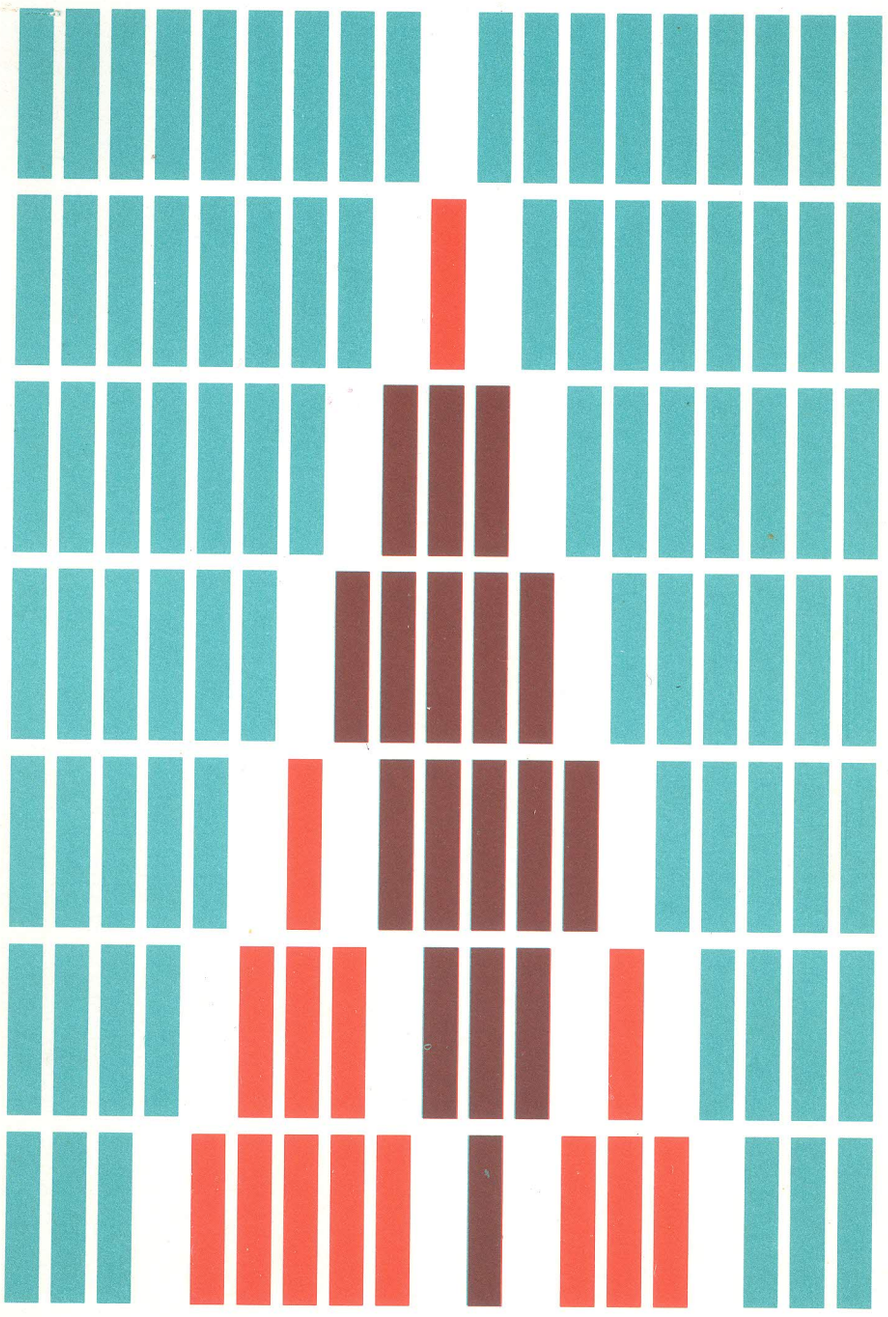
imr

Spring 1969, Volume 10, Number 3



Ideas on a Decision-Information System for Family Planning

Glen L. Urban
Massachusetts Institute of Technology

In recent years, the field of public systems has developed into an area of major interest to academicians. The addition of Professor John Collins, former mayor of Boston, to the Sloan School faculty and the growth of the Joint Harvard-MIT Urban Systems Laboratory are indicative of the emphasis being placed on the management of public systems. Professor Urban's discussion of the family planning problem is representative of the application of management science techniques to social problems. The author outlines a sequence of decisions for family planning, and then describes a management information system designed to support these decisions.

The magnitude of the suggested effort is significant, and the reader may well question whether so complete a system is in fact warranted. No cost benefit analysis is used to justify the extensive resources required to support a sophisticated decision system. The allocation of resources to management science efforts remains, in many instances, a philosophical question. *Ed.*

Introduction

One of the most serious problems facing many developing countries is how to control population growth. Although the use of technology (e.g., penicillin, vaccination, DDT) has caused a decrease in death rates, birth rates have tended to remain constant. In many developing countries, efforts are being made to solve the resulting population problem.[1] In some smaller population control programs, reduced birth rates have been achieved, but little significant change has occurred in larger countries. In India, for example, although the resources devoted to family planning have increased by a factor of 15 in the last five years to the largest expenditure in the world, the birth rate has decreased little if at all. In general, there is great need for a coordinated effort to improve the effectiveness of family planning programs in developing countries through better products, better programs, and better management of these programs.

