An Information Infrastructure for Innovative Management of Government

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Can TQM be implemented in government or can government be reinvented without appropriate information systems? Rebecca Hendrick argues that information systems are fundamental to the success of the innovative management approaches that are becoming popular at all levels of government. There is, however, little discussion in the current literature of the role of information systems in the management of government which can then be used to demonstrate the importance of information systems for innovative management. Hendrick addresses this problem by proposing a framework for an information infrastructure that connects crucial elements of innovative management, such as monitoring and evaluation, with different types of information systems, organizational functions, and decisions. She also discusses some implications of information system design, development, and application for government management and the field of public administration.

Many management trends are currently sweeping the public and private sectors. One popular approach, called total quality management (TQM), focuses on improving the quality of services or products in the private sector through total organizational commitment, worker participation, and rigorous attention to inputs, outputs, and processes (Walters, 1992; Milakovich, 1991; Carr and Littman, 1990). Many TQM ideas have been adapted to the public sector, under the label entrepreneurial government, in a book that has been widely acclaimed by public administration practitioners, elected officials, and other knowledgeable observers of government (Osborne and Gaebler, 1992). Examples of other approaches are process innovation (Davenport, 1993) and managing behavior results (Brumback, 1993). Although each innovative management approach emphasizes different methods, they all advocate activities such as planning, analysis and monitoring, informed decision making, and identifying missions and objectives as well as improving products and services. Furthermore, underlying all approaches is an unwritten assumption that the information infrastructure necessary to perform key activities is present. This study presents a framework for such an infrastructure in the public sector that integrates the information requirements of innovative management (IM), methods of program assessment and monitoring, and the structure of information systems.

If IM is to achieve its objective, information must be available about its operations and environment that is accurate, timely, accessible, comprehensive, and continuous. This, in turn, requires an integrated and coordinated information system for collecting, organizing, and storing data. It also requires a system that creates meaningful information from the data and then presents that information in useful ways. Developing such a system—which is much more than computers, databases, and the personnel who handle them—is a tall order for any organization.

The private sector, however, has a distinct advantage over the public sector in this area. First, the private sector's experience with and knowledge of information systems is much more advanced. There is a vast and well-developed literature, both theoretical and applied, on information systems in private organizations; and business schools graduate thousands of specialists in this area each year. Second, the design and development of information systems in the private sector is simpler and more straightforward. Although some may argue that the differences between business and government are blurring, in general, government processes, structures, functions, and products vary greatly in comparison to business. Moreover, the objectives of government are less clear, clients and stakeholders are more diverse and numerous, and concepts such as quality are more complex (e.g., accountability). Despite these hurdles, if IM is to be implemented successfully in government, a great deal more attention must be paid by practitioners and scholars to developing good information systems in government.

One manifestation of the well-developed literature in business is that numerous frameworks for information systems exist in private sector organizations that link the systems to organization and managerial functions, information attributes, decisions, and technical characteristics (Blumenthal, 1969; Gorry and Scott Morton, 1971; Lucas, 1973; Nolan and Wetherbe, 1980; Sprague, 1980). However, the differences between government and business imply that these frameworks will not automatically translate to government. The framework presented here recognizes these differences. It is based on the assumption that there are two inextricably related components of an information infrastructure within government: (1) assessment and monitoring and (2) information systems. On a basic level, assessment and monitoring (which comprise program evaluation) specify what information about government products and services is important; and they provide plans for obtaining that information. Information systems provide the means of implementing these plans.

In the first three sections, I define assessment and monitoring according to a set of product and service elements that are common to all government programs, and propose types of information systems that are compatible with these elements and with program evaluation. In latter sections, I examine data and information characteristics of the different information systems in relation to assessment and monitoring, organizational functions, and types of decisions. Finally, I discuss some general implications of information system design, development, and application for upper-level management in government and the field of public administration.

