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POLICE AND COMPUTER TECHNOLOGY: USE, IMPLEMENTATION, AND IMPACT

Kent W. Colton
Editor
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ABSTRACT

Over the past decade there has been a significant growth in the use of computer technology by U.S. police departments, and this report discusses this evolution of computer use. Survey work performed by this study shows rising use to be especially apparent for "routine" computer applications where the technology is used to carry out straightforward, repetitive information processing activities such as maintaining real-time police patrol and inquiry files and traffic records.

In general, though, the growth of computer technology in law enforcement has been at a rate somewhat slower than what police departments had predicted in the early 1970s. Further, when computer applications extend beyond "routine" uses to "nonroutine" efforts, such as with resource allocation models or computer-aided dispatch (CAD) systems, where the machine begins to become a tool for decision-making, strategic planning and man/machine interaction, the results to date have been somewhat disappointing. The process of implementation is far more complex and unintended consequences arise. Three case studies of resource allocation models and four cases of command and control applications provide useful insights concerning the implementation and impact of computer technology. They point to new directions in the use of computer technology, one which includes greater attention to evaluation and implementation, stresses performance standards and transfer, and realizes that the police play a broader role in society than fighting crime.

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PREFACE

Kent W. Colton

In Oakland, California, a patrol officer reaches down to the remote computer terminal in his car and types in the license number of the speeding automobile. Within seconds, information is displayed showing that the vehicle is stolen. In St. Louis, Missouri, an experiment is underway to monitor the location of each patrol car by using new locational and computer technology. Precise vehicle movement is displayed on a television-like screen in the dispatch center, and decisions regarding which car should respond to a call are based on this information.

Does this sound like James Bond or Dick Tracy--or is it reality? Indeed, these are just two examples of the wide variety of technological tools that have been proposed, tried, or implemented by police in recent years. What is the degree and nature of such use of computer technology by the police? What types of applications have been implemented? Are they working, and how well have they been accepted by the police? What impact, if any, will they have on law enforcement?

In July 1965, in the face of dramatic rises in reported crime and delinquency rates, the President's Commission on Law Enforcement and the Administration of Justice (sometimes called the Crime Commission) was created. One area selected for special attention in the Commission's final report was the potential contribution of science and technology in the generally labor-intensive field of law enforcement. Because criminal justice agencies must process enormous quantities of data, the use of electronic computers and new techniques of systems analysis, operations research, and computer modeling seemed particularly promising. In accordance with the

Commission's recommendations, the Law Enforcement Assistance Administration (LEAA) was established in 1968. Since its inception, LEAA has distributed over $4.5 billion to state and local governments and to private agencies. A significant portion of these funds was designated for creating such automated information applications as computerized criminal history files.

However, critics have questioned the utility of this expenditure. The federal aid program's emphasis on computer hardware and software development and other types of technology has drawn criticism from a number of groups that believe the money could be better utilized on less technical approaches to the crime problem. Others argue that portions of this money have been wasted and also that the proliferation of such systems represents a potential infringement on civil liberties.

In response to the growing interest in computers and technology for law enforcement purposes, I undertook research in 1971, under the aegis of the International City Management Association (ICMA), to measure the extent of police computer use as well as the degree of success or failure of such systems.[1] Research included a survey of police departments in the United States, as well as visits to 14 police departments around the country.

The 1971 study revealed that 39 percent of the 498 police departments responding to the survey were using computers. For cities with populations

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1. When the study first began in 1970 and 1971, I initially focused on the use of computers by the police. However, this soon expanded to a broader concept of computer technology including not only computer use but a wider range of methods and technologies, such as systems analysis and computer modeling, that are all part of the technology of sensing, coding, transmitting, translating, and transforming information. (See Chapter I for a further discussion.)

of 100,000 and over, the figure was nearly 70 percent. In addition, nearly two-thirds of all the departments responding indicated that they would be using a computer by 1974.

But this study only began to scratch the surface. It could not answer the basic questions concerning the use, implementation, and impact of police computers. As a consequence, in 1974, working with several colleagues, especially Scott Hebert, I undertook further research on the current and projected impact of technology on U.S. police departments. This new study was part of the Innovative Resource Planning (IRP) project at MIT sponsored by the National Science Foundation. Two primary tasks were involved:

(1) a second nationwide survey--including both a mailed and limited telephone survey, again administered by the ICMA--to measure the extent of police computer use and to compare the predictions of 1971 with actual developments;

(2) a limited number of case studies to examine the use of computers and computer technology by various police departments and to review the resulting advantages and problems.

The National Institute of Law Enforcement and Criminal Justice of the LEAA in 1975 funded the third and last stage of research, which was aimed at making additional case studies, conducting further data analysis and a literature search, and tying together all aspects of the work.

Even with support from the National Science Foundation and the LEAA, the budget for case study work was limited. To avoid the danger of being spread too thin to examine all aspects of computer technology, it was decided that the case studies should focus on two areas--resource allocation applications and the use of new technology related to police command and control.

In 1971, in conjunction with the earliest research on the project, visits had been made to 14 police departments around the country. On the basis of insights from these visits, three cities were selected for four more detailed studies: the police departments in Boston, St. Louis, and Los Angeles were chosen for case work related to resource allocation, and Boston was selected for case study work related to command and control. When the scope of the project was expanded with further funding from the LEAA, studies were added in the command and control area in three additional police departments: San Diego, St. Louis, and New York City.

Of course these seven case studies represent only a small part of the work and experimentation that has been carried out in resource allocation and command and control systems, and they were not selected with the intent of choosing a representative sample. However, the sites chosen do typify some of the important implementation efforts that have been made to date, and as such should provide insights for more general application, particularly for those who are interested in the implementation of new technology.

The chapters in this book outline the results of this research. As the principal investigator for the project, I have served as the editor of the report and the author of a number of the chapters. The authors of each chapter will be listed separately. Scott Hebert has been especially involved with much of the research, working as a research associate during the phase of the project funded by the National Science Foundation. Several others have participated in the research, including Mark Schuster, a co-author of Chapter IX, and Richard Larson and Gilbert Larson, two of the three authors of Chapter XI.

The report is divided into four parts. Part One outlines the issues and results of the survey research and the initial site visits to police departments around the country. Chapter I introduces the basic background and concepts for the study, and discusses the relationship between computer technology and the police, hypothesizing about the potential influence and effect. Chapter II summarizes the results of the 1971 and 1974 surveys and reviews the extent of computer use and the evolution that has occurred over the last two decades. Chapter III begins to discuss the implementation of new technology and the problems that have arisen. Questions concerning the potential impact of new technology are raised. The data from the survey and site visits provide preliminary insights about the actual acceptance and influence of such new technology, but these conclusions relate primarily to the more routine applications of computer use by the police. For further insights, particularly as they relate to the implementation and impact of nonroutine applications, case studies are needed. Parts Two and Three of the report present seven case studies.

Part Two focuses on resource allocation applications. Chapters IV, V, and VI outline the administrative histories of the efforts made by the police departments of St. Louis, Boston, and Los Angeles to introduce new techniques into the operations of their patrol forces. Chapter VII delineates the common patterns among these resource allocation cases and attempts to identify those factors which were most influential in determining the nature and outcome of each effort. At the conclusion of Chapter VII, the implications of the cases for the adoption of similar deployment techniques by other departments will be examined.

Part Three, including Chapters VIII through XI, focuses on command and control efforts in San Diego, New York City, Boston, and St. Louis.

The final section of the report, Part Four, provides general conclusions and policy implications. Chapter XII is devoted to the implementation of new technology and Chapter XIII explores some of the broader issues related to the impact and influence of computer technology on law enforcement. Chapter XIII also provides an Executive Summary of the report.

Because the cases examined represent only a small percentage of the total number of situations where new technology has been implemented by the police, no claim is made that the conclusions are final. Nevertheless, they contain insights that should benefit both the law enforcement community and those who are interested in the public policy implications of implementing new technology. At a minimum, they provide a useful basis for future research and analysis.

ACKNOWLEDGEMENTS

A number of people have participated in this project and deserve special acknowledgement. Scott Hebert has been extensively involved in the research and has worked individually and jointly on the case studies. Scott has a challenging and questioning mind, constantly probing the uses, motivations, benefits and costs of technology. Since we have not always agreed on every topic, the exchange of interpretations and ideas has enlivened and enhanced the study. Richard Larson was the project director of the Innovative Resources Planning Project at M.I.T. His assistance has been invaluable in helping to conceptualize the project and in critiquing the research. Numerous other colleagues, friends and students have provided assistance and worked on the research. Mark McKnew has both critiqued portions of the work and contributed substantively. Mark Schuster, Richard Larson, and Gilbert Larson participated in writing specific case studies. Kate Hendricks contributed a number of inputs at the early stages of the project, and Bernard Frieden and Bob Fogelson provided valuable insights, both as advisors to the initial research and then as colleagues. Cora Edensword especially deserves thanks. She has been responsible for typing and overseeing much of the editing and production of this report. Without her many skills and patient support this book would not be possible. Further, let me thank the many other unnamed individuals in the M.I.T. community who have aided this project.

The assistance of those at the National Institute of Law Enforcement and Criminal Justice of the LEAA also deserve special acknowledgement. Paul Lineberry, the project monitor, has offered enthusiastic, meaningful and patient guidance throughout the project; and Dick Linster, the Director of the Office of Evaluation, made the project possible through his initial input and support.

Finally, to my wife Kathryn and our three children, Katie Marie, Bradley and Lynne Christine, I offer special thanks. Their patience and support has made the extra hours of work on this project possible, and to them I will be grateful eternally.

Although the contributions of others should be clear, the responsibility for the final product is mine.

Kent W. Colton

May 1977

CHAPTER I

COMPUTER TECHNOLOGY AND THE POLICE: AN OVERVIEW

by Kent W. Colton

Police began using computers in the early 1960s. At that time they had been available commercially in some form or other for more than a decade. Three streams of development have been involved in the evolution of computer technology: information transmission (the ability to communicate and transmit information using the computer); information transformation (including computation and the development of modern computing capabilities to rapidly transform large quantities of data); and modeling (the symbolic representation of large systems).[1] By the early 1960s these three streams had begun to come together, setting the stage for the application of modern computer technology by the police.

During the late 1940s and 1950s, a number of important innovations changed the computer from a crude experimental device of interest only to scientists to a sophisticated and highly marketable product, especially for the first two streams of computer development, the transmission and transformation of information. These innovations included the "stored program" concept, use of the binary rather than decimal number system, and replacement of vacuum tubes and even rotating gears by transistors and then

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1. For a further discussion of the evolution of computer technology see, for example, Thomas L. Whisler, Information Technology and Organizational Change, (Belmont, California: Wadsworth Publishing Co., 1970), especially pp. 11-16.

integrated circuits.[2]

The sale of computer technology became one of the nation's fastest-growing industries. Fields which relied extensively on numerical data and in which problems were readily definable in terms of mathematical operations benefited substantially from computer applications. In the space program, for example, scientists discovered the value of the computer in handling complex trajectory calculations and in meeting deadlines which involved intricate logistical details.

With the development of the third stream in the evolution of computer technology--mathematical modeling and systems analysis--the computer expanded from a transmitter of information to a potential tool for management and education. "Modeling"--the creation of an abstract portrait of a system and its relationship in order to better understand, predict, and manipulate data--had become a recognized activity in organizations during the nineteenth century as labor became more specialized and people sought

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2. A brief explanation of these three terms seems in order. The first modern computers were rather inflexible, since machine operation for each automatic operation had to be specified and then wired into a "plug board." A great deal of time was consumed wiring and then changing the plug boards for each new operation. With the <u>stored program</u> concepts, certain basic operations are built into the computer circuitry and assigned code numbers. By calling on particular code numbers, a programmer can activate the appropriate circuit without having to wire a plug board. Use of the <u>binary system</u> was important in simplifying computer operations. Using a decimal number system, ten computing elements are necessary to represent the values from zero to nine. In the binary system, four elements can represent the same values. Finally, with the elimination of the mechanical operations of rotating gears and the change from vacuum tubes to <u>transistors</u>, the maximum computation speed was limited only by the speed at which an electrical impulse can travel from one point to another in the transistor. This has made possible the execution of millions of instructions per second. As <u>integrated circuits</u> replaced transistors, speeds increased still more.

to improve performance. But it was only during World War II that "operations research" (now often referred to as "management science") stressed the development of mathematical models as an approach to problem solving. At the same time, "systems analysis" became increasingly popular as a means of approaching the solution of complex problems with model formulation as a central aspect of the analysis process. Many operations research tools which are still in use today--linear programming, dynamic programming, queuing models, inventory models--were in operation by the mid-1950s. A decade later, these tools were combined with the transmission and transformation capabilities of electronic computers, and computer technology began to see use on such disparate tasks as improving the allocation of transportation resources and monitoring retail inventories. Banking, insurance, and accounting experienced successes through the use of computerized systems analysis. From a technological perspective, the time was ripe for the use of computer technology by the police.

This chapter is divided into three parts. The first will describe the early use of computers by police and explain the reasons for their interest in computer technology; the second will consider the expected future use of this technology; and the third will discuss the potential impact of the technology on police tasks, personnel, and structure. The term "computer technology" as used in this report means not only the use of computers by the police to transmit and transform information, but also the application of other innovations such as operations research and systems analysis. The term "information technology" has also been used by some authors to represent the same phenomenon.[3] For the sake of convenience, the two terms--computer technology and information technology --will, on occasion, be interchanged synonymously in the text.

A. Reasons for Police Use of Computers

Despite the advances in computer technology and its successful application to science, engineering, and management, police departments were rather slow to take advantage of its capabilities. Several departments established traffic accident files in 1960; others used computers to compile statistics for local, state, and national crime reports or to handle administrative "housekeeping tasks."[4] These applications were routine, however, and few departments used the computer for modeling activities; in fact, few used it as anything more than an automated file or an elaborate desk calculator. A number of factors militated against the development of more creative police applications: the high costs of computer installation, coupled with local fiscal constraints; the lack of technical skills and education among police personnel; the labor-intensive aspects of police work; the long tradition of relying upon the patrol officer in the street as the principal means of delivering police services; and the fact that many of the problems with which police deal are not, at least for the most part, readily represented by mathematical equations.

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3. For example, in Thomas L. Whisler, Information Technology and Organizational Change, p. 11, information technology is defined as "the technology of sending, coding, transmitting, translating, and transforming information".

4. Chapter II of this report will provide a more detailed discussion of the evolution of police computer applications.

During the late sixties, however, planners began to extend the techniques of systems analysis beyond engineering and management applications to general social problems. They applied systems analysis to such projects as improving the delivery of health care, managing the rapidly growing welfare caseload in urban centers, and measuring the effectiveness of a fragmented and increasingly expensive education system.[5] Use of computers by police and other law enforcement officials also began to expand rapidly. The number of departments owning, or having access to, a computer increased substantially. Many local departments followed the early lead of the St. Louis department and installed real-time computer systems which provide rapid inquiry for the officer in the street of information concerning stolen cars, wanted persons, and so forth.[6] Major steps were also taken to provide local police departments with access to regional, state, and national real-time computer networks.

A survey of 79 cities in 1970 found that law enforcement was the single most-recurring municipal computer application. Fifteen percent of all the computer applications in these cities were in the law enforcement area.[7] Surveys of U.S. cities made in 1974 and 1975 showed the importance of law enforcement applications in terms of overall city computer use,

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5. Records, Computers and the Rights of Citizens, Report of the Secretary's Advisory Committee on Automated Personal Data Systems, U.S. Dept. of Health, Education and Welfare, July 1973.

6. Real-time or on-line refers to direct access, through a terminal, to computer files at any time so that all inquiries will receive almost immediate response--for example, real-time access to a file of stolen vehicles through a video display terminal.

7. O.E. Dial, Kenneth C. Kraemer, William Mitchel, and Myron Weiner, Municipal Information Systems: The State of the Art in 1970, (Long Island University, Public Administration Center), chap. 15, pp. 13-14.

with police applications second only to finance (payroll, accounting, and treasury collection).[8] Since 1968 the number of computer applications reported by police departments throughout the country has been widespread. In 1971, 44 percent of those police departments (in cities with populations over 50,000) that responded to a questionnaire--sent to 498 departments in the United States--were using a computer. By 1974 this percentage had risen to 56 percent, with 74 percent of the responding departments indicating that they planned to be using a computer by 1977.[9]

At least four factors have entered into the increasing use of computer technology by the police.

First, by the late sixties, attractive prices, rising service needs, persuasive salesmen, expanding technological capabilities, ingenious software services, and the prestige of having access to large-scale information processing had stimulated the introduction of automated information technology applications into many organizations and institutions, including police departments. Towards the end of the decade this pressure heightened as the Vietnamese War gradually came to an end, and the industries and personnel that had been heavily committed to the military applications of computer technology began to seek alternative domestic areas for utilizing new techniques and methods.

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8. See "How City Departments Use Computers and Communication Equipment," Nations Cities, October 1974, pp. 26-29; and Kenneth L. Kraemer et al., "Municipal Components: Growth, Usage and Management," Urban Data Service Reports, vol. 7, no. 11 (Washington, D.C.: International City Management Association, November 1975).

9. The International City Management Association surveys were designed by the author and provide the basis for a portion of this study. The results will be described in detail in Chapter II.