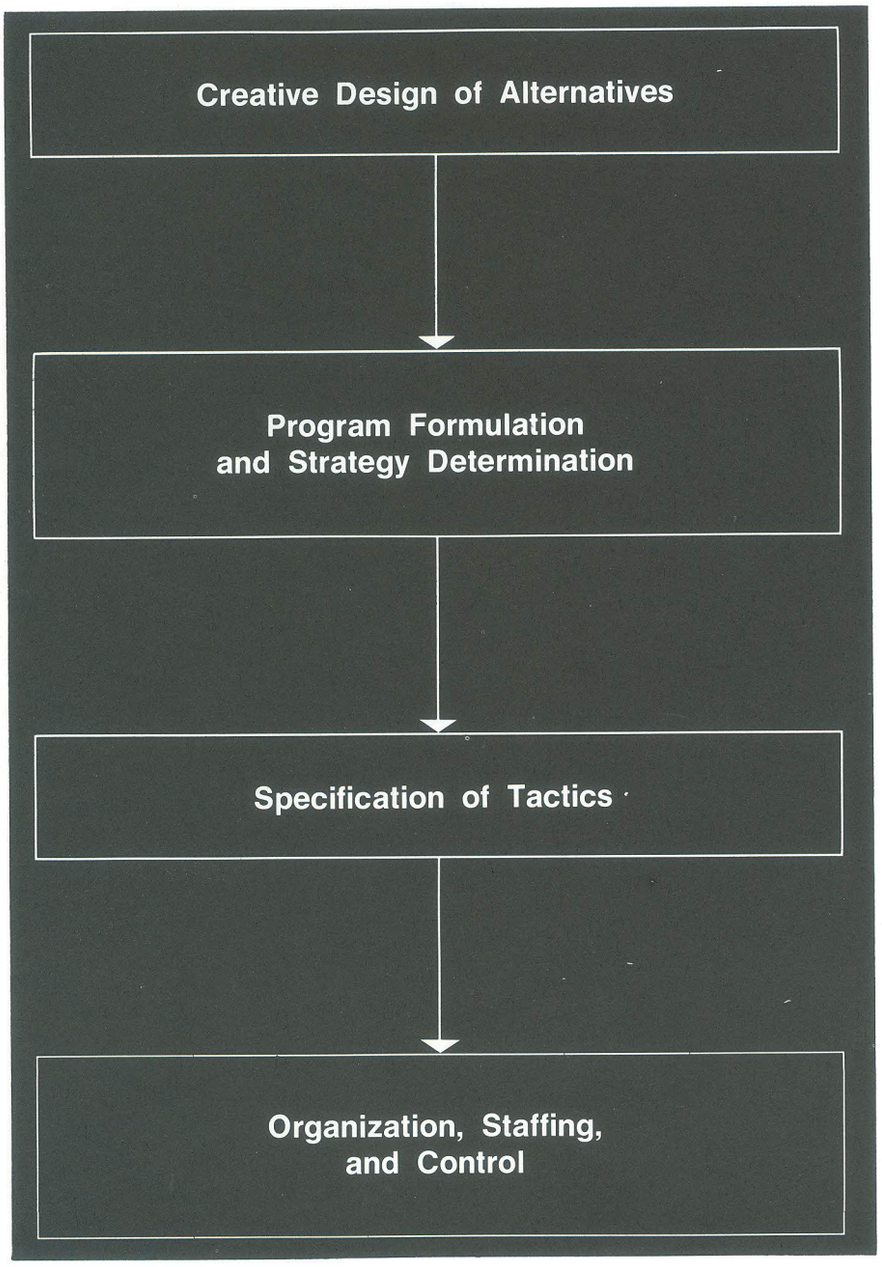
The purposes of this paper are to: (1) structure family planning problems from a decision oriented point of view, (2) indicate how management science methods and a model based information system can improve the effectiveness of the decision system, and (3) outline briefly the functions that must be carried out to establish such a system. It is hoped that these comments will encourage discussion and collaborative work on the management of family planning.

Decision Elements in the Family Planning System

Assuming that a national policy favorable to family planning has been established, four basic decision areas can be identified: (1) creative design of alternatives, (2) pro-

---

[1] See Berelson [3].



1 A Decision Structure for Family Planning

gram formulation and strategy determination, (3) specification of tactics, and (4) organization, staffing, and control (see Figure 1). This is not necessarily the order in which existing decision makers would proceed, but the purpose here is to structure a normative model for the family planning problem rather than to provide a descriptive model of current decision practice. Although Figure 1 shows the decision system as a sequence of activities, feedback will of course take place between each of the elements. A description of this feedback is provided in the sections below.

Creative Design of Alternatives Technology is improving the methods for contraception, but before technological innovations can be successful in a family planning program, they must be matched to the total needs of the users. This task is not a simple one since the users are not homogeneous. The product preferences and acceptability to families vary by the number of children in the family, the education level of the parents, and the geographic location of the consuming unit. Literate urban families, for example, may accept technologically advanced methods like intrauterine devices (IUD's) or birth control pills, while the often large segment of illiterate rural families may be fearful of them. Similarly, families with one child or no children may consider permanent methods such as sterilization unacceptable, while families with five children may find them acceptable. In general, the needs of each segment will be a combination of the physical needs and the social-psychological needs of the families in that segment. Efforts are needed to direct product design to each segment. A line of product alternatives should emerge which contains products targeted for specific market segments.