Because this study is intended to provide a basis for future discussions of its topics among people who are not specialists in the areas of information systems or program evaluation, it does not focus on many details. The reader should also keep in mind that the framework is proposed from an ideal-case perspective similar to the way advocates of IM present ideal solutions to organizational problems. Finally, the information needs of public managers are not directly considered in this study, nor is the receptiveness of managers to developing the information systems and implementing the evaluation methods discussed here. There are already enough studies and surveys on these subjects (Norris, 1984; McGowan, 1984; King, 1982; Kraemer and Danzinger, 1984; Northrop *et al.*, 1990; Bretschneider, 1990; Shangraw, 1986; Stevens and LaPlante, 1986). Rather, this study is consistent with arguments that we need to focus on changing the needs, perceptions, and routines of public decision makers. This does not mean that the practical considerations and political constraints of an information infrastructure should be ignored, but if the focus is only on the structures and procedures that are compatible with existing conditions, then the needs, perceptions, and routines of government are not likely to change.

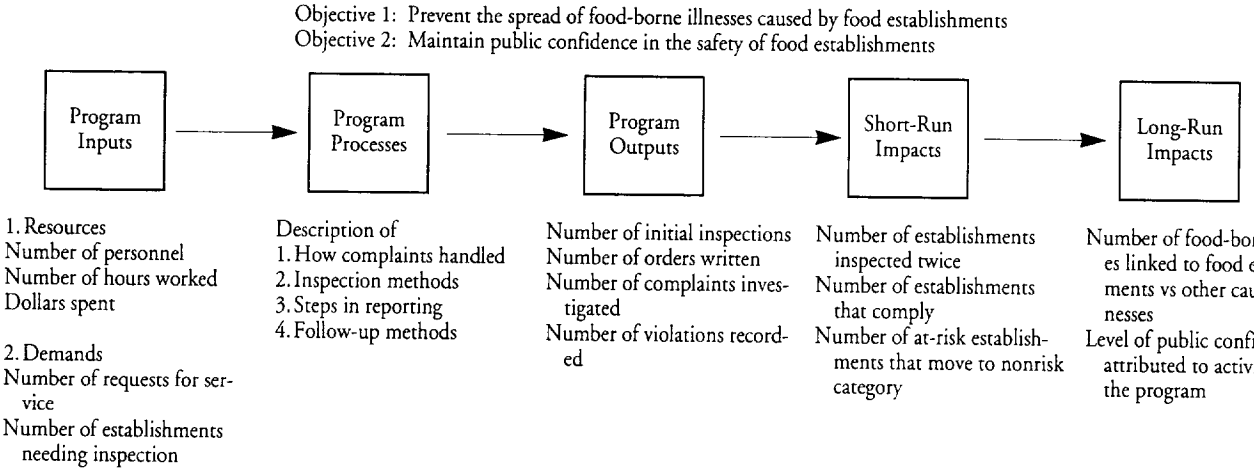
The Elements of Government Programs

To determine what information is necessary for successful IM, it will be useful to define government programs and the provision of public goods and services in terms of a common set of elements. Figure 1 presents a diagram of these elements using an example of a food and sanitation control program in a health department. As systems concepts, these elements are well known and applied in many disciplines. Thus, they are often used ambiguously and should be defined clearly for the purposes of this study.

Five basic program elements are identified in Figure 1: inputs, processes, outputs, short-run impacts, and long-run impacts. There are two types of program inputs: (1) resources that a program or agency uses to deliver its services such as personnel, supplies, time or expenditures; and (2) the demand for or target of program services such as the number of complaints or the number of establishments requiring inspection. Program processes are activities performed in providing services, such as the method of handling complaints, or specific items examined during the inspection. Program outputs are usually defined as the immediate results of the processes such as the number of establishments inspected or the number of orders written.

Programs also have broader effects that are called outcomes or impacts. Although a program may have many levels or degrees of impact, only two levels will be distinguished for this study: short run and long run. Short run impacts occur earlier in time and are less comprehensive than long run impacts. For instance, the number of establishments that comply with written orders (short run) is much more specific than the number of food-borne illnesses linked to food establishments (long run) (Swiss, 1991). It should be emphasized that not all program elements are readily quantifiable, such as the level of public confidence.

Figure 1
An Example of the Program Elements Applied to a Food and Sanitation Control Program of a Local Health Department



The Information Needs of Innovative Management

If government is to reinvent itself through the pursuit of IM goals, such as increased quality of services in which quality is defined by the customer, then government must monitor itself, its services, and its customers' demands to know the degree to which quality is achieved, why it has or has not been achieved, and to insure that quality is maintained. The information that is necessary for these tasks is reflected in two basic TQM tenets documented by Swiss (1992): (1) preventing variability is the key to delivering quality services, and (2) quality services require continuous improvement of inputs and processes.

