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INFORMATION REQUIREMENTS FOR URBAN SYSTEMS: A VIEW INTO THE POSSIBLE FUTURE?*†

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The successful management of urban systems is becoming increasingly a matter of successful information about the urban area and its environment. Using information as a basis for developing a structure for, and outlining the flows in, an urban area, this paper develops a dual hierarchy of information requirements and management activities. Each level of the hierarchy is discussed in terms of the emergent problems and requirements that are likely to confront management scientists and urban administrators in the future. As the information requirements of urban areas become more complex and as the components of the urban system become more highly interrelated, developments in information technology can be expected to have a direct impact on the activities of urban area administrators. This development is illustrated here through the presentation of a selected number of possible impacts of information technology developments upon the information and management hierarchies of urban systems.

Introduction

In the manner that we propose for dealing with the topic of this paper—information requirements in formulating goals for urban (or urbanizing) societies—it is desirable to commence with a few preliminaries. At the outset we should note that we are using terms like "management" and "information" in a very broad sense. For instance, management is viewed as being concerned with providing or setting directions, but not necessarily in the top-to-bottom hierarchical manner that is characteristic of many enterprises and government agencies. Such direction setting and (its concomitant choices of organizations, etc.) may proceed from the bottom as well as from the top.

Similarly broad characterizations are intended for our uses of terms like information and its relatives (data, facts, evidence, etc.) in terms of their potential value for such managements in assessing needs and setting directions. We might, of course, distinguish data from "fact" and the latter in turn from "evidence", e.g., in terms of the way they are treated and used, their qualities such as reliability or validity, before and after treatment (or verification), and their subsequent admissibility for decision purposes. Without disputing the validity of these distinctions for some purposes we shall not make such distinctions here. For our purposes (as already indicated) we shall use the term information to cover all of these categories (and possibly more) in order to examine their potential modes of organization and use in goal setting for the kinds of societies we shall be considering.

Information requirements for any managed system, and any urban system, "managed" or not, are derivative from both the pressing and felt needs of those managed and of the existing techniques or states-of-the art in management. This proposition represents one focus for the developments in this paper. Another focus proceeds from our assumption that it is advantageous to develop the requirements for any system by

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first considering more general systems in which the particular one may be imbedded. This latter course of development will then enable us to recognize any unique features or requirements through contrast with systems which possess some common similarities. Furthermore the requisite means, methods and knowledge may then be assessed and particular developments ascertained from such a more general context.

We turn first to an examination of relevant "technologies" where, as we interpret this term, "a technology" is knowledge rather than hardware and the latter, in turn, represents one way of implementing the organization (including storage and retrieval) of knowledge. Within the approach that we are thus using, we can then note that this will enable us to use "information technology" as a concept that will enable us to address the problems of urban management in a broader context than is, perhaps, customary. Hopefully this will enable us to attain added significance for broad portrayal of the developments we shall be considering.

A number of technologies have made or are making their impact felt on urban areas. Industrial technology—a manifestation of industrial knowledge—transformed cities from centers of trade to centers of production. At the same time developments in agricultural technology released millions of persons from food production and enabled them to go to positions in industry in the cities. More recently, developments in transportation technology facilitated the growth of the horizontal city (or sequences of cities) that are sometimes described as "urban sprawl."

Our task here is to assess the kinds of new technologies that may have impact on urban areas. One such new technology and one which is of primary concern here is "Information Technology" (Kozmetsky and Ruefli [20]) which we can define as: *the whole body of knowledge relating to collection, measurement, storage, manipulation, transmission, transformation and use of information.*

The "information technologies" we are concerned with include not only knowledge implemented in hardware developments related to information generation, flow, organization and use, but also in software—programs, media materials, language and other modes of communication—as well as behavioral and social technologies—group processes, social dynamics, instructional techniques, planning and budgeting capabilities, decision and evaluation methods, and system logic and design, all of which are intimately tied to information. These are part of important political, economic, cultural, and aesthetic dynamics. They concern human purposes, preferences and practices, and are affected by them as well. Thus all of these aspects and more must necessarily be brought into view for explicit consideration when dealing with goal setting in the context of such technologies.

