently expecting major increases in productivity.
>
> Unfortunately, productivity didn't change *at all*. The system designers had overlooked one minor detail; of the 24 people who operated the furnaces over three shifts, *only five could read!* The study team had never bothered to go to the furnaces, and had never studied the *actual* operations, much less learned how to *do* them.
>
> What was wrong? The [analysts] . . . were undeniably bright; technically, the system was fine. What was lacking was a sense of perspective, a knowledge of reality, an understanding of the business, and an understanding of the cultural infrastructure. The furnace production was substantially increased . . . by junking the 2.5 million US dollar computer system and substituting a scheduling method based on colored blocks in a plastic frame. Cost . . . was less that 200 US dollars for the deluxe model. [Italics in the original.]

An initial familiarity with the setting—renewed at times throughout the analysis—is an essential basis, not only for choosing alternatives for analysis, but also for implementing the one that is found to be preferred. This familiarity also is an essential ingredient in a successful implementation: a carefully drawn plan for it, specifying actors, responsibilities, relations, activities, schedules, and desired outcomes.

No two cases are ever exactly alike—and the literature of implementation does not yield a standard paradigm—but the two cases described extensively above suggest many of the elements that must be taken into account in implementation plans and activities.

Similarly, the cases described in Chapter 3 offer some useful insights.

• Although the analysis of blood availability and utilization was sponsored by the Greater New York Blood Program, which serves the needs of 262 hospitals and 18 million people, implementation began in the Long Island Blood Services area, which contains 34 hospitals and serves two million people. However, an initial pilot implementation began by involving a Regional Blood Center (RBC) and only four Hospital Blood Banks (HBBs). As Chapter 3 points out: "They were provided support to correct rapidly the start-up problems that occurred. Once these HBBs were working to the satisfaction of their supervisors, they described the system to the supervisors of the other HBBs at seminars where the operations research staff, wherever possible, played the passive role of providing information when requested to do so. Responding to this approach, all but four very small HBBs in Long Island voluntarily joined the program over a two-year period, and none have dropped out."

It is important to note in this account that the analysts quickly faded into the background (but remained present to help), while the supervisors who were using the system successfully sold it to others.

It is also important to note that the computer modules supporting the new blood-distribution system are run independently, and each allows the relevant officials to use their outputs as the basis for making the judgments for which they are responsible:

— The policy selection module "presents the decisionmaker with alternative targets (shortage rate, outdate rate, scheduling factor) that can be obtained for different levels of blood supply in the region."

— The distribution-schedule module provides "a detailed schedule of the shipments of rotation and retention blood for each blood type that each HBB will recive on each delivery day. These schedules are communicated to the HBBs for comment and feedback. Once this phase is completed, the . . . operation can begin."

— The control procedure allows the RBC manager to keep his operation based on up-to-date estimates of the basic parameters of his region's operations.

Further, these modules are designed to make them as transferable as possible to other regions—one of the goals of the analysis, and one that is being achieved, not only in the Greater New York Area, but also elsewhere in the United States and Europe.

• The fire-protection analysis for Wilmington, Delaware, also developed models that allowed the relevant officials to exercise the judgments appropriate to their responsibilities. A mix of these judgments and supporting analytical results allowed the analysis team to derive and recommend a new deployment that preserved the former fire-protection coverage while achieving some economies. Then, the city officials took over the implementation, in this case largely a process of negotiation and step-by-step decision.

However, in both this and the blood-supply analysis the analysts left behind a set of tools and personnel trained to use them, so that new problems and important changes could be analyzed without asking for the return of the analysis team.

• The analysis dealing with the problem of protecting the Oosterschelde estuary from flooding was done for a highly competent technical organization, the Netherlands Rijkswaterstaat, as part of its own analysis, so implementation in the sense of this chapter was hardly a problem. However, it is clear that the scorecard method evolved by the analysts contributed to the Rijkwaterstaat's ability to present the issues clearly to the Netherlands Cabinet and Parliament, who arrived at the decision about which option to adopt.

