1994 Symposium on
Criminal Justice Information Systems and Technology:
Building the Infrastructure

The Design, Development, and Maintenance of Executive Information Systems for Corrections, Probation and Parole

William G. Saylor, Deputy Director
Office of Research and Evaluation
Federal Bureau of Prisons

This presentation will address issues related to the design, development and maintenance of executive information systems (EIS). I will define the concept of an EIS, and discuss why I believe it is critical for agencies like ours to invest in these types of information systems. I will also describe what is required to develop and maintain such systems, and what it costs, at least in some relative terms. Design and development issues will address personnel considerations (e.g., agency verses contract), tailoring the system to the organization's mission and goals, defining measures of organizational performance, data requirements, and software and hardware options. I will also discuss the use of EIS in support of budget justification, strategic (long range) planning, management decision support, performance monitoring, policy impact assessment, and responding to routine and ad hoc information requests. The results of the design, development and maintenance production cycle are illustrated by an executive information system (the Key Indicators /Strategic Support System, also referred to as KI/SSS), that we have developed completely in-house, for use by the Bureau of Prisons' management. The KI/SSS is updated monthly and is distributed Bureau wide via CD-ROM technology. KI/SSS has proven to be an extremely cost effective means of dynamic information dissemination. In fact, we have achieved far greater information dissemination, with better quality control and less cost, than was possible with the paper medium annual statistical reports and ad hoc request driven methods utilized prior to the development of KI/SSS. Our experience suggests that other agencies could expect similar cost effective results by using similar design and development methods.

1994 Symposium on
Criminal Justice Information Systems and Technology:
Building the Infrastructure

THE DESIGN, DEVELOPMENT AND MAINTENANCE OF STRATEGIC SUPPORT SYSTEMS FOR CORRECTIONAL AGENCIES

William G. Saylor
Deputy Director
Office of Research and Evaluation
Federal Bureau of Prisons

Introduction

The population explosion in prisons over the last decade has brought new demands for correctional managers. These demands are compounded by the many social and technological changes in contemporary society that have broadened the correctional context. Indeed, prisons are microcosms of society, and confined populations generally require many of the services and amenities that contemporary society offers populations outside of prison. Consequently, the traditional methods and tools of correctional managers are no longer adequate. Contemporary demands require managers to augment their personal observations and experiences with other sources of information in order to best deal with the new complexity of decision-making.

Furthermore, the demand for information has grown along with the confined populations. Before confined populations began to soar, demands for information most frequently came from within an agency (e.g., for management decision support purposes). Subsequently, external information requests (e.g., legislative bodies, the public, or the mass media) have increased in frequency. To achieve better managed prisons, more cost effective operations, and better public accountability in this climate requires quick and efficient analysis of large quantities of valid and reliable information. Information that is related to the full range of issues required to manage these micro-societies.

Social and technological changes have increased the complexity of decision making in many contemporary social organizations. This has resulted in many innovations in management methodologies. Some related innovations, total quality management (TQM),continuous process improvement (CPI), and benchmarking, have proven to be useful in managing and facilitating decision making in complex environments. Adherence to these methods requires a continuous monitoring of the "production" process, which allows management to observe unwanted variance in the quality of the "product" throughout the production. The principal premise of these methods is that quality assurance of a product or phenomenon requires a vehicle to continuously monitor the process which produces that product or phenomenon.

This paper will address issues related to the design, development and maintenance of strategic support systems (SSS), a type of information system that can provide correctional management with the ability to continuously monitor correctional operations. I will define two types of information systems as they relate to the Bureau of Prisons (BOP), a management information system (MIS), and a SSS. I will discuss how these types of systems differ, and the dependence of the SSS on the presence of a MIS. I will also describe what is required to develop and maintain such systems, and what it costs, at least in

some relative terms. Design and development issues will address personnel considerations (e.g., agency verses contract), tailoring the system to the organization's mission and goals, defining measures of organizational performance, data requirements, and software and hardware options. Finally, I will discuss some applications of a SSS in support of budget justification, litigation defense, quality control (continuous process improvement) and strategic (long range) planning, performance monitoring, management decision support, benchmarking, policy impact assessment, and responding to routine and ad hoc information requests.