The design of product alternatives should not be directed only at the physical contraceptive features of the product. Creative effort must also be directed toward designing product attributes and communication appeals which the consumer perceives as being consistent with his social-psychological norms. To understand the basic non-physical attributes of the product which are desired by users, careful behavioral science research is necessary. The basic decision making process that governs the adoption of birth control by a family unit must be identified. The active elements in the process, the husband's and wife's sources of information, and the family's decision rules must be determined. This will call for an understanding of the attitudinal and motivational aspects of the family components, as well as an appreciation of the cultural environment surrounding the family decision unit. The nature of sex relationships, the practices of child rearing and training with respect to marriage and sex, and the influence of religious and social norms should be examined in terms of their effect on family planning decisions. In addition, the impact of overall trends toward organization, industrialization, more media availability, and wide-spread education must be understood. Finally, the study of individual decision units and the surrounding culture must be supplemented with an investigation into the process of diffusion of innovation in the social system.

The basic behavioral research tasks described above become directly relevant to the design of family planning products through the creation of effective communication appeals and strategy alternatives. Communication efforts have often generated awareness of family planning but have failed to generate action. In India, for example, current family planning communication methods have apparently generated approval, awareness, some knowledge, and the desire to limit family size,[2] but they have not re-

[2] Ideal family size is usually found to be about three; see [1], [4], [19]. Actual completed size is about six; see [19]. The number of people who want no more than three children is usually reported to be 70 to 90 per cent; see [1], [2], [24]. See, however, [6], which reports 42 per cent.

sulted in wide usage of contraceptive devices. Studies show approval of family planning to be between 65 and 90 per cent.[3] Studies also indicate that awareness (60 to 70 per cent)[4] and some degree of knowledge (40 to 60 per cent)[5] about contraceptive devices can be gained by communication efforts. Adoption of a contraceptive method following action or communication programs, however, is reported to be only 15 to 25 per cent, occurring mostly in the educated urban segment.[6] In the overall Indian program, about 12 per cent of the eligible couples are protected.[7]

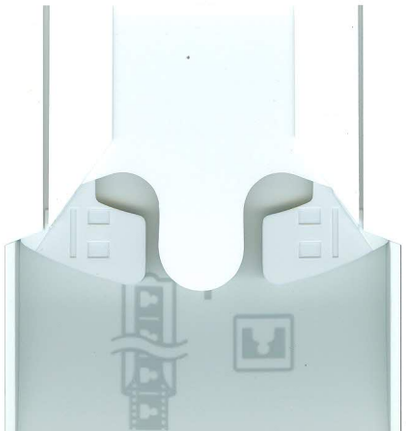
The need to translate approval and desire into depth of knowledge and then into action is paramount. This requires carefully designed appeals that activate family decision units in each segment and motivate them to adopt family planning. Appeals will have to be different for each segment; attention should be directed at each segment's differential characteristics. In the United States, research has shown that the most effective allocation of effort to the process of generating communication appeals ranges between 10 and 15 per cent of total advertising budgets.[8] In most developing countries, the amount allocated to examining and creating effective appeals is less than one per cent. Effort must also be directed to creating channels of distribution to carry the product and to developing media that will be effective in communicating appeals to each segment and each decision making element.

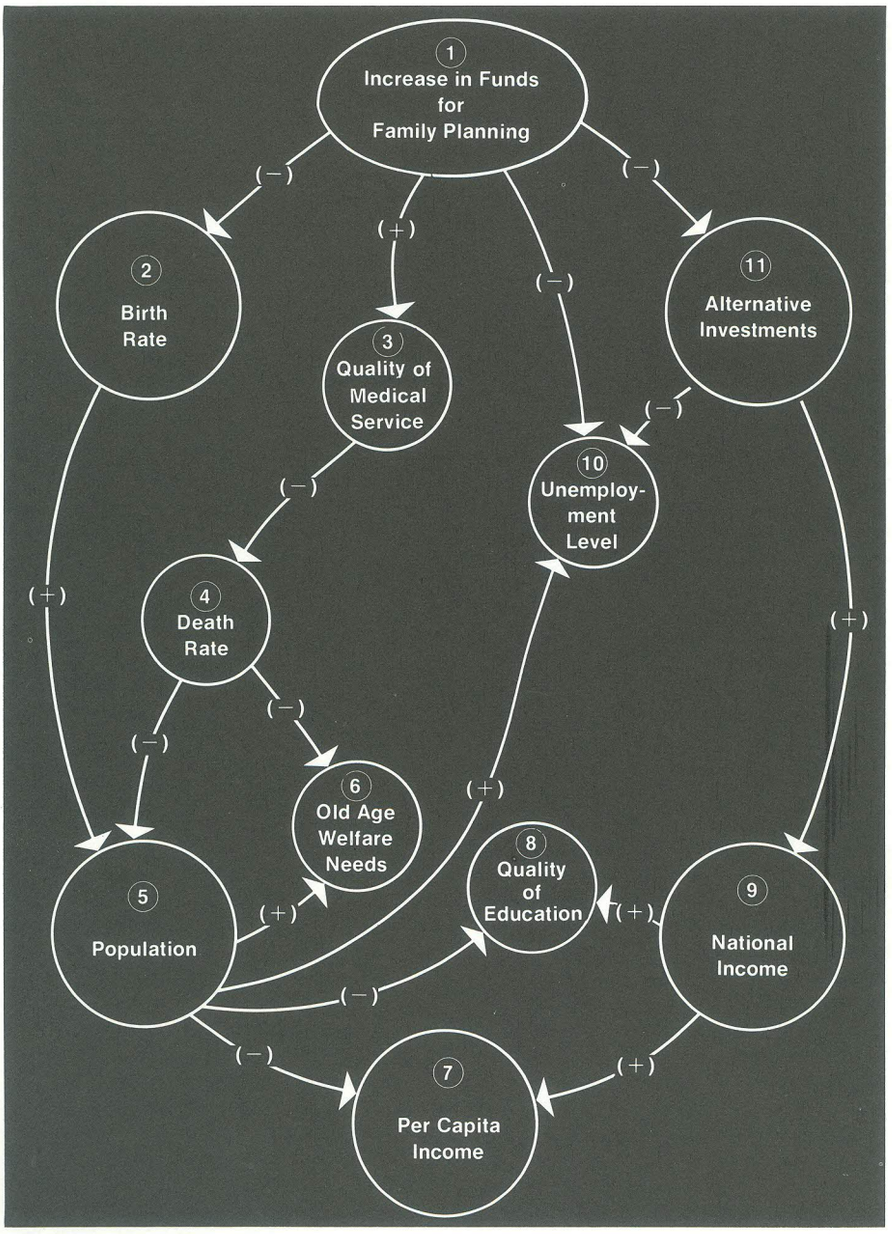
In summary, there is need for coordination between technical and social psychological product design. Alternative devices and communication appeals have to be created and tested. The final psychological and social-psychological "bundle of utility," called the "product," must be aimed at specific target groups so that they will translate their approval into action. A line of products will probably be needed to gain penetration into all segments. This need can be fulfilled by basic behavioral research systems to create and test appeals, and models to link physical product and communication linguistics in the generation of creative alternatives.[9]

