

AN ADMINISTRATIVE ANALYSIS OF THE DECISION
PROCESS AND CONCOMITANT INFORMATION FLOW
IN THE INSTALLATION OF A LAW ENFORCEMENT
COMPUTER SYSTEM

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ABSTRACT

AN ADMINISTRATIVE ANALYSIS OF THE DECISION PROCESS AND CONCOMITANT INFORMATION FLOW IN THE INSTALLATION OF A LAW ENFORCEMENT COMPUTER SYSTEM

By

Clara Elizabeth Molina

This thesis addresses the decision process and concomitant information flow in the installation of a computer system and the use of computer data in law enforcement agencies in Michigan. The evolution of the decision-information theory has been the basis of a cybernetic model for the management of the design, development and implementation of a computer-based information system. This model was postulated as a criterion model for the basic research methodology.

The exploratory research concerned the human interface with computer systems and data in several law enforcement agencies. An administrative analysis of the data obtained from interviews was performed through the use of decision-network analysis and case study analysis. This included a critical decisions matrix reflecting the categories derived from the interviews: initiating the

project, system analysis, reports, personnel, corrections to the system design, and organizational changes.

The evaluation was twofold: the first part, covered in the research findings, presented a summarized case analysis of the process. The second half, covered in the summary, described the relationship of the research data to the theoretical model and those malfunctions of blockage and noise interference in the information flow which impaired the optimal performance of the decision model.

The lack of support for the postulated hypotheses was interpreted as being significant due to two factors: a) the hypotheses dealt with a formal structure of control for the computer implementation process that is only now beginning to be used, (b) and police management has not yet attempted to establish any control on these projects.

Recommendations to increase performance of the system and to permit the establishment of control were for in-service training of police personnel in computer technology overview and in the analysis and application of the computer data to their operations. Additionally, police agencies should establish data processing staff committees in their respective agencies to provide for the diffusion of knowledge and experience in the computer area.

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CHAPTER I

THE PROBLEM

At a time when many police agencies are planning or installing a computerized information system, the difficulties inherent in such a project are often overlooked, both in the literature available to the agency and in the management of the project.

When police agencies were small, the installation of a new records system was not a problem, for the process could be simulated in the chief's mind, and after weighing the various alternatives, he could make decisions based on past experience and information available to him. As agencies grew, and the complexity of the records function grew apace, communication became less direct to the chief and even to the department supervisor, with the result the agency was no longer able to effectively simulate the operation within one person's experience and information.

As tabulating equipment came into use, the reports this equipment provided were often too dated to be of value in a real-time environment with its need for decisions to be made immediately. Yet even with a tabulating unit,

the installation did not present management with problems of an overly complex nature.

The introduction of the electronic computer and the introduction of management information techniques presented police management with the problem of handling information in a real-time environment. These new tools made it possible to simulate the various functions of the agency and to provide immediately available information. Consequently, the emphasis upon computerization, systems analysis, and management information systems has presented new problems of a complexity beyond the immediate experience and understanding of most police managers.

Management has only begun to face the problem of controlling the progress of a computer implementation process and the greatest progress in this area has been within the business community. There are few books or articles that relate this process to the law enforcement area and fewer still that deal with the human interface with the computer. The following exposition addresses four aspects of the problem: sources of background information, uncertainty concerning information needed, dysfunctional management areas, and the lack of communication between technicians and police.

Statement of the Problem

The police executive must be assured of a constant flow of information in order to know how things are going and to make decisions as a result of this knowledge. He develops means for routinely collecting information about a variety of phases of the agency operation: what kinds of offenses are we getting now? how well are staff or patrol performing? what do important outside public organizations think of the agency? how successful is a particular administrative rule or procedure? The information sought and received may be detailed and complex, or crude and simple; the means by which it is received may be formal and routine (such as regular reports through channels) or informal and impressionistic (such as a chance observation while walking through a department). Whatever the content and source of the information, the police executive feels it is never entirely appropriate or sufficient.

In traditional management, the types and sources of background information are varied, uneven, and unreliable. Decisions have been influenced as much by the withholding of information as by injecting it into communication channels at the most opportune time. As systems analysis has made the informal decision structure explicit, it has come under the control of management, and by

extension, under the control of the computer. Kent Colton in a 1971 survey also noted this shift within the informal structure of police agencies, as a result of the implementation of a computer system. Those "who work with management science techniques or in the data processing department tend to increase their area of influence" while the managerial level lost a corresponding amount.¹ As a result, the police executive's feelings of loss of control were increased and he felt his alternatives become constricted and narrowed.

Another problem area is that there is considerable uncertainty about the specific type of information actually needed to make a decision. In an effort to resolve this uncertainty, managers request more and more data. As a result of increasing amounts of data, and the complexity of the decision process, the manager can no longer use the information he has received in a competent manner. As the manager feels greater pressure to use the increased information rather than the more traditional methods of intuition and judgment, his ability as a manager comes under stress. Furthermore, under traditional management, a manager is permitted some ambiguity for he is not expected to know all the answers and account is taken for

¹Kent W. Colton, "Police and Computers," Municipal Year Book, 1972, p. 125.

this uncertainty. As a result, discrepancies between actual information and the executives' estimate of available information, induces errors in decision-making and creates new difficulties. Under a computer-based information system, uncertainty is no longer a valid assumption, for the manager is expected to have accurate information upon which to base his decisions.

Modern organizations are designed with power centralized at the top levels, with a specialization of tasks within the organization. This creates dysfunctional areas which are concealed within the informal structure of the agency. The revelation of these dysfunctions as a result of systems analysis during the computer feasibility study reveals a manager's competence to act upon this information and such competence becomes more important than the power of his position after the installation. Now there is a new currency of power: competency in decision-making and informational validity. No longer may a manager withhold information to secure his power base. The systems analysis, and eventually the computer, will generate it without his permission--or perhaps even without his knowledge.

As a manager finds his leadership becoming based more on competency than formal power, his resistance to an information system increases. The emotional problems within a police agency do not simply disappear when they

are confronted with rationality. Instead, they tend to obstruct the implementation of the rational plan of the information system.

The value of a management information system is not absolute for it varies with the people and the agency involved in the implementation. One of the major problems in police agencies installing computers has been the lack of understanding of both the police needs by the data processing personnel, and of computer operations by police personnel.² It is more important for an information system to be designed around the need for information regarding the achievement of the agency's goals and the more pragmatic relevance to the managerial perception of those goals than to merely perform a record-conversion operation. During the years of a police officer's experience he develops a cognitive reasoning process that is based on 'street insight' and as a result, his perceived goals reflect that process and experience. To gain managerial acceptance of a computer information system, it must reflect the police way of thinking and operating rather than merely being a reporting system.

Such a system is valuable only so long as it helps in the decision-process and yet, few systems are explicitly

²Ibid., p. 126.

oriented towards decision making. In a report to the 1972 SEARCH Conference, Colton reported that 21.2% of the total computer applications were for police administration purposes in 1971. By 1974, a 99.5% increase in planned applications in this area were forecast by the departments involved in the survey.³

Many information systems fail because they were attempts by data processing personnel to impose a tool upon an unwilling management without understanding that information systems are a control method that must be aimed at decision points. It is management's responsibility to recognize occasions for making decisions and then to frame appropriate demands in light of the decisions to be made. Unless management questions the legitimacy of the demand for information in this light, then management itself begins to lose its legitimacy in the eyes of its employees.

If management fails to evaluate the information system, they delegate by omission much of the control of the organization to the system designers and operators who may have many assets, but managerial competence is seldom among their virtues. The managers should be able

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Kent W. Colton, "Use of Computers by Police: Patterns of Success and Failure." Paper presented at SEARCH Conference, New Orleans, La., October, 1972.

to ask questions, but due to the mystique of the computer, feel incompetent to do so. Yet no system should be installed unless the police executives for whom it is intended are trained to evaluate and control it rather than be controlled by it.

Significance of the Survey

As a result of the problems described above, the implementation of an information system in a traditional bureaucratic structure creates a discontinuity in the managerial control function.

Traditionally, management has focused on the needs of the moment and depended upon intuition and experience as the input for a decision. Modern theory views the decision as a process dependent upon an information flow from a variety of sources as input in order to reduce the continuing uncertainty under which a manager operates.

In view of the inherent conflict in this conceptual dichotomy along with the aforementioned discontinuity in the control function, the problems presented in this study demonstrate the need for a method or model in which the increased information flow can be controlled and managed. The subject of the exploratory research will address these problems of decision-making and control in law enforcement agencies that are installing or have

installed a computer information system within the framework of a postulated model.

The significance and urgency of this study is demonstrated by the increasing numbers of agencies that are installing computers. In his summary, Colton points out:

It should be remembered that in many cases it is not the technical but the behavioral, organizational, and administrative difficulties that will hold the police back from achieving the full potential of computer use.⁴

Limitations of the Problem

A problem is deceptive in its simplicity for where one problem stops and another begins is not that clear. Therefore, the problem needs definition of its boundaries. Boundary identification sets limits on the exploratory investigation into the nature of the system. These boundaries restricted the scope of the problem so as to be commensurate with the time available and the amount of detail necessary to understand the process.

The problem was limited to an analysis of the problems that developed in the human interface with the introduction and use of computer data systems. Thus, any information attributes (such as type of data, frequency, and accuracy) that did not effectively contribute to the analysis process were considered insufficient or

⁴Ibid.

redundant. Further, the administrative analysis disregarded both the formal and informal organizational boundaries and considered the decision as an entity in its own right regardless of where or at what agency level it was exercised. Research was limited to the managerial level which was defined as the supervisory personnel and above in the various agencies.

Definition of Concepts

System: An assemblage of interrelated elements that form a synergistic whole in order to achieve a stated or understood goal or objective.

Real-time: All information or data is available or can be retrieved in a time frame short enough so that the decision-maker can utilize it to make an immediate decision or can utilize it to shape an ongoing situation.

Information system: The electronic data processing of operational level programs.

Management information systems: The provision of a data base that will unite the basic functions into a total view of the system and provide management with access to the information in order to measure the impact of a decision through the prediction of possible alternatives to the decision by the use of a historical data base of previous transactions or simulation techniques, and which can evaluate those alternatives in a real-time environment.

Cybernetic model: A simulation of the managerial control function which has the basic elements of an activator, processor, homeostatic sensor, input and output, and feedback.

Manageral control function: A process involving the establishment of performance standards, measurements of performance, comparison of actual performance against standards, and corrective action when performance deviates significantly from the standards.

Feedback: Communication channels connecting decision points through which flows information regarding the performance of the system.

Decision process: The transformation of information through a search, the formulation of alternatives, and the selection of a course of action. The decision-making process also involves the transformation of energy when the sources of power are used to get others to implement a decision.

Equilibrium: The process whereby the occurrence of the open system being thrown into a state of imbalance by a change in the environment and the resultant behavior of the system to eliminate the effect of the change and to return to a steady state of balance and order maintenance.

Homeostasis: The process whereby a specified control device detects changes in the environment, makes compensating adjustments, and holds the system within the desired limits.

CHAPTER II

THEORY OF MANAGEMENT AND ORGANIZATION

Theory provides a guide for research direction and relevance. In order to more clearly understand the background of the problem it is necessary to examine the various theories of management which have developed over the centuries and to delineate the relationships of cybernetic concept of managerial control to system theory.

As far back as 1300 B.C. the Egyptians had a knowledge of management and organizations. Personages such as Aristotle, Thucydides, Caesar and Aquinas have written on the management of organizations. Military forces and the Roman Catholic Church developed concepts of line and staff, formal organizational authority relationships, chain of command, and similar managerial procedures that still exist in police agencies. During the eighteenth and nineteenth centuries economists Adam Smith and Alfred G. Marshall developed the basis of modern organization theory. Smith promoted the concepts of economic man and the specialization of labor, while Marshall was concerned with the operation and management of the organization.

Major developments in management theory have mainly evolved during the present century.

Five significant schools of management and organization theory have grown during these years: behavioral, empirical, quantitative, decision theory and management process.

The Behavioral School

The behavioral school had its beginning in the Hawthorne Studies by Elton Mayo and Fritz Roethlisberger. The orientation of this school has developed along two lines: the human behavior group and the social system group. The main difference is their viewpoint on management. The human behavior group, while agreeing on the orientation towards the individual and social psychology, focuses on good management as a result of leadership and group dynamics as presented by Mayo and the Hawthorne Studies. Douglas McGregor's theory X and theory Y continue this school of thought with its emphasis on the participative approach.

The social system group exemplified by Maslow, Argyris and Simon emphasizes the social and cultural interrelationships of management. This approach attempts to deal with management as a system of distinct parts and their relationships among the organization, the external

and internal environment, and the forces that bring about change.

The Empirical School

The empirical school of thought developed and promoted by the Harvard Business School and the American Management Association tends toward the use of pragmatic experience as the basis for developing the problem-solving skills necessary to management.

The Decision Theory School

The decision theory school approach is oriented towards decision-making as the fundamental aspect of management. Herbert Simon in the New Science of Decision-Making, Forrester, Cyert and March along with the military have adapted the structure of the theory to administration and management. The theory includes all the activities preceding the decision: the need for a decision, possible courses of action, and the choosing and implementing of a specific course of action for the required decision.

The Quantitative School

The quantitative, or mathematical, school theory describes management in terms of symbols, relationships and measurable data. Frederick Taylor, the Gilbreths, Gantt, VonNeumann, Ackoff, and Schlaifer have brought the theory to its current state of the art. Taylor began this

theory with his treatise on The Principles of Scientific Management in 1911 in which he developed concepts of the use of standards in control, the separation of planning from execution, the functional organization, and the exception principle--all of which have been brought into modern decision theory. Practitioners of this school are generally known as operations researchers or management scientists and their primary concern is with decision-making and systems analysis, on the basis of mathematical models of the process or by simulation of alternatives through mathematical derivation.

The Management Process School

The management process school concerns itself with the traditional approach of Fayol and the description and analysis of the functions of management. Mooney and Reiley, Urwick, Terry, Koontz and O'Donnel, Newman and Moore have developed this aspect of management and organizational theory. Fayol, in 1916, established the basic elements of this theory in administration and the general principles of management. His functions of management--planning, organizing, commanding, coordinating and controlling--have become the foundation of planning theory, organizational theory, and control theory.

System Theory of Organizations

The classical and neo-classical approaches to organization have evolved the decision-making model, the bureaucratic model, the social systems model and the systems model. Simon as previously mentioned views management as decision-makers and problem-solvers within the context of the decision-making model. Max Weber delineated the original structure and procedures of the bureaucratic model which has currently become the target of satire in Parkinson's Law and The Peter Principle.

Talcot Parsons developed the social systems model which bases its premises on the theory that organizations are social systems which have evolved as a result of the complexity of modern society.