Second, according to several polls conducted in the late 1960s and early 1970s, a large and growing majority of Americans had doubts about the efficiency of the criminal justice system. Given the labor-intensive nature of police work and the tradition of devoting only a very small percentage of departmental resources to research and development,[10] interest focused on improving the system and allocating more resources to new equipment and technology. In 1967 the President's Commission on Law Enforcement and Administration of Justice (Crime Commission) suggested that computer technology might be an important tool for improving the deployment of criminal justice resources and for keeping track of criminal offenders. The Crime Commission stated that "probably the single greatest technical limitation on the criminal justice system's ability to make its decisions wisely and fairly is that the people in the system often are required to decide issues without enough information."[11]

Third--and partly in response to this public dissatisfaction with the criminal justice system--additional federal resources were allocated to

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10. As reported by Richard C. Larson, "Resource Planning for Urban Public Safety Systems," Technology Review, vol. 76 (July/August, 1974), pp. 20-29, budgets of law enforcement services reveal that 90 to 95 percent of expenditures are consumed directly by personnel salaries, pensions, and related fringe benefits. On the other hand, it is difficult to find even as much as 1/10 of 2 percent of total expenditures of most urban public safety services directed toward research and development, whereas healthy, growing industries in the private sector typically allocate 2 to 4 percent of gross revenues to research and development.

11. The Challenge of Crime in a Free Society, Report by the President's Commission on Law Enforcement and Administration of Justice (U.S. Government Printing Office: Washington, D.C., 1967), p. 13. See also Task Force Report: Science and Technology, Report to the President's Commission on Law Enforcement and Administration of Justice (U.S. Government Printing Office, Washington, D.C., 1967), p. 68.

the law enforcement area. In 1965 the Law Enforcement Assistance Act was passed and the Office of Law Enforcement Assistance (OLEA) was established within the Department of Justice to administer programs funded under the Act. An emphasis, both legislative and otherwise, on meeting the police equipment needs was used to justify expenditures by the OLEA and the LEAA to acquire a variety of technical devices for law enforcement agencies--devices ranging from computer hardware to night vision equipment, walkie-talkies, and helicopters. In its first four years, LEAA distributed over $1.5 billion to state and local governments and to private agencies. A significant portion of these funds--estimated at more than $100 million--was designated for the creation of automated information applications. According to a recent study, $143 million, or 11.5 percent of the total LEAA block grant budget, was spent for law enforcement telecommunications during the three and one half years between July 1, 1971, and January 1, 1975,[12] and this figure did not include matching money from the states. Although no police department has been forced to spend federal dollars, the availability of the money has been an important stimulus to computer growth. In addition, pressure from Justice Department officials to improve surveillance techniques and statistical reporting capabilities has provided additional stimulation for acquiring information systems.

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12. Donald D. Kavanaugh, "Planning Guidelines for Law Enforcement Telecommunications Systems, Product of Project 13, Executive Summary", Government Data Systems, July-August 1976. It should be noted that in this study the term "telecommunications" is defined broadly to include not only computer technology but also a full range of communications networks such as radio networks and digital mobile terminals. Such innovations are often included as a part of police command and control.

Fourth and finally, police departments themselves have placed increasing emphasis on the need to reform, to "professionalize", to modernize. The police have viewed the computer both as a means of bringing about reform and as a symbol of modernity.

These reasons for the expanding use of information technology by the police are helpful in understanding the social and institutional forces surrounding the use of computers in law enforcement. Further, they may point to some of the advantages and problems in automating police functions. But even more important than the reasons for the use of technology are the actual implementation and impact of technology on the police. Over the past decade significant resources have been spent on computer technology for the police with an important portion of the funding coming from the LEAA. Objections have been raised about such expenditures, and critics have argued that federal aid has focused excessive emphasis on technological development and the money could have been better spent on less technical approaches to law enforcement issues.[13] Still, relatively little is known

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13. Two relatively recent reports have essentially taken this position. See for example, Sarah Carey, Law and Disorder IV, Center for National Security Studies, Washington, D.C., 1976, and Law Enforcement: The Federal Role, a Twentieth Century Fund Task Force Report, Twentieth Century Fund, New York City, New York, 1976. Law and Disorder IV calls for the abolishment of the LEAA and the Twentieth Century Fund Task Force Report recommends that the block grant system of funding be dropped and that the money go directly to the states through special revenue spending. Both reports discuss the lack of impact of LEAA programs on crime programs on crime prevention, and question the fact that funding continues for such hardware items as street lighting projects and helicopters, despite the fact that there is little evaluation as to their success or failure.

about the impact and implementation of police computers. In order to begin to address such issues, the purpose of this report is threefold:

- to determine the state of the art with respect to the use of computers by police departments in the United States;
- to examine the implementation of various applications of computer technology and attempt to analyze the causes of success or failure; and
- to study the impact of this technology on the police, as well as the impact of the police on technology.

The report will ask, for example: How have computers been used by the police? Have efforts to implement computer technology been successful or not, and why? What impact has information technology had, or will it have, on departmental structure and organization? What effect, if any, will computer technologies have on the quality of police service and police tasks or functions? Will computer use result in the reduction of crime or the apprehension of more criminals? In short, what difference will computer technology make? And is it, or will it be, good or bad?

To one degree or another, these questions are all unanswerable. In a number of cases, conclusive data are still not available, and in others a final judgement depends on value perspectives. Whether use of computer technology is "good" or "bad", for example, depends entirely on one's particular goals and immediate priorities. Automation may necessitate the hiring of better-educated men and women but at the same time retard recruitment from minority groups because they, as a whole, have had limited educational opportunities. The effect of technology on the quality of police service cannot be determined until certain measures of quality have been accepted. A final evaluation of the impact of computers on crime and on police efficiency may have to wait until more sophisticated techniques of social analysis are available. But even though definitive answers are still out of reach, the questions that have just been asked need to be faced, and some type of framework for evaluation needs to be developed. The deepening national concern with crime and the expenditure of millions of dollars on information systems demand at least an initial understanding of the use, implementation, and potential impact of computer technology on police activities.

B. Expectations concerning the Future Use of Computer Technology

During the next few years various pressures for change will be felt within the law enforcement community. The disagreements concerning the weaknesses of the present system of law enforcement are clear: on the one hand, there is a demand for greater safety in the streets, for "law and order," for well-equipped, centralized police forces; on the other hand, the cry is raised for more responsive and personal police forces, forces that are more fully controlled (or at least influenced) by local communities and the needs of their citizens. Although many different ideas have been put forth concerning the future direction of law enforcement activity, the discussion has focused on three main issues: police task, personnel, and structure. What should be the principal task of the police? Who should serve as a police officer, and what standards should be employed in the recruitment and training of personnel? What should be the organization and management structure of police departments?[14] (The potential impact of information technology in each of these areas will be discussed in the next main section.)

It would be unrealistic to claim that computer technology will have an immediate and substantial influence in these areas. The conditions of the police are to a large extent determined by the conditions of society. As a consequence, the general impact of the computer is likely to be only marginal. Students of technology and society have largely abandoned the view that computers and other technologies will impinge directly on institutions and organizations, causing dramatic collisions and changes of direction. Computer technology does not create social forces or trends; rather, the application and the use of new technologies are strongly influenced by political forces and social values. This is especially true in the law enforcement area. During the last decade, for example, a number of scholars have debated the nature, causes, and solutions to the crime problem, only to realize how difficult it is to trace the relationship between alternative "solutions" and the crime rate.[15] Nevertheless, technology may well support or enhance established trends or directions of

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14. For a similar classification of basic police issues see Thomas Repetto, The Boston Police Department (study done for the Boston Redevelopment Authority), chap. 2, pp. 34-39. This framework also relates to an organizational classification scheme developed by Harold J. Leavitt, in Handbook of Organizations, ed. James G. March (Chicago: Rand McNally, 1965), pp. 1144-1170. Leavitt outlines four primary components of institutional concern: task, structure, people, and technology. One of the concerns of this report will be the influence, if any, of technology on the other three components.

15. See, for example, James Q. Wilson, Thinking about Crime (New York: Basic Books, 1975).

change.[16] Further, because information technology is likely to be used increasingly in law enforcement, it is important to ask what factors are involved in the use, implementation, and impact of these new tools by police organizations. Even if the interaction has been small thus far, trends may be isolated and potential future impacts may be suggested.

The assessment of the implementation and impact of computer use can be approached from several different perspectives. To begin, because police structure and some police functions are similar to those of other organizations, some of the interaction between police and technology will be similar to that experienced by most other organizations. A general set of expectations and a framework for evaluation can, therefore, be outlined that applies to the assessment of computer technology in law enforcement or any other area of implementation. However, police forces also have certain characteristics which make them unique in organizational terms. In most industrial organizations and public bureaucracies, for example, movement to higher levels of power and status is accompanied by greater discretion or freedom of choice in decision-making. Moreover, complexity of task increases with responsibility. By contrast, in police bureaucracies, the lowest-ranking officer--the patrol officer--is often given the greatest discretion, being forced to continually make decisions without

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16. There is some evidence that this may be the case. See, for example, Kenneth C. London, Computers and Bureaucratic Reform: The Political Functions of Urban Information Systems (New York: John Wiley, 1974); and Abbe Mowslowitz, The Conquest of Will: Information Processing in Human Affairs (Reading, Mass.: Addison-Wesley, 1976).

direction from superiors.[17] The administrator's ability to control and influence police behavior is, on the other hand, severely limited. As James Q. Wilson has put it:

> The principal limit on managing the discretionary powers of patrolmen arises, not from the particular personal qualities or technical skills of these officers, but from the organizational and legal definition of the patrolman's task.[18]

Thus, analysis of the implementation and influence of computer technology must also take into consideration the unique nature of police work. These two perspectives--general expectations and characteristics unique to the police--will be discussed in the following subsections.

1. General expectations. In evaluating the use of computer technology, a number of dimensions, including a range of potential benefits and costs, must be taken into consideration. The first level is simply to determine whether or not the use of computer technology "works"--that is, does it stay in operation for a period of years, and does it meet the objectives that were specified at the time of implementation? This may seem almost too obvious to include in a range of evaluation criteria, but past experience has shown and the results of this report will confirm,

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17. In theory, the police have almost no discretion; officers are required to enforce, not interpret, the law whenever a violation occurs. In reality, discretion is inevitable. The disparity between law and accepted social behavior, the inability of police officers to personally observe every public infraction, the lack of factual information, the need for police to overlook minor crimes in order to obtain information about more serious offenses, and the public's intolerance of a policy of strict law enforcement necessitate the exercise of police judgment.

18. James Q. Wilson, Varieties of Police Behavior (New York: Atheneum, 1970), p. 7.

that the operational performance of technological innovations should not be taken lightly. The descriptions found in the literature often exceed reality. Innovations often encounter a range of obstacles, and systems which work at the outset may often be abandoned at a later time.

Beyond the first level of review, three additional levels of impact will be highlighted: technical impacts, service impacts, and power shifts.[19]

a. Technical impacts. Technical impacts are benefits resulting from improvements in the input, processing, and output of information. In essence they are improvements provided through technology, which help to bring better information--for example, a greater speed of processing, greater consistency of outputs, and wider distribution of information. Anthony Downs has listed eight potential technical benefits brought about by the use of urban data systems:

- lower operating costs of data processing;
- faster availability of information;
- wider distribution of information;
- generation of new information never before observed, recorded, or reported;

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19. In an article published in 1967, Tony Downs discussed the payoffs or impacts of urban data systems and distinguished between two types of payoffs: technical and power payoffs. See Anthony Downs, "A Realistic Look at the Final Payoffs from Urban Data Systems," Public Administration Review, September 1967, pp. 204-210. Myron Weiner contends that there is a third level of benefit: service payoffs. See Myron E. Weiner, Service: The Objective of Municipal Information Systems (Institute of Public Service, University of Connecticut, 1969), p. 29. Although all three terms are used in slightly different contexts in this report, the analyses of Downs and Weiner were useful in contributing to the general framework used here.

- greater consistency of reporting data;
- reduced distortion of data reported to top levels;
- eventual development of a giant data inventory to be used ultimately to formulate, test, and modify theories about causal relationships in the urban environment which now can be only guessed at; and
- greater freedom from routine record-keeping.[20]

b. Service impacts. Service benefits are broader and more elusive than technical measures impacts. They concern the degree to which the public is serviced and whether or not computer technology contributes to the quality of this service and the overall tasks of the police. Such benefits are often hard to grasp. First, there must be agreement as to measures of quality, and, second, a causal relationship must be established between the introduction of technology and the level of service provided. A wide range of indicators may be used to try to evaluate service impacts from examining changes in the time required to answer the telephone when citizens call the police, to trying to trace the impact of technology on elusive notions of crime. Even if appropriate measures can be agreed upon, so many different factors influence crime and police work that it is extremely difficult to isolate the impact of only one change, such as the introduction of computer technology. Still, this level of evaluation must be considered.

c. Power shifts. Power shifts are gains or losses in one

20. Downs, "Realistic Look," p. 205.

person's decision-making effectiveness, which are often made at the expense of another person. Changes in organizations, techniques, or decision-making processes almost always result in some shift, or redistribution, of the relative power of the individuals involved: some people will gain and others will lose. Usually each individual's perception of the value of the change will depend upon self-interest. Downs has suggested seven potential power shifts in urban decision-making which may result from the implementation of urban data systems:[21]

- Lower and intermediate-level officials tend to lose power to higher-level officials and politicians.
- High-level staff officials gain power.
- City and state legislators tend to lose power to administrators and operating officials.
- The government bureaucracy as a whole gains power at the expense of the general electorate and non-governmental groups.
- Well-organized and sophisticated groups of all kinds, including some government bureaus, gain power at the expense of less organized and less sophisticated groups.
- Within city governments, those who actually control automated data systems gain power at the expense of those who do not control such items.
- Technically educated officials within city governments gain power at the expense of old-style political advisors.

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21. Ibid.

In essence, then, to try to analyze power shifts is an effort to assess the impact of technology on the people and structure of the police. For example, studies on the impact of computers on private and public organizations suggest that decision-making may become increasingly quantified and rationalized as it moves to a higher level in the organization; and, that while use of the computer stimulates many ideas for changes, it may also increase substantially the costs of adopting those changes.[22] A further power shift may result from the potential influence of computer technology on the influence that people have over the control and manipulation of data. Some people fear that individual privacy may be threatened and that citizens outside the law enforcement community may lose power as compared to those within the police.

2. Unique Characteristics of the Police. Police organizations have a number of characteristics that are quite different from those of other public and private institutions. First, the lowest-ranking officer in the organization--the patrol officer--retains a high degree of discretion. Second, the character of police work is local and fragmented. Separate police forces exist in thousands of local law enforcement jurisdictions in the United States. Certainly there are federal police systems (the Federal Bureau of Investigation and the Secret Service), as well as networks of state troopers in each of the fifty states. But the guiding principle in the United States is that police work is almost entirely a local function, and that recruiting, training, and levels of compensation are determined

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22. See, for example, Thomas L. Whisler, The Impact of Computers on Organizations (New York: Praeger Publishers, 1970); and Kenneth L. Kraemer and John Leslie King, Computers, Power, and Urban Management: What Every Local Executive Should Know (California: Sage Publications, 1976).

by and provided under local control.[23] As a consequence, the police system in the United States is best described as a nonsystem.[24] There are no national standards in regard to entrance qualifications, salaries, conditions of employment, processes of lateral movement between departments, or promotions. Third, many varieties of police behavior are found in the various police departments around the country. James Q. Wilson has identified three styles or groupings of police work: the legalistic style; the watchman style; and the service style.[25]

The legalistic style is characterized by strict interpretation and enforcement of the law. Patrolmen are encouraged to handle discretionary situations within a common pattern and to treat similar cases in an identical way. Thus, if a person is driving 10 miles per hour above the speed limit, he is ticketed, no matter what the circumstances. Legalistic departments are usually characterized by a centralized organization structure, formal lines of authority, specified standards for recruitment and training, continuous evaluation, technical efficiency, and good record-keeping.

In the watchman style of department, a more traditional approach is common, and the authority structure is weaker; each patrolman handles situations more or less as he feels best. The purpose is primarily to maintain

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23. Gerald Leinwald, The Police (New York: Pocket Books, 1972), pp. 18-19.

24. Thomas F. Adams, Law Enforcement (Englewood Cliffs, N.J.: Prentice-Hall, 1968), p. 81.

25. Wilson, Varieties of Police Behavior, esp. pp. 140-226.

order rather than to strictly enforce the law. "Little stuff" is ignored; patrolmen are discouraged from creating too much publicity; more "home town" boys are hired; and formal training is at a minimum.

Service style is oriented towards service to the small, homogeneous community. In fact, it is unlikely that this style could exist or be effective in any large, urban community. Law enforcement and the maintenance of order are taken seriously, but police avoid making arrests or imposing formal sanctions. While police seek to maintain law and order, they perceive their purpose to be one of providing service and security to citizens whom they know personally.

Although it is not the purpose of this report to try to fit specific police departments into Wilson's classification, his distinctions will aid in understanding the operations of various police departments. These styles, coupled with the fragmenting nature of police work, also suggest that the interaction between computer technology and the police will depend upon the nature and style of the organization. It seems likely, for example, that the computer will be well received in a legalistic department where technical efficiency and "precise" law enforcement are major goals. In such a setting the ability of technology to contribute to more accurate reporting and record-keeping should be welcomed. On the other hand, a computer might be of less utility in a department with a watchman or a service style of operation where improved efficiency or the ability to measure strict enforcement would not be considered a major benefit. The process of implementation might also be more complex in a watchman style of department.

C. Potential Impact of Information Technology on Police Tasks, Personnel, and Structures

The question of the potential impact of computer technology on police, and, indeed, of the potential interaction between the computer and police, may be dealt with more specifically by returning to those three different aspects of police activity: task, personnel, and organization or structure.