Program Formulation and Strategy Determination Given a set of creative product alternatives, the next problem is to select the best set of alternatives, mobilize resources to carry out programs, and allocate the resources among alternatives.

In order to determine how much of a country's resources to allocate in the short run and in the long run, the interactions between family planning and the higher order goals must be taken into account. Economists have considered the marginal value of a birth prevented by evaluating the discounted value of net consumption, but this is a very elementary approach.[10] The inter-relationship among the goals of economic growth, social welfare, and social utility must be understood within the context of the system's behavior. Figure 2 presents some examples of these interactions. An increase in funds for family planning will tend to decrease the birth rate (indicated by the negative sign between 1 and 2, showing an inverse partial causation). As the birth rate falls, the population growth rate tends to decrease (indicated by a plus between 2 and 5). But funds placed in family planning, for such purposes as setting up local medical centers, will also increase the availability of medical facilities (shown by a plus between 1 and 3), which may in turn diminish the size of the reduction in population growth rate. National income will tend to decrease since the original allocation of funds to family planning was an alternative to other investments, such as steel

[3] See [1], [2], [12], [13]. For summary of studies, see [15]. [4] See [1], [10], [12], [13], [15], [19].
[5] See [1], [2], [12], [13], [15]. [6] See [1], [2], [15]. [7] See [9].
[8] See Gross [11], for an extensive study of the United States advertising industry and its experience in appeal generation.
[9] See Steffire [22] and [23], for a model that has been successfully used in the generation of appeals for the Peace Corps in Peru and for United States coffee products. [10] See Enke [7].





2 System Interactions

production or fertilizers. Other possible interactions with old age welfare needs, unemployment, and education are also indicated.

The interactions between system elements shown in Figure 2 are very simple and for illustrative purposes only. For example, a more complex linkage exists between education and the birth rate. As the education level goes up, the acceptance of family planning increases. As a further example of the complexities, if a social security system were operating to fill old age needs, perhaps the incentive to have large families could be reduced. Finally, the effects of financing and foreign exchange must be considered. A comprehensive model should include all the system interactions, the magnitude of the interactions, the delays in the system, and the effects of decision policies on the system,[11] and will enable funding groups to determine the overall effects of alternative commitments of resources to family planning.

The use of a comprehensive system model will require a clear understanding of causation, and more importantly, the specification of realistic goals for family planning in terms of the country's total welfare. Many "inspirational" goals have been set in the programs of developing nations (e.g., reduce birth rate from 40 to 25 per thousand by 1975), but these must be balanced against resource availability within the system. The objective is to produce meaningful goals for planning and control and the best budget for family planning in terms of a compatible total attack on the developing nations' problems.

In order to quantify the system's response to investment in family planning, specific programs must be considered. A program may reflect the usage of a particular product like the IUD or sterilization or a particular channel such as the public health or commercial distribution. A rough consideration of the impact of various program expenditures on the birth rate will allow a tentative total budget to be set for family planning. This budget could be changed if detailed considerations of proposals indicate that the response to programs is substantially different from the initial forecast.

The decision maker must next formulate a compatible set of programs which best achieve the goals of family planning with the budget granted to him for each future period. He must allocate the budget among all or some of the alternatives produced in the creative design phase. The goal for this type of allocation would be to minimize the number of births prevented over a period of years, so alternatives would be considered in terms of their effectiveness to prevent births, their cost, and their interrelationships. The inter-relationships will be important since the programs will be sharing such scarce resources as trained people, production capacity, doctors, and funds. The alternative programs may also be related at the user level. These interdependencies should be determined and only the incremental change in the birth rate should be considered in allocating funds to a particular program. Finally, the programs are inter-related by the nature of the segments they must cumulatively serve. Although each program may be specifically designed for a set of market segments, there will be overlapping. Condoms may be targeted for use by the newly married segment in urban areas, but the program might lead these people to choose the IUD as a surer means of family planning, even though the IUD was targeted for families with two or more children. The IUD may overlap with other alternatives such as legalized abortion. These conglomerate alternatives reflect program interdependencies

[11] See Forrester [8], for an approach to the problem.

and must be considered in the allocation of the total family planning budget if the greatest birth rate reduction is to be achieved.