The systems model grew from the writings of Haberstroh, McGregor, and Scott and encompasses resource flows, modern organization theory, the management process, and the functions of management, the techniques of the various schools of management theory and management information systems.

The organization is viewed as consisting of the individual, the formal organization, the informal organization, status and role patterns and the physical setting. These diverse points are linked by the process of communications, balance (equilibrium), and decision-making.

This systems approach changes the concept of the organization from one of structure and functions to one of process and systems. The cybernetic concept of control which is the automatic feedback of information for the self-correction of the system in order to maintain a homeostatic state is the function that integrates all other processes. Thus the system model provides an integrative structure to permit the implementation of the classic functions of management--planning, organizing, controlling--within the framework of behavioral knowledge developed by modern theory and the techniques of the quantitative methods.

Under the systems theory, decision making is the process of selecting from among alternatives a course of action to achieve a stated objective or organizational goal.¹

The goal of the system model is to define a hypothetical system concept that will produce a condition which is non-varying in time. This results in a controlled or closed system. However, systems which are designed to operate with humans will not qualify as closed systems. The typical functions of a man-machine system are

¹Joel E. Ross, Management by Information System (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1970), pp. 29-105.

planning, investigation, designing, recording or classifying, problem-solving, and decision-making. Operational characteristics of these systems are the potential for a large variety of related and unrelated inputs, and a large number of processors of finite capacity (people) occasionally working at underload or overload capacity. Further, these systems contain a large number of anticipated and unanticipated outputs coupled with control mechanisms which operate with unequal efficiency, thus providing the opportunity for unequal applications and results along with actions that are not measured with equal rigor and are seldom re-introduced into the system to improve future performance.

Characteristics that are non-operational in nature in the man-machine interface are systems that are generally in a qualitative state of development while their abstraction is at a very low level (one is unable to conceptualize the system in its entirety) and comparisons between systems reveal large numbers of superficial similarities, most of which are poorly defined, uncatalogued, and whose causal relationships are poorly understood.

This thesis specifically addresses itself to these problems. A review of management information systems and the problems faced in the installation of a computer system are provided in detail in Appendix A. The cybernetic theory

of managerial control which provides the basis for the development of the criterion model is provided in Appendix B.

CHAPTER III

MODEL FOR MANAGERIAL CONTROL

Using cybernetic theory this chapter will construct a managerial control model. As management itself is performed through communication such a model functions solely through communication channels and problems are perceived when these channels are not flowing freely to and from the decision-makers in management.

Management is the primary force within the agency which coordinates the activities of the subsystems and relates them to the environment. Its focus is upon problem-solving and decision-making. Much of the problem of managing complex agencies and projects results from the inability of decision-makers in the various units to comprehend the interaction of their decisions with other segments of the agency. One aspect of the problem is revealed in the requirement that top management in police work should come from the ranks. Upon reaching top levels, the assumption is made that they will have the overall viewpoint as compared to a more provincial departmental view. When an agency remains small, this is feasible.

But with the increase in functions and increase in the complexity, this is no longer a viable method.

Information Flow

The focus of police management must be on the interrelationships and the network of departments that go to form the synergistic whole. Yet the critical element of communication remains in the hierarchy of management. Communication provides for the transfer of information among the various decision-makers throughout the agency and includes the interchange of information with the environment. It involves the information flow and is a key element which allows an agency to function both for feedback control and managerial decision-making. Communication is the medium of control which provides for the flow of information, through the implementation of the objectives via performance and responsibility standards to the later flow of corrective information, which allows management to function.

This information flow should be in a language common to all parties, accurately measured, and transmitted to managerial control for comparison and rapid processing. Without a common language by which to intercommunicate across the various disciplines which now comprise a large police agency, a less than optimal application of the decision process will result.

Relationship to Decision-Making

Information is evaluated in terms of its pertinence for decision-making and may be conveyed either formally through memorandums or reports, or informally through verbal communication of the 'grapevine.' Through these communication channels it contributes to the dynamic state of the agency. As has been previously shown, a control structure is also in a dynamic state which is operating and which may rapidly pass from one state to another for an indefinite period. Accounting for this behavior will require information and data. This can be provided by the lines of communication networks operating within the agency, and the state of these lines at any given time will reflect the amount of information in the system.

As a result, the control structure, the communications network, and the state of the information which flows through them will determine at any given time the state of the agency. The decision-making process is the mechanism which activates or de-activates the flow through its existence at various points in the communications network and is itself a form of information. Decisions are the events that go on in the network that constitutes the agency system and they are describable in terms of the information flow and the communications network.

Sensory devices measure the output or related characteristics as a means of comparing the measurement with a standard and adjust inputs to correct the indicated deficiencies. The objective is to control all the variables so that the model will tend to stabilize near its ideal equilibrium point.

The managerial control unit regulates the changes involved in the control structure through the release of information into the communications network without disturbing the equilibrium of the agency. The means of achieving this equilibrium is by a homeostatic mechanism for holding a variable between desired limits. This device should be capable of dealing with both problems that are known and those that are not known. By this provision, it can deal with both positive (known) and negative (unforeseen) deviations in the system. As long as these deviations are within acceptable limits, the system of control continues to operate effectively. When the input and output values begin to show too wide a deviation, then it is necessary to apply adaptive control methods to set the parameters of the system. If the corrections can be achieved automatically within predetermined limits, then possibilities exist for programming the decision-making process into rules and procedures. When adaptive control is necessary, then the informational data must be analyzed and an explanation of the deviation derived from the

feedback controls, and the new decisions made by the managerial control unit will provide for the establishment of new control parameters.

The operation of a managerial control unit will depend upon its ability to store, transmit, and modify information. At first, a newly formed unit is full of uncertainty and its sense of knowledge chaotic in the sense that within the team effort, it lacks cohesiveness. Once it begins to operate as a team, a degree of order is introduced and this ordering begins to eliminate the uncertainty. This order is information which enables the team to operate for "information kills variety and the reduction of variety is one of the main techniques of regulation because it makes it more predictable."¹

Elements of the Model

Information theory per se in communications is a mathematical tool to show the efficiency of communication processes between man and machines. This thesis will not develop the technical symbolic model, but rather will apply it in a more generalized sense to develop a control model of the communication process for managing the implementation of a computer-based information system. While each

¹Stafford Beer, Cybernetics and Management (New York: John Wiley and Sons, 1964), p. 37.

particular information system may be unique to the agency, an illustrative model and its applicability to these projects can be developed.

The assumption is made that if management is primarily a decision-making function, and the decision process is considered as essentially communicative, then management can be viewed as a communication process and the concepts of communication, organizations, and decision-making are interwoven into the managerial control function.

The managerial control problem has been defined in three areas: the behavioral problems of the systems managers, the implementation process of the information system, and the managerial control method. In order to analyze and resolve these problems, the model must have four elements in order to provide a viable interface between each of the systems and their inherent problems.

The first element the model must have is an item to be controlled. The implementation of an information system consists of many activities, among them problem definition, systems design, priorities, etc., which define its capabilities. However, the effectiveness with which these activities are defined depends to a considerable extent on the task force charged with their development and the task force's knowledge of the interactions among these activities. Through the use of a set of transitions,

or actions, known as transformations, we can describe the basic phenomena of the project as the monitoring of the development of the project activities by the task force. System behavior is a combination of these transformations and the decision process. The interaction of the task force and the system behavior provides the element to be controlled. Thus, changes in system behavior may then be a result of modification of the basic structure or the interaction of the phenomena with control decisions.

The model must have a sensory mechanism to identify the characteristics and conditions which are needed to maintain the equilibrium of the control structure. Information is generated whenever the system changes from one state to another. Through the communication channels, this information is selectively updated and made available to the management control structure which then uses various decision criteria to effect changes or corrections in the state of the system. Control is directly related to decisions made in the structure and because many of these decisions made during the implementation process affect the entire agency their interdependency becomes a critical variable. Due to this crucial nature, sensory devices must be able to react and define the systems conditions at critical points in the process. Methods of observation, inspection, and reporting are the sensors which detect variations in the schedule and development of the project

from the objectives. Through these methods feedback on sensitive conditions can be identified.

One consideration in the design of the sensor is the accuracy of the method. Under pressure of time and money, the sensor must provide for the task force an accurate reflection of the state of the activity at the critical point.

Further, since the implementation of the information system is a stochastic process, the sensor must have parameters within a specified range in order to permit a self-correcting variance in the performance of the controlled behavior. Decisions used as control mechanisms can affect performance by inducing fluctuations such as speed-up or slowdown in an otherwise stable system.

The placement of the sensors at critical checkpoints is vitally necessary to the successful implementation of the control structure. The critical points can be identified through the use of PERT in the formal channels of control. The informal channels must be equally checked to provide communication and information that is not available otherwise. Sensors in these channels that provide valid feedback may be critical subordinates who filter irrelevant information out of the channel and bring attention to critical conditions within the system.

Another sensor may be the use of employee groups. Through the use of group dynamics as proposed by Likert,

feedback on system behavior can be received and evaluated by the managerial task force. However, recognition must be taken of the communication channels through which information sources provide the raw material for a message to be transmitted to a destination. Involved in this transmission is the concept of noise interference which interferes to some degree with the information flow between the transmitter and the receiver.

The possibility of a difference between the apparent achievement or state of activities and the real situation should be recognized. The real situation is changed into the apparent through noise interference in the communication channels. These may be a result of the inadequacy of the sensor or it may result from badly identified characteristics which sacrifice accuracy for compactness. As a result, the decisions may have little relation to the real situation and create excessive deviance in the stability of the structure.

The third element of the model is a homeostatic process or control unit which compares measured data with planned performance and then directs corrective information to the necessary decision point. The managerial task force performs this function throughout the entire implementation process. The continuous routine of decision-results-measurement-evaluation-decision is maintained in each of the three steps of problem definition, system design and

installation. As each activity of the information system is begun, it comes under the control of the task force which measures its performance under predetermined criteria against the police objectives. When variance is discovered, the analysis of data through participative discussion of both data processing and police personnel will provide the required explanation of why the deviance occurred and what activity should be taken to avoid future deviation.

The final element of the model is the activating mechanism which corrects the variance in the channels of communication. Decisions are the activating mechanism for they regulate and correct the deviance that results from interference in the performance of the project on its path to achievement of goal objectives. They interact throughout the entire process from the first decision to perform a computer feasibility study to the decision of the cutover date and acceptance of the system.

Interlinkages among the decision points represent the communication channels. These channels involve all facets of the agency's resources--men, money, material--and the information and decision-making networks into an inter-related structure that provides for the successful implementation of the computer information system.

As the task force processes the information, in its role as decision-maker, the rate of arrival of information and the time taken to process decisions will result

in an average delay. Analysis of this delay will provide a measure of the model's effectiveness. By closely interrelating the capability of the system behavior to respond to varying inputs, the number of sensors and critical points, and the control of performance, decisions can effectively activate the control structure to optimal performance.

Relationship to Problem

Having presented an integration of the control model into the implementation of a computer-based information system, it is now necessary to see how well it responds to the managerial problems presented in the beginning problem statement.

The communication channels developed in the control model provide management with the ability to use both formal and informal channels of information flow. They provide an awareness of the various interacting forces in the agency and increase the exchange of information. Instead of narrowing the alternatives, the model provides for increased effectiveness due to a more perceptive view of the agency.

Information systems provide the decision-maker with data that becomes input into the control model for the review of progress towards the objectives previously determined. As has been mentioned, a police agency is an open

system and needs adaptive control in order to function effectively. The use of the adaptive control permits the manager to achieve his personal goals as well as the agency's under the constraint that both goals are compatible. Through the entire process of the implementation, the manager retains his ability to make decisions that will affect both him and the agency due to the inter-relatedness of the structure.

Further, through feedback, upward communication, and multiple-channel capability, the manager increases his competence in the handling of numerical data. Sensors at the critical points in the process provide for a check on the validity of the information flow.

Within the parameters of the system set by the agency's objectives, the manager is able to define his programs. Should a variance occur that would create disequilibrium, the manager is able to document the cause and present valid evidence as to the causal factor and the correction effected by his decision to prevent a recurrence of the variation, thus increasing his managerial competency.

Finally, the entire model is based on the human interaction of management and personnel as well as the interaction between police agencies and data processing. Cross-linkages with other departments are interwoven throughout the model and receptivity to the information

flow is determined by the manager himself, rather than an external source. Interference with the communication channels is quickly sensed and management is alerted to possible trouble in the project and they are able to react with corrective feedback before the system gets out of phase.

In summary, the proposed management control model permits managers to effectively control planning, operations, and special projects through the communication of decisions, impact evaluation, and corrective feedback. A conceptual diagram of this model is illustrated in Figure 1.

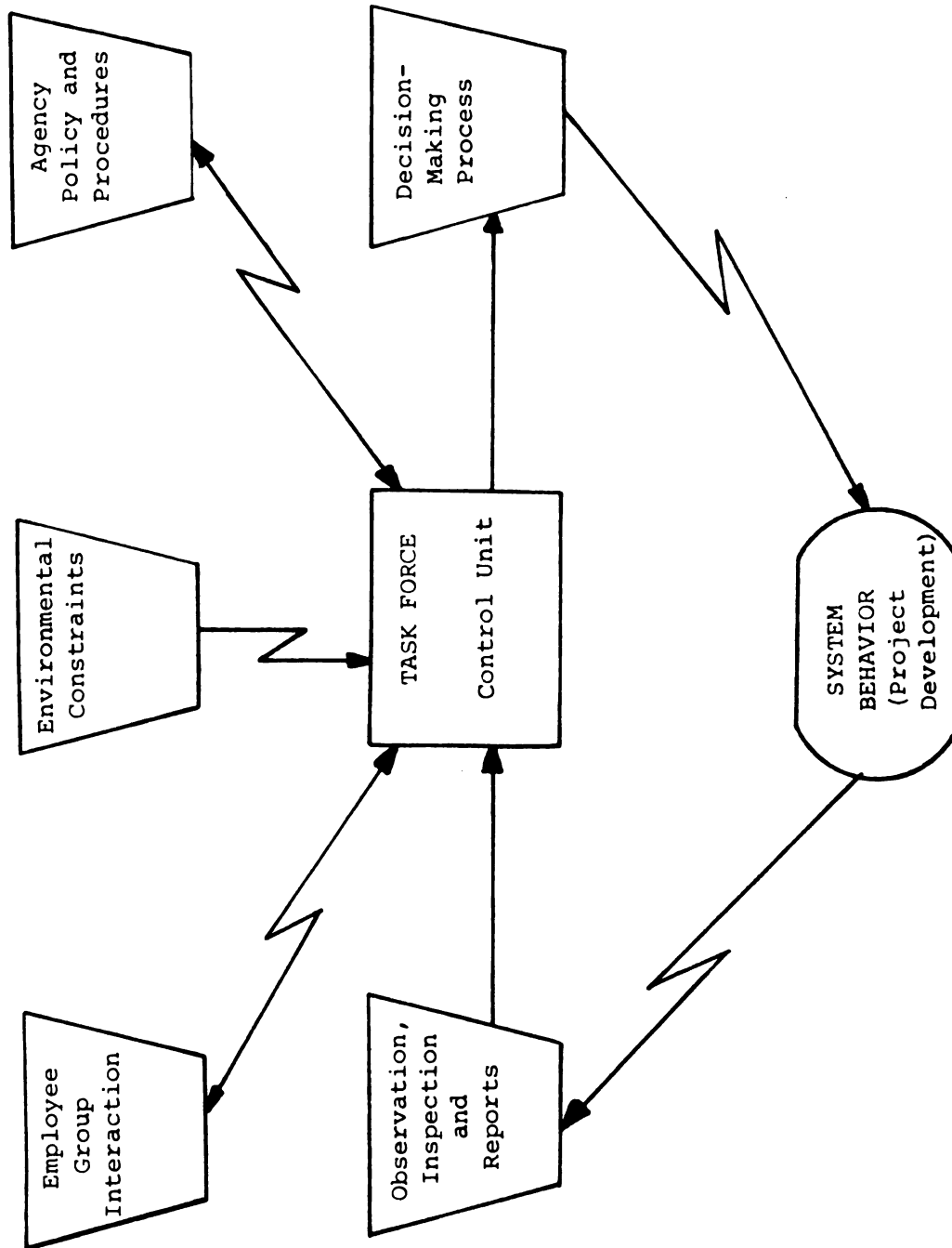


Figure 1.--Conceptual diagram of managerial model.