The first idea addresses the problem of dependability by expressing the need to standardize services at some level. Although standardizing some government services may be undesirable, especially those based on need, delivery and quality of services should not be arbitrary or haphazard. Achieving this level of control over government programs requires that certain characteristics of the programs, such as processes or outputs, be monitored to determine their stability. A departure of any of these characteristics from normal or expected levels could indicate serious discrepancies in the quality of service or, in the case of a sanitation control program, a danger to the general public.

The second idea, continuous improvement of program inputs and processes, also requires that program characteristics be monitored continuously to identify changes in overall quality levels. Without such monitoring or feedback it is impossible to know when services have improved or declined. In this case, program outputs and impacts are monitored to determine the degree to which targeted levels have been achieved. Continuous improvement also requires an understanding of why the program is working or not working. More specifically, a manager needs to know the relationship between program processes or inputs and program outputs or impacts to know how to change the inputs or processes to achieve program goals. This task is often difficult in the public sector because of the relatively comprehensive impacts of government programs and because knowledge of the causes of the problem being addressed by the program and the effect of the intervention may be inaccurate or incomplete.

There are also many problems with measuring program elements and concerns about the misuse of quantitative measures in monitoring public programs.[1] Despite problems, there is a growing sense in the literature that such problems are manageable, if they are supplemented with qualitative information, recognized in the use of measurement techniques, and considered in inferences about program performance. (See Hatry *et al.*, 1977 for an extensive presentation of measures of program elements at the local level of government.) Without measures of program elements, the government has little information on what its activities are, what impacts its activities are having, and what activities work. It cannot respond to clients and constituents, and it has no basis for providing rewards and incentives to employees. If government knows nothing about how its programs are functioning or the impacts of its programs, then its likelihood of achieving any objective may be no better than a crapshoot.

The persuasiveness and simplicity of this premise explains why it has existed in the policy and administrative literature, under the topic of program evaluation, long before IM became popular. (It just has not been packaged quite as nicely.) In this case, it will be useful to review the different types of assessment and monitoring that comprise program evaluation to demonstrate how these methods fulfill the information needs of IM.

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Types of Monitoring and Assessment

Three basic types of monitoring and assessment have emerged since the 1960s: performance monitoring, productivity measurement, and impact assessment.[2] (See Brinkerhoff and Dressler [1990], Rossi and Freeman [1989], and Poister [1983] for a good overviews of these methods.) Performance monitoring focuses on measuring program outputs and short-run impacts. It examines process outputs to determine if they meet expectations and it may examine expected and unexpected short-run impacts. Performance monitoring does not usually establish a causal connection between program processes and outputs or short-run impacts. Another type of monitoring, called implementation or administrative monitoring, often is included in performance monitoring. Implementation monitoring determines whether the program or policy is being implemented as intended by tracking actual program processes or activities and comparing them to specified plans.

In contrast to performance monitoring, impact assessment focuses on determining the long-run impacts or outcomes of a program or policy. Impact assessment also establishes a causal connection between program activities and impacts. Establishing this connection is much more difficult because of the greater potential for nonprogram forces and events to affect long-run impacts and confound inferences about actual program effects. Consequently, the methodologies and information needed for impact assessment are much different from performance monitoring. Impact assessment tends to use rigorous scientific methods to exclude extraneous, external factors that could account for the observed program impacts, whereas performance monitoring uses more descriptive methods and circumstantial evidence. Impact assessment also tends to use more aggregate and external data, while performance monitoring tends to use more detailed information within the control of program and administrative managers.

A third component of evaluation—productivity measurement—examines program efficiency by comparing program outputs and short-run impacts to program inputs. In most cases, productivity measures are presented as ratios of outputs over inputs. Figure 2 presents a diagram of the different monitoring and assessment approaches in relation to program elements.