The problem of program specification can be attacked by management science models. Program formulation models must also consider specific strategies for each program since the allocation will depend upon the way it will be used in the specific program. For example, What should the level of advertising be? How much supply capacity should be established? What price should be set? How much should be paid to intermediaries? If a program is to be a success, the controllable variables must be set correctly. As a further example, training is a variable in a public health education program. If the duration of the training is lengthened, the quality of field workers will rise, but so will the cost; is it worth it? The strategy model must answer this question by linking the response of better training to the program results, and to the total results achieved with a set of programs given the budget for family planning. The objective is to find the most effective allocation to the best set of programs and the best level for the controllable variables in each program, given the financial, production, technical, and personnel constraints on the system.

In addition to these constraints, there may be policies that restrict the number of alternatives. A policy of voluntary participation may eliminate negative incentives such as penalties for having children or manditory sterilization after four children. Another policy limitation might be strictures against abortion on moral or religious grounds. The constrained allocation is a difficult task because many variables, programs, and market segments are involved and because the basic environment of family planning is a dynamic one in which the elements are interdependent. A model for strategy determination must also reflect the basic behavioral decision process that begins with awareness and knowledge, leads to intent and trial, and ends with adoption of family planning. A final complexity is that the strategy can not be a set of actions for one period, but must specify a set of activities for each of a number of periods so that the best timing of the birth reduction and population growth is achieved. Although complex, such problems can be structured through management science models.[12] A good program formulation and strategy determination model should aid in finding an integrated set of programs that effectively utilize the available alternatives and resources for best achievement of national goals.

Specification of Tactics Once the programs are designed and their strategies defined, many tactical decisions are necessary to implement them. For example, after the advertising level of an alternative has been set, the budget must be turned into a specific media schedule. This scheduling must consider the target groups or segments to be reached, the exposure of media to the group, the cost of insertions, the duplication between media, the effects of replication, and the overall gains in terms of program goal achievements. These complex decisions can be made by a media selection model. Experience in the United States indicates that such a model can improve the effectiveness of a media schedule substantially.[13] Models can also be useful in other tactical decisions such as logistics,[14] the formulation of communication material formats,[15] the allocation of public health facilities and personnel to geographic areas, and the determination of the level of inventories of contraceptive devices in the production and distribution system. Tactical decisions must be coordinated and controlled. To aid in planning and control, PERT and Critical Path

[12] These models have been used successfully in new product decisions in the United States; see Urban [25] and [26]. For a specific application to family planning, see [27].

[13] See Little and Lodish [16]. [14] See Shycon and Maffei [21]. [15] See Diamond [5].

methods would be useful for tactical decisions in new programs; they could be used, for example, to assure coordination between the availability of new contraceptive devices with media insertions and communication efforts. The success of a strategy depends upon good tactical decisions, and management science models can improve the quality of these decisions in family planning.

Organization, Staffing, and Control After design, strategy, and tactical decisions have been made, they must be implemented. The implementation phase requires a large and efficient organization which functions as a change agent. The importance of the organization and staffing activities becomes clear when one considers the scale of the endeavor. In India, for example, at least 100,000 people are working in public health family planning activities. This implies many levels in the organization and suggests the need for some degree of decentralization and for specific programs to motivate personnel.

Organizationally, program formulation and policy specification should be centralized in a specific top-level group. Some strategic and many tactical and operational control decisions can be delegated to lower level managers. Making a specific manager responsible for a given program's performance is desirable. He would then have planning responsibility for the program, and would be the source of new plans and changes in strategy and tactics. Since several programs will be active, the goals and constraints of each program should be based on realistic global plans developed during the program formulation stage and should serve as useful guidelines for future performance evaluation of individual managers. Reasonable goals and constraints should be set and each decision maker given a reasonable and sufficient degree of latitude to effect his goal. In this way he will be motivated to search for creative ways of improving his performance.

The staffing of the organization will be important and difficult since it calls for creative and talented managers who can recognize problems and make good decisions. This implies the need for training of managers and for a high incentive system to attract qualified people.

In order to control the organization, data will be needed to monitor resource usage and goal achievement at each level. This control system will also function to direct a flow of required information to each manager and to monitor changes in the environment, which will be fed back to the strategy determination decision phase so that adaptive planning can take place.

Information systems that will assure the decision maker of timely, accurate, and relevant information can be developed with today's technology. Such a system will function to motivate and control all levels of operation, satisfy managers' needs for relevant decision information, and foster adaptive planning.

Summary of Decision Structuring There is great potential for improving the management of family planning in the design, program formulation and strategy determination, tactics specification, and organization, staffing, and control decision areas. Coordinated technical and behavioral research programs can lead to creative product alternatives that reflect a match between the total needs of various target segments and technical contraceptive features. The output will be an integrated product with

physical characteristics and social-psychological appeals that can be communicated to the target segments in such a way as to cause trial and adoption. Program formulation and strategy determination can be improved by management science models that help managers determine the best resource commitment for family planning and allocate the resources for development of the most effective mix of program alternatives. The programs will function as a product line to achieve the total family planning birth goals by their cumulative effect in designated consumer segments. The strategy for each program must be set so that the level of each controllable variable is best in terms of the product line's contribution to birth reduction. This type of planning must be backed by an effectively structured and staffed organization. Information systems can aid in the motivation and control of this organization, and can assure a complete, accurate, and timely flow of information to decision makers.