Bearing all this in mind we may now formulate the question we are addressing in terms of "how will (or should) this information be translated into knowledge and action?" That is to say, this paper will attempt to explore some of the implications of this new technology for the management of urban systems. To do this we shall try to establish a hierarchy of models, information systems, and urban policies and then try to relate these to one another at different levels. As a brief introductory example we might well commence with examples of possible Information and Management Hierarchies such as are portrayed in Figure 1.[1]

For the moment we may best regard the examples of Figure 1 as only illustrative. More generally, however, we will use these hierarchies in order to explore a variety of prospective possibilities and to outline some of the requirements for developments in

[1] For examples of other hierarchies in the urban system see Chadwick [4, Chapter 4].

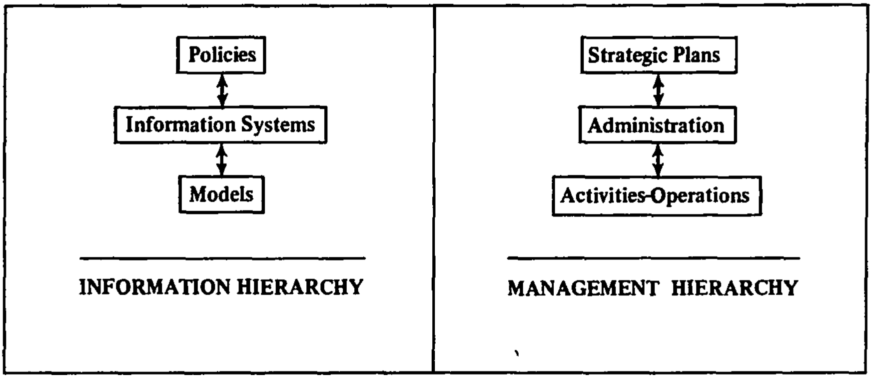

FIGURE 1. A generalized classification of information and management hierarchies.

these areas. Finally we will examine the likely effects of impacts of information technology developments on urban systems.

I. Models for Managing Urban Change

We next turn to the topic of modeling in order to examine its requirements and potentials for goal setting and implementation. We can then commence by saying we believe that the old style of management by precedent and experience will become increasingly inadequate as urban societies continue to develop in the remainder of this century. Problems of response speed to new developments of great scope and complexity such as will be posed in these emerging urban management problems will require that individual and group decisions and operations must be augmented by models. But it is not enough merely to say that there is a need for models in the urban area. Even a cursory glance at the literature reveals an abundance of models in this area. A closer inspection, however, reveals that most of these models are almost all of only one type—namely, planning models.[2] To be sure, some are economic planning models, others are social planning models, still others are spatial planning models, etc. The point is that they are still only planning models.

While there is a need for planning models, the priority placed on their development seems misplaced. The current crisis in urban management suggests a critical need for developing other classes of inadequately attended to models. These classes of models include:

(1) control models or at least models which include control and assessment (in contrast to planning) and incorporate relations between multiple tiers or levels of decision making;

(2) extension of planning and control models to include interorganizational relations and other desiderata of organization structures which are dynamic as well as static in their responses;

(3) restatement and extension of the usual scalar criterion arrangements to multiple criteria as well as allowance for changing objectives (as well as criteria) over time in a rapid manner.

[2] See pp. 39 ff. in A. Charnes and W. W. Cooper [7] for further discussion and distinctions between models for planning, control and operations.

Control Orientation

Over a hundred years ago, Abraham Lincoln pointed out, "If we could first know where we are and whither we are tending, we could better judge what to do and how to do it." On the basis of the evidence in the literature, one can conclude that present modeling efforts have largely ignored Lincoln's hint. The emphasis in the literature seems to be on goal setting and programming resources to reach those goals. And while it is true that numerous statistics on activities in urban areas are collected, they are usually collected along single dimensions, in isolation from other statistics, and without regard for secondary or tertiary effects. Such statistics are rarely compiled in the interrelated fashion that would permit assessment of urban activities on any general scale. Rarer still is the compilation of statistics on the basis of models that permit evaluation of the decision-making activities of urban administrators. In other words, those assessment models that do exist are based on the assumption that the system to be assessed and controlled is the urban activity system, when a more complete view would be that the system to be regulated is composed of the urban activity system *and* the administrative decision-making system.