All three monitoring and assessment approaches require specific and comparable data on the program elements. The approaches also require data to be collected over time and be summarized to produce useful information, and that information be reported in a meaningful way. Some of these approaches use external data, some combine data across governmental units, and some use sophisticated data analysis. If government is to implement program evaluation, then it must have the capacity to handle data in this manner. Specifically, it must have the appropriate information systems in place to support evaluation. Too often there is an attitude in government that each new monitoring and assessment exercise requires a new set of data and new procedures for acquiring information. Acknowledging the importance of

information systems to evaluation reduces the tendency for managers to compartmentalize information system functions in this manner by giving managers a more holistic and historical perspective on the uses of information and the design of information systems.

Information Systems for Program Evaluation

Important Concepts

In general terms, an information system is nothing more than a set of people, data, and procedures that function together to supply information for decision making. More specifically, an information system is a specially designed process and a set of objects and people for collecting, storing, organizing, and summarizing data and also presenting the data as information. The data cover internal and external organizational processes and conditions, and the information is used to support all planning, control, and operating functions of an organization.

Strictly speaking, an information system is any systematic method of handling data and presenting information. Information systems do not require a computer, but could consist of a secretary and a filing system. In reality, computers are central to most information systems. The point is that an information system encompasses much more of an organization and its functioning than computers, computer processing, and computer personnel. Another important point is that, to varying degrees, many people within an organization are part of different information systems, and most people are part of at least one information system. For instance, budget analysts are likely to be a part of information systems in finance, budgeting, and accounting while police dispatchers are usually part of only one information system that keeps track of incoming calls and dispatches (Steiss, 1985).

Two other concepts that are important to the discussion of information systems are information and data. Data are unsummarized facts, ideas, concepts, and observations of procedures or conditions within the organization or outside an organization. For example, there are internal data about an organization's budget, expenditures, personnel, and programmatic operations. There are also external demographic data on the populations being served, on economic conditions, murder rates, pollution rates, and so on. Data are usually quantitative or numerical but they can be qualitative, such as statements in written documents about an organization's operations (e.g., requests for budgetary transfers or reports from health inspectors). Although the difference between data and information is not always absolute, information is considered to be data that have been organized or summarized in a way that is meaningful or readily useful for decisions (Buckland, 1991).

Identifying different decision-making functions within an organization (planning, management control, and operational control) and different types of decisions (structured and unstructured) is helpful in distinguishing among information systems that are generally recognized in the literature. Planning functions usually occur at the top decision-making levels of an organization and tend to focus on activities such as determining organizational objectives, developing policies to achieve the objectives, and identifying the resources used in implementing policies. Managerial control functions are midlevel management activities such as assuring that resources are obtained and distributed properly and assuring that program objectives are achieved effectively and efficiently. Operational control functions, which usually occur at the lower levels of an organization, target the delivery of specific programmatic tasks such as whether particular services are being delivered on time (Gorry and Scott Morton, 1971).

The concepts of structured and unstructured decision problems refer to the ambiguity and familiarity surrounding a decision problem. A structured decision problem has clearly defined options, resources, and tasks. Data and information about the problem tend to be abundant and certain, and the decisions associated with such problems tend to be routine, repetitive, and programmable. Unstructured decision problems have opposing characteristics. Clearly, not all decision problems fit neatly into one of these two categories. Most decision problems will be relatively structured or unstructured and somewhere closer to the center of this continuum (Simon, 1960). Applying these concepts to the managerial functions of organizations suggests that planning functions tend to involve unstructured decision problems, managerial control functions focus on semistructured decision problems, and operational control functions involve relatively structured decision problems.

Types of Information Systems

Three basic types of information systems, which correspond roughly to the different managerial functions of organizations, are generally recognized in the literature (Zmud, 1983; Emery, 1987). The lowest level information system, which is most widely used for structured decision problems and operational control functions, is a transaction processing system (TPS). A TPS is primarily a record-keeping system that collects and stores large amounts of data on specific activities for which the organization is responsible. Much of the work in these systems focuses on validating data such as checking for errors, missing data, and valid transactions. These systems must also be able to easily summarize data in ways that are useful to operational managers and report this as information. Examples of areas in government where a TPS is especially useful are accounting and expenditure transactions, personnel and payroll, procurement and inventory, budgeting, and program records (e.g., client information).