CHAPTER IV

RESEARCH METHODOLOGY

Research proceeds from the conception of the idea for study through the gathering of data, the hypothesis postulated, the sampling methods and data collection techniques. This chapter addresses these sources and methods.

In the preliminary phase of a computer installation, administrative management must review the objectives defined by the systems analysis and, in light of their own knowledge and comprehension of the agency's function, evaluate these objectives for their validity. They must review the work of the system analyst and define the areas of decision-making in planning, control and operations. Each type of decision required should be identified along with its relationship to managerial responsibility and organizational structure.

Hypotheses

In recognition of these characteristics and the problem areas previously defined, the following hypotheses were postulated.

- H1. The failure of administrative management to plan for directed change through the medium of stated goals, programs, and processes induced too great a variation in inputs into the decision model via two categories:
 - a. the emphasis in the decision process was upon the processes needed to induce change, rather than upon the achievement of goals
 - b. there was a failure to communicate goals, programs, and processes to the personnel of the agency.
- H2. The lack of standards of performance created an administrative problem of control on the progress of the installation, thus inducing instability into the decision process.
- H3. The failure to establish accountability through a determination of authority and responsibility for performance during the project created unnecessary deviance from the management project schedule.
- H4. The failure to establish critical check points during the project provided for increasing variance in the projected schedule and an increasing time lag in the completion of the project.
- H5. The lack of relevant and pertinent methods of reporting project progress created an informational blockage that interfered with decision-making on the part of the police agency.
 - Relevance is determined by the function of the report and the level of management towards which the report is directed.
- H6. Methods for promptness in taking corrective action were not established with sufficient clarity and authority to provide for control of the situation.
- H7. Data identifying the causes of the need for corrective action were not provided nor analyzed, thus there was no feedback to the police executives on which to base further decisions.

- H8. Explanations of the need for corrective action were not fully understood by the police agency due to:
 - a. technological phraseology
 - b. inexperience with the particular problem.
- H9. Decisions for remedial action and future modifications were not fully implemented by the police agency due to:
 - a. technological phraseology
 - b. inexperience with the particular problem
 - c. courses of action were not determined.

The significance of these hypotheses is to provide clear and comprehensive formulation of who and what creates problems in the informational flow and decision-making process. These hypotheses have concentrated on the definition of the decision points, the isolation of those decision points most probably contributing to major system malfunctions, and the detailed definition of only those information paths leading to and emanating from the decision points.

Sampling Procedures

In order to determine the causal factors that induced variance and deviation into the decision process in law enforcement agencies, the research methods included a survey of the agencies and consultants who had practical experience with the problem under study. One problem that arose early in the sampling process was the very limited number of agencies that had actually installed computer systems in their agencies. The survey was extended to

include those using computer-generated print-outs. These latter systems were generally run on a city-owned computer. As a result of this extension, twelve interviews were conducted in various organizations.

The most direct method for the selection of the respondents was to select strategically placed administrators who worked in the particular area. In order to ensure a representation of different types of expertise, consultants and an outside data processing agency that were involved in police data processing, were also included.

The respondents were limited to agencies in the State of Michigan, and due to the limited research population that met the constraints defined above, the research attempted to be inclusive rather than a sampling.

Method of Analysis

Analysis required that the researcher assess which of the possible elements were critical. The economy of the system design and modeling further required that there should be a determination between all possible system elements and those which were important to performing an optimal analysis.

In recognition of these requirements, it was felt that an administrative case study analysis of the actual

agencies based upon the principles of systems analysis was the best research method to accomplish this purpose.

This type of research methodology required an understanding of the activities which were associated with the on-going process, the inputs which were processed in the system activity, the outputs which were obtained as a result of system processing, the way in which the on-going process was controlled, and the errors, deviations, and exceptions which were identified as system malfunctions.

In order to determine the nature of the existing system, two methods of investigation were used: data collection and interviews. The elements of the data collection were reports, memoranda, letters and notes pertinent to the decision process or that reflected informational flow to or from that process. The guiding principle was to take advantage of every type of existing information that was of value.

A questionnaire was constructed that addressed the elements of the model and that would provide data to confirm or deny the postulated hypotheses. A copy of this questionnaire is included in Appendix C.

The proposed method was to use it as a basis for an unstructured interview. During the pre-testing, the questionnaire was found to be too structured for the state of police information systems as they exist today. As a result, the questionnaire was divided into general areas

that were presented and the respondent was given the opportunity to answer from his own perceptions of the category. Notes were taken and the questionnaire was used as a control instrument to check that all areas, including their questions, were answered.

These general areas were defined as:

- initiation of the project
- systems analysis
- reports
- personnel
- corrections to system design
- organizational changes.

This method elicited answers as well, if not better, than the proposed method. As this study was exploratory in defining the process and issues in the installation and use of computer data systems, the unstructured interview format achieved its purpose of eliciting spontaneous responses.

Problems of Reliability and Validity

Validity in research is a primary criterion. A postulated model for decision-making was established against which to measure the performance of the actual decision process. The relevance of this model to decision theory is obviously determined by its validity. By testing the variation of the principal factors of the model, it

can be tested for validity in the representation of the situation for practical application. Therefore, after the interviews were analyzed, the principal data factors were fed back into the model in order to verify the assumptions on which the model is based, and the operational structure of the model itself, so as to determine its relevance to practicality. The degree to which the model succeeded in doing what it purported to do was a measure of its validity.

There were four types of validity criteria used:

face validity: based upon the researcher's judgment of the model

consensual validity: involved the use of expert judgment, and was determined by members of the faculty of the School of Criminal Justice.

criterion validity: determined how relevant the model was to the system theory of decision-making process.

predictive validity: a measure of how well the postulated model predicted the decision process.

Face validity of the model was upheld. Decisions and the concomitant information flow were the measures of evaluative criteria within the context of the proposed model. The data reflected the hypothesized action of the model.

Consensual validity was upheld by the thesis committee's examination and approval of both the prospectus and the final presentation of the research data.

Criterion validity was based on the decision-making process and information flow. The interviews repeatedly reflected the lack of information needed to make valid decisions regarding control of the process in every instance where police personnel were not directly and continuously involved in the decision process. As both the decision matrix analysis and case data summary demonstrate, the model proved relevant to the system theory.

The most significant test of validity is the predictive which tests the theoretical formulation of a meaningful causal sequence in the decision process. The predictive validity was consistently upheld. In each case, the critical input factors were identifiable and their influence could be seen throughout the process. In those cases where their lack was identified, system deviance was inherent in the process and the outputs in the form of agency acceptance were lacking to the degree that the input was deficient.

In order to determine the effectiveness of the proposed model, it was necessary to also evaluate its reliability as well as its validity. Reliability was tested and the degree to which the model could be depended upon to secure consistent results upon repeated case studies indicates its applicability to managerial control techniques. When variation in results occurred, a

meaningful pattern or factors that could be attributed to other than chance resulted in consistency of the evaluative analysis.

Instrument reliability was determined by the use of a pre-test in a local police agency within the Lansing area and its evaluation was summarized under Method of Analysis.

Subject and interviewer reliability were more difficult to control in an exploratory research project of this type. Acknowledgement is made of the possibility of this occurrence, although the researcher has attempted to continually maintain the necessary objectivity required during the research analysis.

CHAPTER V

RESEARCH FINDINGS

Along with the analysis of the data, exploratory studies may lead to insights or hypotheses, yet they do not necessarily test or demonstrate them. The exploratory study is simply a first step in the process. More controlled studies with larger data bases are needed to test whether the postulated hypotheses have a general applicability. It is the purpose of analysis to summarize the completed research data in a manner that will yield answers to the stated problem. The categories used in the questionnaire have provided a structure for this analysis. This has permitted the presentation of the data, both as to general observations, and as to those singular instances that do not permit such generalizations, within each category.

Initiation of Project

Management's receptivity and willingness to take a look at computer systems many times depends upon one man who can see the possibilities presented by using a computer for data retrieval. Once the idea is presented, the burden

of carrying out the implementation process, from the initial feasibility study to the point where reports are generated for agency use, falls upon this man's shoulders.

Mixed Objectives and Budgets

In some agencies the project is initiated as a result of the inability to get the information desired, in others because of the desire to find a means to provide better and faster generation of statistics, while several were the result of vendor's salesmanship.

In only one police agency was the Request for Proposal written. Usually, this comes from outside the agency, generally another governmental unit, even when a police information system is involved.

Budgets are at first developed by the agency proposing the computer system. Later, when cities develop data processing centers, budgetary requests are routed through the Data Processing Directors, who perceive police requests for computer hardware and/or software as desirable due to the federal funds that are available in this area.

System Development Varied

Once the idea has been approved and the budget passed through the governing body, the decision process branches into several paths. In police agencies that develop their own systems, there is generally one man who perceives the possibilities of computer data. He sells his

chief on the idea and ends up with the responsibility for the applications. In police agencies with their own computer installations, budgets and applications were developed by police personnel directly responsible for the operations. In agencies using city-owned computers, a police officer is trained as a programmer and writes the department's programs. The exception to this method is the use of city data processing personnel.

In general, these two methods tended to be a less than satisfactory practice, as the city unit would establish priorities and police agency personnel felt they were given a low priority in the development, debugging and running of batch applications. One department that used a city-owned computer was the exception to this, as a daily block of time had been established for the police agency in which to run their programs. When an urgent run was desired, the department personnel went to the computer center and got on the computer immediately. Only those departments that had their own computers ran in a real-time environment, the remainder were limited to batch processing.

The third alternative within police agencies was vendor-installed software. This turned out to be least satisfactory due to the lack of support by vendor personnel and the attempt to constrain the police department into the boundaries of the program in order to eliminate extensive re-design of the software on the part of the vendor. In

these agencies, a low priority for the development of police applications was also perceived by police personnel. Further, problems of communication between computer people and police personnel were more prevalent in this situation.

Outside Agency Perceptions of Police Needs

Where outside data processing personnel are involved, they perceive the police agency as not being able to articulate their needs. This is seen as due to police management not understanding what computers can do and the requirement that police personnel must now define why the decisions they previously had made by subjective judgment, were right or wrong.

Additionally, police information systems have had to address both the areas of security and privacy of data along with the political environment. Police agencies are seen as very sensitive to the external environment and to financial considerations.

Staffs from these agencies are perceived as outsiders by police personnel and they have difficulty in getting answers until they have demonstrated both credibility and competency to the police agency involved. If these two are not proven, the agency develops a resistance to the proposed system that will eventually impair its successful implementation. Where police personnel are not actively involved in the project initiation stage, the

outside agency gets little feedback on its ideas and the variance between what the agency wants and the outsider's perception of their need increases in distance.

On the other hand, where law enforcement personnel have worked closely with the outside agency, they have maintained control over the system objectives. This has developed as a result of clearly defined functions where the outside staff provided technical expertise and the police personnel defined the system requirements, such as input, output, and report formats.

Minimal Time Schedules and Cost Analysis

Very few agencies developed time schedules for the project. Those that were developed were due to outside personnel for their benefit. The result of this deficiency was that only one police agency established control of the project in this area.

Cost/benefit analysis of the functions chosen for computerization were performed in only one police agency and no outside agencies.

Systems Analysis

Systems analysis consists of defining objectives, determining alternatives to present procedures, analyzing cost/benefits, designing a system plan and establishing evaluation criteria. The research data shows that these tasks received minimal consideration. The emphasis was

upon the process--that is the programmed application itself rather than the goals it was to meet.

Informal Procedures Versus Formal Analysis

In departments having police personnel involved during the initial stage, systems analysis is performed by these personnel. Where outside agencies are involved, their personnel do the analysis. Overall, it appeared that the background and experience of the police personnel contributed to the definition of the requirements of the agency as they were seen by the agency itself as contrasted to the perceptions gained by the outside personnel. The outside agencies depended upon a formal, structured systems analysis, while police personnel used an informal approach to the task. This latter tended to be more of a personal contact where need was determined and the police officer who has responsibility for the programming determined if it were possible and if it were practical--that is, will new data be required or can it be drawn from the present data base? Further, the officer was responsible for the input and output elements as well as the report format.

Consulting firms and outside data processing agencies determined input, output, and report format on the basis of their formal studies and the analysis was presented to the top police management for approval. One respondent reported they had divided the analysis up into sections and suggested that the police personnel take individual sections

and report to the committee on only that one section. It was felt that this presented a better method than having them attempt to review the entire study as it provided for more comprehension of the system design on their part. This same unit has set up committees made up of police personnel to perform the design of the system with regard to input, output and report formats.

Audits

As far as could be determined, none of the systems were audited or reviewed at any time to determine if the reality met the design. Nor was there any expectation of it.

Relationship of Functions to Objectives

Functions to be put on the computer were chosen primarily on the basis of the initial objective for installing a computer system. If faster statistics were to be generated, then statistical programs were the first to be written. Programs using straight objective data that police personnel were accustomed to using were accepted with less resistance than new data applications that were developed. A prime example of the former is the identification of elements used on arrest warrants.

When police agencies used city computers, some data processing centers gave police a block of time and left the determination of what programs would be run up to the

agency. Other data processing centers set boundaries on what applications could be run, by establishing time limits or core limits on the various programs. The view of the police officer in charge of the computer data determined what programs would be run under these conditions, although this decision was subject to administrative staff review. All of these were factors in determining which data-gathering functions would be put on the computer.