The design, development and maintenance production cycle is illustrated throughout by, an information system (the Key Indicators/Strategic Support System, also referred to as KI/SSS), that we have developed completely in-house, for, use by the Bureau of Prisons' management. The KI/SSS is a personal computer (PC) based menu driven system that is updated monthly and is distributed Bureau wide via CD-ROM technology. KI/SSS has proven to be an extremely cost-effective means of dynamic information dissemination. We have achieved far greater information dissemination, with better quality control and less cost, than was possible with the paper medium annual statistical reports and ad hoc request driven methods used prior to the development of KI/SSS. Our experience suggests that other agencies could expect similar cost-effective results by using similar design and development methods.

What is a management information system?

Management information systems are designed to provide detailed information about individual (or basic) units of measure. That is, information about an individual inmate or staff member, or an individual cost center. The intent of a system is to provide contemporaneous characteristics (views or descriptions) about the units for administrative purposes (e.g., the facility where an individual is located, or their status with respect to some characteristic). Large organizations generally require MIS that are implemented on mainframe computers. The size and complexity of a MIS frequently parallels the size and complexity of the organization in which it is implemented. Due to a system's complexity, modifications to a large MIS often involve lengthy development queues.

What is an strategic support system?

A strategic support system (SSS) is a personal computer based automated information system that is designed to expedite and lessen the cost of decision support information retrieval for (or by) managers. Although this type of system could be viewed as an executive information system, I use the label strategic support system because it more precisely states the purpose of the system. The purpose is to provide managers with the information they need to make optimal decisions about issues that are of significance to the organization.

The system is designed around the organization's mission, goals and objectives. A SSS provides a meaningful synthesis of operational data relative to the organization's mission. Stated differently, the data needs of a SSS are by-products of the organization's operational data needs (that are typically met via mainframe management information system applications). The SSS measures can be viewed as a family or families of vital measures about the organization and its performance relative to its stated goals and objectives. It is a repository

for historical and contemporary organizational measures that can be quickly retrieved and displayed in both text and graphic formats.

A SSS provides an alternative vehicle for accessing and displaying operational data, one that presents the information in a different (summarized) format. MIS are designed for administrative purposes. Consequently, the data contained there are very detailed and related to specific individuals or basic units. Such detailed information about individuals is not well suited for the purposes of management decision support. For decision support purposes managers need data that summarize individual details in ways that relate to the organization's objectives, and can, therefore, measure organizational performance.

Considering the types of tasks that managers must accomplish, a MIS does not have much direct utility for them. As a result, there is often little opportunity for managers to monitor these data sources. This poses a dilemma for those who abide by the management principle that what gets monitored gets done correctly and on time. A SSS provides an opportunity for managers to observe mainframe MIS data indirectly. Consequently, a SSS allows managers to drive the quality of MIS data as well as the operations the data represent. If a manager finds that the SSS data are contrary to their expectation, it doesn't mean that the MIS data are definitely in error. However, it does provide the prudent manager with an opportunity to communicate with operations staff in order to understand why the data look different than they had expected. If the operational data turn out to be in error then the problem is on its way to being resolved. Alternatively, if after a discussion with operations staff the data appear not to be in error then the manager has a better understanding of the operational details and is in a better position to manage the process than he or she was prior to the inquiry.

The operational data that feed a SSS can come from any number of MIS. Strategic systems integrate a wide array of data elements from different MIS. For example, a single SSS can contain information that is routinely extracted from inmate, staff, and financial MIS. Data element integration permits a systematic view of organizational measures and an assessment of the relationships among these measures. Managers cannot easily acquire a systematic view of operational MIS data without an integrative vehicle such as a SSS. The integration of data elements from different operational MIS ensures that system users are provided with the necessary contexts. Without relevant contexts data are simply numbers, not information useful for analytic or decision making purposes.

A strategic system is designed to provide on-demand access to the kinds of information managers need to monitor and evaluate performance in their specific areas of responsibility, and provide support for policy formulation and policy impact assessment. If a system is to be useful for these purposes then it must be as dynamic as the organization for which it is developed. The system design must permit continual system modification that will enable the system to keep pace with changes in the organization and management's anticipations and reactions to those organizational changes. The system design also needs to accommodate managers by providing a transparent user interface (e.g., a menu driven interface), one that recognizes that managers generally do not have extensive computer experience and have limited time to learn about a system via user's manuals or other technical documents. The interface design must permit users to concentrate on their analysis and not on the vehicle they are using to retrieve the information needed to address their questions.

Why do correctional agencies need strategic support systems?