The inadequacy is even more serious than we have just suggested when we consider the kinds of responses and interorganization arrangements that will be needed. In control-and-assessment models, goal setting is merely the first step in a process which extends to clarifying and attaining the goals themselves. In the case of an urban system such a model may start from the current state in order to ascertain its current vector of directions (e.g., via a citizen information system of the Johnson-Ward[3] variety), its management decision rules and also the physical or other environmental constraints. Note that this is a process of discovery and not merely a test of feasibility. On the other hand, feasibility (a special case) is also involved. If one or more infeasibilities are found, then a process of adjustment and revision ensues. On the other hand, the goals, too, are subject to alteration and so are the decisions. If, at some point, the goals are found to be effective, then the model should be capable of entering a mode where it generates an efficient programming of resources to attain the goals.

For the speed of response required, it is evident that such a model should also be capable of operating on "real-time" data from the urban system. This includes accommodating the parallel decision-making activities of others besides the official urban administrators. Concomitantly it should also facilitate assessing the performance of the urban managers *vis a vis* alternate decision rule possibilities.

In each of these modes, the model should be capable of identifying probable gaps between desired and actual performance, establishing a control point, and generating alternative programs and goals to keep the entire system within pre-established limits. Furthermore it should be able to report as well as display results to the whole class of potential clients—namely, the urban resident as a body politic and not merely the urban officials who have heretofore formed the foci for all such efforts.

Multiple Decision Levels

The complexity of the urban activity system has generated a large administrative structure designed to manage the urban area. Usually this structure takes the form of a large multi-level hierarchical organization. Most urban models, however, appear to be predicated upon a monolithic decision-making entity. In practice, this results in organizational subunits being asked to use models with objective functions that are suboptimizing in their nature (and ignore overall goals) or else to use objective func-

[3] See the article by N. Johnson and E. J. Ward, below.

tions that impute global objectives directly to the lowest operating level without distinguishing adequately between plans and operations and without regard for all the intervening levels of management.

What is needed is a new class of models which are designed for management level i in all pertinent detail and also incorporate relations between level i and levels $i + 1$ and $i - 1$ with explicit allowance for feedback relations and actions between these levels. (Ruefli [23] and Cassidy, Kirby and Raike [3].) To state this differently, information feedback is one mode of producing coordination, and such three-tier arrangements for accommodating these coordination requirements can explain and complement the usual one-tier information hierarchy (or flat) model. Via such extensions we can then begin to produce models that will explicitly relate the decisions and goals of urban area residents to the activities and decision rules of the administrators or officials in a variety of entities deliberately organized for continued formal decision making. See, e.g., [10].

Interorganizational Relations

In addition to ignoring multiple levels or tiers of management, in their relations to citizens, the usual one-tier (flat) model also portrays the urban decision system as a monolithic unit which imposes itself on and hence completely governs the interactions of the various organizational subunits that comprise the urban system. But this is hardly adequate even for the confines of a city government. On a given management level, for most urban area problems, the concerted action of a number of organizational entities (police, sanitation, education, fire, welfare, etc.) is required to achieve satisfactory levels of success. At the very least, that agency working on an urban area problem must be able to count on the noninterference of other agencies. For example, the plans of a municipal police department to reduce crime levels can be thwarted by court decisions regarding probation and sentences, by penal authorities mixing juvenile and adult offenders, by welfare agencies reducing aid to families, or by schools refusing to make after-hours recreational programs and facilities available to youths.