Elements of the Decision-Information System

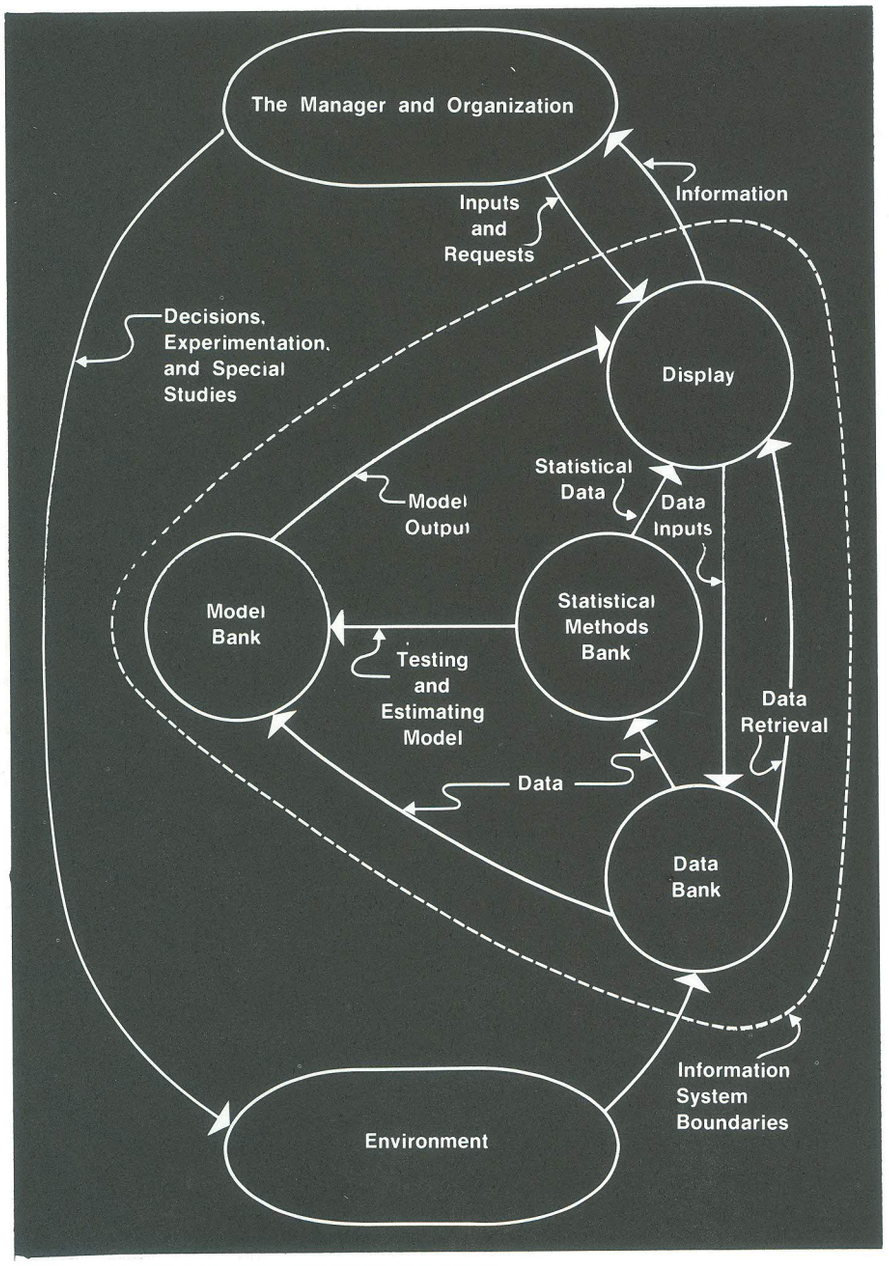
Man-Information Interaction A large amount of data is needed to support a decision system on the scale of the one described here. Making the data relevant to the decision maker involves a "man-information" interaction. The "man" is the manager and his organization. The "information" is contained in a system that responds to his demands and needs. The information system attempts to translate environmental information into a more relevant form. Within the system are a data bank, a statistical methods bank, a model bank, and a display unit (see Figure 3). These internal components interact with two external components — the manager and the environment. The environment includes all the conditions, activities, and influences affecting the organization.

Data Bank The data bank represents the system's first contact with the environment, serving as a storehouse for the information that the organization deems important for its decisions. This information will be retrieved by the manager and examined through a display unit. A simple system depicting this retrieval function is a series of filing cabinets containing records of environmental activity. A more complex system might be computer based, with a television screen for display purposes and retrieval performed by a computer program searching the magnetic disk records that make up the data bank.

All data relevant to the design, program formulation and strategy determination, tactical, and control decisions in family planning will be contained in the data bank. Such a bank could be composed of four sections:

1 Vital Statistics: births, deaths, immigration, emigration, fertility, spacing of children, age of marriage, age and sex composition. This information is needed to reflect population changes and forecast future population levels. As is well recognized, conventional registration systems do not give accurate measures of these statistics. Special sample surveys of sufficient size to give the vital statistics for each consumer segment have to be conducted on a regular basis.

2 Internal Data: expenditures, cash flow, accounting data, contraceptive placements, inventories, reports of district and local family planning center activities. These data are needed for control and for determining the results of strategy planning.



3 Components of Decision-Information System*

* Adapted from Montgomery and Urban [17].

3 Regular External Data: diaires of doctors and field workers, register of eligible couples. These disaggregate data will be collected regularly. A doctor's work book, for example, might contain individual reports of IUD insertions and removals. These data could be analyzed to determine the frequency of IUD removals and the number of women in each segment having side effects. The amount of data in this section is very large; however, only an accurately maintained and controlled sample will reside in the data bank.