Inmate population growth is pervasive from a correctional management standpoint, taxing virtually every aspect of the prison environment. For example, the population growth that the Bureau is experiencing is expected to continue into the next century. This long term growth makes it imperative that the BOP managers monitor every facet of the system's operations to facilitate strategic planning, minimize the problems associated with inmate population growth, and make the best resource allocations possible.

Furthermore, growth in inmate populations has resulted in larger agencies and larger budgets and consequently increased oversight and scrutiny from appropriation bodies and the general public. Greater levels of visibility have resulted in larger volumes of information requests. One way of responding to the increase in the volume of requests for information is to decentralize information dissemination responsibilities. A decentralized information delivery structure allows information to be produced and used more readily for both internal and external purposes. Decentralization also eliminates centralized information request queues. This allows managers to become autonomous with regard to the pursuit of their data and information needs. Moreover, managers can tailor their information to fit their immediate needs. However, the diffusion of organizational information requires a mode of delivery. Strategic support systems as defined here are one option when considering the development of such a device.

An information reservoir, like a SSS, which accumulates summaries of organizational measures over time can accommodate a variety of management information needs. The following 7 types of information applications provide illustrations of how a SSS can enhance and benefit management's information consumption.

1. Management decision support.
   Management's information concerns focus around data availability and validity, and timeliness of information delivery. Managers need relevant information on demand so that it is available when decisions are made. A PC based SSS that is updated monthly from operational data bases eliminates these management information concerns.

2. Information requests from internal or external sources.
   A decentralized information delivery system reduces the burden and delay in responding to information requests. Consequently, a SSS allows for more efficient use of resources. A SSS provides a single source of information for ad hoc information requests, routine statistical reports, management decision support, and research and evaluation. When these information needs are dealt with independently there are duplications of efforts that waste resources. One information source for these related activities also reduces the potential for seemingly discrepant or even contradictory reports or findings. When these information needs are met by different data generating processes there are opportunities for discrepancies due to differences in computational methods, confusion over the data extraction date, or differences in data definitions. Additionally, some information requests or mandates (e.g., in conjunction with litigations) can be burdensome and costly. An information repository, like a SSS, can provide insurance against these sorts of costly information requests.

3. Budget Justification.

A SSS provides budget staff with a quick and easy means by which to observe changes in population levels or changes in population characteristics over time or across units or facilities. Monitoring population changes can provide justification for prior budget allocations (i.e., demonstrate the responsible use of funds) as well as demonstrate anticipated budgetary needs.

4. Monitoring performance measures.

Strategic systems can provide managers with a vehicle for monitoring trends in organizational performance. Managers can assess the impact of management decisions, for example determine whether a given policy or program has had its intended impact and if so what the magnitude of that impact was.

5 & 6. Strategic planning and Quality control.

In my view strategic planning and quality control are interrelated processes and, therefore, I will discuss them together. Strategic planning is an effort to produce fundamental decisions and actions that shape and guide what an organization is, and what it does. This is accomplished by setting or changing organizational objectives, identifying and obtaining the resources required to meet these objectives, and determining the strategies, programs, and policies needed to accomplish the objectives. Quality control can be defined as a set of activities or devices that help to attain the excellence of something. It is a process of establishing standards of comparison against which to check the results of a process. The control of quality is accomplished by the establishment of measurable standards for comparison against measures of quality characteristics. Quality characteristics are any properties that define or describe the nature of a product.

Strategic planning and quality control are complementary activities. While strategic planning establishes the requisite policies and resources, quality control monitors the progress made in pursuit of these goals and provides the information needed to make any necessary adjustments. In this regard, strategic planning is a prospective process, one that requires us to look forward and compare where we are now a relative to where we want to be at some future point. Conversely, quality control is a retrospective process, one that requires us to look back and compare where we have been relative to where we are now, to determine if we are satisfied with the current product. As such, strategic planning and quality control have a cyclical relationship whereby strategic planning sets the course and quality control tells us how well we stuck to our course and whether we arrived at our intended destination. Consequently, the utility of any strategic planning effort is contingent upon the quality (accuracy and comprehensiveness), and quantity (volume) of information available to the process. The greater the reliance on quality control processes in formulating a strategic plan, the more efficient and effective our planning effort becomes. A SSS promotes the use of strategic planning and quality control cycles by providing managers with quick access to organizational measures over spans of time.