This is not to suggest that what is needed is a model that encompasses the objectives and constraints of all concerned organizational entities. Rather, models developed and employed by entities in various organizations should provide linkages that enable the subunit decision makers to recognize extra-organizational considerations, assess their impacts on proposed activities, and design alternative or contingency plans. An especially important instance of this occurs in the case of linkages from an urban area into its environment: to other urban areas, to state and federal governments, to sources of technological and economic development, etc. Provision of such linkages in models for organizational subunits will become increasingly important as developments in information technology accelerate the performance of existing linkages or bring potential linkages into being. Design and redesign of such linkages will also force modelers to consider formats and contents of data sources in other organizations and encourage some preliminary moves toward standardizations that will avoid some duplication and provide some economies by reducing change-over costs when standardization does occur.

Multiple Criteria and Changing Objectives

As we have already indicated, most existing urban area management models assume a single objective for the decision makers. Given the nature of urban activities, the divergences among interests of groups of clients or constituents, and the variety of

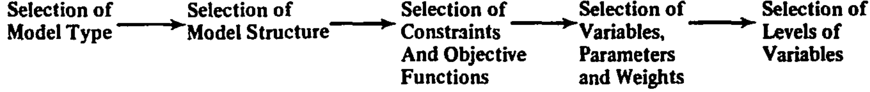

FIGURE 2. Modelling decision process.

active constraints faced by the urban decision makers, as well as the diffuseness of the locus of decision making and the number of agencies involved in any one program, models able to incorporate multiple goals would appear to be necessary. Nor is this all. The data banks and other parts of proposed information systems need to be designed so that they can be employed rapidly and efficiently in the synthesis as well as the implementation of these models.[4] This is in addition to the analytic multiple goal models and the explicit design of other models for use in a multi-goal orientation such as may already be found in Charnes and Cooper [7], Ijiri [17] and Courtney, Klastorin and Ruefli [11]. That is, the indicated extensions must allow for changing goals and optimizations or simulations which do as well as possible while allowing for such changes.

We can bring this all into sharper focus by delineating some of the dimensions for change which have only been implicit up to now. Most modeling now deals primarily with changes in levels of activities, stipulations, goals etc., in an assumed organization context. Such models are not well equipped to deal with some of the dimensions for change that are significant in urban systems. This includes changes in organization structure and interorganizational linkages along with changes in types of resources and their utilizations as well as changes in objectives, policies and procedures.

The speed of response to such changes must also be considered, as we have already noted, if we are to comprehend fully our opportunities for guiding them in a rational or even satisfactory manner. The schema of Figure 2 will help us to portray what is involved if we say that we need models that can operate earlier in this sequence in order to identify and structure what is involved. That is, we need models that are able to select "optimal" objective functions, goal sets, and constraints. Such models would allow us to better assess proposed changes in urban goals, operating procedures, and administrative policies. First steps in this direction of developing such models have appeared recently (e.g., Feinberg [12], and Geoffrion, Dyer and Feinberg [13]). But these are only first steps in that they still assume stable structures such as are available only in the later stages of Figure 2. We will now need to be able to progress beyond the current "problem solving" approach to a more rational "problem identifying and structuring" approach for urban areas. In return we will then have better assurance that the problem we are addressing is correct and, with the indicated speed, we will also be better able to use any resulting solutions in order to avoid (or at least ameliorate) the need for dealing with other problems that have possibily worse (or less wanted) solutions in turn.

II. Information Systems for Managing Urban Change

A. *Information Systems Are Models*

Even if the class of models described in the previous section were to be developed, their existence would probably not be coincident with their successful implemen-

[4] E.g., model synthesizing routines might be incorporated in these data banks along with algorithm generating and model identifying and transforming routines such as are discussed in Chapter XV of [7].

tation in an urban area decision system. Although many model builders act, and substantial segments of the literature read, as if models in the urban area could operate effectively as self-contained entities, in practice the contrary is true.

To be useful, models must be coupled into the urban activity system, and this is usually accomplished through the medium of an information system. In fact, the models we have been discussing are best regarded as specialized components of information systems. Conversely, information systems can be conceptualized as a generalized class of models. In this regard the discussion in the last section can be extended to cover information systems also.