Reports

Reports on the progress of the system had their content and manner of presentation determined by the personnel directly involved in the design of the system. The same personnel designated the computer-generated report content and format, with the exception of one agency.

Status Reports on System Progress

There were no routinely scheduled reports made on the installation or implementation of the data systems. Within police agencies, there was an informal communication flow between the officer and his superiors regarding the current status of various programs. One department documented reports when requested. Outside agencies presented reports at stages they perceived as necessary or when it was necessary to have a decision from the police agency.

Under both methods, the person presenting the report determined the content of the report and answered any questions that might arise as a result of the report.

When special reports were requested, the request was made within the informal communications network.

Problems of Computer-Generated Reports

Computer-generated reports are not generally used for managerial purposes within police agencies. In some departments, while programs have been written to generate certain police-oriented reports, the programs have fallen into disuse due to management simply not using them.

Contrary to the assumption stated in the problem, police managers do not request more data, they ignore the increased flow. One officer stated that reports were understandable to the extent they were directly relevant to the particular task of the unit within the department. If the commanding officer could not understand the report, it would not be used.

Another agency saw the problem of analyzing the data as the stumbling block for not using the reports. In another department, the officer in charge of the computer data performed the analysis of the reports, which were looked upon as statistics, and presented them at monthly staff meetings. If, as a result of these meetings, a need was created for additional information, then a special report would be generated.

During the early stages of the computer systems, a couple of departments had overzealous programmers who generated reports for the sake of data conversion rather than addressing the needs of the department, or so they were perceived by present personnel in the agencies.

Formats of these reports and the elements are designed by the personnel working on the computer staff, whether inside or outside the police agency. In only one department was the format decided upon by the unit requesting the report.

Personnel

Police officers from the Records Unit were generally assigned to the implementation of the computer system. This reflects the view that computer systems are only concerned with record-keeping.

The informal communication network carried more information regarding the system, both as to implementation and status, than were formally presented to the agency personnel.

Selection of Personnel

Within police agencies, personnel were not specifically selected. Rather, their position chose them. Police programmers are almost always in the Records Unit. Police personnel interviewed felt that the use of police officers provided for a more comprehensive understanding of the

department's needs, while civilians tended to perceive police problems through their own viewpoint and cognition, rather than the police viewpoint. The two exceptions to this are the two agencies that have installed their own computers. One agency has created the position of police programmer and drawn men from all through the department, giving on-the-job training, while the other uses civilian personnel with experience and/or education in data processing.

Outside personnel are selected on the latter basis of experience and education in data processing.

Information Regarding System

Agency personnel were informed of the system in various ways. Administrative staff were given more of a briefing than lower line personnel. This reflects the fact that program data was developed for the managerial level.

One vendor gave an indoctrination meeting that was described as a "typical computer-oriented talk." Another agency met the problem by holding briefing sessions with each unit. This provided orientation for the sergeants and lieutenants.

In other agencies, the informal communication network operated and programs were 'filtered' past the police executives and passed on down to middle-management.

Reactions to the System

Reactions to the system were perceived in varying ways. As previously reported, there was a general

resistance to the data. The primary question that kept being asked of the computer personnel (whether police or outsiders) took two forms: "What good is this information?" and "Why should it be on a computer when I can get it manually now?" This last was particularly relevant to one department where the manual report totals are available three to five days before the computer printout.

When an old routine is dislodged to be replaced by a new one, resistance occurs where personnel desire to maintain the status quo. One respondent stated that if the workers are not informed of the importance of the data handling, the new system will not succeed. A system depends upon the people involved. The manager is seen as needing to know his people. It was stated that the degree to which he knows how they will react as compared to his assumptions of how they will react, will reflect the success of the implementation.

Acceptance by Police Personnel

In general, police computer systems developed by police personnel received a greater acceptance within their departments than those designed by outside personnel. The majority of all persons interviewed saw the initial resistance as due to the lack of understanding how the computer could aid the job performance of the police officer.

After using the data for a time, there has been a very limited acceptance of computer data by police

supervision and management. Basically, this has been due to a lack of training and knowledge on how to use this data. The result has been that many programs are written, but few are used.

The impact of a computer system is seen as abrasive at times upon the personnel involved. It has created a new environment, more paperwork and required an increased accuracy in reporting. Yet due to these factors, it also has created an upgrading of the personnel involved. Data gathering is usually performed by the lower personnel level of the department and is oriented towards the managerial level. The result is that the manager is caught between the confrontation with his people who must gather the data and his being the beneficiary of data he may see no use for but which he perceives may reflect on his competence if he doesn't use it.

Throughout the interviews, the resistance of police management to the data was emphasized. Yet this resistance was due solely to a lack of training and understanding on how to analyze the data and apply it to their particular operations.

There appeared to be little resistance to the computer by line personnel. This may have been due to the fact that the data affected their jobs very little.

System Acceptance as Seen by Outside Agencies

Outside agencies at times perceive the police as 'para-military' organizations who can by edict impose a system upon the agency personnel. Yet they too felt that the primary reaction is negative until trust is built up by the outside personnel and this trust evolves with the problem resolution. One method was to create a low profile so that the police personnel would see the system being installed as 'their' system.

Another respondent saw the involuntary acceptance of a system as creating personnel problems. "Intransigence comes in many forms," was one comment. Resistance can develop in such forms as returning late from coffee breaks and lunch hours, increased tardiness and absenteeism or in department morale. The manager, he felt, needs to watch for the symptoms, then diagnose the problem and reformulate his approach to reflect the solution.

Corrections to Systems Design

Correction discovery and procedure are informal processes within the majority of departments with little documentation as to future corrections. This reflects the one-man operation which is characteristic of these agencies.

Informal Procedures

When the need for a correction in the system design or computer program is discovered, procedures are informal

in that the error is tracked down, corrected and the system or program proceeds onward. One of the main reasons for the the lack of documentation is that in many agencies one person handles the data and he feels no need to document why he made the changes. One agency felt that the lack of documentation regarding changes made during the design phase had created problems later on when the system was running and changes needed to be made. There was no record of why previous changes had been implemented.

One agency was still at the policy stage and changes were left to the police administrators to decide upon, but there was no written documentation as to why changes in policy were made.

In another agency, the changes to system orientation were created by a lack of computer time and the implementation of a statewide system. The lack of computer time created a need for cutting corners and dropping stored information and programs. The result was a culling out process and a change in the thinking about the feasibility of computer usage. The statewide system led to the dropping of information the agency felt was redundant due to its being carried within the state network.

Reactions to Corrections

One reaction to a suggested program change was for the computer personnel to set up a six-month time period before they could make the proposed change. The police

agency had no control over this. During the design stage, another agency held a minimum of two sessions a week with daily review preferred, with the outside consultant staff. Questions were asked and resolved at that point. This provided for a constant monitoring of the change process and prevented the occurrence of the need for more drastic changes later in the process.

Organizational Changes

Major organizational changes were minimal, occurring in only one agency. Ripples were apparent in other agencies but at present remain small enough to be scarcely noticeable.

Frequency and Type

Organizational changes were not too frequent. In departments with their own computers, data processing centers were established, but in only one agency was it made a separate unit. The majority of computer data systems remain within the Records Department.

One agency developed an organizational change in the reporting hierarchy so that decisions would not be filtered and could not be stopped by personnel who perceived the system as a threat to their operation. Another agency evolved changes in organizational procedures to increase the use of computer data throughout the department. This

involved moving the records information closer to the computer terminal so that the necessary data would be more readily used. Another procedural change was the delegation of responsibility for the use of the data to middle-management and supervisory level rather than leaving it to patrol officers to update the data.

A third agency was concerned over the process involved in making changes, stating that unless changes were made by an evolutionary process rather than revolutionary, a "holocaust will result" as this creates trauma within the personnel in the department. This particular agency saw the need to anneal the user's needs with the philosophical hopes of the systems designer in order to create a successful system that would be able to meet the changes in society's definition of its socio-economic problems. When changes are involved, the respondent felt, they should originate from the lowest level and be beneficial to both the system and the agency. He saw changes that are imposed from the top as not being a good approach. A better method was to use evaluation to determine user satisfaction. If the user was dissatisfied, that was the point where changes to the system should be made.

Another respondent felt that it was not a good idea to make organizational changes. If change is necessary due to a people-problem the system should work around the person and leave the chief to deal with the officer. Further,

a system should be designed so that if the agency experiences organizational changes, the system does not need to change.

The decision to impose change too fast was seen as a very costly decision due to the problem of assimilation of change by the personnel involved.

Power Shifts

There were few power shifts seen by agency personnel nor was there a "halo of expertise" conferred upon police officers working in data processing. There was some status seen as policemen perceived the unit as a means to get off the street.

In only one agency could promotions be seen as directly related to the acquisition of a data processing background. Outside agencies appeared to perceive these possibilities more than police personnel. These differing perceptions may be directly related to the differences in viewpoints of the relevance of the computer to management.

Communication Problems

Communication with outside personnel was seen as a problem due to the specialty environment each worked in and the terminology involved. If the police agency doesn't recognize the problem, they felt the expert (or outside personnel) should try to explain it to them in their terms,

not in "computerese." As one respondent commented, "This can be a very touchy process."

Informal channels of communication constantly developed both within the agency among police personnel and with outside personnel. These have been referred to several times in this analysis and will not be repeated here.

Unexpected Reactions to the System

Systems were seen as having a tendency to increase the quality and professionalization of law enforcement due to the need for better reporting, both in accuracy and quality. Additionally, the need to externalize decision-making processes created a standard data base that improved all decision-making with that particular area. A by-product of this tendency was the frustration demonstrated by the officers who are in charge of the computer data. They deal with this in varying personal ways, but the basic cause of the frustration is their knowledge of how computer data can help the agency and the lack of acceptance of this technology by present police management.

One agency saw no reactions to data, but foresaw possible repercussions arising from a program now being written. A comparative similarity would be a program whose objective is the evaluation of the actions of a patrol officer on the street. Due to the subjective and

and circumstantial nature of these judgements, the results would be subject to criticism by those who felt threatened by such evaluation.

Another agency foresaw changes occurring that are not now expected in police agencies when a proposed system goes into operation, while a third respondent saw the moment when the system goes into operation as creating more unexpected trauma and reactions than are presently expected.

Yet another respondent stated that the trivia that occurs during the implementation process is so unexpected that it is almost enough to defeat the original system plan.

Outside personnel, more accustomed to computer installations, stated that they tried to expect the unexpected as surprises could be detrimental to system implementation.

Decision-network Analysis

Decision-network analysis requires the delineation of decisions and the point in the information flow at which those decisions become critical.

Analysis of the responses regarding critical decisions has been presented in matrix form in Figure 2. By correlating critical decisions to the analysis categories,

the data suggests those points at which decisions must be made regarding the implementation process in order to maintain managerial control.

CRITICAL DECISION MATRIX						
	Initiation of System	Systems Analysis	Reports	Personnel	Corrections to the System Design	Organizational Changes
Getting Support of Top Management	X	X	X	X		X
User Involvement	X	X	X		X	X
Communication of Plan to Users	X		X	X	X	X
Decision to Implement System	X	X				X
Equipment Selection	X	X			X	
Orientation of System to Users	X		X	X	X	X
Relevance of Data		X	X	X	X	
Selection of Personnel		X		X		X
Training in Use of Data			X	X	X	

Figure 2.--Critical decision matrix analysis.

Hypotheses Results

It is always a necessity to formulate hypotheses at a level sufficiently abstract so that the research findings may be related both to theory and to the concepts developed. Theory consists of a set of hypotheses which form a deductive system. These sets are arranged at varying levels from the highest which occur as premises in the system to the lowest which occur as conclusions. These levels may create an out-of-phase variance when the subject of the research studied is of a more simplistic phenomena than that postulated. The analysis discovered this variance in the comparison of the postulated hypotheses with the data. In the study phase of the research, the hypotheses were conceptualized at a much higher level while the actual system was discovered to be at a more elementary level of management.

Hypotheses Evaluation

H1: The failure of administrative management to plan for directed change through the medium of stated goals, programs, and processes induced too great a variation in inputs into the decision model.

Conditionally supported.

In the majority of police agencies, computer systems have evolved by growth and not by plan. The emphasis has been upon applications and few in police management have

perceived the goals these applications were intended to meet outside of the police officer doing the programming.

In those instances where outside personnel were involved, plans have been defined, but not communicated to the police agencies involved especially as regards programs and processes during the design phase.

As a result, there has been little administrative control over directed planning for change. One factor bearing on this variance is the police chief. Where he is seen as forward and progressive, computer systems develop apace; when a conservative chief takes over, the system slows down and stabilizes itself.

H2: The lack of standards of performance created an administrative problem of control on the progress of the installation, thus inducing instability into the decision process.

Not supported.

There were no standards of performance established at any time, and in only one agency was control of the installation process established. Although this may appear to support the hypothesis, the lack of instability was not apparent in the decision process.

H3: The failure to establish accountability through a determination of authority and responsibility for performance during the project created unnecessary deviance from the management project schedule.

Not supported.

Few schedules were established and of those that were, only one was by a police agency. This agency

maintained control precisely through the establishment of accountability by defining authority and responsibility for specific areas of design.

H4: The failure to establish critical check points during the project provided for increasing variance in the projected schedule and an increasing time lag in the completion of the project.

Not supported.

No data available to either confirm or deny this hypothesis.

H5: The lack of relevant and pertinent methods of reporting project progress created an informational blockage that interfered with decision-making on the part of the police agency.

Conditionally supported.

Reports were generated by personnel designing the system which management accepted. Informational blockage occurred only to the extent that police management did not exercise control due to the lack of knowledge of what these reports should contain and therefore what management should control.

H6: Methods for promptness in taking corrective action were not established with sufficient clarity and authority to provide for control of the situation.

Supported.

Due to the informal nature of the present system, no formal procedures have been established. As a

result, no control was established over the situation except for that presented by the informal methods.

H7: Data identifying the causes of the need for corrective action were not provided nor analyzed, thus there was no feedback to the police executives on which to base future decisions.

Supported.

There were no data available nor was any mentioned during the interviews regarding the need for corrective action. The majority of measures taken made corrections to the system as a result of re-action rather than being an analysis of the data for future planning.

H8: Explanations of the need for corrective action were not fully understood by the police agency.

Supported.

No explanations were given in the majority of cases. Where corrective action was required, it was performed without involving any personnel other than those immediately needed. Therefore, there were no problems due to technical phraseology nor inexperience.

H9: Decisions for remedial action and future modifications were not fully implemented by the police agency.

Supported under the constraints listed above.

Generally, courses of action were not determined. If they were, they were not conveyed to the police agency personnel.