1. Police Task. The popular conception of police work, supported both by news media and by movies and television, is one which assumes that the bulk of a policeman's time is devoted to the exciting and dangerous job of crime fighting. In fact, a comparatively small part of a policeman's time is devoted to crime control and law enforcement. Instead, service activities and order maintenance occupy the largest portion of police time. In the Syracuse Police Department, for example, it was found that only 10.3 percent of the citizens' complaints radioed to patrol vehicles were in the law enforcement category. The percentage breakdown of all activities was as follows:[26]

Service (accidents, ambulance calls, animals, assistance of persons, drunk persons, escort vehicle, lost or found property, etc.)	37.5%
Order maintenance (gang disturbance, family trouble, assault, fight, neighbor trouble, investigation)	30.1
Law enforcement (burglary in progress, check on car, prowler, make an arrest, etc.)	10.3
Other (information gathering, book and check, get report)	22.1
TOTAL	100.0%

26. Wilson, Varieties of Police Behavior, p. 18. This finding is supported by the results of other studies. See, for example, John A. Webster, "Police Task and Time Study," Journal of Criminal Law and Police Science, March 1970, pp. 94-102.

Police, then, are often asked to provide emergency medical aid, respond to traffic accidents and other emergency needs, escort vehicles, rescue cats, and direct traffic for church gatherings. Theoretically, such services could be provided by private firms and sold in the marketplace competitively, perhaps at a lower cost. But as a matter of historical tradition and community convenience, they are provided by the police.

Order maintenance activities invest the police with the responsibility of maintaining peace in the community. Gang fights, disorderly conduct, family trouble, and neighborhood disturbances are situations in which the police are called upon to maintain order. It is in order maintenance that the police meet their greatest difficulties, because the greatest amount of discretion is required in this area. An officer must often choose between making an arrest and resolving the problem in another way. Tempers are often on edge, and wrong action will only aggravate the situation. The experiences of the late sixties showed that when situations are volatile enough, riots may result. The risk of physical harm is always present.

Given the current distribution of police activities, the basic question concerns what the primary focus of police service should be. Should more time be spent fighting crime or providing service and maintaining order? Some writers argue that police should be freed from the routine service tasks and allowed to focus on crime-fighting. Others feel that since police actually spend a majority of their time providing service and maintaining order in highly discretionary and judgment-oriented ways, police training should be altered to reflect this reality. For example, training should include social work and family counseling.

All three police tasks--law enforcement, service, and order maintenance --generate information and create a need for data processing. Whenever a call for help is received, it is noted; if an arrest is made, a record is kept; if an officer in the field is about to stop a car which he suspects is stolen, he needs information to confirm his intuition. But since the specific information needs related to each task are different, several questions might be asked: What influence, if any, has computer technology had, or will it have, on the performance of police tasks and on the resolution of the task-priority issue? Or, placed in the context of the earlier discussion of general expectations, what will be the service impact? Though no major changes should be expected, it may be possible to find evidence of subtle impacts on police tasks and service. The following effects--both benefits and risks--may well proceed from the application of information technology to police tasks.

First, because the computer is able to process large quantities of data and to repeat itself precisely, rapidly, and without fatigue, information technology may produce a number of technical benefits, at least in certain application areas. Its use may result in improved efficiency in collecting traffic tickets, better distribution of information, rapid availability of data to the officer in the street, and greater consistency of reporting. Second, improved service impacts may result, although such impacts are far more difficult to document. Third, because the computer can manipulate numbers so effectively, information technology may lead to a greater emphasis on the quantitative approach to police work. Since law enforcement (as opposed to order maintenance and service tasks) lends itself best to quantification, use of the computer and other technologies may lead to an increased emphasis on the law enforcement activities of the police, thus reinforcing the popular image of the police task. For example, it is possible that by using computers to make information instantly available to the policeman on patrol, many of the burdens of discretion may be lifted. Patrolmen can also be more adequately prepared for dangerous situations and encounters with dangerous individuals if they have complete information on such subjects as wanted persons and stolen property.

But risks are also involved in utilizing a computer and stressing the quantitative approach. The use of the computer will probably lead to a greater sharing of information among various police jurisdictions at all levels--local, regional, state, and national. The use of this information in the performance of police tasks raises questions regarding privacy and the maintenance of individual rights. It is also possible that information technology may have a depersonalizing effect on police activity. Some feel, for example, that it might lead to the shifting of patrolmen from sector to sector according to needs that have been identified through quantitative analysis, rather than their remaining on beats long enough to become familiar with people and places and to carry out their work in a personal manner.

2. Police personnel. The basic questions in this area concern the people who work for police organizations. What attributes must be possessed by police personnel? What criteria should be established for promotion? What deficiencies exist in the current training and selection process? What influence, if any, will computer technology have on police personnel? Here potential impacts begin to relate to possible power shifts mentioned earlier in the chapter.

The complexities inherent in the policing function require that an officer possess intelligence, sound judgment, tact, physical courage, emotional stability, and honesty. Yet, as the President's Crime Commission stated in 1967:

> While innumerable commissions and expert observers of the police have long reported this need, communities have not yet demanded that officers possess these qualities, and personnel standards for the police service remain low.[27]

A variety of proposals have been made to upgrade the standards and qualities of law enforcement through improved education, more careful screening of personal and psychological characteristics, new approaches to police training, and reduction in police residency requirements.[28]

Computer technology may have some positive influences on the upgrading of police personnel. Technologically educated people may gain in power and influence in police departments. In addition, it is possible that increasing use of computers and systems analysis will draw to police work men and women with strong educational backgrounds.

Although advantages may be identified, the use of the computer will also inevitably present certain difficulties. Programming the machine, first, to perceive behavioral relationships and, second, to handle human languages are two of the greatest problems. One would limit the application of information technology to settings where human relations are vital, and

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27. President's Commission on Law Enforcement and Administration of Justice, Task Force Report: The Police (Washington, D.C.: U.S. Government Printing Office, 1967), p. 125.

28. The President's Crime Commission recommended that in the long run all police recruits should possess a bachelor's degree. As a minimum requirement in the short run, the Commission suggested that all future personnel serving as police officers should have completed at least two years of college at an accredited institution (p. 126). As noted earlier in the chapter, this proposal, if implemented, might work at cross purposes to another goal of police staffing--the recruitment of police officers from minority groups, where the opportunity or ethic for a college background may be limited.

the other would necessitate the translation and interpretation of information before and after it is processed. When computer technology shifts away from those areas which simply require the replication of routine processing activities and moves towards more "creative" applications which require the quantifying and automating of such endeavors as the control and dispatch of police officers or the allocation of patrol resources, difficulties will most likely increase. Then interaction between those who design computer programs and those who are to use them will be essential.

Analysis of the impact of computer use on police personnel must also allow for the particular characteristics and self-perceptions of police officers. Studies have shown that police often consider their job to be an unpopular one and their behavior to be disliked by the public.[29] As a consequence, they develop a defensive posture and react by turning inward, "minding their own business", "keeping their mouths shut," and "not sticking their necks out." The social cohesion of a department results from this perceived rejection and hostility of the public coupled with the contrasting warmth and security of the police force itself. As the focus turns within, the potential for corruption seems to increase. Secrecy becomes the rule and change is suspect, particularly change introduced from the outside.

The implications of such perceptions for police use of information

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29. See, for example, James Q. Wilson, "Police Morale, Reform, and Citizen Respect: The Chicago Case," in David Joseph Bordna, ed., The Police: Six Sociological Essays (New York: John Wiley, 1970), pp. 137-162; William A. Westly, Violence and the Police, A Sociology Study of Law, Custom and Morality (Cambridge, Mass.: MIT Press, 1970), pp. 48-112.

technology are fairly obvious. People soon learn to be comfortable with their established relationships and organizational structures; their security is derived from stability and cohension. Often their minds are set against change, particularly change imposed from outside or by a machine. Thus moderate or even strong resistance to the introduction of computer technology may be expected, at least from some police departments. The computer is an "innovation," a new approach to operation, a potential controller and revealer of valuable information. Moreover, despite some evidence to the contrary, the computer is perceived as a threat to job security. If it will not eliminate jobs entirely, it may at least influence a shift in work activities.

Perhaps, then, the impact of computer technology on police personnel will be less important than the impact of police personnel on computer technology.

3. Police organization and structure. One of the basic concerns regarding police structure today is the question of centralization versus decentralization. This has stemmed partly from an almost unquestioned emphasis on the "professional" model of police work as the primary key to police reform. The basic tenets of this approach include highly centralized responsibility (greater power for the chief of police and other administrative heads of the police department), an effort to eliminate political interference and corruption at both the precinct and central headquarters level, and an attempt to reduce discretion by laying down standards and guidelines for behavior and performance.

In recent years, however, some rhetoric has been directed towards returning greater control to communities and personalizing government through more decentralized forms of control. With this movement have come varying and sometimes conflicting suggestions for decentralizing the police. These range from programs for administrative decentralization within the police bureaucracy, such as team policing, to proposals for citizen advisory boards and plans for placing the police under various forms of direct "community control." Administrative decentralization of police functions would give component units of police departments greater freedom and would result in a shift in decision-making power from city headquarters to the precinct and district levels. Dispersal of police authority, on the other hand, would not merely pass power down the line within the police bureaucracy, it would pass the power from the police to "the community," and, more specifically, to the various political groupings within the community.

The introduction of computer technology cannot be expected to have much impact, at least in the short run, on efforts to extend control of the police to "the community." On the contrary, the resolution of these issues of power and control will be primarily political. It is expected, however, that the use of the computer by the police may have some influence within police departments. Such shifts relate to the power impacts discussed earlier in the general expectations section of the chapter, and might, for example, include the following:

- The power of those at the top administrative level may become more centralized. Nevertheless, many administrators will probably lack understanding of the new systems, and this lack will keep them from realizing their full potential.
- The influence and importance of those with technical backgrounds related to quantitative and computer skills will increase.
- Computers will be most welcome in legalistic police departments,

and the use of computer technology may push other departments toward a more legalistic style of activity.

D. A Framework for Evolution

In evaluating the use of computer technology by the police, it is possible to outline a general framework for evaluation, a framework based first on general expectations related to computer use in all institutions, but modified somewhat based on the unique characteristics of police work. At least four levels of evaluation may be considered:

1. Does the application of computer technology work? Does it stay in operation for a period of years? And during these years, does it meet the objectives that were outlined at the time the innovation was installed?
2. What have been the technical impacts achieved through changes in the input, processing, and output of information? Is new information available or is it provided at a lower cost or with greater speed? Is there a greater sharing of data among police agencies because of computer technology?
3. What have been the service impacts, if any? Here the question of police tasks and whether they have been influenced by computer technology is particularly relevant. Has the greater availability of information really made a difference? Are police activities performed more rapidly or efficiently? What unexpected influences on police task and service have occurred?
4. Have there been any power shifts through the use of computer technology--that is, have there been any impacts on police

personnel and structure? The unique nature of the police and their tendency to resist outside influence and change will influence implementation. If implemented, though, will computer technology shift power to those in a police department who are more quantitatively oriented? Will it lead to centralization or decentralization? Will certain police departments that are more legalistic in their approach be more likely to achieve success in implementing technological innovation?

This report will not be able to answer all of these questions concerning each application of computer technology. Still, such a framework allows a useful beginning for review. The questions to be answered are more than: "Do the benefits justify the costs?" Rather, there is a wide range of issues, as outlined above. More than just monetary factors must be considered when outlining technological change. Because of the fragmentary nature of police work and the variety of styles of police behavior, the circumstances in each police department will differ. Some will resist implementation more than others, and some will achieve greater success than others. Although this report will try to draw general conclusions, it is probably impossible to produce a definitive evaluation that will be applicable to all police departments. Ultimately, costs and benefits depend on individual goals, priorities, and structures; each police department will be somewhat different.

In conclusion, the potential impact of computer technology on police work has both positive and negative dimensions. Since the police task is highly discretionary and requires the processing and handling of large amounts of information, an added capability to manipulate such data and to provide information with speed and precision can help satisfy the basic needs of police work. On the other hand, the tendency for policemen to perceive their jobs as unpopular with the public, to seek privacy in their work, and to resist change, along with the difficulty of programming the computer to perceive behavioral relations and to understand and reproduce human language, point to potential problems in implementing computer technology. These problems will appear particularly in those areas in which the machine is being used for nonroutine purposes rather than for automating the routine processing and retrieving of specific data.

CHAPTER II

THE EXPERIENCE OF POLICE DEPARTMENTS IN USING COMPUTERS AND OTHER INFORMATION TECHNOLOGIES

by Kent W. Colton

In 1971, working in conjunction with the International City Management Association (ICMA), a survey was designed and implemented by the author to measure the extent of police use of computers in the United States.[1] In addition, visits were made to 14 police departments around the country in order to enrich and supplement the survey findings.[2] The results of the 1971 survey showed that 39 percent of the 498 police departments responding to the questionnaire had implemented some type of computer application. For departments in cities with populations of 100,000 and over, this figure rose to 69.3 percent. Nearly two thirds of all the departments responding indicated that they would be using a computer by 1974.[3]

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1. Certain portions of this chapter contain data and information published in other articles by the author. These include K. W. Colton, "Computers and the Police Revisited: A Second Look at the Experience of Police Departments in Implementing New Information Technology," Innovative Resource Planning Report PP-02-74; and "Computers and the Police: Police Departments and the New Information Technology," Urban Data Service Report, vol. 6, no. 11 (Washington, D.C.: ICMA, November 1974). Materials are included in this chapter with permission from the International City Management Association.

2. The following cities were visited: Boston, Mass.; St. Louis, Mo.; Wichita Falls, Tex.; Tulsa, Okla.; Springfield, Mass.; Hartford, Conn.; Atlanta, Ga.; Dayton, Ohio; Kansas City, Mo.; Los Angeles, Calif.; Long Beach, Calif.; San Francisco, Calif.; Oakland, Calif.; and Denver, Colo.

3. K. W. Colton, "Uses of Computer by Police: Patterns of Success and Failure," Urban Data Service Report, vol. 4, no. 4 (Washington, D.C.: ICMA, April 1972); and Colton, "Police and Computers: Use, Acceptance and Impact of Automation," ICMA, 1972 Municipal Year Book.

In the spring of 1974, in order to confirm the 1971 survey results and see if the projections had proven accurate, a second survey was designed and carried out under the joint auspices of the ICMA and the Innovative Resource Planning Project (IRP) by the National Science Foundation (NSF). Two primary tools were used in this second study -- a mailed survey followed by a series of telephone interviews.

The ICMA distributed my survey questionnaire to 410 police departments around the country. This questionnaire was designed to permit specific comparison with the 1971 survey, as well as to collect additional information on issues which had grown out of the analysis of the earlier survey. The sample included all police departments in cities with populations over 50,000. (The first questionnaire had also been mailed to 25 percent of the police departments in cities with populations between 25,000 and 50,000.) Of the 410 police departments surveyed in 1974, 325 departments responded, representing 80 percent of the sample, as Table 2-1 shows. (Appendix A provides a more complete description of the research and survey methodology.)

In order to explore the results of the mailed survey more deeply, telephone interviews were conducted with the police chief or, on occasion, with a member of the chief's staff, in a sampling of 28 of the responding departments.[4] Because of the small sample size, no definite conclusions can be drawn from the interviews, but they have been an

4. Police departments for the telephone interviews were selected from a sampling of those in cities with populations of 100,000 or more and which were using Electronic Data Processing (EDP) equipment for police functions. Eight-two jurisdictions met these criteria. These cities were stratified according to geographic location, and 28, or approximately one-third of the 82, were selected randomly for the telephone interviews.

invaluable aid in understanding and interpreting the mailed survey.

As expected, many of the findings of the second (1974) survey were similar to those of the first study. Had this not been the case, I would be concerned about the reliability of the two data sources. As it is, with the combined weight of the two surveys, it is possible to speak about the results with greater confidence. (For the sake of comparison, Tables 2-1 and 2-2 provide a breakdown of characteristics of the respondents to the 1971 and 1974 surveys.)

The first main section of this chapter which deals with the use of information technology by the police, presents the general results of the two surveys, describes the computer applications actually utilized by the police, and discusses the evolution of police computer use since 1960. In order to compare these research results with other studies, a literature search was conducted, and the second section of the chapter outlines the results of the search.

A. Computer Use by the Police

The first real-time police computer system in the United States was installed in the St. Louis Police Department in the mid-1960s.[5] Since then, tremendous nationwide growth has occurred in police use of computer technology.

1. <u>Survey results</u>. In spite of this growth in the police use of

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5. Real-time or on-line refers to direct access, through a terminal, to computer files at any time so that all inquiries receive almost immediate response (for example, a real-time access to a file of stolen vehicles through a video display terminal).

Table 2-1: Police Computer Use Response, 1974 Survey

Demographic and Governmental Characteristcs	Departments Surveyed (A)	Departments Responding: Number of Responding (B)	Departments Responding: Percentage of Responding (B/A)
Total, all cities	410	325	80
Population group			
Over 500,000	26	20	77
250-000-499,999	30	26	87
100,000-249,999	98	80	82
50,000- 99,999	256	199	78
Geographic region			
Northeast	102	71	70
North Central	109	82	75
South	103	88	86
West	96	84	88
City type			
Central	260	212	82
Suburban	150	113	75
Form of government			
Mayor-council	165	115	70
Council-manager	215	186	87
Other[a]	30	24	80

a. Includes cities with commission, town meeting, and representative town meeting.