• Since the IIASA global energy analysis looking 50 years into the future could not be done for a world decisionmaker (since such persons do not exist), implementation might seem at first glance not to be an issue. However, there are hundreds of enterprises and government agencies involved in energy policies and operations, and thousands of industrial executives and public officials with relevant responsibilities; for all of these this analysis offers useful insights, and for many it suggests local analyses that can be done against the backdrop of the global findings. The IIASA analysis team has helped such organizations and people in a variety of ways: by interpreting data, by adapting models, by extending analyses, by consultation, and other activities—all of which can be thought of as implementation.

The important lessons of all of the examples in this section 9.3 are that implementation is as various as the problem settings themselves, that it is an important (indeed, essential) extension of the systems analysis activity, and that it deserves careful thought, meticulous planning, and energetic effort—all guided by considerable diplomacy.

4. OTHER PROBLEMS

For certain issues, the alternatives competing for choice by the decisionmakers may differ in the ease with which they can be implemented. To the extent possible, the probability of unsuccessful implementation should be taken into account in the comparison. If alternative A is chosen and it is discovered later that implementation cannot be carried out successfully, resources will have been expended and possibly other costs generated. Alternative B or some inferior modification of A may then have to be implemented instead. Thus, in a cost-benefit analysis, to determine the excess of benefits over costs for the various alternatives, the probability of failure during implementation ought to be estimated for each alternative and the expected costs thereby incurred taken in account (Peterson and Seo 1972).

Similarly, before implementation has started, the decisionmaker must make sure that the necessary resources, financial and otherwise, are available; the analysis, if done properly, will have determined the requirements.

The wastepaper baskets of the world are full of sound proposals never carried out because the resources were not available to act on them. It may not be the whole resource that is lacking, but only one small, nearly trivial, element of the whole. Nevertheless, once the opportunity has been lost, it seldom comes again. Accordingly, it is essential for any recommendation arising out of a project directed toward a single decision to be matched to the available resources, financial, material, and human.

The first resource that has to be considered is, of course, money. In most organizations, the financial resources are limited either by the amount of cash that can be raised or by rules laid down by a higher level of management. Thus, the project must be not only attractive in itself but also relatively attractive in connection with other proposals that management may be considering. Clearly, it is essential for the analyst to be aware of the system in which financial decisions are made, what the criteria are, and, if possible, what rival projects may be competing.

Physical resources and other costs must also be considered. A decision that to implement requires equipment that cannot be obtained or land that may not be available, or gives rise to environmental consequences that may be unacceptable, will inevitably be rejected, even though it may be highly desirable without these physical limitations. It can never be argued by a systems analyst that "such factors are not my concern."

It can be argued that the importance of financial and physical resources is self-evident, that any competent systems analyst will automatically take full account of them in the course of his work. Moreover, it is easy to see how this can be done, and easy to check that it has been done. However, the problem of the human resources is altogether more difficult. Clearly, the human consequences of the proposals should be included in the systems analysis, just as the financial and physical ones, but the problems of doing this are more subtle. The proposal may call for more or fewer people working in an installation; it may require them to do different work. Some will gain in influence and power, others lose. Too, the good manager is concerned not only with the direct consequences but the secondary consequences. What effect will such a change have on the attitudes and efficiencies of those working with him? Is the proposal so against their opinions and prejudices that they will adopt it with reluctance? Will this reluctance reduce their efficiency or the quality of the advice he will receive on other matters? The good manager is not simply looking at this one decision. He must have peripheral vision that enables him to sense all the other consequences. If the advantages to be derived from a proposal that his staff will find difficult to accept are very great, he may still decide to go ahead. If, however, they are relatively small, he may well decide that the incidental cost to him of monitoring the implementation outweighs its apparent advantages. Thus, in translating proposals into reality, it is essential to make a careful study of the manager's human resources.