4 Special Data: behavioral science research results, tests of new products, experimental testing results, audits of retail stores, and awareness, knowledge, attitude, and usage studies. This is perhaps the most important set of data. A store of behavioral science studies on motivation, cultural patterns, family decision making, and diffusion of innovation will be available to support design and strategy decisions. Information on tests of new products and their appeals will help management to assess the impact of new programs and their relationship to other products. Special response data resulting from the actual experimental perturbation of controllable parameters in various local areas will assist in estimating the impact of new strategies. Finally, awareness (including media exposures to various segments), knowledge, attitude, and usage studies will supply behavioral input to the models for strategic and tactical decisions. These data should be collected regularly on a sampling basis for each segment of the market so that changes in response can be quickly monitored and appropriate adaptive behavior formulated.

Statistical Methods Bank Information in the data bank may not be directly relevant to the manager in its raw form. For decision purposes, he will generally require that the data be processed in some manner. He may want totals or averages, or more complex manipulations, such as a regression analysis or contingency tables. The statistical methods bank will have the capability of manipulating and analyzing data and presenting them in the desired form on command from the manager. The transformed data may also be stored in the data bank for later use.[16]

Model Bank A number of models have been discussed in the decision structuring section of this paper. The usefulness of these models as specific decision aids was presented, but models also serve as a basic mechanism for understanding problems since they (1) require the explicit recognition and identification of problems, (2) cause managers to define openly all the elements in the problem and their inter-relationship, (3) lead to decisions to collect actual data and transform these data into relevant information, (4) allow managers to formulate and test hypothesis about the system, (5) provide a basis for discussions, and (6) lead to a common understanding of the problem. With an understanding of the problem and its structure, more accurate forecasts can be made by the use of predictive models. Finally, better strategies and tactical decisions can be made with the help of models that recommend best courses of action.

The models contained in this bank are representations of the environment and the decision variables in it. The manager can call on one of these models to transform input data from the data bank for help in understanding and solving his problems. These input data may be the original data or they may be the output of some other model. Once the output has been displayed, it can be stored in the data bank for future retrieval and

[16] See Montgomery and Urban [17], pp. 22-24, for a more detailed description of a statistical bank.

display. If the manager is not satisfied with the retrieved, statistically manipulated, or model generated data, he can initiate tests that will generate new data. His requests for experimentation in the external environment will generate results that will be monitored by the system and stored in the data bank.

In terms of the models that were discussed in the decision structure section, a hypothetical model bank might be composed of:

Design of Alternatives

Simulation of family decision process
Descriptive diffusion model
Experimental appeal testing model

Program Formulation and Strategy Determination

System budgeting model
Resource allocation and strategy model
Micro-analytical simulation of users

Tactics Specification

Media selection model
Personnel allocation model
Inventory model
Production-distribution simulation
Production cost minimization model

Organization and Control

Adaptive control model
Descriptive model of organization decision procedures and information flows

Man-System Interaction The discussion of the components of the information system has now led to the point of interaction between the system and the manager. The design and specification of the system are oriented towards the manager and his needs. To design the system components, a clear understanding of the demands on the system is needed. The manager's demands will depend upon the problems he faces and the decision structure he uses in approaching the system. The most elementary decision demands on the system will be with respect to data retrieval and an assessment of what the present family planning situation is. This may widen to a need to understand the underlying phenomena of consumer behavior. At the next level, the manager may desire the ability to forecast marketing events. The highest level demands on the system are problem-centered demands.

A manager may approach the system with a formal decision structure. He may begin with problem recognition and definition, proceed through the process of generating, assessing, and selecting from alternatives, and end with testing, implementation, and control of the decision. At any point in this structure, the manager may request infor-

mation and guidance from the system. The system should be designed so that a manager may approach it and interact with it to solve the relevant problems of family planning.[17]

The man-system interaction is an organization system interaction, so care must be taken in the design of the system to assure that the flow of information, inquiries, and decisions functions to produce effective implementation of planning and control procedures.

Developing the Decision-Information System

Given that the management of family planning can be improved by a decision-information system, the next question is what is necessary to develop such a system. Four basic functions must be carried out: (1) data collection, (2) system and model design, (3) behavioral science research, and (4) implementation.

The data collection task implied in the specification of the system data bank is very large, and requires continuing and validated national data channels. Primary data collection instruments have to be developed. Sampling procedures and experimental designs must be specified. The accomplishment of these tasks requires a large expenditure of funds, a trained field staff of interviewers, and capable administration of the data collection function. The demographic sections of the data base could be the responsibility of an indigenous agent. In some developing countries, there are commercial market research firms capable of carrying out some of the behavioral and experimental data gathering; a number of academic institutions could also be of help. But basically a large input of funds for data generation and a commitment of people to the function of data collection are necessary.

The information system and model building function requires a high degree of technical expertise and computer capacity. Previous sections have outlined an information system, but this is not a complete description of what must be included. A full set of system design specifications must be formulated and these specifications must then be converted into actual models. There are schools in some countries where such work could take place, but the major input will be required from foreign management and population centers working in collaboration with indigenous institutions and decision makers.

The collaboration should involve active participation from all institutions in the design and coordination of all phases. One member may be better equipped to carry out a particular function. Foreign schools, for example, might best provide the computer related work, while local groups can best carry out the basic behavioral research and cultural analysis. In addition to utilizing each partner's best abilities, the collaboration should also serve to build and widen each institution's capabilities.