Source: 1974 survey

Table 2-2: Police Computer Use Response, 1971 Survey

Demographic and Governmental Characteristics	Departments Surveyed	Departments Responding		Departments Using Computers			
				Yes		No	
	(A)	Number (B)	Percentage (B/A)	Number (C)	Percentage (C/B)	Number (D)	Percentage (D/B)
Total, all cities	498	376	75.5	146	38.8	230	61.2
Population group							
Over 500,000	26	20	76.9	20	100.0	0	0
250,000-499,999	30	29	96.0	23	79.3	6	20.7
100,000-244,999	98	77	78.6	45	58.4	32	41.6
50,000-99,999	227	175	77.1	45	25.7	130	74.3
25,000-49,000	117	75	64.1	13	17.3	62	82.7
Geographic region							
Northeast	-	92	-	13	14.1	79	85.9
North Central	-	100	-	41	41.0	59	59.0
South	-	91	-	46	50.5	45	49.5
West	-	92	-	45	48.9	47	51.1
City type							
Central	-	203	-	103	50.7	100	49.3
Suburban	-	141	-	38	27.0	103	73.0
Independent	-	32	-	5	15.6	27	84.4
Form of government							
Mayor-council	-	134	-	47	35.1	87	64.9
Council-manager	-	211	-	89	42.2	122	57.8
Other[a]	-	31	-	10	32.3	21	67.7

a. Includes cities with commission, town meeting, and representative town meeting.

Source: 1971 survey

computers, the results of the 1974 survey reveal that the implementation of information technology occurred at a slower rate than had been predicted in 1971. In 1974, of the 325 cities responding to the questionnaire, 183, or 56 percent, were using a computer. In 1971, for departments of comparable size, 44 percent of the departments had indicated computer use (see Table 2-3 and Figure 2-1). By 1974, therefore, an increase of 12 percent had occurred in the number of law enforcement agencies using computer equipment; but the predictions for computer use by 1974 had been much higher. In 1971, 24 percent of the departments of comparable size that were not using a computer had stated that they would be using one within three years. Thus, although a number of departments did acquire computer capability between 1971 and 1974, the growth of computer use during that period was only about half of what had been predicted three years earlier.

Some of the variation may be accounted for by a slightly different response rate between the two studies, and perhaps by ranging interpretations when different people filled out the two questionnaires. But more important, people tend to be overly optimistic in estimating future growth. The slower rate of 12 percent may also indicate that some police departments are taking a more careful and sophisticated approach to computer use. A healthy pragmatism exists in many departments, and in some there is even skepticism. Still, estimates of future growth that were given again in 1974 were quite high. Of the responding departments, 74 predicted that they would be using a computer by 1977 (see Figure 2-1).

According to the 1971 survey, the single most important factor in determining whether a police department used a computer was the size of the city in which it was located. As anticipated, the data from the second (1974) survey revealed this same pattern: 100 percent of the responding departments in cities of 500,000 and over were using a computer; 70.8 percent of the departments in cities between 100,000 and 500,000; and 44.2 percent of departments in cities under 100,000. (See Figure 2-2 and Table 2-3.) In addition, as Table 2-3 indicates, more police departments in central cities tended to use computers (60 percent) than did departments in suburban cities (49 percent).

Regarding a second factor -- form of government -- council-manager cities showed a much higher percentage of use (61 percent) than did cities with mayor-council forms of government (47 percent). This was true even though mayor-council cities tend to have larger populations and thus might be expected to have a higher rate of computer use.

Geographically, the West had the largest number of computer users in 1974, with 61 of the 84 responding departments, or 73 percent, indicating that they had access to a computer. (See Table 2-3.) The South, which had been the leader in 1971, came in a close second with 67 percent of the responding departments reporting use, followed by the North Central states with 49 percent. In 1971, the Northeast had been the lowest user of computers, and in 1974 that was true again, with only 34 percent of its police departments using computers. Among the individual states, California and Virginia had by far the largest number of cities with police-related computer use.

It is particularly revealing to compare regional predictions of computer use which were made in 1971 and what had actually occurred by 1974. (See Table 2-4.) Significantly, the West was the only region of the country to fulfill its expectation: 73 percent use. The South fell short of its predictions, but not by as much as the North Central and Northeastern regions. In fact, failure of the North Central and Northeastern areas to

Table 2-3: Police Computer Use, 1974

Demographic and Governmental Characteristics	Number of departments responding (A)	Police departments using a computer: Number (B)	Police departments using a computer: Percentage (B/A)	Police departments not using a computer: Number (B)	Police departments not using a computer: Percentage (B/A)
Total, all cities	325	183	56	142	44
Population group					
Over 500,000	20	20	100	0	0
250,000-499,999	26	22	85	4	15
100,000-249,999	80	53	66	27	34
50,000- 99,999	199	88	44	111	56
Geographic region					
Northeast	71	24	34	47	66
North Central	82	39	48	43	52
South	88	59	67	29	33
West	84	61	73	23	27
City type					
Central	212	128	60	84	40
Suburban	113	55	49	58	51
Form of government					
Mayor-council	115	54	47	61	53
Council-manager	186	114	61	72	9
Other[a]	24	15	62	9	38

a. Includes cities with commission, town meeting, and representative town meeting.

Source: 1974 survey

Table 2-4: Regional Comparisons of Computer Use by Police in 1971 and 1974

1971 Computer Use

Geographic region	Departments responding Number (A)	Departments using computers Number (B)	Departments using computers Percentage (B/A)	Additional departments planning computer use by 1974 Number (C)	Total number of users by 1974 according to 1971 predictions Total Number (D) = (B+C)	Departments actually planning on use by 1974 Percentage (D/A)
Total, all regions	375	145	39	89	234	62
Northeast	92	13	14	24	37	40
North Central	100	41	41	23	64	64
South	91	46	51	20	66	76
West	92	45	49	22	67	73

1974 Computer Use

Geographic Region	Departments responding Number (E)	Departments actually using computers Number (F)	Departments actually using computers Percentage (F/E)
Total, all regions	325	183	56
Northeast	71	24	34
North Central	82	39	48
South	88	59	67
West	84	61	73

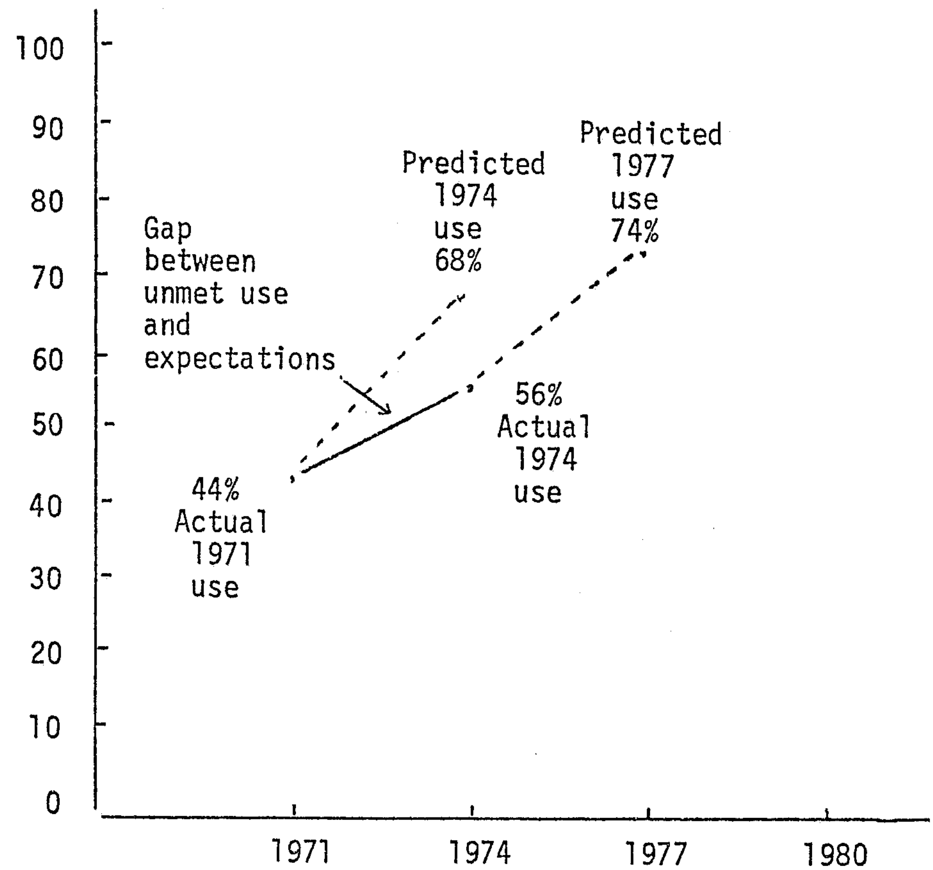
Table 2-5: Predicted Future Computer Use by Police

Demographic and Governmental Characteristics	Departments reporting not using a computer Number (A)	Departments planning future computer use Number (B)	Percentage (B/A)	Departments not planning future computer use Number (C)	Percentage (C/A)	Departments uncertain about future computer use Number (D)	Percentage (D/A)
Total, all cities	142	59	42	17	12	57	40
Population group							
Over 500,000	0	0	0	0	0	0	0
250,000-499,999	4	4	100	0	0	0	0
100,000-249,999	27	15	56	0	0	12	44
50,000- 99,999	111	40	36	17	15	45	41
Geographic region							
Northeast	47	16	34	3	6	21	45
North Central	43	21	49	5	12	17	40
South	29	11	38	3	10	14	48
West	23	11	40	6	26	5	22
City type							
Central	84	34	40	9	11	30	45
Suburban	58	25	43	8	14	19	33
Form of government							
Mayor-council	61	23	38	5	89	27	44
Council-manager	72	33	46	12	17	25	35
Other[a]	9	3	33	0	0	5	56

a. Includes cities with commission, town meeting, and representative town meeting.

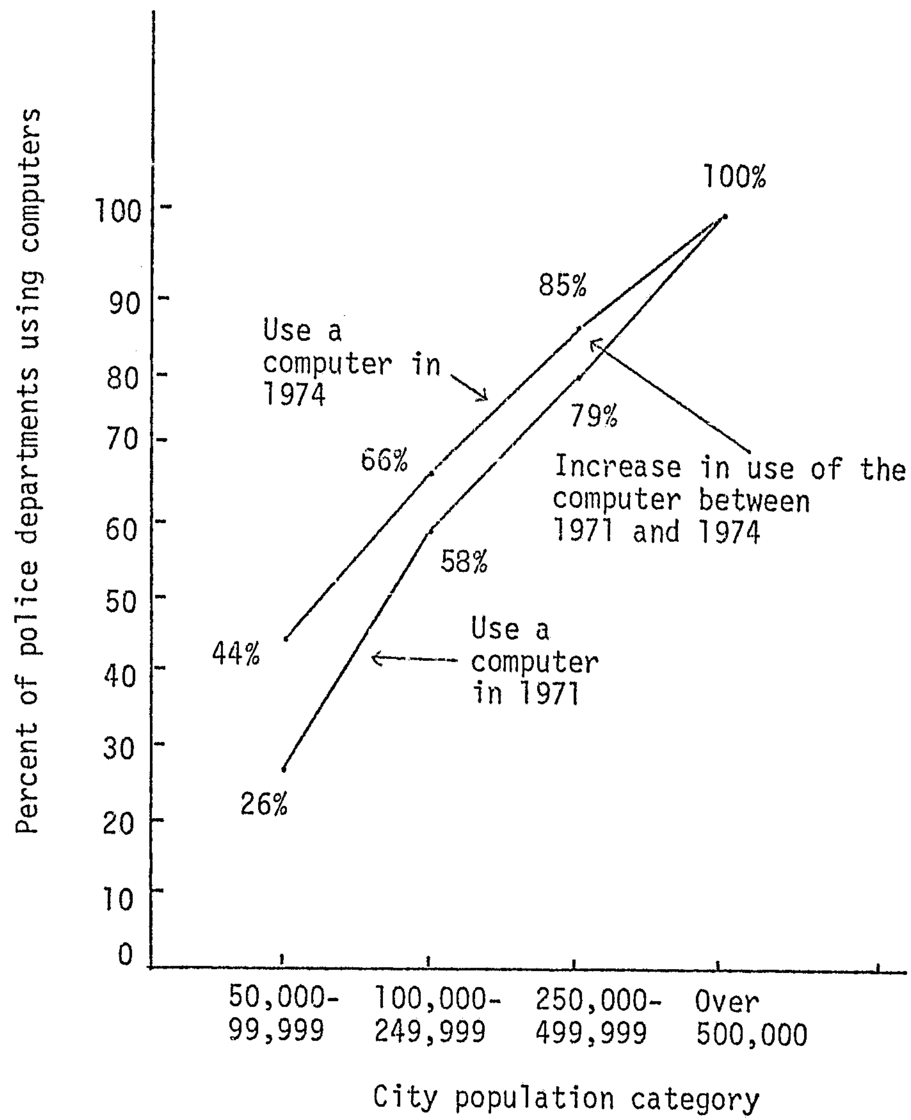
Source: 1974 survey

Figure 2-1: Police Computer Use, 1971, 1974, and 1977



Source: 1971 and 1974 Surveys

Figure 2-2: Influence of city size on current and past use of computers by police departments for 1971 and 1974



Source: 1971 and 1974 Surveys

to meet expectations was responsible for a large majority of the predictions that were not met in 1974. Predictions for future computer use which were made in 1974 are shown in Table 2-5.

2. Computer applications. In filling out the mailed surveys, police departments were asked to indicate for each of 24 different application areas whether they were presently using a computer and to specify whether or not such applications involved real-time access.[6] Departments were also asked whether they were planning to implement a particular computer application within three years, and to specify whether or not this application would be real-time.

a. Areas of application. As figure 2-3 indicates, the 24 applications were grouped into eight areas, depending on their basic thrust: police patrol and inquiry, traffic, police administration, crime statistical files, miscellaneous operations, resource allocation, criminal investigation, and command and control.

° Computer use for police patrol and inquiry allows a police officer to make rapid real-time inquiries about identification of people or property (wanted, missing, or stolen). The types of applications include files of outstanding warrants, stolen property files, and listings and cross-references between registered vehicles and their owners. The types of technology utilized in this application area vary widely: some police departments retrieve information on

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6. The 24 application choices for the second survey were nearly identical to the list presented to the departments in the 1971 questionnaire. The only differences were that (1) the "communications switching" application was dropped from the list in the 1974 questionnaire, and (2) th application "traffic allocation and distribution" was added.

Figure 2-3: Computer Application Uses

Application areas	Computer applications
Police patrol and inquiry	Warrant file Stolen property file Vehicle registration file
Traffic	Traffic accident file Traffic citation file Parking violation file
Police administration	Personnel records Budget analysis and forecasting Inventory control file Vehicle fleet maintenance Payroll preparation
Crime statistical files	Criminal offense file Criminal arrest file Juvenile criminal activity file
Miscellaneous operations	Intelligence compilation file Jail arrests
Resource allocation	Police patrol allocation and distribution Police service analysis Traffic patrol allocation and distribution
Criminal investigation	Automated field interrogation reports Modus operandi file Automated fingerprint file
Command and control/ Computer-aided dispatch[a]	Computer-aided dispatching Geographic location file

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[a]The numbers displayed in the figures and tables in the remainder of the chapter for the command and control/computer-aided dispatch area will include only data concerning computer-aided dispatch applications.

"teletype" computer terminal for each police dispatcher. Recently, CRT digital terminals have been placed in patrol cars so that police officers can make inquiries without going through an operator.

- The traffic application area includes automated records of traffic accidents, citations, and parking violations. Besides providing statistical data, these applications often bring additional revenues to the city through increased efficiency in collecting fines for traffic and parking violations.
- Computer use in police administration corresponds closely to computer use in other governmental areas and in business organizations, including personnel records, payrolls, budget analysis and forcasting systems, inventory control files, and fleet maintenance records.
- Crime statistical files include basic files on the type and number of criminal offenses and arrests and on juvenile criminal activity. These records are used widely in filling out reports (such as the FBI Crime Reports), and in supplying historical records. The data are also vital to computer use in other application areas, such as resource allocation, program formulation and planning, and criminal investigation.
- Miscellaneous operations include files related to jail arrests (to keep track of people who have been arrested, acquitted, or released on bail) as well as files related to intelligence.
- Resource allocation applications may be used to analyze police service and provide for the allocation and distribution of patrol units. In some cities, computers help predict workloads and alter

police patrol force deployment to meet changing crime patterns on an hourly and seasonal basis.

- The criminal investigation application area provides an officer or detective with supporting information for investigating and solving crimes. This may include information on crime patterns, modus operandi (an individual or group pattern, or a method of operation), automated access to field interview reports, a nickname file, and fingerprint matching.
- Command and control computer uses provide for the automated or paritally automated "command and control" of field units in order to speed up and more effectively handle and control the dispatch patrol officers in answer to calls and the completion of other police duties. Computer-aided dispatch (CAD) systems which automatically transfer calls from the police telephone operator to the dispatcher and keep track of the status and service times of calls provide the framework for automated police command and control. Other innovations are also contemplated, including 911 emergency telephone number source, mobile and portable digital terminals, and automatic vehicle location or monitoring systems to track the location of police vehicles. Such command and control systems generally require some type of geographic base file for the city.[7]

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7. Of the possible command and control applications, police departments were only asked in the 1971 and 1974 surveys if they had computer-aided dispatch systems or geographic base files. Further, since geographic base files are not a police computer application per se, but rather are a means to an end, in the aggregate data displayed in the remainder of the chapter about the command and control/computer-aided dispatch data, only the numbers concerning computer-aided dispatch will be reported.

b. Routine and nonroutine applications In evaluating the use and impact of computers in the U.S. police departments, a further distinction should be made between "routine" and "nonroutine" applications.[8]

Routine applications involve the relatively straightforward, repetitive manipulation and inquiry of prescribed data, often by means of a definite procedure. The same manipulation which the machine accomplishes has usually be done by hand before the advent of the computer, which just makes the process quicker and easier. For example, although police patrol and inquiry applications are technically advanced and may bring great benefit, such inquiry systems are relatively straightforward; the tasks involved were performed manually before the computer and can be considered routine. Other routine applications areas comprise traffic files, crime statistical files, police administration, and miscellaneous operations, as Figure 2-4 illustrates.