This relation between models and information systems often goes unrecognized and unexploited. Numerous trade-offs between models and information systems can be made. Models driven by a single objective can be implemented in a multi-goal environment via an information system that adds in the missing goal considerations (e.g., linear programming models allocating government resources); nonadaptive models can be made almost so by an adaptive information system or by an information system that permits rapid sequential running of the model (see Feinberg [12]); single institutional models can be linked by inter-institutional information systems (e.g., a city's payroll model linked to a bank's accounting models). Similarly, a number of uni-dimensional information systems can be linked through a multi-attribute model to form a mutli-dimensional system, etc.

While the trade-offs between models and information systems can often serve a useful function during the integration of the model into the decision system, it seems a priori desirable that such trade-offs be made as part of the design process. Consider an analogy from transportation systems. If the goal is to produce a smooth ride for the occupants of automobiles a trade-off may need to be made between the smoothness of the roadway and the complexity of the suspension system of the vehicle. Rough roadways require complex suspension systems while smooth roadways permit simple suspension. There is a trade-off between the social costs of building highways and the individual costs of vehicles. To consider one part of the system fixed and to absorb the disturbance in the other component is to suboptimize and to ignore the possible advantages in the trade-off. Likewise, to design either an urban system model or an urban information system on the assumption that the characteristics of the other component are fixed might be suboptimizing.

The situation is further complicated by the observation that the trade-offs between models and information systems are not made with respect to a given point in time. The technology of models is evolving as is the technology of information systems. Models developed on the basis of existing information system technology, while capitalizing on existing trade-offs, may be suboptimizing with respect to trade-offs over time.

Unfortunately, we do not at this time have the conceptual framework, theoretical knowledge, or the practical experience to make the required trade-offs on a rational basis. One of the first steps towards acquiring this knowledge would be to develop a theoretical framework for and collect empirical data on the economics of information systems. (See Glaser [18.2].)

B. *Classes of Information Systems*

Just as a single model in an urban decision system does not operate in isolation, neither does a single information system. As Figure 3 illustrates there is, in any urban area, a system of information systems. Briefly, these classes of information systems