While the hypotheses as presented did not find support within the range of the research data, the theory and concepts from which they were derived still are valid premises. The function of theory is to develop general principles, which in turn are derived from hypotheses of the phenomena occurring within the theoretical boundaries. The significance of the lack of support for these hypotheses from the research data may be interpreted in two ways:

- a) the hypotheses dealt with a sophisticated formal structure of computer implementation that is only beginning to be used. The majority of previous implementations were more informal and did not require the more formalized structure of control.
- b) Police management has not attempted to establish any type of control over these projects.

Formal hypotheses may only foreshadow the informal process. When the process grows to the point of needing control and structure, formal procedures are established as guidelines for the process. At present formal control is established over the functional position, not the process. This reflects the contrast between system management that controls the process and the system, while traditional management exerts control over functions and structure.

CHAPTER VI

SUMMARY AND RECOMMENDATIONS

The research was conducted with emphasis on the discovery and formulation functions of an exploratory study in order to provide a focus on the human interface with a computer-data system. The data collected reflect the effectiveness of various methods and procedures in achieving goals inherent in that process. Through the following interpretation and evaluation, the research data are linked to the framework of the postulated model in a logical fashion.

Model Evaluation

Management provides for the coordination of the various functions of the agency and relates them to the environment. When agencies are small, management is simple; complexity grows with the increased size of the agency. Yet police agencies have been slow to adopt the more sophisticated techniques needed to manage these larger and more complex organizations. As a result, the introduction of highly technical managerial tools into this environment has caused a dichotomy between performance and

use, and the technical capacity of the tool. Performance is held to a basic level with few standards developed to evaluate its applicability to the agency. Use of the output data is equally limited. Police management little comprehends the possibilities inherent in use of the computer as a managerial tool, but rather tends to view it within the confines of being a records-keeping device that provides a faster retrieval of statistical data. Even within this confined viewpoint, the analysis of the statistical data is generally dependent upon one man in the department who may or may not be used to disseminate this information. Due to the limited view of the utility of computer data, there are few provisions made within departments for the training of a successor to this one man. In the majority of departments surveyed, this key person was nearing retirement age and his experience and expertise were being neither employed nor transmitted for the optimal use of management.

Model Control Mechanism

Within the model framework is the controlling mechanism itself called the control unit for identification. Control is established in several differing ways during the implementation process, depending on the initial plan. It may be established in the position of project director or manager, or in the head of the records unit or even within a committee structure that provides for the representation of several agencies. Yet within all these varying methods,

the key element is the use of only one police officer who becomes familiar with the system. There is no attempt to establish a working committee in the agency itself, to provide for a diffusion of knowledge.

The concept of one-man responsibility is consistent with traditional methods of management. It fails when confronted with modern technology and the need for diffused responsibility in order to create an acquaintance with the uses and possibilities of computer technology.

This one-man concept further increases the likelihood of not programming decision-making into rules and procedures. Without the necessity to transmit information through a formal channel, there is equally no necessity to formalize the criteria for the passage of information. Without criteria on which to judge the validity and reliability of information by formal and objective standards, the information is judged by informal and subjective methods which create wide divergence in its flow and variance in its reception. Under this situation control becomes minimal and the implementation process proceeds forward under its own impetus. The result is a tangential fit to the special needs of a police department.

The model postulates a path under which the control unit permits variance and divergence within its boundaries, but equally provides for corrective action when the system

goes outside those boundaries. Thus, it permits the system to achieve its goals much as a road will lead to a destination.

Controlled Item

One element in the model is an item to be controlled and this has previously been defined as the implementation process of a computer-data system. The behavior of the process, the transformation of ideas into fact, is controlled by the control unit through its knowledge of the interactions between the proposed ideas regarding the process and the needs of the particular agency. Within police departments their unique needs have not been precisely defined due to the heterogeneity of their functions. This has created a lack of specific goals and sub-goals along with the development of programs to meet those goals. As a result of lack of overall planning, the agency tends to sub-optimize and place the emphasis upon processes--better and faster statistics--rather than on the use of statistics to forecast immediate sub-goals and long-range goals, such as the control of preventable crime.

The result of the lack of specific long-range objectives creates the situation in which the process is heading in the general direction but where the exact destination lies is unknown. Therefore, the control unit lacks a necessary element of control--an objective--and must accept a wide variance in the applicability of the system outputs

to the needs of the police agency. This wide variance does not permit a modification of system behavior because there is no direction in which to modify the behavior except for broad distinctions, such as forward, sideways or even backwards, as has happened.

Use of Sensors

The second element in the model is the use of sensors to provide information regarding the status of the system. These sensors must be able to define the system conditions at critical checkpoints. Within the control process it is not sufficient to have a control mechanism and an item to be controlled. It is also necessary to establish the critical points at which control is most necessary and/or most effective in order to achieve the stated goals.

Police agencies have not established these critical checkpoints within the implementation process. They have failed to establish schedules which would help define the points in the system process where it is crucial to review the progress of the implementation process-to-date and have failed to define the decisions which must be made at these points in order to continue the process along the pre-determined path.

Without knowledge of these critical decision-points, the agency is unable to maintain effective control. Instead decisions may be made at locations where, instead of helping to maintain equilibrium, they create an imbalance that

swings the system widely out of control. The creation of new patrol beats in order to meet the constraints of a canned program is a prime example of this type of decision. The re-organizational process necessary to implement this type of decision creates an additional instability to the initial one created by the change process inherent in the computer data implementation and the energies of the agency must then be diverted to stabilize this reorganizational process rather than used in the management of the implementation process. This in turn creates a lack of control.

Checkpoints may be established in the informal communication network via critical subordinates. This method has been utilized most frequently by police agencies. As the research data indicates, the use of critical subordinates is impaired due to filtering and noise interference between the control mechanism and the sender of the information.

This lack of focus on the interrelationships of the department have created problems of control. Control is the element that creates boundaries within which the agency achieves its planned objectives through an organization of processes. The police agency has traditionally used the chain-of-command and delegation of authority principles of management for control procedures. It has recognized that the informal communication network exists within this structure and has utilized it at times for information and

control. In fact, the informal network has been the principal method of information flow and control in the implementation of the computer-data system. This method works well within small agencies but as the agency size increases and modern technology is introduced, more formal methods such as written reports are required both to transmit information upward through the increasing levels of command and outward to the technicians who must use and maintain the equipment. Additionally, this information should be clear and relevant to the situation. Yet there has occurred blockage and noise interference in even the informal channels of communication within these agencies. Blockage has occurred through the lack of understanding and knowledge regarding the implications of the problem. Noise interference is caused by filtering of information, sometimes deliberately, other times without conscious knowledge of the filtering process. This latter is reflected at the receptor of the flow. The recipient of the information does not understand the implications of the information received and therefore does not act upon it in a relevant manner. This occurs both within the agency and in its contacts with outside personnel. With outside personnel, the problem of language and its particular meaning within certain contexts creates a large part of the noise interference within the model.

The use of employee groups as feedback and sensory devices is minimal. The data revealed the effects of employee dissatisfaction were apparent through lowered morale on the job, but within the agencies themselves, there was no recognition of the connection between the systems effects and the employee dissatisfaction. As a result, there has been little feedback to top management on the results of decisions regarding the system. What information has flowed to management has been through informal channels and has not received the status and authority of the formal communication process.

This has created a dichotomy to what is perceived as a 'successful' system and the actual reality of its effectiveness. The computer generates data reports, which are perfunctorily glanced at, filed--either in a wastebasket or file, dependent upon the person--and forgotten.

This dichotomous situation is created both by the lack of adequate sensors and poorly identified goal objectives. In turn, decisions are made on the basis of experience rather than present reality with the result that a police agency reacts to its environment rather than managing it through planning, organizing, and controlling it.

The traditional methods of establishing control--through reports and observation--is superficially adhered to due to the lack of knowledge on the part of police management as to what criteria these accounts should report.

When reports are received by the police management, both the content and the timing are dependent upon the reporter. This method violates even traditional methods of control much less the more modern methods which are designed to cope with today's technology and organizational complexity.

There can be no control established without criteria such as standards of performance and timeliness, by which to judge both the progress and performance of the system.

Homeostasis of the Model

The third element of the model, a homeostatic process, is used to compare the incoming data with the planned objectives and to provide data to the control unit for a decision on variance from the established norm. Without accurate measurement or knowledge of its validity, the information received is only partially useful to the decision-process. Yet even partial information is feasible, providing there are criteria by which to judge it. For example, no police officer will unconditionally accept information from an informer without knowing how valid or accurate the information is. Instead he will evaluate it in the context of previous experience and knowledge.

For police agencies this contextual cognition is lacking in the computer area. Generally, the managerial staff has had no previous contact with this area except what they have heard or read regarding computer systems.

Each item of this type has been previously filtered by the sender to conform to the particular point he wished to emphasize. The result is a multiplicity of items, but no awareness of the synergistic whole.

The result is that management yields to expertise and accepts it without questioning its importance or relevance to the agency's needs. Part of this process is the lack of a common language, communicable and understandable by both the computer personnel and the police managerial personnel. This has been noted in various ways in the data and findings. The outside agencies perceive police as not knowing how to articulate their needs through a lack of objectives; the police feel they are better able to understand what these needs and objectives are. The trickle of information that flows across this carrier is used as a base for the design and implementation of computer-data systems. The lack of mutually comprehensible terminology results in an inadequate knowledge regarding those situations which may cause the system to become unstable.

The function of a homeostatic device is to provide for the discovery and correction of system variance in order to prevent instability. The data have shown that there are no formal methods of control over this variance, but only a reaction to the situation when it occurs. Without documentation and formalized methods to deal with variance, there is no established procedure for its correction or

maintenance within predetermined limits, and management must then deal with each occurrence as a new item of input rather than permitting an orderly equilibrium of routine procedure.

The burden of these situations falls upon the one person who is trained in computer techniques. While he can understand the need for the change and generally has the authority to make those changes, there is created a blockage in the information flow at this point due to the lack of a communication channel through which to transmit the knowledge and information gained to a receiver who can use this data as a basis for future decisions. This again creates the need to react rather than plan and the agency's energies are directed to organizing for reaction rather than for goal achievement due to this lack of control.

Activating Mechanism

The last element in the model is the activating mechanism which permits or initiates the flow of information. This has been defined as the decision, for a decision initiates and regulates the performance of the process. The communication flow channels create the interlinkage that connect all of the separate decisions into a total process. As has been noted throughout this summary, blockage and interference with the flow of information to the control unit have created a lack of viable alternatives for decision-making by the police managerial personnel.

Under current police practice, the decisions that are made concerning the implementation process may or may not proceed through the model in the form of data regarding their effectiveness. The model proposes feedback from the behavior of the system, employee groups, external environment (such as outside personnel), and the agency's own policies and procedures. The data have shown that these informational feedback flows are not sufficiently used to provide management with strong control decisions. Partially utilized under traditional management, these divergent flows have prevented a greater deviance from police objectives than would have been created otherwise. Management has sufficed, rather than optimized.

The search for and use of these inputs can create, and in one case studied has created, a strong method of control for police agencies using this process. The recognition of this need is beginning to permeate the police function with the result there appears to be an increased effort to more effectively define how computer technology can increase a department's management of its environment.

One interesting phenomenon that results from the use of the informal communication network for the decision-process is the growth of the computer system. Under progressive, technologically-minded chiefs of police, the system grows and professional managerial skills are diffused more effectively through the agency, while under a

conservative, tradition-minded chief, the system contracts and stabilizes into a vital core while managerial skills remain within the more traditional concepts.

Depending upon how lower supervision perceives the chief's regard for the computer-data system, it is either praised or damned but it is the symbol of a modern department and must be retained. The decision process, its implementation and its perception by the personnel of the agency reflect the condition of the system. The components of the model provide a framework which link the control structure, the communication network, and the state of the system into a relevant whole for the managerial control function.

Within the present state of the police management, the control structure is traditional where it exists within the implementation process, but it is generally lacking overall, the communication network is informal and the state of the information is filtered due to noise interference.

Recommendations

In order to more effectively perform the managerial functions of planning, organization and control during the implementation process of a computer-data system, the following recommendations are made.

1. In-service training should be implemented in two areas: (1) computer technology and (2) analysis and application of computer data.

The first is requisite to the second for the agency personnel perceive computer technology as solely a statistical function. This was true during the computer's infancy. In the decades since, it has grown to become a managerial information function. Although it is recognized that police management is in a process of growth and increased professionalism in the managerial area, this technique of computer technology is a fact of life in police agencies and the need for knowledge in both areas stated is critical to the successful implementation and usage of a computer-data system.

The analysis and application of data to the varied police functions is required by the increasing complexity of today's society within which the police provide needed services. Data analysis techniques are increasingly needed in the sophisticated applications being written for computers. Operations research, decision theory and management science are all based on these techniques. While few police chiefs are familiar with these methods, there remains a dependence upon staff personnel to provide alternatives within their specialized area of police operations that demonstrate a competency and command of the managerial function along with meeting the needs of the police agency.

2. The establishment of a task force to act as a control unit with the planning unit personnel as its nucleus.

One member from each area of operations on the second or third command level of management, such as lieutenants or captains, should be assigned to this task force.

This would provide the needed control for the process, yet also provide cognizance of the varied functional objectives of each unit. Their knowledge of operations combined with their experience on the management level will contribute to both goal definition and organizing the processes to achieve those goals.

Their authority within their particular unit is recognized by lower personnel and their ability is recognized by top management. Further, they are materially interested in the successful implementation of the system as they see their promotional chances enhanced both by their knowledge acquired while on the task force and their increasing skill in the use of advanced managerial tools.

The continuance of the task force into a control committee after implementation provides for the transmission of knowledge and experience to newer members who arrive in the wake of promotions.

Summary

The model effectiveness and recommendations have evolved from the research presented throughout this thesis. While the focus has been upon the management of the control

process, the final decisions about police actions remain in the hands of the chief and his immediate staff. However, they will now be able to make decisions from a position of strength and the choice of priorities can be by reason, not emotion, for with established criteria the decision can follow more easily.

But the emphasis in this research has been on the human interface with the machine. As has been demonstrated, there are limits to the rate of change that can be imposed without overly disturbing the social structure of the agency. Control of the process is required to maintain the agency in a dynamic equilibrium with its personnel and to establish a balance that will permit the police to develop in response to their changing environment.

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APPENDICES

APPENDIX A

INFORMATION SYSTEM IMPLEMENTATION

INFORMATION SYSTEM IMPLEMENTATION

The analysis and design of a computer-based information system begins with systems analysis. The essence of this method is judgment and sharp intuition. It is a process that involves defining objectives, determining alternatives, analyzing cost-benefits, developing a model, and establishing evaluation criteria. The elements of systems analysis are:

1. To define the 'right' problem in such a way that the answer will provide a manager with the information he needs, yet no more than he requires, based upon his function.
2. To recognize uncertainty and to provide through management science techniques a reduction in that uncertainty.
3. To improve upon the obvious alternatives available to the resolution of the problem and to discover new ones.
4. To maintain objectivity in all analysis.