5. COPING WITH IMPLEMENTATION PRIOR TO DECISION

Matters of good practice. How can the implementation process be structured so as to increase the possibility that what is decided will be carried out and the objectives attained? Sabatier and Magmanian (1979) contend that these five conditions are sufficient to insure successful implementation:

1. The program is based on a sound theory relating changes in target group behavior to the achievement of the desired end-state (objective).

2. The statute (or other basic policy decision) contains unambiguous policy and structures the implementation process so as to maximize the likelihood that target groups will perform as desired.

3. The leaders of the implementing agencies possess substantial managerial and political skill and are committed to statutory goals.

4. The program is actively supported by organized constituency groups and by a few key legislators (or by the chief executive) throughout the implementation process, with the courts being neutral

or supportive.

5. The relative priority of statutory objectives is not significantly undermined over time by the emergence of conflicting public policies or by changes in relevant socioeconomic conditions that undermine the statute's 'technical' theory or political support.

This last condition, of course, can not be known in advance. While the analyst can not insure that conditions such as these exist, he can help a great deal in bringing about 1 and 2. He does this by formulating clear objectives, by suggesting sound alternatives and finding ways to overcome them before planning the implementation program.

First, if the alternatives proposed to the decisionmakers are not directed toward clear objectives or are not based on sound analytic principles, the decision may be a poor one and not suited to the issue to be resolved. The program that is implemented is then not likely to be successful. To quote Bardach again (1980):

> ...the basic social, economic, and political theory behind the policy must be reasonable and sophisticated: it will not do, for instance, to pretend that most people do not act most of the time in accord with a rather restricted notion of their self-interest; nor will it do to ignore inconvenient features of the world like the sparse supply of managerial and technical competence or the enormous variety of local circumstances which policies must serve or the immense difficulty of coordinating large-scale activities on the basis of plans and promises rather than market signals.

Second, a basic administrative strategy for implementation should be designed. Such a strategy should be simple, placing as little reliance on bureaucratic processes as possible (Pressman and Wildavsky 1973, Levine 1972, Kneese and Schultz 1975). It should include an estimate of the financial resources required by the implementing organization to hire staff, administer the program, monitor the changes, and to carry out any further analysis necessary.

For each policy alternative—who has to do what? when? how?—must be investigated. If the implementing organization exists, the analysts need to pay attention to the effects of the program to be implemented on the organization itself. Such effects may seem trivial but can have serious consequences. A decision to change the pattern of garbage collection in New York City was seriously delayed because it disrupted car pools (Beltrami 1977). Sometimes incentives can be designed that will increase cooperation.

In any event, the analyst should work with his client's staff, involving them in the research if possible. This means not merely providing data and assumptions but questioning forecasts and hypotheses, proposing alternatives, and pointing out where the difficulties in implementation may lie.

Third, obviously the analyst must try to anticipate the problems to be faced during implementation. To do this, he may consider the list of program elements and their source and support—such things as regulations and guidelines, financial accountability mechanisms, goods and services needed, the participation by various agencies and bureaus, sources of funds, and so on. Next, he can ask: "What can go wrong?" "What can be done about it?" A systematic way to approach these questions is through developing a scenario.

Implementation scenarios. The development of scenarios is one of the most useful devices for anticipating the future where uncertainty is large (Chapter 4, Brown 1968, Helmer 1966). Preparing a set of hypothetical "future histories" of a proposed program forces the program designer to think seriously about the stresses and strains to which his proposed program may be subjected if implemented. Bardach (1977, pp. 254-255) observes:

> It is no easy task for the designer to predict, and following prediction to readjust, the outcomes of such dynamic and complex processes as are involved in a loose system of implementation games. In fact, the system is so complicated that it thoroughly defies analysis by means of even the most complex models known to any of the social or behavioral sciences. It must be approached through what has come to be known

as "scenario writing." This latter method simply involves an imaginative construction of future sequences of actions—consequent conditions—actions—consequent conditions. It is inventing a plausible story about "what will happen if..." or, more precisely, inventing several such stories. Telling these stories to oneself and one's professional peers helps to illuminate some of the implementation paths that the designer does not want taken. He or she is then in a position to redesign some features of the system of implementation games that permit him or her and his or her colleagues to tell stories with happier endings. Trial and error through successive iterations produce better and better endings.