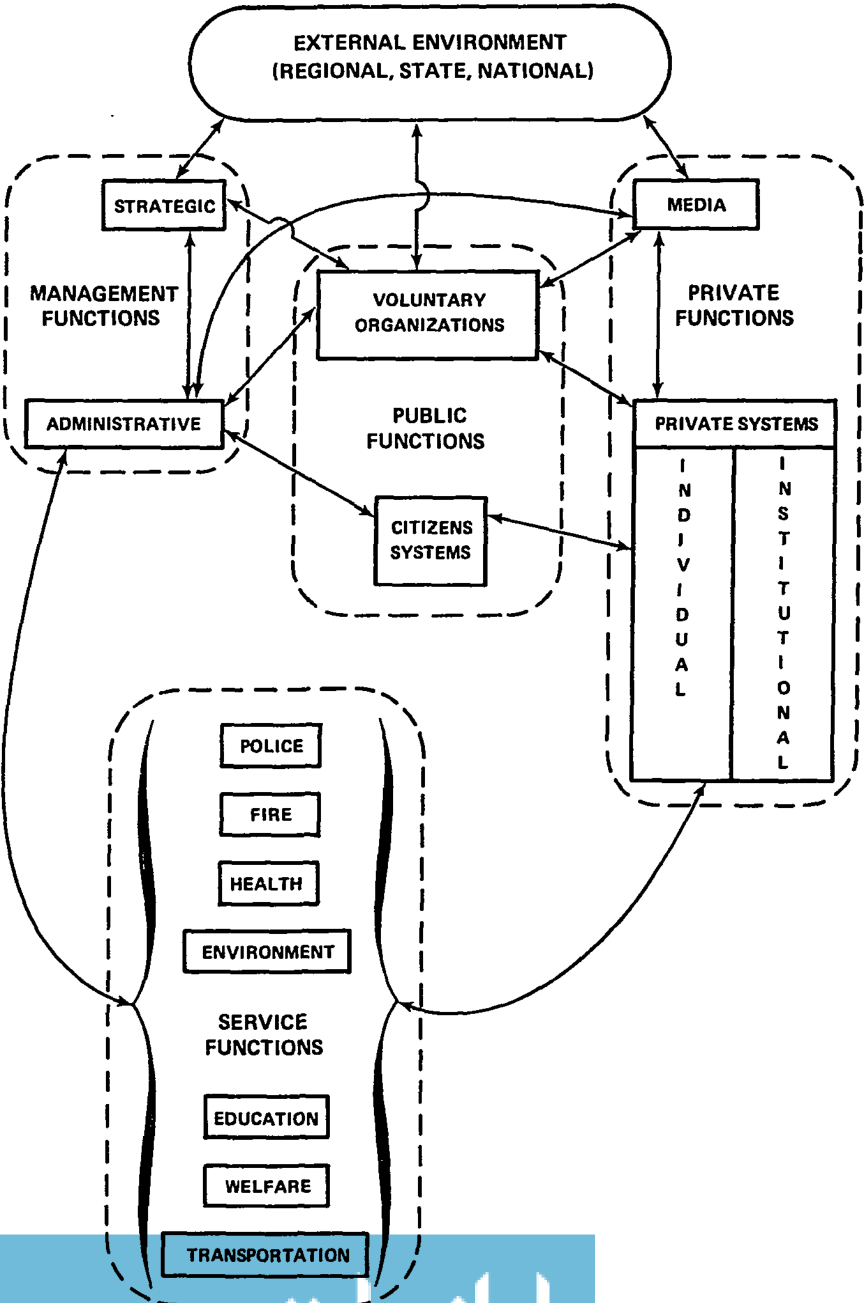

FIGURE 3. Classes of urban information systems.

include:

1. *Private Function Systems*—privately owned and privately managed systems: (a) the media—radio, television, newspapers, movies, billboards, etc., and (b) individual use systems—telephones, mail, commercial in-house systems, private health systems, private education systems.

2. *Public Function Systems*—nonprivate, nongovernmental systems used primarily by citizens: (a) voluntary organization systems—religious, political, social clubs, environmental groups, sports groups, etc., and (b) citizens information systems—systems designed to organize and report urban area data to and from citizens (see, e.g., [10]), voting systems, etc.

3. *Service Function Systems*—information systems involved in the provisions of governmental managed services: (a) police and judicial—local, state and federal, (b) fire protection and rescue, (c) health care systems, (d) environmental, (e) education, (f) welfare and employment, (g) transportation, and (h) other services—utilities, sanitation, etc.

4. *Management Function Systems*—information systems that are involved in the administration of the urban area: (a) operational management—the system that provides the information for administering the ongoing operations of the urban area, and (b) strategic management system—the information system that links the urban area managers and the external environment.

Such a classification scheme is, of course, arbitrary and also simplistic. The sharp lines shown in the diagram and implied by the labels suggest a partitioning that does not exist. One information system blends into another in design as well as in operation. As between information systems and models, there exist trade-offs between and among information systems. Poor private information systems can be compensated for by public function of government service information systems. Limited public mail services can be augmented by private mail services, and so on.

Again this is one area in which we have little formal knowledge. Research efforts have focused on isolated systems—primarily in the service and management areas, largely ignoring, for example, the role of voluntary organizations' information systems in focusing support for and generating demands on urban systems. It seems reasonable that these information systems in providing inter-institutional linkages play a significant role in defining the nature and scope of urban activities. Until we have knowledge of each of these subsystems separately, and again as elements of a larger system, we will not be able to evaluate the global dynamics of the urban system.

III. Urban Policies

It is now time to bring into sharper focus the fact that we have thus far attended to the idea of urban systems and goal setting as though this may be done in any "urb" or "city" in isolation. This is not really the case, however, and to see why this is so we can turn to a third level in our hierarchy, the policy level, which may seem to be somewhat discontinuous with the first two levels—*viz.*, models and information systems. A next logical step up the chain might also appear to be regional or national information systems, but this is not adequate either. In fact, for our purposes, these latter systems represent "more of the same" and do not represent a qualitative step up the hierarchy. Urban policies and strategies, on the other hand, set up the models and information systems in a more general context. Urban policies go beyond a simple formulation of urban goals (e.g., *Goals for Dallas* [14]) and more nearly resemble corporate strategies (see Ansoff [1]) but in an urban context. Goal formulation may be a desirable step for an urban area, but is by itself inadequate because the sources of many urban probems occur in higher level contexts and are formulated by forces and demands that are beyond the scope of goal seeking at the urban level.