However, all these principles are explicated under the constraints of intuition, expertise, the interdependence of all systems, and future uncertainty.

Management has the function of selection of objectives, allocation of resources, planning of operations and scheduling, control of agency progress and operations, and evaluation through feedback. The analysis of these functions must take cognizance of the problems of communications,

quantitative options available, risk evaluation, decisions-impact evaluation, and the reception of feedback on a real-time basis.¹

In the analysis of an information system, the decision patterns must be analyzed as to the data elements and the reports derived from them. The system is defined when the elements are established and the decisions identified that link them.

Management decisions trigger various actions connecting the staff and operational areas of the agency. Once a decision is made, it must be communicated and implemented. The results of that decision are fed back to management through reports. The systems analyst shows the connections between data and reports generated through means of a flowchart. He must analyze the information flow to eliminate non-essential or duplicated procedures and to channel information where it is most needed. This information can fall into three categories: external information to or from sources outside the company, internal information generated within the agency, and decision information which consists of the function performed and the structure in which the function is performed. Thus the flowchart should show the order of events that are required and should identify the decision points.

¹Martino, R. H., Management Information Systems (Pennsylvania: MDI Publications, 1969), p. 34.

Once the system is defined and designated, a realistic assessment of the applicability of EDP operations should be made. The initial step is a feasibility study. This should begin with an assessment of the objectives and climate of the agency. The evaluation of this point should be based on defining the true objectives of the study and how receptive is the agency to a computer-based information plan. It should include exploring the possibility that the decision is being made on the basis of economic necessity or availability (such as LEAA monies available) or is it hardware-oriented (i.e. has a computer manufacturer suggested the "feasibility" of a computer for the agency's operation along with the promise of writing the grant application for them). The study should address the investment required of the agency not only during the initial installation and implementation period, but also the orientation of the agency to merely record-conversion or its willingness to "pay the price" for experimentation into the area of management information systems. Another factor to be evaluated at this stage is the agency's willingness to carry out organizational changes or the necessary realignment of personnel and positions responsibility for the data-processing operations.

After the initial report of management's receptivity and willingness towards the information system, a preliminary look at the opportunities presented by such a system

must be analyzed. Is the agency able to identify the opportunities for control and planning available to it under such a system? How sophisticated will the system be at the beginning, and later? The analyst must determine on a 'rough-cost' basis whether the computer is worth the expense and effort of a detailed system analysis in the light of his previous results. The most promising applications for computerization should be identified on the basis of a flowchart of the process, the manhours now spent in the operation, the work that could be eliminated by EDP, and an estimate of the machine time that would be required.

Further, such analysis should include the opportunities to improve managerial control on operating results through the determination of the kinds of information needed to achieve optimum results, the frequency and speed of information now available, the new kinds of information that would be needed under optimal conditions, and the potential payoff and payout of this new information. Along with the internal analysis of the agency, the external analysis should be conducted in which environmental needs are explored and outside resources are identified. Among the environmental needs are the politics of the situation and governmental statutes that may apply, such as possible constraints and local financial policy with regard to the agency's acquisition of the computer. Further, the demographic and social trends should be explored with regard

to economic trends. As an example, these would affect the possibility of qualified civilian personnel, or even availability of personnel within the agency. It could also affect the determination of applications to be programmed, although at present the trend is toward traffic matters and police operations due to their greater immediate impact. The technological environment should be explored with regard to the forecast of new products and their probable effect on the agency. The social demands of society, such as its changing social values should be evaluated in the context of the agency's ability to meet these demands and the effect that computerization of records would have upon these varying values. Civil rights and their changing social values would be an example for the need to investigate this area. The agency's capability and transaction activity are other areas to be evaluated in the context of the analysis. Outside resources such as other information systems that may be interfaced for additional information and for the experience they could provide the agency in the area of performance, present activity, and future plans for their systems are further areas for the analyst.

The system analyst should present top management with a report covering the above-mentioned elements. He should further include an analysis of the measure of performance on which the system is to be evaluated (i.e. for business this would be the net profit), the environment

which is considered as a constraint upon the agency, the resources available for the proposed system, the components or subsystems of the agency and an identification of their 'mission', and the managerial decision-making process within these subsystems.

At this point, should top management decide to continue, a task force team of second and third line management should be appointed for the design and implementation stages of the system. Second and third line management are chosen because these personnel understand the problems of the police agency; they have the authority to make a commitment and where they do not have the authority, they can readily secure it because of their working relationship with the chief; they are materially interested in both the success and practicality of the system as prospective members of top management; and because of the fact of their own commitment to the system, their subordinates will actively assist. Their experience gained as members of the task force will later have a significant impact on the system.

Dr. R. L. Martino suggests that consultants should only be retained if the agency does not have the required experienced personnel and the system developed by the consultants should, with modifications required by the particular computer hardware selected, be the actual

running system when the computer is in operation.² However, the information system should be created independently of hardware considerations. It should be a matter of "with this information, which computer will best process it, rather than with this computer what can we do?"

The task force must have a definite approach to developing premises which serve as a basis for system design. They must review the objectives defined by the system analyst and, in the light of their own knowledge and comprehension of the agency's function, evaluate these objectives for their validity. The value of having personnel familiar with the operations of the agency not only provides an understanding of the objectives of the operation and a knowledge of the existing operating patterns, it also provides the ability to relate the information system to operating needs, and the ability and organizational position to work with operating people to effect change. Technical expertise may be provided by consultants in the area of competence in the design of the information system. A mix of agency personnel and consultants with technical expertise provides the most advantageous format for the agency.

The task force should be trained to give them an appreciation, if not technical competence, of systems technology in the area of documentation techniques, such as

²Ibid., p. 84.

flowcharting, and project planning procedures, such as network analysis, for purposes of control. The agency personnel should become acquainted with other computer systems and what they can do. They should be given a basic computer orientation, a description of the types of computers available, the factors involved in contract negotiations, the problems involved in installation and suggested data processing organizational structures. Much of this information can be gained from discussion with other agency personnel in the field that have already installed computer systems. Yet without a knowledge of what they should be looking for, the task force personnel may well be given the "Grand Tour" of flashing lights, whirling tapes, and paper-eating printers.

The development and installation of a computer-based information system can be broken down into three stages:

- a. definition of the problem
- b. design of the information system
- c. programming, cutover to the new system, and system evaluation and modification.

Each of these stages has many separate operations and activities which may overlap at times. A detailed flowchart of the interrelationships of these activities, as defined by R. L. Martino, is included on pages 110-115.

The first stage, definition of the problem, should be reviewed at this time by the task force in the light of its relevance to the composite agency system and the

interrelationships inherent between the stated problem and its affect upon the agency. Once the problem has been adequately defined and placed in its proper perspective, various techniques have been developed for the collection of the needed information requirements. Throughout the review of this first stage, the task force should define the areas of decision (i.e. planning, controlling, and operating) necessary to the managment of the agency.

There are differential information requirements for each of these areas. Planning is the process of deciding on the objectives of the organization, on changes in these objectives, on the resources used to attain these objectives, and on the policies that are to govern the acquisition, use and disposition of these resources. The informational needs of this area can only be defined by the agency's personnel from their unique knowledge and experience.

Managerial control is the process by which managers assure that the resources are obtained and used effectively in the accomplishment of the agency's objectives, while operational control is the process of assuring that specific tasks are carried out effectively and efficiently. Each of these processes differ in terms of time spans, levels of aggregation, linkages with organizational and operating units, and input-output foci. Each type of decision required for the above should be identified and the relationships

determined from the view of managerial responsibility and organizational structure. Decisions with the same or largely overlapping information requirements should be grouped together as a single manager's task. This aggregation of decision-making will reduce the informational requirements for the function and will permit the manager an increase in his understanding of the job. Personnel knowledgeable in the functioning of the agency should perform this task of aggregation and simplification.

Included in this evaluation of the system analyst's work, is an analysis of the design approach suggested by him. Whiseand and Tamaru consider three possible system design approaches:

1. Equipment and method improvement: with this approach analysis and changes to the existing system are discouraged and the attention is focused on supplying the current data faster in improved technology.

This is known as the "one-for-one" system, and in place of analysis, this technique substitutes a reduction of elapsed time to install the new system and has minimum study costs in the implementation of the changeover to the new system. Under this method, equipment is selected on one of the following bases: lowest in cost, outstanding (but unevaluated) performance, personal preference, or the integration with existing equipment. The costs of studies

to analyze equipment characteristics are eliminated as well as the costs of a study of the existing study versus the proposed system. The disadvantages are that whatever problems are present in the system remain undefined and unsolved. Further, optimal system design and equipment utilization will not be realized. If the problems of the existing system are of a nature that computerization will make them recognized, then the time and cost of the system re-design at that point may well wipe out any savings realized by the lack of analysis.³

2. Data augmentation: this approach tends to collect data for its own sake without regard for its eventual use or necessity.
3. Decision-orientation: this approach has four sub-phases:
 - a. specification of the managerial and operational decisions that are necessary to accomplish the agency's goals.
 - b. investigation of the types of policies available for decision-making.
 - c. determination of the data elements required by these decisions.

³Stanford L. Optner, Systems Analysis for Business Management (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1964), pp. 42-43.

- d. development of preferred processing techniques for the required (or desired) data.⁴

The development of an information system requires the technical personnel to synthesize and design a police-oriented system. This stage should include a continued examination of various scientific techniques in the operations research area for their particular applicability to the system being designed. Two relevant applications to be examined in this area would be patrol allocation and crime mapping techniques that have been developed for use by police agencies. The constant need during this stage is to focus on the solution of the problem through a preliminary statement of system requirements: reporting frequencies, types and routings of reports, types of equipment available, and what information is best automated or programmed and what should be left as currently is being done. After an evaluation by the task force of the preliminary design, a determination of hardware cost, and software performance on the proposed system should be made. In addition to performance, software should be evaluated as to whether it is thoroughly debugged (functioning without breakdown or program errors), and its present availability. Cost effectiveness of both the hardware and the software as to

⁴Paul Whisenand and Tug Tamaru, Automated Police Information Systems (New York: John Wiley & Sons, 1970), p. 74-75.

optimum configuration, minimal units necessary for the proposed system and an evaluation of what units, if added, would measurably increase the effectiveness of the system are additional items for the decision of the task force personnel. In their decision, they should consider the effectiveness of the proposed system in view of its simplicity, flexibility, reliability, economy and acceptability.

Simplicity is necessary for the definition of the limits of the system and the correlation between simplicity and reliability--there are fewer things to go wrong. The system should be flexible enough to absorb changes in input factors or environmental conditions. If it is simple and well-defined, it will be able to accept minor variations without breaking down, otherwise, even minor changes create a pyramid effect growing throughout the program until the system comes to an abrupt halt or the output is garbage.

The system should be reliable and a careful modular selection and arrangement of the operating components should be made in order that periods of down-time and maintenance for repairs and recovery due to system failure are minimized. Yet economy must be considered for the cost should not be more than the proposed savings. Building in great redundancy or providing for every contingency will soon destroy the operating economy of the system.

Acceptability is gained through the use of the task force and acquainting the agency personnel with the potential of the proposed system.

To summarize the second stage, a depth analysis of the existing routines and a development of the systems requirements based on the depth study should show the character and volume of input data, information to be stored and processed, and the output data. Further, the timing element of required information should be determined, along with the amount of exceptions to the routine which cannot be computerized. Finally, the access requirements to the information should be determined.

After the design stage is completed, a request for equipment proposals is sent out to computer equipment manufacturers. When two or more proposals appear to fit the system requirements, a benchmark program may be used to determine which is the best possible for the particular operation. This approach is to order the equipment components based upon the system requirements of one or two applications which dominate the total data processing requirements. The use of these applications on different types of computers will provide a more realistic approach to evaluation than the access time, which is dependent upon many variables, or the processing time, equally dependent upon many variables.

Meanwhile, the task force should be able to determine possible savings through the evaluation of one-time costs, such as initial record-conversion and programming, and the annual costs of the computer operating system, based on equipment maintenance and operating personnel. Along with the evaluation of costs, the task force should also weigh the possible impact upon the agency, the availability of personnel, and the alternative uses of talent (i.e. if the agency decides to use only sworn personnel, which patrol officer should be chosen to become a programmer?).

Another decision for the task force in this phase is the approval of the system documentation. This should be a detailed design including such details as the scope of the system, the data element matrix, and a list of programs to be written and other relevant information. In the same time frame, the task force must decide upon the data-processing section responsibility for the programming and installation of the system. If this is done by an outside consultant, personnel from the agency should be trained to take over these tasks along with operating the system upon the completion of the installation. The underlying objective should be the optimal mix of equipment and people in order to provide effective management of the section. These objectives should be individualized to take into account the particular needs of the police agency, the availability of suitable hardware and/or software, any time constraints

(including LEAA funding), and financial considerations such as the local budgetary soft and/or hard match for the funding.

The third stage of the system implementation is the programming, cutover, evaluation, and modification of the new information system. No equipment should be ordered until the design phase is completed and approved by the top management of the police agency. Once ordered, delivery should be designated for the cutover period when both the hardware and the written programs can be debugged and made to operate efficiently. In addition, the development of test data and monitoring test results should be done during this programming phase.

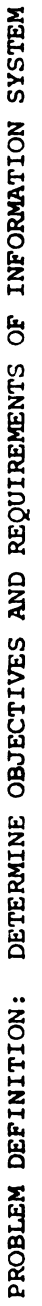
In addition to a poor decision on time delivery which can cause an extremely costly rental based upon premature acceptance of the system, the cost of programming can become excessive if not properly phased in with the installation. During this phase, poorly defined departmental responsibilities can create innumerable problems, if these responsibilities have not been clearly stated by the task force.

It is usual for both the old system and the new information system to run parallel for a period to provide stability during the cutover, and to provide for system evaluation in terms of stated requirements and for effectiveness.