Nonroutine applications are more elustive. In this area the machine becomes a tool for decision-making, strategic planning, and man-machine interaction. There are no absolute, cut-and-dried methods for handling problems in nonroutine application, either because they are complex or because their importance calls for custom-tailored treatment. The human element is vital to judgment, evaluation, and insight. Nonroutine

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8. The distinction between "routine" and "nonroutine" problems regarding computer applications is also discussed in G. Anthony Gorry and Michael S. S. Morton, "Management Decision Systems: A Framework for Management Information Systems," Working Paper No. 458-70, MIT Sloan School of Management, April 1970, where the terms "structured" and "unstructured" are used. The terms "programmed" and "unprogrammed" are used by Herbert A. Simon in The Science of Management Decision (New York: Harper and Row, 1960), p. 6, to draw a similar distinction.

Figure 2-4: Routine and nonroutine police computer applications

Routine		Nonroutine
Police patrol and inquiry	---+-->	
Traffic applications	---+-->	
Miscellaneous operations	---+-->	
	<--+---	Command and control/ Computer-aided dispatch
	<--+---	Criminal investigation
	Crime statistical files	
Police administration	---+-->	
	<--+---	Resource allocation

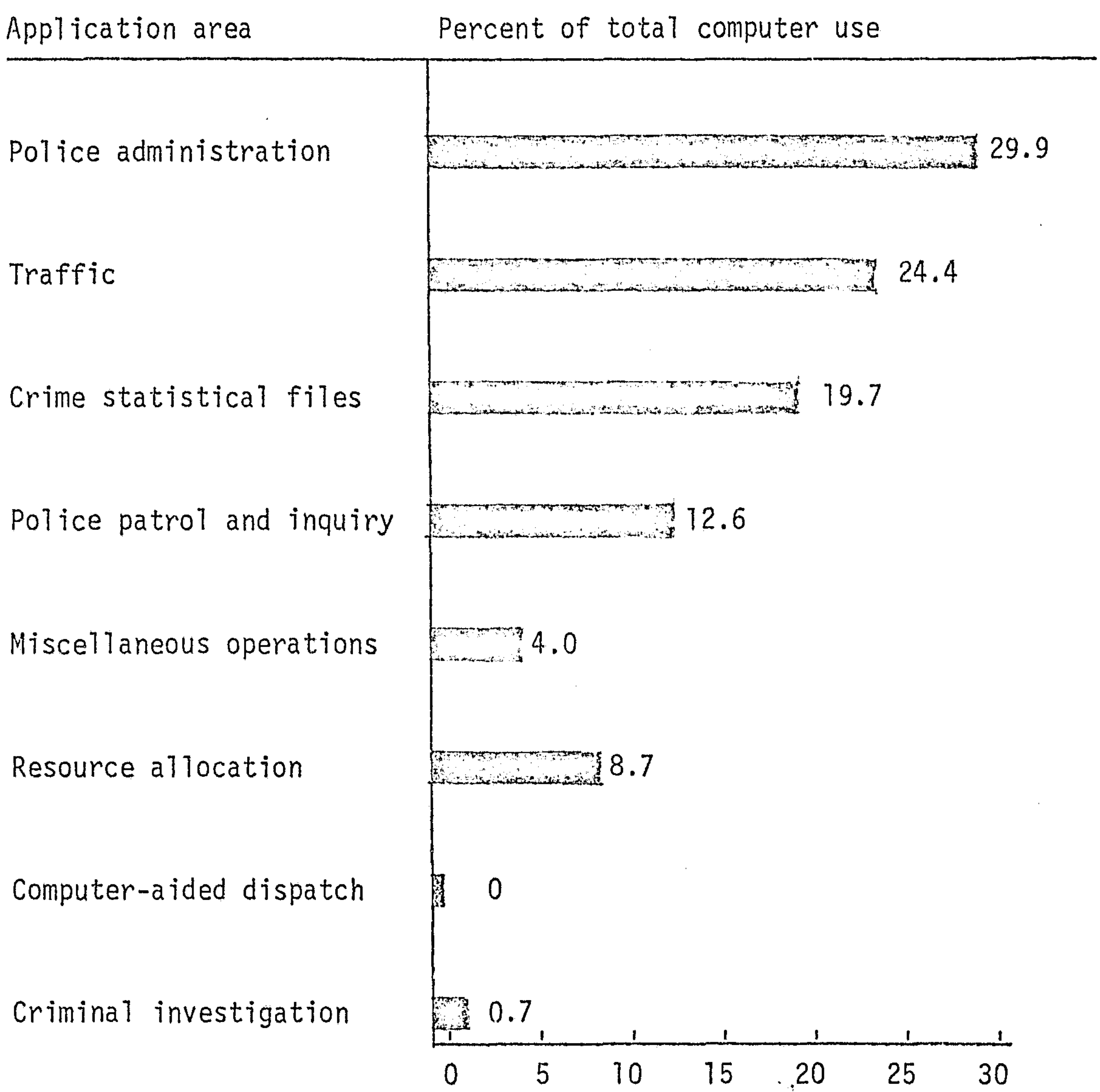
application areas in law enforcement include resource allocation, investigation of crime, and command and control (including such applications as computer-aided dispatch and automatic vehicle monitoring). (See Figure 2-4.)

Rather than viewing routine and nonroutine categories as sharply defined classifications, however, one should regard them as converging opposite ends of a spectrum. As applications move toward the nonroutine end of the spectrum, systems design becomes more difficult; and behavioral, personaltiy, and organizational considerations become more significant. For nonroutine applications to be successful, an effective interaction between man and machine is necessary. Several applications fall between the two extremes. The best example is crime statistical files which, though generally routine in collection and processing, provide the basic data for a number of nonroutine activities such as computer assisted criminal investigation and resource deployment. Although no classification system is perfect, this distinction between routine and nonroutine computer applications in law enforcement can be very useful in analyzing the implementation and impact of computer use.

3. The evolution of computer use. The growth of computer use by the police may be divided into four periods: 1960-1966, 1967-1971, 1971-1974, and 1974-1977.

a. 1960-1966. Police first used the computer in nonroutine ways in connection with traffic, police administration, and criminal statistical files. The last application provides data for state and local reports and the FBI's Uniform Crime Reports. By the end of 1966, the other two uses -- traffic and police administration -- represented, in terms of number of applications, better than half (54 percent) of the total computer use, as shown in Figure 2-5. The most common single application was payroll preparation, with 20 of the 32 departments that were using a computer in 1966

Figure 2-5: Status of computer use in 1966



Source: 1971 Survey

indicating such use. Bye the end of this period, criminal statistical files came third among the areas of computer use.[9]

b. <u>1967-1971</u>. By the mid-sixties, the capability for real-time computer applications had been developed, and the President's Crime Commission suggested a variety of ways in which the rapid access to information could benefit a department's operation. Consequently, between 1967 and 1971, some shifts in emphasis occurred in the use of computers. While the total number of traffic and police administration applications continued to increase, the relative percentage of uses in these two areas dropped.[10] Uses in the criminal statistics category experienced continued growth. Forty-seven departments added automated criminal offense files to their computer operation -- the largest abolute increase for any individual application during this period.

Even more striking was the tremendous growth in the police patrol and inquiry area. Rising from relative obscurity in the previous period, inquiry applications increased sevenfold between 1967 and 1971. By 1971, almost one fifth of all reported police computer use was devoted to the rapid retrieval of information on outstanding warrants, stolen property, or vehicle

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9. In both 1971 and 1974, police departments were asked to indicate whether they were using a computer in any of the 24 application areas. The total number of computer applications in all police departments was then calculated. Applications were grouped into the eight application areas shown in Figure 2-3, and a percentage of total computer use for each application area was derived by dividing the total number of application in that application area by the total number of computer applications in all police departments.

10. It should be noted that in interpreting the various figures and tables concerning computer use, the police administration area has a special advantage. As Figure 2-3 shows, five applications are included in that area, whereas in most others there are only three. Consequently, the tables for police administration are weighted on the high side.

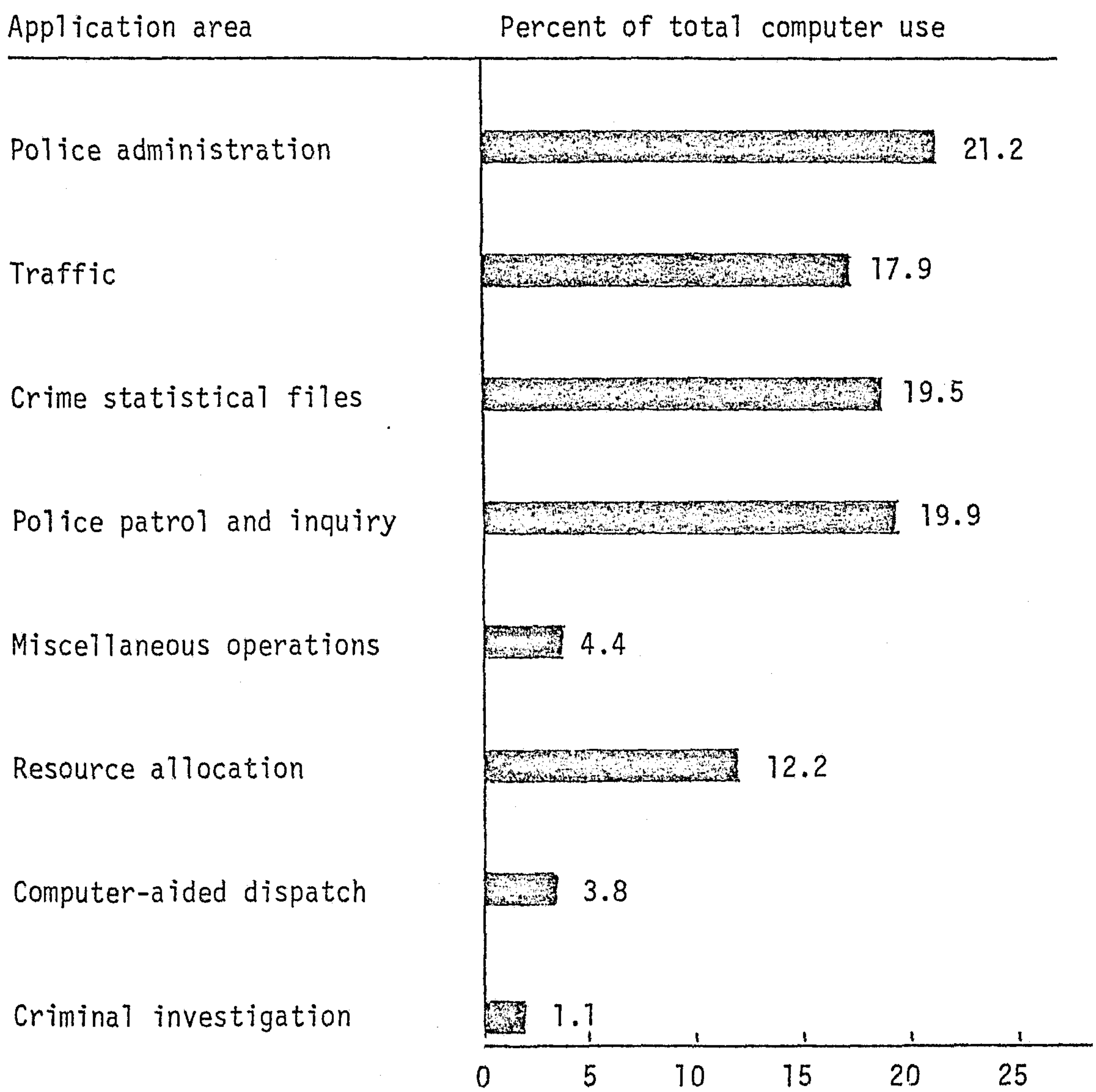
registration. Police patrol and inquiry applications in general moved from fourth to second place in terms of total computer use (see Figure 2-6).

The primary reasons for this widespread adoption of patrol inquiry applications were the safety and convenience of the patrol officer in the street. When an officer stops a speeding car, it is extremely helpful for him to know if the car is stolen so that he can be prepared for a hostile reaction from the driver. Naturally, any computer application which can reduce the risk of officer inquiry will be given a high priority in departmental planning. Also, the patrolman receives a response with maximum convenience and minimum delay because an overwhelming percentage of police and patrol and inquiry applications are real-time and allow a response in seconds rather than minutes.

During the late sixties, attention was also focused on one nonroutine area of computer application -- using information technology to aid in patrol resource allocation decision-making and in the evaluation of police service. In absolute numbers, the resource allocation area still represented only a small fraction of total police computer operations at the end of 1971; but the greater than sixfold increase between 1966 and 1971 suggested that this category would soon become a major application area.

c. <u>1971-1974: predicted versus actual use</u>. In the first (1971) phase of the research, predictions of police computer use in the near future were based on the relative rates of growth in the various application areas up to that time, on departmental responses regarding future use, and on responses concerning the importance of various application areas. From this information, it was predicted that the police would continue to maintain crime-related and police administration files at a high rate, and that therefore these areas would constitute the major uses in 1974. Police patrol and

Figure 2-6: Status of computer use in 1971



Source: 1971 Survey

inquiry applications were also expected to achieve strong growth, moving to third in the total number of applications, with traffic-related applications dropping to fourth. Furthermore, the research predicted that while real-time systems would remain important, resource allocation applications would more than double between 1971 and 1974. The anticipated growth in this nonroutine category of resource allocation was consistent with the 1971 survey findings that police regarded patrol deployment and resource allocation as their most significant computer application.

Another significant finding of the first survey was that although neither computer-aided dispatch nor ciminal investigation had received much use in police departments by 1971, these two nonroutine applications still were ranked fairly high in terms of ratings of importance -- above traffic. police administration, and miscellaneous operations.[11] The survey showed that the number of departments with a computer-aided dispatch program was expected to increase by 1974 to almost six times its 1971 level. Criminal investigation applications were expected to experience an almost equally high rate of growth. Although these two categories would remain relatively minor in terms of average use, such increases were seen as important because they represented a shift towards greater use of nonroutine computer applications by the police.

Comparisons between the predictions of the 1971 survey and the results of the 1974 survey indicate, however, that the actual pattern of computer expansion differed in several ways from the predicted pattern, particularly

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11. Respondents were asked to indicate which three applications they considered the most significant.

in the nonroutine areas.[12] In the four routine uses, the general pattern was much as expected, although the total number of applications added was fewer than one might have anticipated. As was predicted, crime statistical files had the highest absolute use in 1974, as Table 2-6 shows. They were closely followed by applications in the areas of police administration, police patrol and inquiry, and traffic. The nonroutine area of resource allocation was still fifth in terms of the overall number of applications, but it had grown significantly -- increasing from 12 percent of the total number of police computer applications to 16 percent.

By 1974, use had "evened out" in all five of these application areas. Three years earlier, major differences in use had existed and continued major differences were anticipated for 1974. But by then the first five application areas were separated by a difference of only 57 applications between the highest (crime statistical files -- 315) and the lowest (resource allocation -- 258). The primary reasons for this were the major increase in the resource allocation area and the failure of the other four areas to expand at the anticipated rate.

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12. Care should be exercised in comparing the results of the 1971 and 1974 surveys. Both surveys were sent to essentially the same set of police departments, except that the 1974 survey was not sent to any police departments in cities with populations below 50,000. Tables 2-1 and 2-2 indicate the response rate for both surveys was relatively high, 75 percent for the 1971 survey and 80 percent for the 1974 survey. However, although there were undoubtedly significant overlaps, the police departments that responded in 1974 were not exactly the same ones that responded in 1971. Assuming that the respondents in both 1971 and 1974 are representative of the overall population of police departments, it is reasonable to compare the percentages of use in the various application areas from one survey to the other. The 1971 and 1974 data are presented in Table 2-6, but caution should be exercised in comparing the actual numbers of the two surveys because the data bases of the two are somewhat different.

Resource allocation was the only area whose growth rate since 1971 significantly exceeded predictions. The actual percentage was 16 percent -- a third higher than the predicted 12 percent. This growth in use corresponds with the high rating of importance ascribed to resource allocation in 1971. It should be remembered, however, that having a computer capability is not the same as actually applying it to resource decision-making. The extent to which computers have actually been implemented is still in question and will be discussed in greater detail in Chapters IV through VII.

As for the other two nonroutine application areas -- criminal investigation and dispatch -- the 1971 projections were overoptimistic. In 1971, it was predicted that in three years 9.5 percent of all computer applications would be in the criminal investigation area, whereas the actual percentage in 1974 was only 4.7. Similarly, in 1971 a large number of departments (61) had predicted that they would implement a computer-aided dispatch system by 1974. The 1974 survey, however, indicated that such systems had been installed in only 15 departments -- less than 1 percent of the total number of computer applications (see Table 2-6). The general failure of the departments to acquire such systems within the specified time frame is evidence of the difficulty involved in implementation. It also suggests that the departments did not understand the logistics, in terms of time and cost, to develop these systems: for example, a geographic base file is needed before s sophisticated computer-aided dispatch system can be implemented.

Although the expansion of police computer use by 1974 deviated from the patterns suggested in 1971, the second survey showed that during the three intervening years, the departments' perceptions of the relative importance of the different applications did not change significantly. According to the surveys of 1971 and 1974, the departments believed that overall resource allocation activities were their most important computer applications (Figure 2-8). Next in perceived importance came the crime statistics area, closely followed by the police patrol and inquiry application area. Computer-aided dispatch remained the fourth most valued application area -- an interesting fact in view of its poor implementation record. Police administration and traffic applications ranked very low in both 1971 and 1974.