The most difficult task is implementation of the system. If a decision system is not used, it is a failure, no matter how academically rewarding its development may have been. A separate set of resources will, therefore, be required for training existing and new managers in the system's usefulness and operation. The decision makers must

[17] See Morton [18].

be convinced that the system's sole function is to help them and that there is no need to fear it. Necessarily, this education and implementation process interacts heavily with the system and model design. The actual decision maker should be the prime determinant of problem specification, factors to be considered, model structure, and input information. The implementation function will require full-time personnel responsible for liaison with system designers and decision makers. Formal training programs conducted by management institutions can aid in staffing the system. In addition, private management resources in developing countries can be encouraged to contribute managers and knowledge to the system.

In summary, implementation of a decision-information system for family planning involves data collection resources, collaborative system development, and behavioral research capabilities. All institutions active in the program will have to assume a share of this most important task. Once a country has developed such a system, effort should be directed to transferring the system's technology and the experience of its managers to other developing countries.

Conclusion

If a decision-information system can be designed, supported by good data and behavioral research, and implemented, the quality of the management of family planning can increase. By improving the design of products and appeals, the methods of program formulation and strategy determination, the specification of tactics, and the organizing, staffing, and control of the effort, management science and information systems can make a meaningful contribution to the reduction of birth rates in developing countries.

References

[1] Balakrishnan, T.R., and Matthai, R.J. "An Evaluation of a Family Planning Publicity Program in India." Hooghly Study Report, undated.

[2] Balakrishnan, T.R., and Matthai, R.J. "India: Evaluation of a Publicity Program on Family Planning," *Studies in Family Planning* (June 1967).

[3] Berelson, B. "National Family Planning Programs: Where We Stand." In: S.J. Behrman, L. Corsa, and R. Freedman (eds.), *Fertility and Family Planning*. Ann Arbor, University of Michigan Press, 1969.

[4] Bogue, D.J. "Some Tentative Recommendations for a 'Sociologically Current' Family Planning Communication and Motivation Program in India." In: C.V. Kiser (ed.), *Research in Family Planning*, pp. 503-538. Princeton, N.J., Princeton University Press, 1962.

[5] Diamond, D.S. "A Quantitative Approach to Magazine Advertisement Format Selection," *Journal of Marketing Research* (November 1968), pp. 376-387.

[6] Driver, E.D. *Differential Fertility in Central India*. Princeton, N.J., Princeton University Press, 1963.

[7] Enke, S. "The Economic Aspects of Slowing Population Growth," *Economic Journal*, Vol. 76, no. 301 (March 1966), pp. 44-56.

[8] Forrester, J.W. *Urban Dynamics*. Cambridge, Mass., MIT Press, 1969.

[9] Government of India. *India: Family Planning Programme Since 1965*. New Delhi, Ministry of Health, Family Planning, and Urban Development, 1968.

[10] Govindikari, A. "Communication in Family Planning: A Study in a Community Development Block," *Institute of Rural and Family Planning Bulletin — Gandhigram* (July 1967).

[11] Gross, I. "An Analytical Approach to the Creative Aspects of Advertising Operations." Unpublished Ph.D. dissertation; Cleveland, Case Institute of Technology, 1967.

[12] "India: The India-Harvard Ludhiana Population Study," *Studies in Family Planning* (July 1963), pp. 4-7.

[13] "India: The Singur Study," *Studies in Family Planning* (July 1963), pp. 1-4.

[14] "India: A Study in Family Planning Communication, Meerut District," *Studies in Family Planning* (July 1967).

[15] Kamala, G.R., and Mullick, S. *Studies in Family Planning in India*. New Delhi, Central Family Planning Institute, 1968.

[16] Little, J.D., and Lodish, L.M. "A Media Planning Calculus," *Operations Research*, Vol. 17, no. 1 (January-February 1969), pp. 1-35.

[17] Montgomery, D.B., and Urban, G.L. *Management Science in Marketing*. Englewood Cliffs, N.J., Prentice-Hall, 1969.

[18] Morton, M.S. "Interactive Visual Display Systems and Management Problem Solving," *Industrial Management Review*, Vol. 9, no. 1 (Fall 1967), pp. 69-81.

[19] Poffenberger, T. "Urban Indian Attitudinal Response and Behavior Related to Family Planning: Possible Programme Implications," *Monthly Commentary on Indian Economic Conditions*, Vol. 9 (March 1968).

[20] Raina, B.L., Blake, R.R., and Weiss, E.M. *A Study in Family Planning Communication*. New Delhi, Institute of Family Planning, 1967.

[21] Shycon, H.N., and Maffei, R.B. "Simulation — A Tool for Better Distribution," *Harvard Business Review,* Vol. 18 (November-December 1966), pp. 65-75.

[22] Stefflre, V. "General Foods Post Division." In: M.F. Brown, *et al.* (eds.), *Problems in Marketing,* 4th ed. New York, McGraw-Hill, 1968.

[23] Stefflre, V. "Simulation of People's Behavior Toward New Objects and Events," *American Behavioral Scientist,* Vol. 8 (May 1965), pp. 12-15.

[24] "Tables with Notes on Family Planning." *India: National Sample Survey 16th Round,* July 1960 - June 1961.

[25] Urban, G.L. "A New Product Analysis and Decision Model," *Management Science* (April 1968), pp. 490-517.

[26] Urban, G.L. "SPRINTER: A Model for the Analysis of New Frequently Purchased Consumer Products." Sloan School of Management Working Paper 364-69; Cambridge, Mass., Massachusetts Institute of Technology, 1969.

[27] Urban, G.L. "A Strategy Model for Family Planning." Forthcoming.