Obviously, scenario writing is an art. It requires imagination and intuition. One suspects there is not much that can be formalized or codified about how to do it well. This may be one of the reasons why scenario writing is, in fact, not very common even among the most experienced policy analysts and designers.

Bardach (1977, pp. 264-265) offers an outline for writing an implementation scenario. It suggests such steps as making an inventory of the program elements, paying attention to who controls them either directly or indirectly, and statements as to how management will deal with problems of social entropy, incompetence for instance. Also it asks the scenario writer to show how the policy will deal with various dilemmas of administration—tokenism, procrastination, massive resistance, diversion of resources, and others.

For certain problems special analyses directed toward questions of implementation may be desirable, for others an actual experiment may be called for before full-scale implementation is attempted.

Implementation analysis. Many studies can and should be done in two stages: a first analysis to find out what type of action should be taken or what sort of alternative to recommend, and then a second analysis to specify the details of the designated alternative and of the program to implement it. Such analyses, leading to the translation of a policy decision into a specific program whose objective is to carry out the policy's intent, are termed implementation analyses.[1] As an example, consider the hypothetical public transportation study mentioned earlier. To evaluate the advantages of a streetcar system over a subway, the decisionmakers probably need not consider whether the tracks should be laid on 1st or on 2nd Street, or whether the cars should have forty or fifty seats. But if a streetcar system is to be installed, these decisions will have to be made. Again, in the Oosterschelde flood-control study outlined in Chapter 3, after the decision was made to choose the flow-through dam with a gate that could be closed during a storm, further analysis had to be done to determine the most practical width for the gate.

Sometimes the analysis that takes into account the details of implementation can be postponed until after the primary decision; in other cases, it may have to be done earlier, at least in part, in order to set the ranking of the top two or three alternatives.

Social experiments. Decisions (whether they are the results of analysis or not) taken to alleviate social problems are notorious for unsatisfactory consequences. Implementations have frequently failed to achieve their objectives, often resulting in exorbitant costs and inducing great social disruption. One possible way to find out in advance that a program may not work as intended and thus avoid wasting resources and political prestige may be to conduct a social experiment before starting a full-scale program.

> In practice, a social experiment is an organized attempt to pretest a particular innovative policy before committing vast resources to the solution of some large social problem. An example might be the experiment in New Jersey with income maintenance, undertaken before there was a national commitment to such a program. In this case, alternative programs were tested on sample populations in several

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[1]The term implementation analysis is also used to refer to the study of why authoritative decisions do not lead to expected results (Bermen 1978) or to how "specific nonmarket activities (e.g. public policies) can be expected to operate, and to depart in predictable ways from their costs and consequences as originally estimated" (Wolf 1978).

other states (Brewer 1973).

The housing experiment described in Chapter 1 is another such example. For further discussion of the use of social experiments see the chapter on experimentation in Volume 2 of this Handbook and Riecken (1974).

A major advantage of experimentation is that it reveals empirical information about the proposed large program. Clues to the possible activities of those who lose or gain from the program are obtained and minor changes that ease the path to implementation without compromising the objectives may be discovered.

Social experimentation is not a panacea that guarantees successful implementation. There are frequently ethical, methodological, or political reasons why experimentation is unwise. Brewer (1973, p. 156) mentions some of these ethical issues:

> How are different benefits received by experimental subjects reconciled and justified? At the conclusion of an experiment, how does one make restitution for an experimental alternative not finally chosen but upon which recipients have become dependent? What about confidentiality of data and other human problems associated with the conduct of the experiment? These and many other primarily ethical issues all come into play and must be accounted for by the social experimenter.