Another type of information system is a management information system (MIS), which is appropriate for management control functions within an organization. Compared to a TPS, an MIS is less concerned with data accuracy and more concerned with summarizing, condensing, or manipulating data and providing a broad range of information to managers. The MIS has a more sophisticated method of linking or relating data than a TPS. An MIS should link relevant activities in different operational areas or different components of the same operational areas. It should also allow comparisons of past and present activities in relation to organizational goals and management's expectations. An MIS might even provide projections of future conditions, some monitoring of external conditions that could affect management control activities, and a means of signaling current or future problems. An example of information provided by an MIS in a school district might be: average standardized test scores and average grades of students in different schools compared to the average salaries or the average number of years' teaching experience of teachers in each school. In contrast, the information supplied by a TPS in the same school district would be much more detailed and simplistic, such as a frequency distribution of the grades received by all students in each school for the previous grade-reporting period.

The third type of information system is a decision support system (DSS), which is used to support unstructured problems and planning functions within an organization. A DSS allows more sophisticated analysis of data and presentation of information than an MIS. Data analysis in a DSS is often performed using statistical techniques or models that are supplied by the system or built by the user as needed. Sensitivity testing or "what if" analysis of the models also is available, and the results of such analyses can be graphed. A DSS may enlist

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and network different media, telecommunications, computers, software, and databases that are inside and outside an organization. Given current software and fiscal constraints in government, most existing decision support systems are not as comprehensive as defined here. Although a few true decision support systems exist in government (but more in the private sector currently), they are likely to become much more prevalent in the future given the trends in information system development (Swain & White, 1992).

It should be emphasized that each information system builds upon or evolves from the system below it. To be able to summarize data in many different ways, one must be collect, validate, and organize the data appropriately. The construction of sophisticated models and graphs of information requires that the supporting data be summarized and accessed in ways that can be incorporated directly into the models and graphs. Thus, a good MIS requires a good TPS, and a good DSS requires a good MIS (Emery, 1987; Blokdijk & Blokdijk, 1987).

Information and Data Characteristics of Information Systems

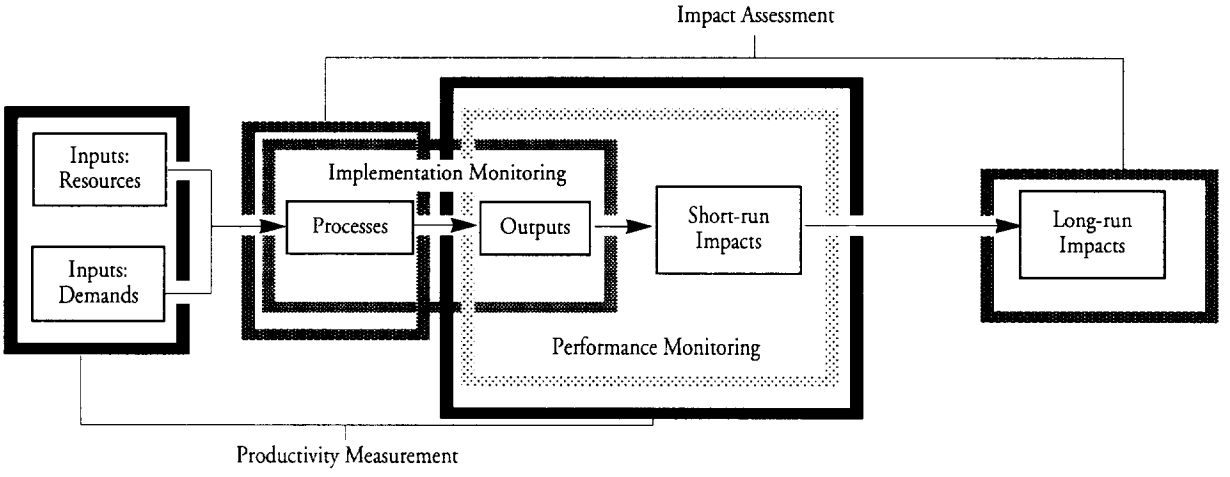
The correspondence between monitoring and assessment discussed earlier and different information systems discussed in the previous section should be apparent. Transaction processing systems support implementation monitoring as well as performance monitoring and productivity measurement at the operational level of an organization (monitoring and measurement focused on outputs as diagramed in Figure 2). Management information systems support performance monitoring and productivity measurement at the management control level (monitoring and measurement focused on short-run impacts) and some types of impact assessment. Decision support systems, which are usually viewed as support for policy analysis and strategic planning activities, are also useful for impact assessments that require sophisticated data analysis and modelling.