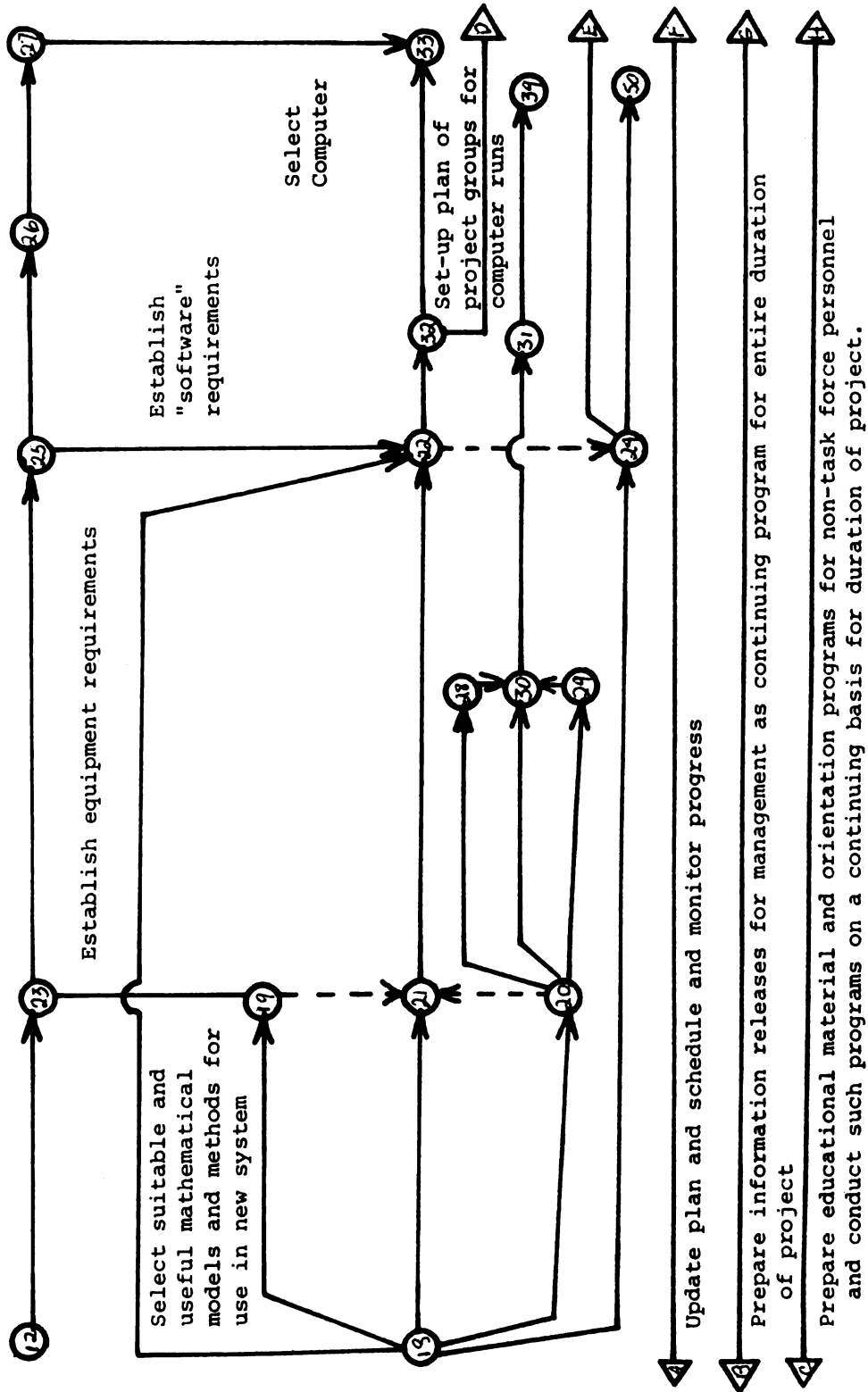
Until this evaluation is completed and is satisfactory to the police agency, top management should not sign off on the acceptance of the computer. If premature acceptance is made the manufacturer's support is diminished along with the increased rental or purchase cost.

This is a brief outline of the steps necessary in the design and implementation of a computer-based information system. The timespan for this implementation is generally 24 months. From a managerial viewpoint this represents an expensive investment of time, money, and resources for an information system that will in some manner affect the entire agency. In order to operate effectively during this timespan, management needs a method of control.

1. Start
2. Establish Preliminary Task Force Objectives
3. Establish Training Agenda
4. Select Task Force
5. Prepare Organization Chart by Function and Information Flow
6. Relate Current Systems Work to New Project
7. Train Task Force
8. Establish Plan of Training, Announcements and Publications to secure management support to program
9. Conduct top management orientations
10. Prepare preliminary project plan and Schedule (PERT or CPM)
11. Determine Data flow volume and direction of current system
12. Conduct preliminary study of EDP equipment and associated "software" packages
13. Determine and document logical decision tables of present system
14. Determine and document arithmetic rules of present system
15. Determine and document data elements of present system
16. Conduct applied research of mathematical models and evaluate potential use and value in now system
17. Establish management needs from new system (include long-range plan)
18. Establish final and realistic objectives of new system and secure top management approval

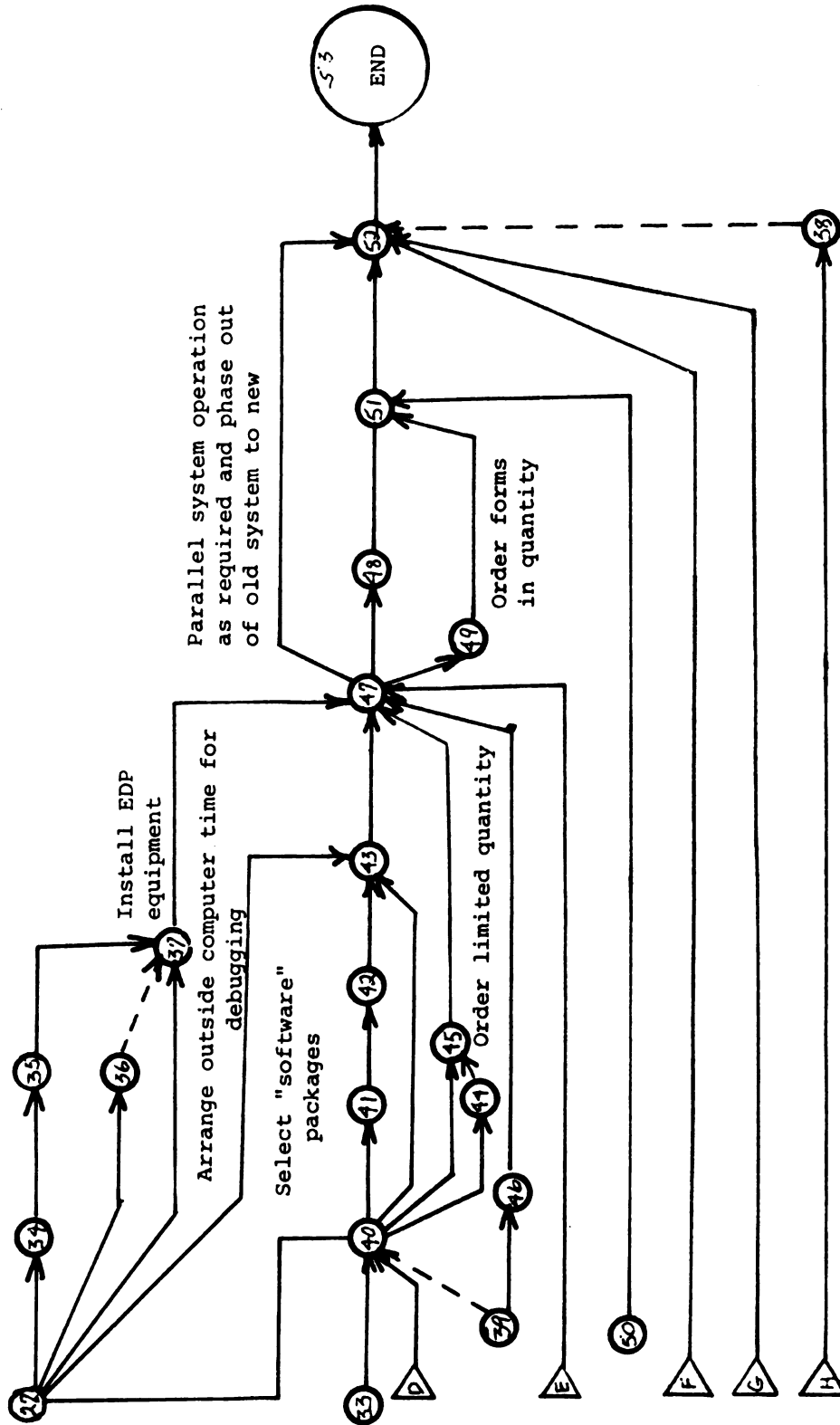


12. Conduct preliminary study of EDP equipment and associated "software" packages
18. Establish final and realistic objectives of new system and secure top management approval
19. Establish logic rules for new system as required
20. Establish new data elements and inter-relationships of new system as required
21. Establish new arithmetic rules for new system as required
22. Finalize rules, elements, and inter-relationship of new system (including long-range plan)
23. Study possible equipment locations and configurations
24. Begin study of possible and required changes to present organizational structure
25. Select data center locations and necessary configurations
26. Select EDP equipment
27. Submit plan for approval and audit
28. Prepare preliminary output formats
29. Preliminary evaluation of input requirements
30. Prepare preliminary input formats
31. Finalize output and report formats
32. Establish programming requirements
33. Select programmers



DESIGN AND DEVELOP SYSTEM: CREATE THE NEW SYSTEM INCLUDING SELECTION OF EQUIPMENT

27. Submit plan for approval and audit
33. Select programmers
34. Select and train key operations personnel
35. Develop operations procedures and personnel needs
36. Delivery period for EDP equipment
37. Prepare EDP site
38. Continue until completion of education program
39. Finalize input requirements
40. Train programmers
41. Flowchart runs
42. Block diagram runs
43. Code runs
44. Convert existing data to machine readable form
45. Establish card formats, tape and disc file designs and field patterns
46. Design input forms
47. Debug all runs with test data
48. Test system with real data
49. Modify forms as required
50. Finalize organizational changes required
51. Modify system as required
52. Run new system
53. Continual evaluation of new system.



PROGRAMMING CUT OVER AND EVALUATION OF SYSTEM: TRANSLATE THE "BLUE-PRINTED" SYSTEM TO A RUNNING AND OPERATIVE ENTITY (Flowchart courtesy of R. L. Martino).

APPENDIX B

MANAGERIAL CONTROL METHODS

MANAGERIAL CONTROL METHODS

Any situation can be controlled if it is possible to measure and compare the performance situation with a standard, if the required changes can be activated, and if both the measurement and the regulation are rapid enough to make a good correction before the factors of the situation have become inconsistent with correction or before the situation out of control.

Control is the function that provides direction in conformance to the objectives or the maintenance of variation from the objectives within allowable limits.

Historically, management's attempts to control a project have been through financial methods of fiscal reports at stated intervals. The American Management Association has defined such budgetary control as the establishment of comparative levels of activity between different units beforehand, the limitation of autonomous expenditures, and performance measurement.¹

Yet these do not provide the kind of time control that is needed in the project management of a computer installation. Another method of control is reports in which the operating performance is compared to predetermined performance standards. These are comparable to the

¹Melville C. Branch, The Corporate Planning Process (New York: American Management Association, 1962), p. 195

quarterly reports required by LEAA funded projects. A previously determined schedule derived by the agency in question is used as the comparison standard. However, the reports are provided by management and thus do not help with the function of managerial control as they are post facto rather than a priori.

One definition that helps to accomplish the goal of managerial control is that it is a "well-defined system of planning and organization whereby the company activities are measurable through processes of systematizing, observing, reporting, and analyzing to determine whether desired company objectives are, or can be, properly attained."²

This definition suggests internal controls and audits which are dependent upon managerial objectives of planning, organizing, and motivating. As this system of control does not insure compliance, the use of auditors provides for methods of reporting and correcting deviations in the agency's objectives.

Internal controls are not unknown to police agencies. O. W. Wilson in his book on police administration suggests an internal investigation division, but the orientation is towards "recording, registering, supervising,

²Robert Albright, "Elements of Managerial Control," Management Controls in a Growing Enterprise, Vol. II, Series 4, (New York: Hofstra University Yearbook of Business, 1947), p. 61.

and controlling the investigation of complaints against officers and ferreting out evidence of corruption within the force."³

Another book on police administration has one chapter on internal controls, yet specifies that controls "apply to established policies and procedures" which are carried out through the processes of inspectional services, internal affairs, and disciplinary processes. Other types of control they mention are criminal intelligence, report review, and communications. These types, however, are "largely incidental benefits (arising) from sound management, and ...department-wide control is not their key objective."⁴

None of the aforementioned internal controls will permit the attainment of the necessary managerial functions of planning, organization, and control.

To return to the previous definition of control, the necessity of correcting deviations would suggest the maintenance of an equilibrium between the balance of the activities that are directed towards the achievement of the stated goals. If planning sets the course, then managerial control observes the deviations from the course and initiates

³O. W. Wilson, Police Administration, (New York: McGraw-Hill Book Co., 1963), p. 120.

⁴International Management Association. Municipal Police Administration (Washington D.C.: 1969), pp. 198-208.

action in the operations function to return to the chosen course or to an appropriately changed one.

Additionally, a balance must be maintained within the control structure itself. Various activities may create a disequilibrium. Easily measurable objectives tend to get too much weight while the intangible ones may get too little, or the short-run results may be over-emphasized to the detriment of long-range results. Another action may be that the relative emphasis desired within the control structure may shift over a period of time without a corresponding restructuring. Finally, high status and/or the energy of a staff man who is concerned with only one aspect of control may upset the desired equipoise.

There are two requirements for the maintenance of the control equilibrium. The first is for speed and simplicity of the controls in action. This is dependent upon where in the agency the control is actually performed. The second requirement is a knowledge of the effect of the control methods on the motivation of the employees.⁵ Social control is effective in this area but this is conditional upon group dynamics. Yet a good control structure must be sensitive to these dynamic forces in order to maintain its equilibrium.

⁵William H. Newman, Administrative Action: The Techniques of Organization and Management, (New Jersey: Prentice-Hall, Inc., 1963), pp. 458-460.

Amatai Etzioni has described three types of managerial control structures: coercive--the use of potential or actual physical means; utilitarian--the use of material means, such as money; and normative--the use of symbols such as prestige, or acceptance of the agency's norms. Each kind of structure generates a particular type of involvement on the part of its members. The coercive generates an alienative involvement; the utilitarian calculative involvement; and the normative tends to generate a moral involvement with members who intrinsically value the mission of the organization.⁶ On the basis of the above, police agencies would be placed between utilitarian and normative due to the civil service aspect of the jobs which would place them in the utilitarian structure, and the peculiarly police-moral orientation which would place them in the normative structure. In terms of commitment and involvement, the managerial control function for the police agency should provide its personnel with the means for increasing this moral motivation.

In order to clarify the control structure, it is necessary to determine how managerial control is accomplished. Several methods have been suggested such as the comparison of a new product with the systems project

⁶Amatai Etzioni, Complex Organizations: A Sociological Reader (New York: Holt, Rinehart & Winston, 1964), pp. 35-37.

development cycle,⁷ another is through the elements of a system study,⁸ and a third is by a detailed decision analysis process.⁹ Each of these methods is oriented towards a business environment. The situation requires a method that can be oriented towards law enforcement agencies and has a familiarity that will provide acceptability.

This requirement may be met through the use of objectives, standards of performance, individual responsibility for achievement, the establishment of critical points for checking on progress, the establishment of methods of observation, inspection and reporting, corrective action, analysis of data and the development of an explanation for the deviation. A decision for remedial action and modification for future deviations is the final step in the process.