Methodological problems are often formidable. It is not easy to design a valid experiment. An experiment is not a mere demonstration or a small-scale trial implementation of a large program that is under consideration. Such exercises are often useful but a proper experiment requires a properly selected control group and careful analysis of the results. An excellent discussion of the sort of implementation problems that would be likely to arise with a full-scale program, that were not detected in a small-scale demonstration, is provided by Davis and Salasin (1978).

6. COPING WITH IMPLEMENTATION AFTER DECISION

It should be clear that analysis before, or just after, a decision cannot insure that the implementation will go smoothly. Circumstances change and the unexpected can happen, requiring modification in the program for implementation. Analysis is needed both to find satisfactory modifications and to monitor and evaluate what takes place. Usually, because the authorities responsible for overseeing the implementation program are not those who made the original decision, analysts other than those who did the original study are involved.

Other than through the use of analysis, the decisionmaker or the agent of the deciding authority has essentially two approaches to keep implementation on the desired path: mediation and persuasion, and intervention using the power of the mandate.

Mediation and persuasion.

Organizational development. Here, a "change agent" enters into a collaborative relationship with the organization and attempts to produce the planned change. He attempts to change structure and processes within the organization; decisions are not viewed as being imposed from on high but rather decisionmaking is envisaged as a participatory process (K. A. Archibald 1970). The organizational developer may be a systems analyst, but different training is required. The approach does run the risk, however, of legitimating large distortions of the policy goals (Bardach 1980, p. 289). The successful strategy, however, often depends critically on the special characteristics of the target organization. As an example, see R. W. Archibald (1979) on the problems of managing change in fire departments, organizations that are characteristically low in complexity, but high in centralization and in formalization.

Negotiations. The negotiator's goal is to reduce the delays, the misunderstandings, and the confusion associated with implementation by communication, persuasion, and face-to-face bargaining. The analyst can help by suggesting the ways to compromise that do the most to retain the policy goals. The negotiating process can create problems as well as solve them, however (Bardach 1977, pp.

221-244).

Using the power of the mandate.

Project management. Project management has worked well for the US Department of Defense (Polaris) and for NASA to carry out most space missions. Project managers are widely used in private industry for keeping a project on schedule and costs within preset limits. One individual controls the implementation. Traditionally, he uses systems analysis, computers, PERT, and other "modern" management aids. This approach represents a way of overcoming the limitations of the usual functional separation of labor (into sales, production, and research, for instance) when the organization undertakes a large complex project by concentrating power and responsibility in one individual. How well project management works for social programs is still a question.

Political control. A project manager is limited by lack of authority; he is an agent, not the originator of the policy mandate or its political trustee. He cannot stand against strong political opposition. In contrast, an influential legislator or top political appointee can keep a program on track by interesting himself in its progress, playing the role of a "fixer" (Bardach 1977)—mediating, arbitrating, coaxing, bullying, using his political clout. Such a fixer cannot work alone; he needs a staff, including analysts, to handle the detail work.

7. CONCLUDING REMARKS

To select an implementation strategy and to modify it when necessary to hold to its objectives are sometimes not considered analytic functions. But all the characteristic activities that analysis can assist are there; choices have to be made in the face of uncertainty, data has to be turned into information, analyzed, and communicated, tasks have to be delegated, and incentives established. Hence systems analysts have a role, not only in preparing for implementation, but also in carrying it out, and in evaluating and monitoring the results to determine whether the policy is performing as it should. If they are to have this last role, however, funds must be provided.

If, during the course of an analysis, it becomes clear that a program or course of action cannot be implemented successfully, then it should never be recommended to the decisionmaker for his choice. This does not mean it should not be investigated, or even that it should not be called to his attention. In government, it is often clear from the start that the policy that will bring the most significant improvement in a given situation is not politically feasible and cannot be implemented. Such policies should often be studied nevertheless, for otherwise there may be no way for the public to learn the costs of current political constraints.

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