In order to check the reliability of the questionnaire responses concerning ranking of importance, interviewers asked a number of the same questions over the telephone which had been posed in the mailed survey. Again, departments considered resource allocation to be extremely important. Indeed, a number of chiefs felt that the financial squeeze in which many cities found themselves was going to get worse before it got better and, therefore, the department should use its available resources in the most efficient manner. A further finding was that the chiefs and their command staffs were strongly committed to implementing those applications which they believed would be most helpful to the officer in the street. In particular, they were committed to the acquisition of a real-time police patrol and inquiry system. The number of interviewed departments whose representatives said that their want/warrang file was their most important computer operation was very high -- as high as the number that ranked resource allocation applications as most important.

In summary, important variations appeared between the computer use anticipated by the police in 1971 and its actual implementation by 1974. In routine application areas, use increased; indeed, four of the five top application areas were routine. In each case, however, use was less than had been predicted. Resource allocation was the only area, routine or

Table 2-6: Comparisons of 1971-1974 Predicted Use and 1971-1974 Actual Use of Computers by Police

Application Area	Actual Applications in 1971		Applications Predicted in 1974		
	Number (A)	Percentage of Total	1971-1974 Predicted Increase (B)	Total Predicted Plus Actual (C) = (A+B)	Percentage of Total
Police patrol and inquiry	180	19.9	138	318	15.7
Traffic	162	17.9	151	313	15.5
Crime statistical files	177	19.5	203	380	18.8
Police administration	192	21.2	191	383	18.9
Miscellaneous operations	40	4.4	83	123	6.1
Resource allocation	111	12.2	131	242	12.0
Criminal investigation	34	3.8	158	192	9.5
Computer-aided dispatch	10	1.1	61	71	3.5
Total	906	100.0	1,116	2,022	100.0

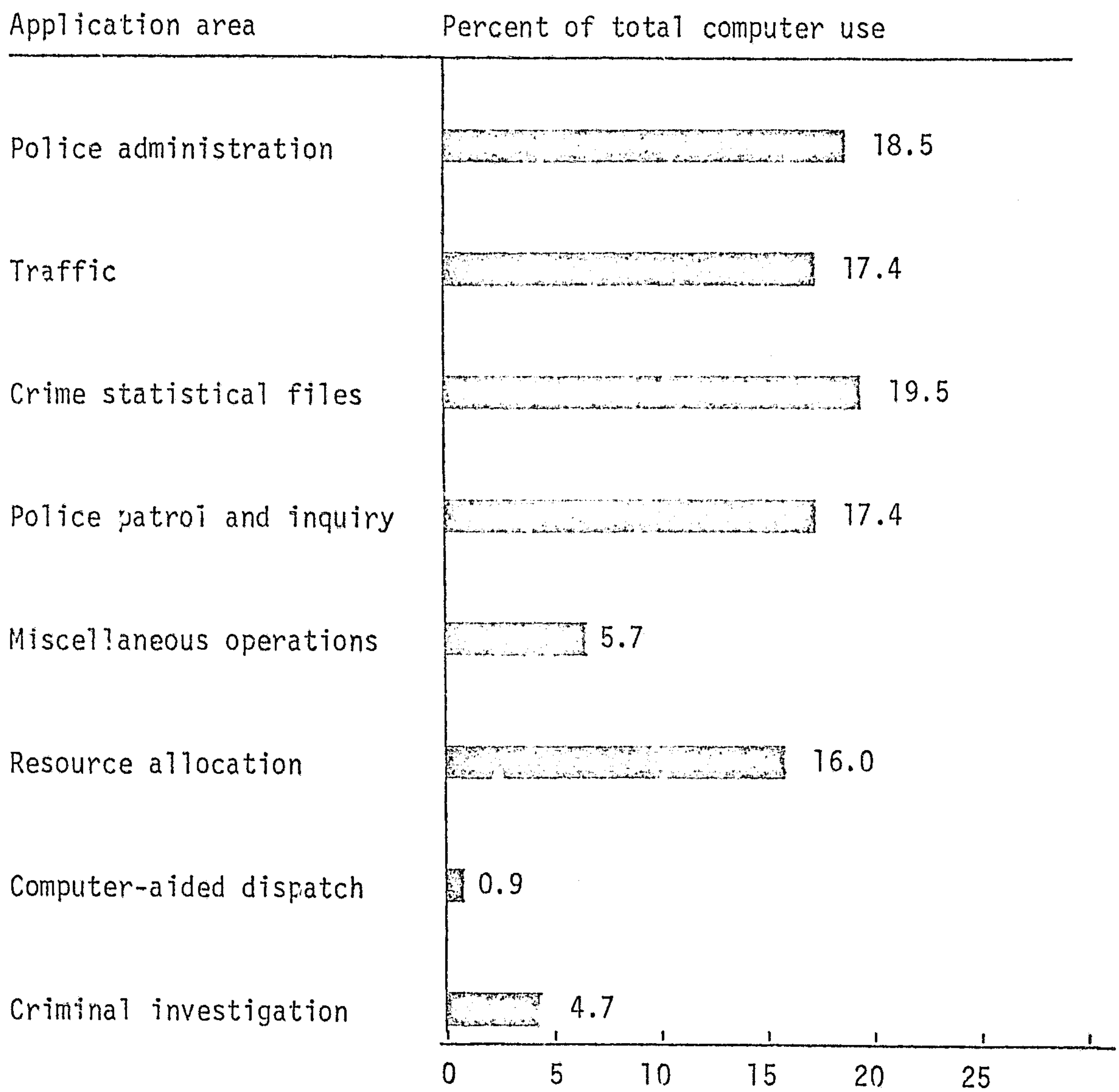
Source: 1971 and 1974 surveys

(continued)
Table 2-6: Comparisons of 1971-1974 Predicted Use and 1971-1974 Actual Use of Computers by Police

Application Area	Actual Applications in 1974: Number (D)	Actual Applications in 1974: Percentage of Total	Applications Predicted in 1977: 1974-1977 Predicted Increase (E)	Applications Predicted in 1977: Total Predicted Plus Actual (D) = (D+E)	Applications Predicted in 1977: Percentage of Total
Police patrol and inquiry	280	17.4	127	407	14.3
Traffic	280	17.4	141	421	14.8
Crime statistical files	315	19.5	173	488	17.1
Police administration	298	18.5	202	500	17.5
Miscellaneous operations	91	5.7	98	189	6.6
Resource allocation	258	16.0	219	477	16.7
Criminal investigation	75	4.7	189	264	9.3
Computer-aided dispatch	15	0.9	89	104	3.7
Total	1,612	100.0	1,238	2,850	100.0

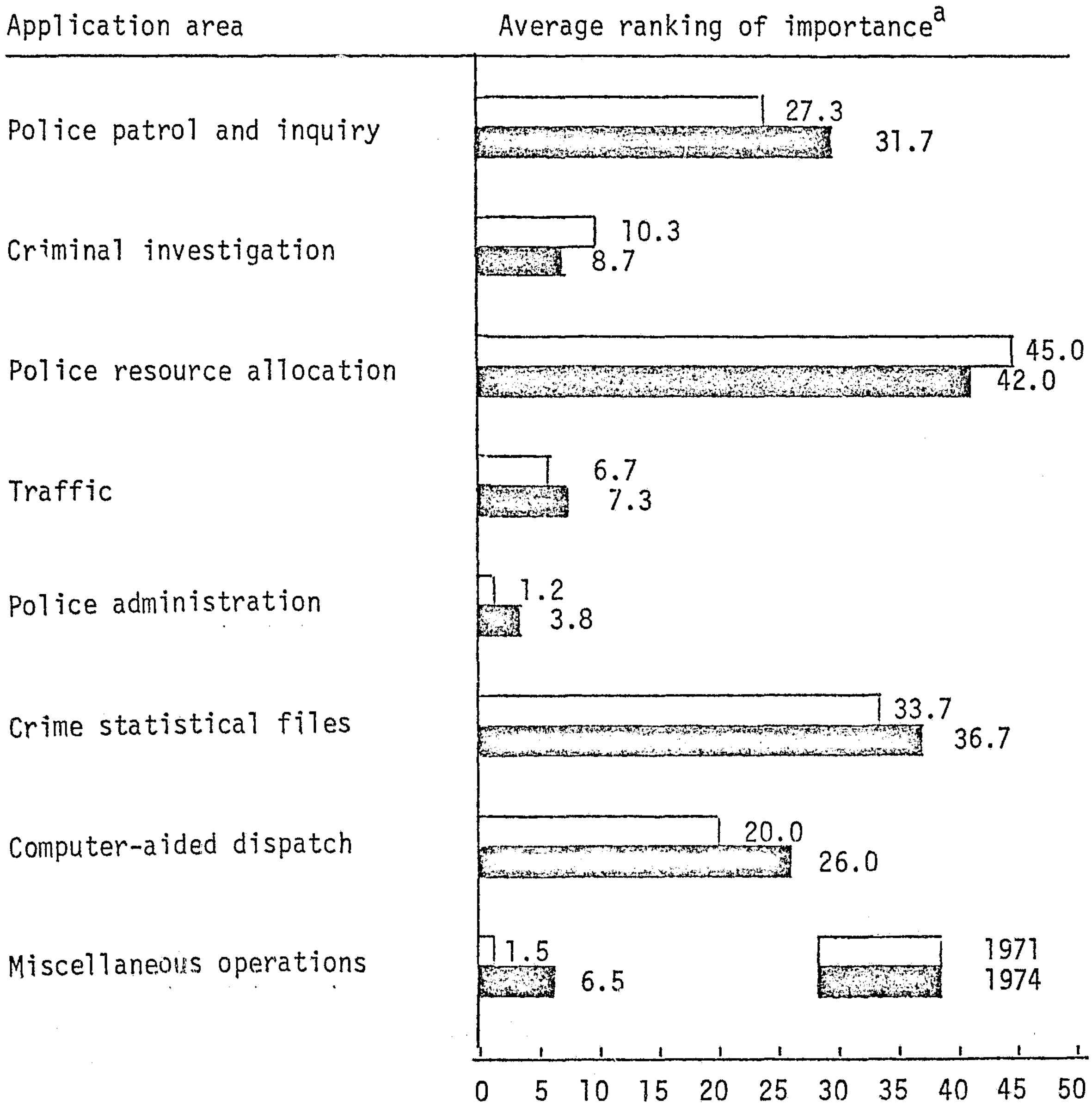
Source: 1971 and 1974 surveys

Figure 2-7: Status of computer use in 1974



Source: 1974 Survey

Figure 2-8: Importance of computer applications in 1971 and 1974, as ranked by police departments



[a]Ranking is based on the average number of times applications were selected by police departments as one of their three most important applications.

Source: 1971 and 1974 Surveys

nonroutine, in which the expected use level was actually met and surpassed. In the other two nonroutine application areas -- criminal investigation and computer-aided dispatch -- use fell far below the initial expectations of 1971.

d. 1974-1977: predicted use. In predicting police computer use for the next three years, the survey of 1974 offered advantages over the 1971 survey. It was known, for example, that the departments' own projections tended to be overly optimistic.

According to the 1974 survey responses (shown in Table 2-6), the greatest predicted growth through 1977 would come in the nonroutine application areas. Resource allocation was top (with a predicted growth of 219 new applications), followed by police administration (202) and criminal investigation (189). Computer-aided dispatch was also high. If geographic base files were considered part of that application area, an estimated 175 applications would be added by 1977.

Perhaps the most striking fact of the 1974 predictions for 1977 is the continued rise in popularity of the resource allocation application area. From fifth place in 1971 and 1974, resource allocation promised to become one of the major computer uses by 1977, along with police administration and criminal statistical files. Since resource allocation had been the only application area to equal and surpass its predicted use from 1971 to 1974, it seemed more likely that future growth would occur in this area than in others. Applications for traffic and for police patrol and inquiry would be fourth and fifth, respectively. Once again, with the exception of resource allocation, the top computer uses were expected in the routine area.

Growth in the two nonroutine areas of computer-aided dispatch and criminal investigation was the most questionable projection. Command and control and computer-aided dispatch systems, if they include such new technology as vehicle locator systems, are complicated endeavors requiring a good deal of effort, time, and money. If such a small number of departments were able to implement a computer-aided dispatch system within the three-year span from 1971 to 1974, it would be unreasonable to anticipate a much greater rate of success by the end of 1977. This is especially true if one considers that in 1974 only 44 of the sampled departments had working computer-based geographic base files. Moreover, because of the "command and control" orientation of computer-aided dispatch systems, such applications would have a greater probability of encountering resistance from the rank and file. From a technical viewpoint, certain criminal investigations applications should be less difficult to design and implement than command and control applications. But since it is a difficult task to educate detectives to actually use such systems, growth in this area was likely to fall short of projections.

B. Computer Use as Reflected in the Literature and Other Related Surveys

Since the second (1974) survey of police use of information technology was conducted almost three years ago, a search of the literature published since that time was undertaken in order to update this study and to see if any changes had occurred in the use of computer technology by the police.[13]

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13. The literature search for this project was conducted by Mark McKnew, a Ph.D. student in the Civil Engineering Department at MIT. His work on the project, including the first draft of the description of the literature search, has been extremely helpful.

A broad range of police, management, and municipal administration literature was examined, including police literature and texts;[14] journals dealing with new technology;[15] management literature, particularly materials focusing on urban administration;[16] and articles and pamphlets published by government agencies and by hardware and software vendors.[17] In addition, the reports of three other survey projects, similar to the surveys in this study, were examined and analyzed. The remainder of this chapter will discuss the findings of the literature search and the results of the related surveys.

1. Findings of the literature search. Taken as a whole, the literature confirmed and amplified the findings of the previous surveys. Among all the applications disucssed in the literature, the routine predominate.[18] Most nonroutine applications that ar outlined are still in the planning or

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14. The journals examined include The Police Chief and Journal of Police Science and Administration, published by the International Association of Chiefs of Police (IACP); Journal of Criminal Justice, published by Pergamon Press; and several other regional publications, such as Illinois Peace Officer and Law Enforcement (published by the Missouri Peace Officers Association).

15. Typical of these publications is Government Data Systems (published by United Business Publications, Inc.), and Electronic News.

16. Representative journals in this area include Management Science; and Public Administration Review: Nation's Cities, sponsored by the National Leage of Cities; and Public Management.

17. For example, one reference document is the 1976 issue of Directory of Automated Criminal Justice Information Systems published by the Law Enforcement Assistance Administration of the U.S. Department of Justice.

18. For an illustration of some of the routine applications which are discussed in the literature, see C. A. Schlesinger and D. E. Geissler, "Computerized Booking at the New Orleans Central Lockup," Policc Chief, vol. 42, no. 4 (April 1975); and Investigation Support at the City of Long Beach Police Department, IBM, October 1973.

implementation stage.[19] Of the routine applications, police patrol and inquiry receives the greatest attention, for it is perceived as providing direct assistance to the "officer in the street."[20]

It is difficult to draw many pertinent conclusions from the literature, since most of the sources reviewed present little material specifically related to police use of information technology. Instead, they deal with the general use of electronic data processing (EDP) by government agencies.

An exception to this pattern is the Police Chief, a journal published by the International Association of Chiefs of Police (IACP). Since January 1974, 21 articles discussing specific law enforcement computer systems have appeared in this journal. Only five of these concern nonroutine applications that had been implemented or were in the process of implementation at the time of publication. One deals with computer-aided dispatch (CAD),[21] one with an automatic vehicle location system,[22] and three with resource

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19. For example, see R. L. Hoobler and K. N. Fortier, "For the San Diego Police Department: A Computer-Aided Dispatch System," Police Chief, vol. 42, no. 10 (October 1975) and Ken Chelst, Implementing the Hypercube Queuing Model in the New Haven Department of Police Services: A Case Study in Technology Transfer, (New York: Rand Institute, R-1566/6-HUD, July, 1975).

20. See for example, M. F. Bockelman, "The Kansas City ALERT II System: A Vital Element in Today's Police Operations," Police Chief, vol. 42, no. 4 (April 1975); and the City of Charlott, N.C., Charlott USAC Project - The Police System Level Software Users' Manual, January 1975.

21. Hoobler and Fortier, "For the San Diego Police Department."

22. Eugene Camp, "St. Louis FLAIR System: Fleet Location and Information Reporting," Police Chief, vol. 42, no. 10 (October 1976).

allocation.[23]

With one exception, these articles, which are primarily descriptive in nature, do not discuss special implementation or operation problems. That exception is the article that describes the San Diego CAD system and discusses the contractual and implementation aspects of the new system.[24] Another article, appearing in 1976, also discusses CAD, but it is a general overview and does not consider the implementation and effectiveness of any specific system.[25]

As for the articles and pamphlets that have been published by government agencies and software vendors, they are, naturally, concerned with describing, in the most favorable terms possible, the successful (generally routine) systems in use across the country. Though informative, they seldom evaluate the actual operation of the system or the implementation process.[26]

The fact that most of the literature deals with routine uses of

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23. G. J. Pini, R. Cohen, and M. E. O'Neill, "POSSE: The Blending of Technology and Human Resources," Police Chief, vol. 42, no. 10 (October 1975); J. D. Caldwell and J. M. Nehe, "Implementing Unit Beat Policing: Patrol Distribution in Arlington County," Police Chief, vol. 41, no. 9 (September 1974); C. J. Macsas and C. Makres, "Real Time Tactical Deployment Project - Dallas Police Department," Police Chief, vol. 43, no. 10 (October 1976).