To illustrate the above points we may consider certain facets of societal demands as they might affect the urban segments of society. We note that there is an increasing demand from urban area residents for goods and services as a social requirement, in contrast to the more individualized demands of the past. Some of the general characteristics of such societal demands are:

1. *Contracted Time Frame.* People want demands satisfied in one or two decades, preferably less, even though the scale of such demands may appear overwhelming (e.g., reduce crime, provide transportation, decrease (increase) welfare, etc.).

2. *Inadequacy of Individual Institutional Responses.* No one institution is responsible for urban problems and no one institution has accepted responsibility for the solution. The organizational arrangements necessary to satisfy these demands require that we incorporate entities of more than one institution, e.g., consortia of business, government, education and voluntary organizations should be formed to aid in formulating, solving and assessing social demands.

3. *Wide Geographic and Social Scope.* No one segment of society has a monopoly on generating these demands and they are often stated in terms of comparisons between urban areas or among social groups.

4. *Development of Public/Private Markets.* Because new markets will likely be created by these demands the volume and lifetime of the former will be reflections of urban area priorities and policies. As these priorities and policies shift, the markets will rise and decline.

5. *Indeterminancy.* One of the chief problems of collecting statistical data and information required for societal demands is generated by the need for a number of institutions to interface their information systems with institutional, regional, and national systems of radically different characteristics. The differences arise because of the differences in goals and information structures necessary to measure strength and duration of demand as well as achievement along the goal dimensions.

These new demand characteristics coupled with the more traditional demand characteristics generate a public sector equivalent of a market scope (see Ansoff [1, p.5]) for urban systems. It remains to develop a product scope to complete the policy framework. Continuing the analogy with corporate strategy, if an urban area can be regarded as a firm, then its product is the firm itself. Thus, if we represent a simplification of an urban system's produce market scope by the diagram in Figure 4 (Ansoff [1, p. 128]) we find that the new demands have engendered a new degree of specialization for urban enclaves themselves. On this basis we can expect to find urban systems that have adopted strategies that lead them into cell D in Figure 4 being

	Current Market (Demands)	New Market (Demands)
Current Product (System)	A	B
New Product (System)	C	D

FIGURE 4

characterized as research cities, educational cities, welfare cities, etc., with a very few "total" cities. These specialized urban systems may in fact be continuations of existing specialized cities (e.g., Washington, D. C. as a government city), growth of existing specialized communities (e.g., college towns, research centers, etc.) or evolution of existing "generalized" cities through accidental or intentional adoption of an urban strategy.

It is worth noting that the form with which urban systems provide themselves with this strategic capability has *not yet been conceived* by any of our existing institutions. We can state generally that the effectuating mechanism in an urban system should be the strategic information system included in Figure 3. Once again we therefore see that the information system itself must enable us to detect when the underlying structure is not really adequate and please note that such systems do not usually exist in a formal sense in most urban systems. The formulation of strategic frameworks, the designing of strategic information systems, and the development of strategic decision models in such a setting is a challenging one, indeed, and should be a priority task for the members of TIMS who are concerned with "identifying, extending and unifying scientific knowledge which contributes to the practice of management."

IV. Impacts of Information Technology

Having discussed some of the informational structure of the urban area, there remains the task of outlining likely implications of developments in information technology for urban areas. At this point we should emphasize that we certainly do not expect that information technology will be the primary motivating force behind urban change, but we do expect that information technology will play an increasingly important role in urban systems. For one thing, as urban areas become more and more complex it becomes less possible for residents and administrators to experience first hand (or even second hand) the wide range of urban processes. Thus it becomes increasingly the case that the urban system is experienced through processed information.