7. Benchmarking.

Benchmarking is a continuous process designed to ensure that an organization is using the best known operational practices. Best practices

are identified by observing the operations of similar organizations, or organizations performing similar tasks, that are known for outstanding performance. For example the BOP managers frequently use the KI/SSS to compare facets of their operation to the same operations in "sister" facilities (i.e., facilities they have deemed to be similar to their own). Alternatively, it might be useful to compare BOP operations to prison operations in states or foreign countries. It is also very useful to compare a specific operation to an organization that specializes in that type of operation. For example, it is informative to compare information on BOP hospital operations and practices to the operations and practices of hospitals outside the prison environment. A strategic system can contain measures that allow benchmarking to be a readily available management practice.

What is required to develop a strategic support system?

The type of vehicle used to deliver information to managers can take a variety of forms and each type has cost considerations associated with it. One option is to deliver the measures via paper medium. This may be the least expensive and is certainly the least efficient. Of course poor efficiency also has an associated cost. The drawback to a paper system is that it can be voluminous and therefore more time consuming to use and possibly more costly to deliver to users (e.g., due to increased mailing costs). Paper systems are also inflexible. What you see is what you get. A second option is to develop a mainframe decision support system. These types of systems allow individuals with little or no computer programming expertise to access and retrieve summaries of mainframe MIS data via a PC based menu or graphic user interface. When properly designed these types of systems can be very effective and efficient. They do, however, contain a hefty price tag. They require an extensive hardware, software, and telecommunication infrastructure. The initial investment as well as the ongoing maintenance costs can be prohibitive. A third option, one that we have pursued at the BOP, is a hybrid mainframe-PC system that resides somewhere between the standardized (routine) paper reporting system and the mainframe decision support system. This hybrid design allowed us to develop a decision support system that made use of the BOP's existing mainframe MIS structures and the developing PC and, CD-ROM technologies. We use the computing power of the mainframe, and our understanding of the organizational structure of the BOP, its mission, and management's initiatives, to create meaningful summaries of operational data with a monthly periodicity for monthly distribution via CD-ROM and user application via PC.

System construction requires formulating measures (indicators) of events or performances, preferably from existing mainframe or PC databases. Quantifying various aspects of an organizational setting requires an understanding of: the organization's mission, management's agenda with respect to accomplishing the mission via the goals that are established, an understanding of how to identify and create measures of social organizational processes, and technical skills in database management and computer programming. Accomplishing this requires the identification of an individual or group of individuals with knowledge of these substantive, managerial (organizational), and technical skills.

The group of individuals involved in the development can be organizational staff with the prerequisite experience and expertise, or contract employees. If an organization has a research component with staff who have the technical expertise and time (as was the case in the BOP) then there are clear advantages

to developing the product in-house. The biggest advantages are that the organization's employees know the system (i.e., the organizational structure, goals and objectives, terminology, and so forth) and are more accountable to management. Alternatively, a vender that specializes in this sort of technical system development could have a larger technical staff and less disruptions, and could therefore complete the project more quickly. However, an outside contractor would not have the same understanding of the organization nor the same accountability to the organization's management. Consequently, if an outside contractor were used it would be important to have a technical staff member from the contracting organization oversee the project.

Once a group is composed the first issue that must be considered relates to the data requirements of the system. The most desirable arrangement is to provide for the data needs of the system as byproducts of the agencies' operational data needs. This is desirable for several reasons. First, this provides the least expensive means of generating data for a system because the data are already automated for other purposes, hence the agency is getting more mileage from the investment that is routinely made for operational purposes. Second, if the data are automated for operational purposes, they will have operational validity and users can have more confidence in the data. That is, the data are used daily at an individual inmate, staff member, cost center, or whatever, level for administrative purposes and this daily scrutiny, as well as any agency review or auditing practices, will insure the accuracy of the data.

In designing the system one must decide on the unit of measure and the periodicity of the data. The unit of measure relates to the objects on which the measures are made. For correctional agencies likely units of interest could be housing units, institutional units, and aggregates of institutional units (e.g., aggregates of institutions based on security level or geographical regions). Periodicity relates to the frequency of measurement. The most likely period of measurement for correctional agencies would be monthly although the period could be quarterly or annually.

Organizational measures on the units of interest to the SSS users can be constructed in a variety of ways. The method of construction is best determined by the nature of the phenomena being measured. For example, occurrences of events can generally be represented as counts or rates. Performance measures can often be meaningfully expressed with summary statistics such as means (averages), medians (50th percentile), or measures of variability (e.g., the range of values observed from smallest to largest, or the variance or standard deviation about the mean). Population characteristics or profiles are well represented as proportions. Measures of homogeneity or heterogeneity (similarity or dissimilarity) are also informative when expressing population characteristics.
Decision support, and policy and program impact assessment applications require that the data be stored as a series of cross-sections (a sequence of snap-shots in time). A system designed in this way provides users with a continuous accumulation of views of what the organization looked like, with respect to the measures the system contains. This allows users of the system to isolate an instant in time or view changes in the system over a span of time.