24. Hoobler and Fortier, "For the San Diego Police Department." Chapter VIII of this report presents a case study of the implementation of the San Diego system.

25. This article, entitled "Computer-Aided Dispatch and You," by James M. Erikson, appeared in the October 1976 issue of Police Chief. It tells beiefly what a CAD system is intended to do and how it would operate in a typical dispatch-communications system. The author emphasizes the system's ability to quickly display unit status, to record data for computer processing, and, most importantly, to reduce dispatch time.

26. For instance, see Investigation Support at the City of Long Beach Police Department and CCAP/7 Helps South Carolina Enforce the Law, published by IBM in October 1973 and December 1973, respectively.

information technology is not surprising. Many nonroutine applications are still in the developmental stage and articles on the new nonroutine uses are likely to be subject to the usual delays in publication.

It was interesting to find that a good deal of literature focuses on the implementation of innovation. A certain amount of it even deals with the implementation of new technology in law enforcement. The primary conclusions of this literature will be discussed in Chapter XII of this report; however, it is worth noting that the articles cover the following topics: the definition of innovation; the factors within organizations that affect agencies' predisposition towards innovation,[27] and the factors that determine the success of failure of an innovation.[28]

2. Results of the related surveys. Since early 1974, at least three survey projects have been undertaken on the use of computer technology by cities and states in general and by the police in particular:

- In 1974 the National League of Cities (NLC) surveyed municipal departments in 83 selected U.S. cities. This sample, which included 600 municipal departments, was primarily designed to inventory the

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27. See R. B. Duncan, "The Climate for Change in Three Police Departments: Some Implications for Action," in Innovation in Law Enforcement, LEAA, U.S. Department of Justice (June 1973); C. H. Milton, "New Concepts in Law Enforcement: Public Management," (Washington, D.C.: ICMA, July 1974); C. H. Milton, "Demonstration Projects as a Strategy for Change," in Innovation in Law Enforcement; A. Vastola, "Police Innovation - Issues and Answers," Police Chief, vol. 42, no. 12 (December 1975); and Case Studies of Technological Innovations in State and Local Services, Rand Corporation K-1870-NSF, February 1976.

28. See J. M. Chaiken, T. Conbill, L. Holliday, D. Jaquett, M. Lawless, and E. Quade, Criminal Justice Models, an Overview, Rand Report L-1859-DOJ (Santa Monica, Calif.: October 1975); and Robert Yin, Karen Heald, Mary Vogel, Patricia Fleischauer, Bruce C. Vladeck, et al., A Review of Case Studies of Technological Innovation in State and Local Services, Rand Report R-1870-NSF (Santa Monica, Calif.: February 1976).

use of EDP systems by all city agencies; the results for specific departments were presented separately. The NLC used the sample to project national computer usage for various municipal departments by city size.[29]

- In 1975, the Public Policy Research Organization (PPRO) at the University of California at Irvine and the ICMA sponsored a survey project that sampled 2,294 cities with populations over 10,000. Of this sample, 1,349 (59 percent) responded. The survey, which was designed to determine general municipal EDP usage, presented results based on functional agencies (e.g. police protection, accounting and personnel).[30]
- In 1975, the LEAA commissioned a survey of EDP application in the areas of law enforcement, courts, and corrections that was administered by all the states and by counties and cities with populations over 100,000. The responses represented 278 jurisdictions and 534 computer systems. Of this total, 376 systems were police or police-related applications.[31]

These surveys, like the literature on computer technology applications,

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29. "How City Departments Use Computer and Communications Equipment," Nation's Cities, October 1974, pp. 26-29.

30. Kenneth L. Kraemer, William H. Dutton, and Joseph R. Matthews, "Municipal Computers: Growth, Usage and Management," Urban Data Service Reports, vol. 7, no. 11 (Washington, D.C.: International City Management Association, November 1975).

31. Directory of Automated Criminal Justice Information Systems, vol. I, LEAA, U.S. Department of Justice (February 1976); and Directory of Automated Criminal Justice Information Systems Security and Privacy, vol. II, LEAA, U.S. Department of Justice (February 1976).

confirm the large predominance of routine over nonroutine applications in police computer use. For instance, in its study of 83 cities, the NLC found that only one of the ten most common police computer applications was nonroutine. This application, police deployment planning, or resource allocation, was cited as the sixth most frequent use of police computers. The routine applications of traffic violations, parking fine collections, accident reports, and uniform crime reporting were rated as the four most frequently used applications.

The NLC survey revealed two other interesting trends. First, municipal departments in smaller cities were less likely to share their computers with other municipal agencies than were departments in larger cities. Police departments, in particular, were found to share computer facilities only 3 percent of the time, the least of any governmental agency. Second, police departments were the second most frequent users of EDP, surpassed only by accounting and finance. This second conclusion is particularly noteworthy, demonstrating, as it does, the high use of law enforcement applications in the world of municipal information systems.

The PPRO and ICMA survey of 1975 reached a similar conclusion. In this study, survey questionnaires concerning municipal EDP use were sent to 2,294 cities with populations over 10,000. Each city was asked to report computer usage in all of its departments, including the police. Of the 305 cities with populations over 50,000 that responded, 72 percent stated that they had a police computer application, and 86 percent of the cities with populations of 100,000 or more listed police computer systems. In terms of overall use, police applications were second only to accounting, treasury, and collection uses.

These percentages -- 72 percent for cities over 50,000 and 86 percent

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for cities over 100,000 -- are even higher than those of the second 1974 survey discussed earlier in this chapter -- 56 percent for cities over 50,000 and 76 percent for cities over 100,000. This is not surprising. The PPRO survey was conducted one year later, and the growth it reports is consonant with that predicted in the 1974 survey. Probably more significant, though, is the difference in the nature of the respondents. The questionnaires for the 1974 study were sent directly to the police agencies, while the PPRO's were addressed to the municipal governments. Thus the responses to the PPRO survey probably included the many mixed application systems which city administrators, but not police departments, would have defined as police applications.

This point concerning the existence of a large number of mixed application systems is borne out by the LEAA-sponsored survey of 1975. Its questionnaires, which were sent to all the states as well as to all cities and counties with populations over 100,000, asked the respondents to list all information systems developed for police, courts, corrections, and other departments. Of the 549 jurisdictions canvassed, 278 responded. They listed 534 systems, 376 (70 percent) of which were described as police-related. Among the police-related systems, however, 85 (23 percent) were listed as mixed applications that also served other parts of the criminal justice and public safety systems.

The LEAA survey provides useful information on the difference in use between routine and nonroutine applications. Each time a system was described, the respondent was asked to list the functions it performed and to indicate whether it was operational or not. Since it was not only possible but common for a system to have more than one function, the report summarized the systems on the basis of the functions they performed. In addition, each system was characterized as either operational, planning, design, or testing. Overall, the survey showed a large predominance of routine applications. For instance, of the 534 systems described, 45 percent had applications for research statistics, 31 percent functioned as on-line inquiry systems, and 26 percent were used for uniform crime reporting. A large majority of the systems were dedicated to routine functions of one kind or another, and they were often constructed to perform several routine functions at once.

As for nonroutine applications, many of these were still in the planning and implementation stage. For instance, 52 jurisdictions (18.7 percent) listed CAD applications, but a closer inspection of the system status and descriptions yielded a total of only ten (3.6 percent) operating CAD systems. The other 42 systems were either not operational or were not CAD systems.[32] This small number of operational CAD systems approaches the number reported in the survey of 1974. (At that time only 15 police departments said they had CAD applications, but no effort was made to screen whether or not the systems were actually operating.)

Resource allocation applications were the most common nonroutine use revealed by the LEAA study of 1975. Seventy-one resource allocation systems were reported to the LEAA, but only 39 seemed to be operational

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32. Each of the listed CAD applications was examined for four characteristics. The system must be listed as operational, operating in a real-time environment, must use information entered into the system by a complaint evaluator, and must recommend a unit for dispatch. Half of the systems were rejected because they were not operational but were in a planning, design, or testing mode. Several others were operating in the batch mode or were only real-time want and warrant systems.

police-related applications.[33] This means more than 14 percent of the jurisdictions surveyed had operational police resource allocation systems.

C. Conclusion

The use of information technology by the police, though it has developed more slowly than was predicted in the early 1970s, has come a long way since the initial stages of implementation. Routine applications, which are still much more evident in police departments than nonroutine applications, have evolved since the early 1960s from the basic uses for administration and finance to a wide range of police patrol and inquiry applications, providing instant data to the officer in the street and the rapid retrieval and processing of all sorts of law enforcement information.

Nonroutine applications are receiving increasing emphasis even though implementation has been slower than predicted, and many of the nonroutine uses -- for example, in the command and control area -- are still in the planning and testing stages. An exception to this pattern is resource allocation, which continues to be the primary nonroutine computer use that has been implemented with some consistency across the country.

After a decade and a half of the use of information technology by the police, the question, "Will the computer and other modern methods be used?" has been superseded by, "How will information technology be used, to what extent, and with what implications?" The computer, with all its fascinating

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33. Each of the 71 listed resource allocation systems was reviewed to determine if it was operational. In the process, five non-police applications were discarded and six duplicate systems were consolidated, leaving a total of 39 jurisdictions with operational resource allocation systems.

implications and problems, has become a permanent part of law enforcement technology.

CHAPTER III: THE IMPLEMENTATION AND POTENTIAL IMPACT OF COMPUTER TECHNOLOGY

by Kent W. Colton

How successful have police departments been in implementing computer use; and what impact, if any, has the use of computer technology had on the police and their work? The surveys and visits to police departments conducted as a part of the research for this report yield a number of ideas and conclusions concerning these questions. This chapter will outline some of these findings, particularly as they relate to the "routine" or structured application of technological innovations. The basis for the findings will generally be the two surveys of 1971 and 1974 and the visits by the author to various police departments around the country. Sections Two and Three of the book will then discuss case studies of the nonroutine use of computer technology. Chapter III contains four sections: first, a preliminary discussion of computer implementation (this topic will receive further review in Chapter XII); second, an evaluation of routine police computer applications; third, a review of the potential impact of computer technology on police work; and fourth, some concluding thoughts.

A. Computer Implementation

Four general topics will be addressed in considering the subject of the implementation of computer technology by the police:

- reasons for police use of technology;

- problems hindering computer operations;
- transference of computer technology; and
- differences between implementing routine and nonroutine uses.

1. <u>Reasons for police use of computer technology</u>. Because each police department is unique, a whole set of motivations may be involved in the decision to utilize information technology. Three general reasons, though, seem especially prominant: a desire to improve police service; federal funding; and vendor influence.

In the first place, police departments need to process large amounts of information with speed and precision. The computer is ideally suited for such purposes. Those departments responding to the first (1971) survey gave as their first three reasons for using a computer: to improve service to the public; to improve the patrolman's ability to rapidly identify and apprehend criminals; and to make internal operations more efficient (Table 3-1). All of these reasons reflect a desire to make information more readily available and thereby to increase the effectiveness of police work.

Second, the federal government has spent large amounts of money over the past decade to support police and criminal justice operations. One of the purposes in allocating these dollars has been to improve police hardware and introduce technical innovations. In some instances a department's primary reason for installing a computer is simply that the money is there. Visits by the author to 14 police departments in 1971 and in case study work support this theory. In several situations department personnel reported that computer development took place as long as federal money was available. One civilian employee went so far as to say that his work (primarily related to resource allocation and scheduling) was considered a luxury in the department: as long as outside sources could fund the effort, it was fine, but if such sources were to dry up, his work would almost certainly cease.

One of the questions in the 1974 survey was whether departments had received LEAA funding, and, if so, what impact such funding had had on their computer use. The respondents that used computers were almost evenly divided between those that had received LEAA funding (86 of 169, or 50.9 percent) and those that had not (83 of 169, or 49.1 percent). (See Table 3-2.) Only some three out of ten departments responded that LEAA funding had had no effect on their computer operation. Some six out of ten responded that without LEAA aid either they would have had no EDP facilities at all or their computer efforts would have been more limited (Table 3-3.) Of those that were not then using a computer but were planning to do so in the near future, 42 percent hoped to receive aid from LEAA, 10 percent did not, and 28 percent were uncertain.

Third, the presence and salesmanship of various hardware and software vendors is a powerful stimulant to computer use. Catherine Milton, writing on the transferability of innovation, lists three reasons to support her contention that hardware (e.g. computer) innovations are more easily transferred than other types of innovations.[1]

° Companies that sell hardware use a lot of advertising and "gimmicks"

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1. Catherine H. Milton, "Demonstration Projects as a Strategy for Change," Innovation in Law Enforcement (Washington, D.C.: LEAA, U.S. Department of Justice, June 1973), p. 123.

to fill an information gap.

- It takes less planning and time to write a hardware grant.
- A piece of hardware is less threatening than other innovations, but it still allows the agency to maintain a progressive image.

The telephone interviews of 1974, as well as field work, have confirmed the importance of these influences. One departmental spokesman explained that his department's original impetus for computer use was a combination of the city's desire to have a computer and one vendor's desire to build a law enforcement computer package which could be sold elsewhere. As a result, the development of this particular system did not always reflect the desires and best interests of the police department. In another department it was stated that software and hardware vendors had oversold the system, resulting in unmet expectations.

Of course, LEAA money and vendor pressures are not necessarily negative influences on police computer use. On the contrary, one of the primary purposes of LEAA funding is to help police departments set up programs and techniques that they could not afford to do on their own. When, however, a computer has been viewed as a "luxury," a special effort should be put forth to anticipate its implementation problems and potential impact.[2] the remainder of this chapter

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2. This view is reinforced by Robert Yin et al. in <u>A Review of Case Studies of Technological Innovations in State and Local Services</u>, Rand Report #R-1870-NSF, February 1976. This study contends that the presence of federal support corresponded negatively with successful implementation when compared to other types of financial support. (See Table 40, pp. 123-124.)

Table 3-1: Police Assessment of the Reasons for Computer Usage

Reasons	Departments rarking as most important effect No. (A)	Departments rarking as most important effect % of total(A)	Departments ranking as second most important effect No. (B)	Departments ranking as second most important effect % of total(B)	Departments ranking as third most important effect No. (C)	Departments ranking as third most important effect % of total(C)	Weighted ranking total[a]
Makes internal operations more efficient.	27	23.7	26	23.0	16	14.3	149
Helps monitor performance of precincts or units	0	0.0	6	5.3	11	9.8	23
Improves patrolmen's ability to identify and apprehend	35	30.7	16	14.2	10	8.9	147
Improves ability to investigate crime.	7	6.1	13	11.5	11	9.8	58
Improves surveillance	0	0.0	1	0.1	1	0.1	3
Improves service to public.	38	33.3	17	15.0	14	12.5	162
Gets better management information.	5	4.4	29	25.7	34	30.4	107
Serves as a part of "professionalization".	0	0.0	3	2.6	12	10.7	18
Other	2	1.8	2	1.8	3	2.7	13
Total	114		113		112		

a. Based on a composite score combining and weighting (A), (B), and (C). The total is derived as follows: 3 x (A) + 2 x (B) + 1 x (C) = weighted total ranking.

Source: 1971 ICMA survey.

Table 3-2: Departments Receiving Funding from the Law Enforcement Assistance Administration to Aid in the Use of Computers

Funding assistance	Number of Departments	Percent of Total
Total, all cities	169	100.0
Received LEAA assistance	86	50.9
Did not receive LEAA assistance	83	49.1

Source: 1974 ICMA survey

Table 3-3: Impact of Law Enforcement Assistance Administration Funding on Use of Computers

LEAA impact	Number of Departments	Percent of Total
Total, all cities	107	100.0
Computer would not have been possible without LEAA funding	17	15.9
Computer operations would have been smaller without LEAA funding	46	43.0
Uncertain of effect	13	12.1
LEAA funding made no difference	31	29.0

Source: 1974 ICMA survey

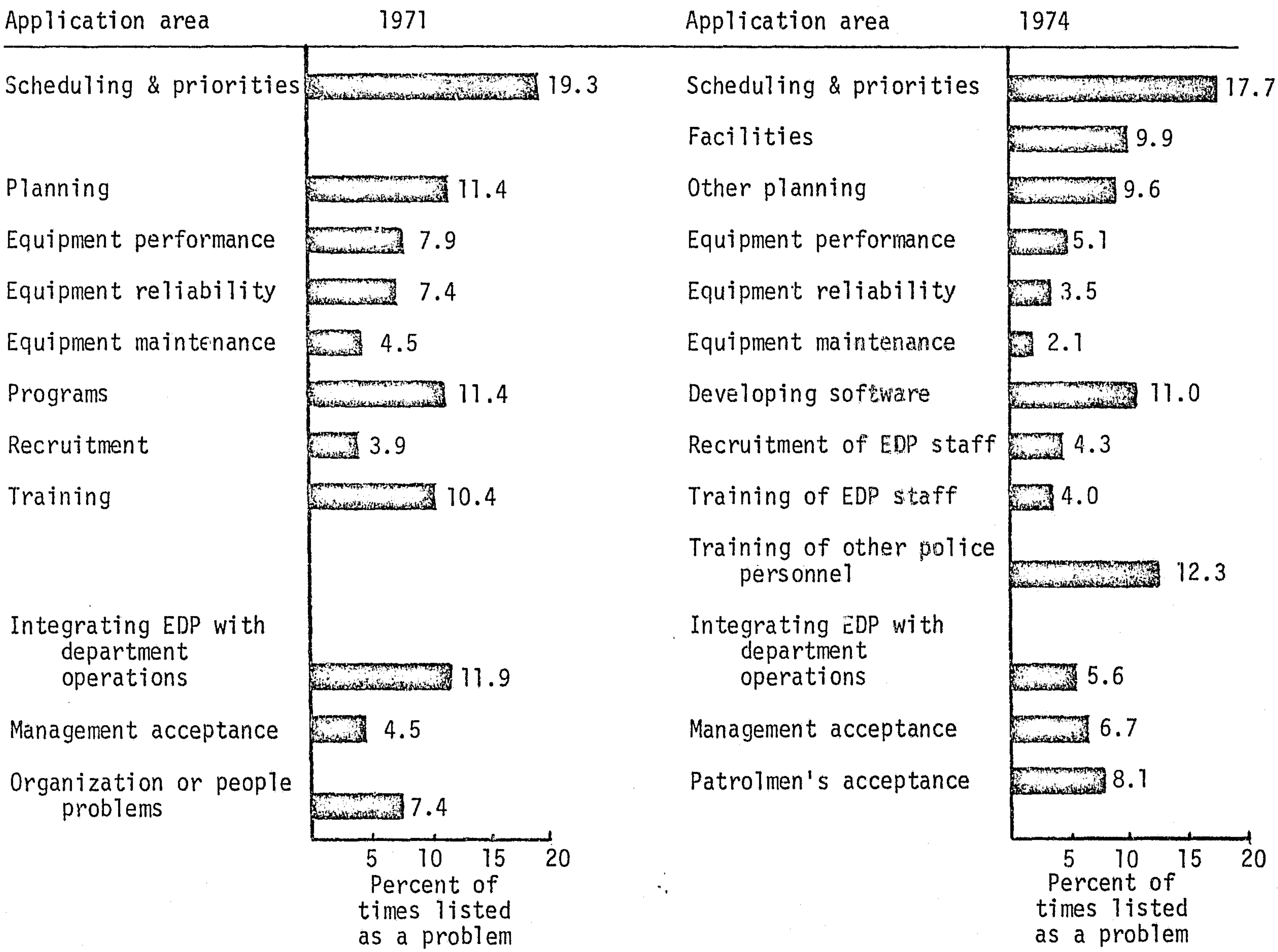
will address some of these basic issues of implementation impact.