The importance and compatibility of the different information systems to successful monitoring and assessment (and various organizational functions) becomes apparent from the data and information characteristics of the systems compared to the data and information needs of program evaluation (and organizational functions). Table 1, which draws from previous works by Gorry and Scott Morton (1971) and Zmud (1983), presents these characteristics and needs. (See Kirs, Sanders, and Cerveny (1989) for validation of these related frameworks.)

Operational control, which includes implementation monitoring, some performance monitoring, and some productivity measurement, requires large amounts of precise data and many details on program operations and outputs. It also requires these data over time. For instance, recycling programs could keep daily or weekly measures of materials collected or households served to assist in monitoring contractors, employees, and public participation in the programs in comparison to expected behavior and participation levels. Collecting these data by area or truck route also allows managers to focus their monitoring and do geographic analyses across variables. Historical analysis of the data allows program managers to identify changes in measurements that signal potential internal or external problems; and it allows managers to obtain timely feedback on adjustments to programs. This type of monitoring is even more crucial to programs affecting the health and safety of the population such as police and food sanitation. In these cases, program inputs, such as reported crimes or sanitation complaints, should be monitored also to help determine potential implementation problems and appropriate target levels for program outputs.

Although manipulations performed on the data for these purposes are not complex, they are highly repetitive; for example, weekly summaries of types of crimes reported or tons of plastic collected. The information and data summaries generated by the transaction processing system are used often and by many people within an organization. Furthermore, the availability of this information to managers must be relatively immediate to allow timely identification of problems and meaningful feedback. The combination of high volumes of data, repetitive operations, rapid supply of information, and wide distribution of information makes a transaction processing system mandatory to achieve effective and efficient control over program outputs.

Figure 2
Program Evaluation (Assessment and Monitoring) in Relation to Program Elements



If the data necessary to produce meaningful information for operational control are to be available, many people in an organization must contribute to the collection, validation, and input of data. As such, these data functions must be incorporated into all program procedures, and members of an organization must be able to implement them easily and quickly. Because these data functions must be an integral part of program implementation, it will be extremely difficult to do monitoring on a regular basis, as IM approaches advocate, if a design for the information system is not in place and if the information system is not developed in conjunction with monitoring activities.

Although the characteristics of impact assessment and strategic planning are different from implementation monitoring and operational control, an information system is equally vital to the former activities. First, impact assessment and strategic planning are long-range activities that take a broader and more comprehensive view of organizational and program events. Furthermore, the data used by a DSS that are appropriate for these activities tend to be more aggregate, summary data that are integrated from many more sources within an organization as well as outside an organization. Because the data are more aggregate, the volume of data processes in a DSS is less and the required accuracy of the data is lower. The operations on the data necessary to produce useful information for impact assessment and strategic planning (e.g., models, statistics, and graphs) tend to be complex, which makes a DSS more valuable, especially if these activities are to be performed regularly within government. This does not mean that impacts of the same program are assessed often. Rather, the government is regularly performing impact assessments of different programs at the same time.

Table 1
Data and Information Needs of Program Evaluation in Relation to Information Systems, Organizational Functions, and Program Elements

Program Evaluation	Implementation Monitoring	Performance Monitoring	Impact Assessment
Information systems	Transaction processing	Management information	Decision support
Program elements	Inputs/outputs	S-R impacts	L-R impacts
Organizational functions	Operational control	Management control	Strategic planning
Type of decision making	Structured	Semistructured	Unstructured
Data characteristic			
Source	Primarily internal	⟷	More external
Currency	Current	⟷	Historical
Required accuracy	High	⟷	Low
Volume	High	⟷	Low
Integration	Few sources	⟷	Many sources
Level of aggregation	Detailed	⟷	Aggregate
System operations			
Flexibility	Low	⟷	High
Repetitiveness	High	⟷	Low
Complexity	Low	⟷	High
Expertise of user	Low	⟷	High
Number of users	Many	⟷	Few
Information characteristic			
Scope	Narrow, specific	⟷	Broad, abstract
Frequency of use	High	⟷	Low
Availability	Immediate, many	⟷	Delayed, few
Number of characteristics	Few variables	⟷	Many variables
Type of relationships	Linear, association	⟷	Interactive, causal
Inferences made	Deductive, direct	⟷	Inductive, indirect