We cannot here enter into all aspects of these topics but we can at least list the following for consideration. Since information technology developments can increase the volume, the timeliness, the accuracy, and the degree of processing of urban area information we can expect:

1. By permitting greater ease in the identification of common interests, information technology will permit more highly focused demands on urban systems.

2. By increasing speed, volume, and scope of communication, information technology will increase the timing and magnitude of demand.

3. Because of focused, fragmented demands, consensus of urban area residents may be harder to obtain. (See Crecine and Brunner [18.1, p. 153].)

4. Costs of information processing may become the major cost component of urban government (see Machlup [21] and Burck [2]), adding new importance to productivity problems in this sector. (See Rose [22].)

5. As information processing becomes more critical to urban management, information systems specialists may come to play a pivotal role in the urban process.

6. By collecting and storing more and more data on the citizenry, urban governments may generate serious conflict between individual privacy and public knowledge.[5]

7. Through improved data transmission and broadened data requirements the

[5] See the discussion in J. F. Collins [9.3].

various segments of the urban system may become more highly interrelated. Since models or information systems that were well behaved in semi-isolation may not be stable when tightly coupled to other models or information systems, problems of system stability may arise.

8. Similarly, information technology developments may facilitate stronger informational links to an extended external environment. This will increase the importance of the strategic function, a function about which we have little knowledge. System stability problems may also arise at the regional, state or national level as the informational couplings develop.

9. In systems already staggering from the impacts of change, the rapid pace of information technology developments will put increasing importance on the ability of urban systems and managers to adapt to change.

From one standpoint, a consideration of this list may lead to pessimistic conclusions. To be fair, however, we must also recognize that information technology may also have more salubrious impacts. In particular, the citizen of tomorrow need not be the same person as the citizen of today. Improved communications may create a more informed citizenry; advances in educational technology may permit more timely and higher quality education; each person may also be linked in more flexible fashion to his peers, and information technology may provide added opportunities for increased individuality and reduction in some of the present senses of isolation. These are at least considerations which need to be borne in mind if improved humanity as well as improved efficiency is to result from responding to the challenges noted at the end of the last section.

V. Conclusion

Bearing these considerations in mind we may now conclude by recapitulating the path followed in this paper. The structure that was chosen to serve as a framework for discussing urban change was an informational hierarchy of models, information systems and policies. Using this hierarchy, information requirements for urban systems were first outlined in terms of desirable characteristics of urban decision models. These models were then placed in the context of information systems and the urban information structure was cast in the framework of a set of linked information systems. The general context proposed for the set of information systems (and hence the administrative decision system) was the urban policy structure. The rationale for this proposal was that many of the problems of urban areas come not from wholly internal sources, but rather are determined to a significant degree by demands, activities, and policies external to the urban system. A formidable challenge to management scientists arises from the tasks involved in characterizing and developing the requisite informational mechanisms at the strategic level.

At each level of the hierarchy of models, information systems, and policies we have outlined a series of information requirements. At this point it is not possible to place a preemptive priority on research at any one level. Nor is it deemed wise or feasible to propose a massive organized across-the-board assault on all levels of the hierarchy simultaneously. The impacts of information and other technologies outlined in the previous section will not allow the luxury of a static target at any level in an urban system. Nor does the present state of the art permit us to make meaningful predictions about specific events in the urban context.

Urban change can only come about as a result of the actions of the various institutions of society; thus changes become matters of choice on the part of policy makers rather than events to be predicted. The problems of choice cannot be solved by creating a commission or project to study them, for in this most psychologically important of all institutionalized social functions nobody is either entitled or qualified to speak for everybody. And this, perhaps, is the major point: important choices lie before us, but they cannot be made in any monolithic way. We are entering upon an era of critical social experimentation, and we need to resist the temptation either to look for a "one best way" or to cut matters short for the spurious attractions of overly simplistic solutions. Even the almost efficient way, e.g., as judged by economy or convenience, is not necessarily best or even meaningful when the criteria involve not only the quality of life but the quality of the human beings who live it. Such, in our judgment, is the character of the challenge we must now meet in the urbanizing societies we shall be encountering.

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