Most correctional agencies will have some mainframe data relating to their inmate population, possibly recording admissions and discharges, or physical or offense characteristics. Similarly, agencies will frequently have some staff data for payroll purposes. Even the most basic information can provide the core

of a SSS. For example, just a monthly enumeration of admissions and discharges that can be quickly accessed by management and which depicts these counts of admissions and discharges for a month or sums the counts for some number of months, say twelve or more months, could be of assistance for budgetary or population management purposes.

The expense in operational data is in the process of getting the data automated. Once the data are automated, the cost of extracting that data with a set periodicity, say monthly, and the media to archive that extract, are insignificant. Given the initial investment in getting data automated, it is penny wise and dollar foolish not to extract and archive the data for future use. An organization could easily spend as many resources responding to information requests in a less automated manner. At the BOP we extract data from each of the mainframe MIS the last weekend of each month. These extracts are initially stored on magnetic cartridge and ultimately on magneto-optical or CD-ROM media. These archived extracts provide the data backbone (or data conduit) for the BOP's Key Indicators / Strategic Support System.

Two types of mainframe production runs are scheduled each month. The first extracts the data from the mainframe MIS. The second uses the power of the mainframe to summarize the extracted data in meaningful ways. These summaries are subsequently transferred (downloaded) to PCs for incorporation into the strategic support system. The mainframe programs used for this extraction and summarization must be easily and quickly modifiable. This suggests an interpreted language (e.g., SAS) rather than a compiled language(e.g., COBOL). In the BOP we have used SAS to accomplish this phase of the mainframe system development.

The PC side of the KI/SSS development is implemented with an integrated data management/graphic/statistical analysis system product called PRODAS. PRODAS, like SAS, is an interpreted (not compiled), syntax driven language. The PRODAS data manager relies on a keyed database structure, which allows for fast direct access of database records. The strategic system's menu driven user interface was completely written in-house using object oriented Turbo Pascal. Update capabilities that keep an information system abreast of organizational and operational changes are crucial to the viability and survivability of a strategic system. The PC products used to develop and maintain KI/SSS have allowed us to quickly accommodate management's, requests for modifications and enhancements.

What does it cost to develop and maintain a strategic system?

The cost is certainly influenced by whether the system is developed internally or externally. Another factor is the existing resources an organization uses to respond to internal and external information demands. For example, prior to the development of KI/SSS the BOP Office of Research was almost completely consumed by responding to information requests. In most instances the requests were dealt with independently. Each request required a run against one or more fairly large mainframe databases. This method used considerable staff time as well as computer resources. Moreover, the stochastic nature of the requests made it difficult, if not impossible, to manage the office and to meet commitments to more lengthy basic and evaluation research initiatives.

The same staff who were responsible for responding to these information requests previously were involved in the development and subsequently, the maintenance of KI/SSS. Where these staff would previously make numerous runs in a month

(generally one per request), the same staff now, make a smaller number of mainframe runs a month to produce and maintain the databases that make up the KI/SSS. The remainder of their time can now be used to further embellish the strategic system or conduct research. Consequently, for the BOP the system cost less to develop and maintain than was previously spent responding to demands for information. The strategic system has allowed us to more efficiently produce a larger volume of information at less cost than was required to produce the requested information in response to each request independently.

Conclusion

In order to plan for the future, measures of institutional operations must be readily accessible to prison system managers. The development of a strategic system is the essence of proactive data management. Planning for an organization's strategic information needs can produce measurable resource savings. Conversely, the costs of management decisions made without the benefit of adequate information may not be obvious, and are often difficult to measure.

A strategic system can contribute to management's ability to ensure quality planning because it will place a multitude of relevant information at their disposal. Strategic systems provide managers with a tool with which to monitor their organization's performance. The ability to monitor an organization can provide managers with a better understanding of whether there is compliance with existing strategic goals (and the plans and policies designed to achieve them), whether policies are having their intended impact, whether policies are in need of modification, or whether new policies or plans are needed. A strategic system allows managers to make decisions based on information that is selected for its relevance rather than by the constraints of what is available and can be accumulated and assembled within the time allotted before some action is required.