Although the complexity of data operations and the unique information useful for strategic planning and impact assessments imply that these techniques might be performed efficiently without a DSS, the techniques are easier and more likely to become regular if such a system is present. Another implication of the uniqueness of information supplied by a DSS is that such systems must be more flexible and allow the user to customize operations to accommodate special information needs and data applications. As a result, direct users of decision support systems must have greater expertise in the operations and applications of such systems than other types of systems, and managers are more likely to rely on experts to run the DSS.[3]

The Design and Development of Information Systems in Government

A number of important issues concerning the development and application of information systems within government are implied by the previous observations. Three issues with significant implications for improving program evaluation and achieving the objectives of IM in government are: (1) the relationship between monitoring and assessment and the development of information systems, (2) the appropriateness of incremental or rational approaches to the development of information systems, and (3) whether systems should be designed for specific or comprehensive applications.

Most literature does not consider the fundamental role of information systems to the successful implementation of evaluation. I argue that monitoring and assessment become less elaborate and demanding if the supporting information systems are present. The relationship between evaluation methods and the different information systems can be viewed as a step function in which the level of assessment and monitoring should be compatible with the level of the information system. For instance, it does not make sense to do an impact assessment if one does not know how the program is being implemented. Thus, implementation monitoring should precede impact assessment; and the TSP that supports implementation monitoring is the foundation for the DSS that supports impact assessment.

A second issue concerns the debate over whether information systems in the public sector should be developed in an incremental, piecemeal manner or using a more holistic and rational approach. Authors have advocated the former method based upon the view that information systems begin in organizations as sets of individual, uncoordinated subsystems that eventually merge into a "loose federation," and they note the inherent limitations on long-range planning in government (Bozeman and Bretschneider, 1986). All things considered, however, a balanced combination (cycle) of top-down design or planning and bottom-up development makes the most sense especially in light of the data and information demands of program evaluation and the need to reduce incompatible, overlapping, and overly specialized systems (Rubin, 1986; Gilb, 1988).

If information systems are designed in a more rational and centralized manner, then what does this imply about the application of information systems? Should information systems be developed for specif-

ic, narrowly defined areas of government and policy problems, or should they be more comprehensive and flexible? As a general rule, transaction processing systems are less comprehensive than management information systems that are less comprehensive than decision support systems. Nevertheless, current trends are clearly toward information systems that support program evaluation in more organizational areas rather than fewer (Caudle, 1990). This is apparent particularly in the application of geographic information systems to local government, and in the development of information systems that accommodate decisions across budgeting, finance, and personnel areas (Huxhold, 1991; Swain & White, 1992; and Fadoir, 1990 & 1991).[4] Although comprehensive systems are more complex, if designed and developed appropriately, they reduce database duplication among governmental units, decrease the probability of having to restructure an information system to accommodate new information needs, and allow sharing of information across departmental boundaries and with external entities.

The implications of these suggestions for management of the public sector revolve around management's knowledge of and involvement with information systems. At a basic level, public managers and information system users in all parts of an organization will have to become more knowledgeable about information systems and their components. Often, matters concerning information systems are left to specialists or contracted out of an organization. However, information systems are much more than computers and software, and they are integral to evaluation and monitoring. Information systems must provide meaningful and useful information, and they must be able to adapt to changes in an organization's information needs. Given these demands, the design, development, and maintenance of information systems should not be delegated solely to persons who have little role in the management decisions for which the systems are used (Stevens and McGowan, 1985). Furthermore, familiarity and expertise with information systems throughout an organization increases the likelihood that the systems will be used appropriately and effectively.[5]

Clearly the trend with information systems is toward integrating them into other major internal activities of an organization, such as budgeting or strategic planning, and into the higher levels of an organization. As such, information systems are common resources that will be used by many units of an organization and may even require contributions from these units to help design, develop, and maintain them. A complicating factor in this scenario is the development of significant information resources within separate organizational units. For instance, using an information system does not always require constant and direct access to a comprehensive system, especially where data can be downloaded from a larger system thereby allowing the data to be processed separately. Furthermore, the capabilities of current office computers allow for the development of information systems within organizational units. This combination of centralized and decentralized systems presents unique management problems for government.