An adaptation of cybernetic theory to this method shows a relationship between objectives and control through the purposive system concept. A purposive system will give an account of the successive states of the system as its purposes (or objectives) unfold. This succession of states (or programs) is given by a set of transitions (or

⁷Walter J. Schroeder, "If You Can't Plan It, You Can't Do It," Journal of Systems Management (April, 1969), 8-15.

⁸Lloyd A. Thompson, "Effective Planning and Control of the Systems Effort," Journal of Systems Management (July, 1969), 32-35.

⁹Merle P. Martin, "Systems Analysis Strategy," Journal of Systems Management (May, 1972), 36-41.

processes) of one item to another, and this set is technically known as a transformation. When the transforms obtained from a transformation include no new items, but are concerned with rearranging the items already there, it is a closed system. On the other hand, open systems not only interact internally, but also interact simultaneously with the external environment. Due to this dependence upon the environment, such systems must be flexible to change, yet maintain a stability necessary to maintain their equilibrium. With two types of systems, two types of control are necessary, one a self-regulating governor automatically adapts within a predetermined range of movement, and the other an adaptive control method which takes the complex, multi-environmental input, processes it and then through its informational output sets the parameters of the closed system, which is similar to the internal organization of the agency. Some parameters of the closed system are resource allocation, service requirements, patrol allocation, etc. Under this system, the objectives or goals would be referred to as standards for comparison with output, similar to PPBS objectives. The programs are the detailed methods by which information input, including that on goal attainment, is transformed into output.

Thus adaptive control involves directed change through the medium of goals, programs, and processes. Two aspects of this control are apparent. First, the specific

changes are dominated by the task goals toward which control is oriented. Management by objectives in which the emphasis is on the achievement of goals, rather than on the processes necessary to reach these goals, creates an atmosphere conducive to team work and getting things done as a group rather than as an individual department. "It is this climate or environment that provides the basic control, not directives."¹⁰

Second, the change is induced in the perception and behavior of an individual or group acting in social context. There is a basic tension between these aspects of the control process, in that a change functional for the agency is induced only if it serves the purpose of the group. The resulting dynamics, which include the integration of purpose, the resistance and conflict observed before integration is achieved, and the factors that determine these phenomena, are all part of the necessary equilibrium in the maintenance of managerial control.¹¹

Through the use of standards of performance the managerial function of organizing would be enhanced by the coordination of people and resources into a system to

¹⁰William Travers Jerome III, Executive Control: The Catalyst (New York: John Wiley and Sons, Inc., 1961), p. 20, cited by Robert Albright, op. cit., p. 50.

¹¹Chadwick J. Haberstroh, "Goals, Programs and the Training Function," Management Controls: New Directions in Basic Research, (New York: McGraw-Hill Book Co., 1964), p. 268.

achieve the objectives and goals previously established. Thus we have the setting of objectives which feed back under a cybernetic control model to become standards of actual performance. By setting these standards, the contribution of each component and subsystem could be ascertained by measuring its output. Further, its efficiency could be determined by comparing this measure of output against a measurement of resource input. This would involve reviewing the need for the function in terms of the objectives of the system and then determining its cost and contribution in relation to other necessary functions. With a good system functioning efficiently, it would provide objective evidence with which to measure the performance of all financial and non-financial elements, and thus appraise the conformity of current total agency operations to previously established standards or plans. If the data is gathered and presented adequately both the individual department operation's effectiveness can be determined and its contributions to the overall achievement of the agency's goals. It can further provide a quantitative basis for judging the manager's performance in the accomplishment of those goals.¹² This evaluation would point out areas of inefficiency and enable management

¹²James D. Gallagher, Management Information Systems and the Computer, (New York: American Management Association, Inc., 1961), p. 63.

to adjust its operation to meet changing conditions. Through managerial control, the various subprograms could be measured on their conformity to the established standards of performance and adjustment of activity deviations would provide a more realistic management achievement of goal objectives.

In this dynamic environment, the problem arises of requiring personnel to accept change. Albright, in a survey of managerial control philosophies and practices, found that resistance to change was the biggest deterrent to desired managerial control, and the factor designated to be the most desirable in developing managerial control was a "harmonious, cooperative team effort."¹³ Successful managerial control foresees the trauma resulting from the rapid application of systems techniques as potential sources of difficulty both to the individual and the agency. By giving adequate consideration to the problems of change, both technical and social, prior to and during the implementation of such systems, management can maximize the acceptance of change through the use of group dynamics.

Through its own developed system of rewards and penalties the group enforces its own norms, whether these are for or against change. As Likert has pointed out in

¹³Albright, op. cit., pp. 68-9.

his theory of the "interaction-influence" system, the greater give-and-take and supportiveness of managers contributes to a greater sensitivity and receptivity on the part of each individual to the influence of others. This high level of influence and interaction permits greater control on both the part of the group and the manager who interacts with the group. Through increased group participation and influence, the individual becomes more involved and motivated to achieve agency goals that are internalized through the process of group dynamics. Thus the individual responsibility for goal achievement can be maximized through internalization via the group.¹⁴

The greatest amount of variation among system components is likely to be found in the behavior pattern of individuals. Unless the managerial control function can stabilize this variation within the structure, then the human problems will create a dysfunctional instability similar to that presented in the first part of this thesis.

Simon and March have developed a "Theory of Organizational Equilibrium" which is a statement of the "conditions under which an organization can induce its members to continue their participation, and hence assure organizational survival." It is based on certain inducements received from the agency for which, in turn, the members

¹⁴ Rensis, Likert, New Patterns of Management, (New York: McGraw-Hill Book Co., 1961), pp. 166-169.

give certain contributions. In order to maintain equilibrium, the organization must provide sufficient inducements, such as pay, job satisfaction, etc., in large enough measure to equal or be greater than the contributions the individual is required to give. However, the theory presumes a structure of interrelationships between the agency, as represented by management, and the individual worker.¹⁵

Through the maintenance of equilibrium in the control structure, a better basis is provided for determining authority and responsibility for performance. Through the use of the "interaction-influence" theory greater accountability for objective achievement is achieved as both managers and workers "will wish to have (their) records show favorable performance and trends."¹⁶ Through the identification of individual responsibility for goal achievement, a deviation from the objective can be fed to the managerial control unit along with corrective information. The information can be processed and delivered to the department or individual who can make the correction, thus permitting adaptive control.

¹⁵James G. March and Herbert A. Simon, "The Theory of Organizational Equilibrium," Complex Organizations: A Sociological Reader, (New York: Holt, Rinehart & Winston, 1964), pp. 61-71.

¹⁶Likert, op. cit., p. 188.

In order to detect these deviations, it is necessary to establish critical points for checking on the progress of goal achievement. One such method is network analysis, or PERT (Program Evaluation Review Technique) which projects the time frame of the project through a sequential representation of required tasks, events and activities to its final completion. Its advantage is it enables managers to plan the allocation of personnel, material, and financial requirements on the basis of a time network analysis where there is no standard cost and time data available. PERT requires that all of the individual tasks to complete a program be visualized in a sufficiently clear manner to enable those tasks to be constructed into a network of events (beginnings or endings) and activities. An activity represents the time and resources which are needed to progress from one event to the next. The emphasis is placed on defining the events and activities with enough precision so that there is no difficulty in monitoring the actual events or accomplishments as they occur. These events and activities are sequenced under certain rules that do not permit a looping, in which a succeeding event has an activity that leads back to a beginning event, nor can one activity start before its preceding one is completed. Time estimates may be made on the basis of most optimistic (one chance in a hundred that the activity will be completed under best possible

conditions), most likely, and most pessimistic (one chance in a hundred it will be completed at all). These three time estimates represent an attempt to diminish uncertainty in the project.

The use of PERT by police management presents problems in the area of attempting to apply quantitative methods to a previously unknown activity. From previous experience, it is extremely difficult to estimate a most likely time without the additional estimates of a pessimistic or optimistic time. Perhaps if top management could have some data from other police agencies of a possible time schedule it would facilitate the agency's use of PERT. Another problem area is the completion of specified tasks. If these activities and events are not accomplished in sequence, it is impossible to follow a PERT chart, unless it is redone. If the original chart has been computed by hand, this presents an almost impossible task to keep up with the changing time requirements. If it is computer run, the cost of the program rapidly becomes excessive. One project that attempted to maintain control via PERT developed a systematic time lag that upon investigation turned out to be the exact amount of time lag for the information feedback to the PERT control unit. The cost of implementing a PERT system has been quoted as being initially in the order of twice that of a conventional

planning system.¹⁷ Despite the problems, the use of a detailed network analysis will provide management with information to detect critical checkpoints of control. Gantt charts present another method of time control, yet do not provide for the establishment of a critical path.

At certain intervals within a specified process, these checkpoints or sensory devices must be incorporated into the overall control structure in order to determine if the objectives are in a state of being "on target." If the progress of the objectives meets certain predefined criteria, then the progress continues. Otherwise, the deviation is noted and information is sent to input to be processed and channeled through output into corrective action.

The criteria necessary for determination of normality or "on target" or deviance is established through methods of observation, inspection, and reporting. These are sensory devices that measure the data with certain standards of achievement. Much of this data will be quantitative and the trend is to convert it to EDP. Unless management performs the vital responsibility of making decisions in view of the overall system or agency objectives, and filters are built in at strategic point in the

¹⁷Robert W. Miller, "How to Plan and Control with PERT," New Decision-Making Tools for Managers, (New York: New American Library, 1965), p. 103.

process, managers will be inundated with data and will no longer be able to perform their function of control.

Therefore, reports must be oriented toward both the level and the function of the user in such a manner that only exceptional items outside the range of predetermined normality are reported to the next higher level of management. Along with the need for exception reporting there is the need for conciseness, accuracy, and a certain level of pre-analysis. Top management does not have the time to go through data of the actions of everyone on patrol, for example, but incidents that may bring a reaction from the community should be reported to the chief in order that he may determine a course of action based on his information and experience. Pre-analysis would put reports into categories, so that management would know if a particular series of cases were to have a decision made, were to be merely noted and filed, or reflected an outstanding job on the part of certain personnel.¹⁸

These methods of observation, inspection, and reporting should provide for flexibility in order to react to constant change. To meet this flexibility the methods should provide for promptness in reporting and in

¹⁸John E. Bonney, Jr. "Perceptive Feedback," Management Systems, (New York: John Wiley and Sons, Inc., 1968), pp. 271-275.

correction. When there is a significant difference between output and the plan, the situation may be out-of-control and corrective action becomes imperative. The efficiency of the system is measured by how accurately it can identify variations from the plan and by how quickly it can report the need for correction to the activating mechanism. Error is inevitable yet is only a deviation from the established standard. Cybernetic theory operates on the acceptance of error for the error is depended upon to bring about correction through feedback information bringing about corrective action.

When lag in time between input and output is great, more instability is introduced. Feedback can reduce the time lag, yet corrective action which is out of phase will magnify rather than overcome the deviation. As a result, every control structure should be designed to make its own corrections when necessary, and the objective is to make the error as small as possible within practicable limits.

Once corrective action has been established, the data identifying the need for action should be analyzed to find an explanation of the deviation. Further, the analysis process will provide management with additional experience with which to review new information as it is received.

After the explanation of the deviation has been discovered, then new procedures of processing should be implemented to maintain equilibrium within the control structure.

In summary, both the systems concept of analysis and cybernetic theory rely primarily on a framework for visualizing the internal and external environmental factors as an integrated whole. They both allow recognition of the function of subsystems, as well as of complex supersystems within which the agency operates.

APPENDIX C

PROPOSED INTERVIEW QUESTIONS

PROPOSED INTERVIEW QUESTIONS

1. Who initiated the project?
What was the objective in installing the computer system?
What functions were to be implemented?
2. Who wrote the Request for Proposal?
Who approved it?
Who evaluated the responses to the RFP?
What information did they use for their decision on the choice of an outside consultant?
3. How were decisions made regarding the project (i.e. by the chief, by a team, by omission)?
Did these decisions go up the chain of command in the agency?
4. Who determined the budget for the project?
Who approved it?
Were the estimated costs realistic?
Were there cost overflows? In what areas?
5. Who designed the time schedule?
What factors were deemed important in meeting the schedule?
Was it met?
What were the delays?
Why were they caused? Were there signs beforehand that the delay could happen? Were they recognized?
6. Who performed the systems analysis?
Who approved it?
Did it conform to the agency's perception of their function?
7. Who designed the system?
Who participated in the design? Reason for choice of these personnel? At what points were major decisions required in the implementation of the design? According to the design? In actual fact?
8. Who designated the outputs to achieve the stated functions?
Who determined the form of these outputs? Frequency? Distribution?

9. Who determined the information to be fed into the computer?
On what basis was the determination made?
Were they adequate?
10. Were changes made in the design during the implementation phase that were not foreseen in the system design phase?
What was the reason for these changes?
Who determined that they should be made?
Why was this particular person designated to make the decision?
11. What reports were made during the installation?
Who decided on the content of the reports?
On what level of aggregation or summary was the data made?
For whom were the reports intended?
Were they understandable to the recipients? Why or why not?
Were any special reports requested? Why?
12. What personnel were used in the system implementation phase?
If agency personnel were used, how were they selected?
How were they trained?
(These same questions apply to consultant personnel.)
13. How were the agency's personnel (outside of the data processing people) informed of the system?
Of the possible impact upon them and their jobs?
How did the line personnel react?
14. Were there unexpected reactions to the system?
15. Were there organizational changes?
Who decided upon them?
How were they implemented?
What reactions occurred due to these changes?
16. How was the plan audited to determine if the actual design was comparable to the projected plan?
17. On what basis were the functions of the system design determined?
By whom?
Who approved them?
18. Was a cost/benefit analysis made of the functions chosen for computerization?

19. At what point was management informed of the need for corrective action during the various phases of project?
How was management informed?
By whom?
What type of information was passed to them?
20. How was the need for corrective action determined?
What data were analyzed?
Who analyzed it?
21. What explanation was given for the need for corrective action?
Who gave it?
To whom?
Was it understood?
22. Were procedures established to prevent or foresee the occurrence of this need for corrective action in the future?
How were they determined?
Were they implemented?
23. During the installation process, were there observable shifts in the agency's power structure?
What kind of shifts? Magnitude of shift?
What was the reaction to personnel faced with a resultant loss of power?
24. Were there communication problems between agency personnel and outside consultants?
What kind of problems?
Were they resolved? If so, how?
25. Did personnel in the agency work together as a team in managing the installation or were there differences of opinion reflecting each person's particular viewpoint?
If so, what happened?
How were differences resolved?
26. Did an informal channel of communication develop between agency personnel and the outsiders?
If so, whom did it consist of?
Between agency computer personnel and others in the agency?
27. What decisions do you consider to be the most crucial to the successful implementation of the project?

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