With respect to the study of public administration, one point stands out: the management and development of information systems and resources must have a more central place in the field of public administration. For the most part, the study of information systems is viewed as specialized and of interest only to a few people with training and interests in computers. This study suggests that information systems are integral to many of the fundamental functions of public organizations. It also suggests the need for a great deal more work in this area, especially work that targets two broad subjects: (1) the relationships among policy and management decisions, information needs, program evaluation, and the design and development of information systems; and (2) the management of information systems and information resources and their place within the larger organization. The private sector and business literature have come a long way towards addressing these subjects. It is time that public administration begins to embrace these concerns.

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Notes

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1. One troublesome problem is that many programs and policies have nonquantitatve and intangible objectives or impacts. An anticrime program that brings neighbors together in a common activity to reduce crime on their block may also improve the appearance of the neighborhood or facilitate neighborliness and the sharing of resources. Clearly, the latter benefits are much harder to measure than crime reduction. A related problem is the validity of operationalized measures of programmatic characteristics in relation to the true nature of the program characteristic. For instance, measuring neighborhood appearance as the number of graffiti markings plus the number of bits of litter may not accurately reflect the appearance of the neighborhood, and it may misrepresent the program's impact.

   There are many arguments regarding how to handle measurement problems. One argument is to use only measures that are valid and available. Another argument is to measure only program characteristics over which administrators have control. There are also opinions about having too few measures of program characteristics as well as opinions about having too many measures of program characteristics. Even as early as the writings of Amitai Etzioni (1964), there were concerns about the dangers of using imperfect measures of organizational goals, or using only those measures that are quantifiable. Etzioni discussed the problem of over-measurement and warned against "goal displacement" in which imperfect measures of goals become the program goals and program activities are focused on only those characteristics that are measurable.
2. I have excluded auditing, which is basically input tracking, from this list.
3. The advantages of managers being able to use a DSS on their own is well known. The term EIS refers to Executive Information Systems that are "smart" DSS's or MIS's that require less expertise to use. The tradeoff is that an EIS must have relatively sophisticated expert system (artificial intelligence) capabilities (Mohan, Holstein, and Adams, 1990).
4. Current technology and software facilitate the development of broader-based, flexible systems that are closer to the "ideal" systems described here. One trend is "open ended" solution designs for all aspects of the information system, from strategies for information collection and database structure to data manipulation and presentation (Gilb, 1988). Very simply, an open-ended solution is one that is designed to be "adaptable, extendible, portable, and improvable" to accommodate changes in the structure and application of the system as well as the learning that takes place during system evolution. A second trend is the use of relational databases as opposed to the more limited hierarchical or rectangular data structures (Jurie, 1992). The information demands of performance monitoring and evaluation research and the move toward more comprehensive information systems require that the supporting information systems be able to link data from many sources, aggregate and distribute this data in a variety of ways, and upload and download data to alternative stand-alone programs and computers according to different formats. Relational databases have the ability to accomplish all these tasks. A third

trend is the use of intelligent advisory systems (a precursor to expert systems) and related automated features such as remote data entry and real-time systems (Hadden, 1986; Halachmi, 1991; and Tien and McClure, 1986). Essentially, intelligent advisory systems function as intelligent, user-friendly interfaces between information system users and the information system subfunctions. An appropriately designed intelligent advisory system with on-line data entry and file updating among networked computers would condense data collection and storage into one subfunction. Combine these features with remote data entry and it gives employees in the field these same capabilities.

5. Bozeman and Straussman (1990, 113-114) discuss the prerequisites for successful use of information systems by management:

> (1) a rudimentary understanding and comfortable use of the technology, (2) a willingness to 'work with the system' and patiently make modifications as system flaws or changes in the organization require, (3) an ability to gauge the system's application strengths and weaknesses, (4) an appreciation of the variations of human-system interaction, and (5) a commitment to evaluating the system from an objective view that neither romanticizes the technological components nor faults the technology for being unable to do what no technology can do—make good, authoritative managerial decisions.

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