2. Problems hindering computer operations. The main problems the police face in using the computer are not technical but behavioral and policy-oriented. More than 50 percent of the departments responding to both surveys stated that their greatest problems were scheduling and priorities -- determining what applications to implement and what the priorities and scheduling should be (Figure 3-1). The next greatest problems were the training of police personnel (other than technical EDP staff) in computer operations and the development of software.[3] Other problems, in order of frequency, concerned facilities for the EDP equipment, other planning, patrolmen's acceptance, management acceptance, and integrating the EDP operations with the rest of the department. Strictly hardware or equipment stood low on the problem scale.

In telephone interviews of 1974 the specific kinds of scheduling and priority difficulties were the main topics of conversation. Conflicts between the police department and the city concerning the ownership and control of the computer and the resulting lengthy turn-around times were mentioned often. Most of the chiefs interviewed felt that the city was responsible for the turn-around time problem: one city did not provide around-the-clock service; another had arbitrarily (according to the

3. On closer examination it became apparent that problems in developing software in many cases referred to the departments' inability to get adequate programmer time from the city for the development of the software programs that the police most wanted. In other words, this response was closely related to scheduling and priorities and in many cases was a manifestation of conflict between the police and the city EDP staff over priorities.

Figure 3-1: Problems Hindering Computer Operations



police spokesman) decided to go off-line, a decision which seemed ironic since the computer had originally been justified for on-line police use; and in a third city the police department had been given a low priority which did not allow the information to get back quickly enough. Several chiefs believed that such difficulties arose from the "fiscal" orientation of the city-run computer. The city gave priority to applications that produced revenue and showed the greatest "cost-benefit" ratio. This goal, of course, differed from that of getting "real-time information to the policeman on the street."

To many policemen, the resolution of this issue was easy. As one chief stated, the police "fight very hard for a computer system dedicated solely to the police." Unfortunately for the cities, particularly for the smaller cities, the answer was not that simple. Costs of a system dedicated, controlled and paid for solely by the police were often prohibitive, particularly in a city with no more than 250,000 people. Further, based on the authors's visits to police departments, it appeared that the "dedicated" computer system was not the ultimate panacea. Even when a department owned and controlled its own system, there were still problems with the computer being out of service and determining scheduling priorities. Some of the more successful systems existed in cities in which the city government owned and controlled the computer; whereas some of those police departments that had full control over the EDP equipment and staff had made almost no technological progress since 1967.[4]

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4. See Kent W. Colton, "The Dedicated Police Computer -- Does It Really Make a Difference?" The Bureaucrat, vol. I (Winter 1972), pp. 357-365.

Whether or not the police should have dedicated computer systems is an unresolved question, but it is clear that dedication alone does not ensure technical success.

a. Integrating computer use with the operations of the police department. By 1974, although the questions of scheduling, priorities, control, and ownership remained unresolved, some progress has been made in several other behavioral aspects of computer use by the police. In 1971, the second most important problem was integrating the computer operation with the rest of the department, but in 1974, that issue had a comparatively low significance (see Figure 3-1). Indeed, in many cities the computer had become an integral part of departmental operations. When asked if he felt the computer was essential to his running of the police department, one chief replied, "You bet -- I would hate to tackle the job without it." According to another police spokesman, the computer was the "greatest thing since fingerprint classification."

In 1974, neither the mailed survey nor the telephone interviews revealed any widespread resistance by the police to the introduction of computer applications, particularly routine applications.

Most patrol officers, having little contact with the operation or output of EDP applications, did not consider the introduction of the computer to be either very significant or particularly threatening. If a patrol officer became involved with a computer operation, it was usually in connection with a want/warrant or motor vehicle inquiry, or with the provision of incident reports. In both these activities the procedures were similar to those that had existed before the computer was installed. If a computer was in use, an officer could request more detailed information when he submitted an incident report, but often the forms were precoded, so that although the patrol officer provided more data, filling out the report took less time. Most of the chiefs who were interviewed felt that trends of suspicion toward and reluctance (or even refusal) on the part of certain patrolmen to use computer applications could be reversed by in-service training. If one explained to officers what the computer was going to do and why and then allowed them to voice their concerns, the men would be more likely to accept the new system. In a number of departments, the utilization of the inquiry system was so much greater than expected that the departments were forced to install additional terminals and terminal operators. For example, when the police patrol and inquiry system was first established in Washington, D.C., police were receiving 22,000 to 23,000 inquiries per month; but as the system became more rel le, usage skyrocketed to between 50,000 and 60,000 on-line inquiries each week.

The paramount importance of officer acceptance of computer use should not be overlooked. When the Los Angeles Police Department first designed and implemented an Automated Field Interview Reporting System, it was an instant success. The program aided investigation by providing rapid computer access to information on stops and interviews made by policemen in the field. After a few years, however, the interview form was redesigned and fit less easily into the patrolmen's pockets. The men stopped carrying the forms, and it was only when the pocket-size form was reissued that the system began to function again. to assure acceptance and use of information systems by the police is not a technical matter alone but involves such practical behavior factors as convenience and comfort.

In 1974, according to the telephone interviews, management's acceptance of the computer was a more stubborn problem, for in this realm the computer operation was more likely to disrupt the status quo. Most personnel at the middle management and command staff level had been conditioned to accept traditional methods.[5] New methods brought an element of uncertainty to their work and prompted resistance. Acceptance of new decision-making processes that relied on complex quantitative data required familiarizing the supervisors with the new technique. As one chief put it, the biggest problem is trying to get top-level supervisors to understand what the system offers them and to take advantage of it. The men in the field aren't a problem, it's the supervisors.

b. Staffing a police EDP facility. In the telephone interviews of 1974, a number of chiefs gave considerable attention to the issue of hiring an adequate EDP staff. Several of them said that their main piece of advice to a department just starting to develop an automated information system would be to concentrate on bringing together a competent EDP staff. Others mentioned the difficulty of competing with private industtry for good systems analysts and computer personnel and urged departments to pressure police and city budget bureaus to provide adequate salaries for such staff people.

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5. This point applies to both patrolmen and middle managers. What differentiates the two is that the middle management got where they are by being the best at doing whatever they did before the computer was present. It is understandable that they may be insecure about being presented with a new (uncertain) task.

Further, by 1974 an interesting shift had occurred in regard to the type of personnel whom the police felt should be trained as programmers. In 1971, sentiment had been strongly in favor of training patrolmen as programmers. (As one officer stated, "You can train a police officer to be a computer programmer, but you can never train a programmer to be a police officer.") In 1974, however, the majority of chiefs indicated that they would rather not have police officers trained as programmers; they would prefer to have a mix of sworn and non-sworn personnel within the EDP staff, with civilian computer experts reporting to a supervising police officer. Many believed that patrol officers were too valuable and too well trained in other matters to be assigned to programming duties. They also believed that civilian employees could probably bring more computer-related skills and expertise into the department than a patrol officer could learn in a quick computer course. In general, as one chief indicated, "analysts should be civilians, and police officers should be police officers and not computer programmers. Civilians can ride along with patrolmen to get a feel for the officers' problems, if necessary."

3. Transference of information technology. "Avoid reinventing the wheel" was the most common piece of advice offered during the telephone interviews of 1974. Departments in the planning phase of their computer operation effort were encouraged to visit other cities to see what had been done already and to benefit from these experiences. Most of the interviewed departments had sent some of their personnel to visit at least one of the reputed leaders in the police computer field. The chiefs stressed what departments should seek out computer users in cities

which were most like theirs. The bigger departments might have the fanciest equipment, but the most valuable and practical advice would come from similarly oriented, if less advanced, police forces.

Even with this attitude of cooperation, the process of technology transfer seems to be proceeding slowly. A large number of visits among different police departments have been made, but only a comparatively small amount of work has actually been transferred. One reason may be the lack of formal mechanisms for the transfer. The primary people who visit police departments to discuss technology are vendors who have a strong vested interest in making implementation look easy. Perhaps something more is needed to provide police departments with neutral advice and technical assistance, and this topic will be discussed in greater depth in Chapter XII. It must be remembered, however, that technology transfer is first an organizational and behavioral problem, and only second a technical one.

4. Differences in implementing routine and nonroutine police computer uses. Routine types of police operations, especially those in which the storage of and rapid access to large amounts of information are desired, are particularly suited to computer processing. These operations include police patrol and inquiry, traffic, criminal statistics, and police administration -- the four top areas in terms of number of applications in use in 1974. Although the level of success in their implementation varies somewhat from department to department, this can generally be attributed to internal departmental and behavioral factors, factors that will be discussed in depth in Chapter XII.

By contrast, the success of implementing nonroutine applications has been mixed. Nonroutine areas often involve initiating a new process or way of behavior in the department. Computer-assisted resource allocation may mean a new means of decision making in deployment and a significant change in the current beat structure; computer-aided dispatch may alter the criteria by which a dispatcher decides which car will be sent to respond to a call, or it may provide central headquarters with new information regarding a police officer's behavior and activity while on duty. Criminal investigation applications may alter the detective's job and approach towards law enforcement investigation.

In addition, the process of implementing computer use in nonroutine areas is not purely quantitative. A number of qualitative considerations also arise. In an article in Technology Review, Richard C. Larson outlines some of these factors:

> First, objectives, performance criteria, and constraints for these systems are very difficult to isolate and design. One may state as an objective for public safety systems the "efficient, effective, and equitable distribution of quality emergency service, within reasonable budget constraints." But it is hard to transform such sweeping statements into performance criteria [that] ... are easily measured. ...Moreover, objectives for an urban public service may vary between administrators, operatives, and consumers. ...One soon begins to realize that a popular word in operations research, optimization, often bears little relevance to the operational realities of governmental constraints.
>
> Second, as system pbjectives are poorly defined, so, too, are measures of system productivity. ... Because productivity measures are lacking, those forces that would tend to favor the status quo within an urban public safety system often prevail. The alternative of "no change," while it assures that visible failure will not occur, makes visible progress more difficult to achieve.
>
> Third, with their civil service orientation, these systems have tended to be insular, fraternal, and staffed with career employees whose average formal education often stops with high school. ...Implementation in governmental service, in contrast with their industrial

> counterparts, must be viewed as a multi-year process.
> [Finally], the operational behavior of urban public safety systems is complex and, at this time, poorly understood.[6]

Because computer use for nonroutine applications is far more complex than for routine applications, progress is often slow. The long-run use and the implementation of such use by police departments remain uncertain. This is particularly true in the area of computer-aided dispatch and criminal investigation, where achievement has lagged far behind initial expectations. Even in the rapidly growing area of resource allocation, it is still questionable how well such uses have become integrated into the police operations. Whereas police patrol and inquiry applications have become an integrated part of day-to-day operations, it is not yet clear whether nonroutine applications will gain acceptance and use in the long run and, if they do, what their impact will be. The feasibility and utility of such nonroutine applications is still being tested. The case studies in Parts Two and Three of this report will examine the actual state of implementation of various nonroutine applications.

B. A Review of Routine Police Computer Applications

Police departments process large amounts of information. A great number of events transpire under the jurisdiction of the police, and detailed reports must be prepared on many of them. Records are kept of the

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6. See Richard C. Larson, "Resource Planning for Urban Public Safety Systems," Technology Review, (June 1974), pp. 20-29.

type and number of crimes committed, and reports of aggregate statistics are required at the state and national level. Some of the information gathered serves a self-protecting function by documenting police behavior. If a citizen calls two months after the occurrence of an incident and complains of police brutality, investigators must be able to go back to the original records and reconstruct the incident. Other kinds of information are essential for investigation and prosecution. The police are only one part of the criminal justice system, which also includes courts and corrections. Since action by the police usually commences the process of criminal justice, records must be initiated at that point which will be relied upon later on in the trial and correction proceedings.

Administrative and routine operations also require a large amount of detailed data processing. Needs in this area include keeping track of paid and unpaid parking tickets, sending out warrants on traffic and parking citations, meeting payroll commitments, keeping inventories of equipment and vehicle status, and preparing and updating personnel records.

The police officer in the field, too, has heavy information needs. Since the job requires quick judgment and decision-making, any data which will inform or provide justification for action can be of significant help. To know within seconds that a car has been stolen, that a person is wanted, or that an address may be dangerous is of real benefit.

For years police departments have been keeping records and processing information, largely without automation. Such activities will continue in departments that do not use computers; but because of the massive volume of information, large portions of these data, once recorded, will never be used again. The computer, on the other hand, is ideally suited for retrieving as well as processing and storing data. Many police departments have taken advantage of computer strengths and have automated their routine information-processing activities. Four illustrations will be presented here to demonstrate the potential impacts -- benefits and costs -- of such routine efforts to apply information technology to law enforcement work. The first example concerns the traffic citation system in Tulsa, Oklahoma; the second and third review the police aptrol and inquiry applications in Kansas City, Missouri, and Los Angeles, California; and the fourth examines the criminal justice information system used in Santa Clara County, California.

a. The traffic citation system in Tulsa, Oklahoma. In July 1970, the Tulsa Management Planning and Systems Department of the Office of the Mayor working in conjunction with the Police Department and the Court Clerk implemented a new automated traffic citation system. The result was a total increase in traffic income of $260,000 for the first year of operation, $32,000 of which came from backlogged citations.

The basic purpose of the automated traffic citation system was (and is) to keep track of all parking and moving violations and to provide administrative control. The system has five basic parts:

- All tickets for both moving and parking violations are numbered and the data regarding each citation are key-punched.
- Notices are automatically sent regarding traffic violations. After an appropriate period of time, a bench warrant is also issued automatically.
- All payments made at the cash register are automatically punched on a computer paper tape so that the system is updated

automatically without delay or excessive expense.

- Daily cash reports and monthly statistics are provided. Each month, for example, the Department of Public Safety receives a list of all moving traffic violations paid.
- Reports on the activity of patrolmen are printed on a regular basis. The reports include information on the parking and moving traffic citations issued by each patrolman on a weekly basis.

The system provides a number of benefits. To the Court Clerk, the greatest advantage is "administrative control." The system keeps him informed as to what is happening. Not only does it tell him what is happening regarding the collection of revenues; it also provides information to police administrators on the activities of their men. These data are a valuable aid in evaluating work and allocating resources. In addition, there have been major financial returns.

Prior to the implementation of the traffic citation system four people were employed to notify motorists by phone of outstanding bills for traffic citations. When the new system was implemented the phone calling ceased, notices were automatically sent by machine, the monthly salaries for traffic citation collection dropped from $3,400 to $1,400, and the monthly collections increased significantly. During the first month when computer notices were prepared, $34,000 was collected (as compared to the previous average of $5,000), and in the first six weeks of operation $46,000 was collected. The back-up of outstanding, unpaid warrants was reduced from $86,000 to $52,000.[7] An increase was also seen in the dollars collecting for parking tickets. $15,000 was collected during the first six months of operation in 1970 as compared to in the next three months after the system was installed when $32,000 was collected.

It is estimated that the total overall increase in traffic income for the first year of operation of the new traffic citation system was $260,000. Naturally, some of this increase must be attributed to normal average rise in dollars collected. However, it is probably quite safe to attribute most of the increase to the new computerized system. Figure 3-2 plots the increase in revenues collected pertaining to traffic from January 1970 to April 1971. The increase between the first four months of 1971 compared to the first four months of 1970 was by itself an increase of $167,295.

It is now appropriate to look at the costs incurred in order to achieve these benefits. The costs are really divided into two basic parts: costs to establish the system, and maintenance and operating costs. The basic costs to establish the system were estimated at $42,000 ($20,000 for personnel, $10,000 for computer time, and $12,000 for equipment).

In addition, the operating costs to run the system for a year from

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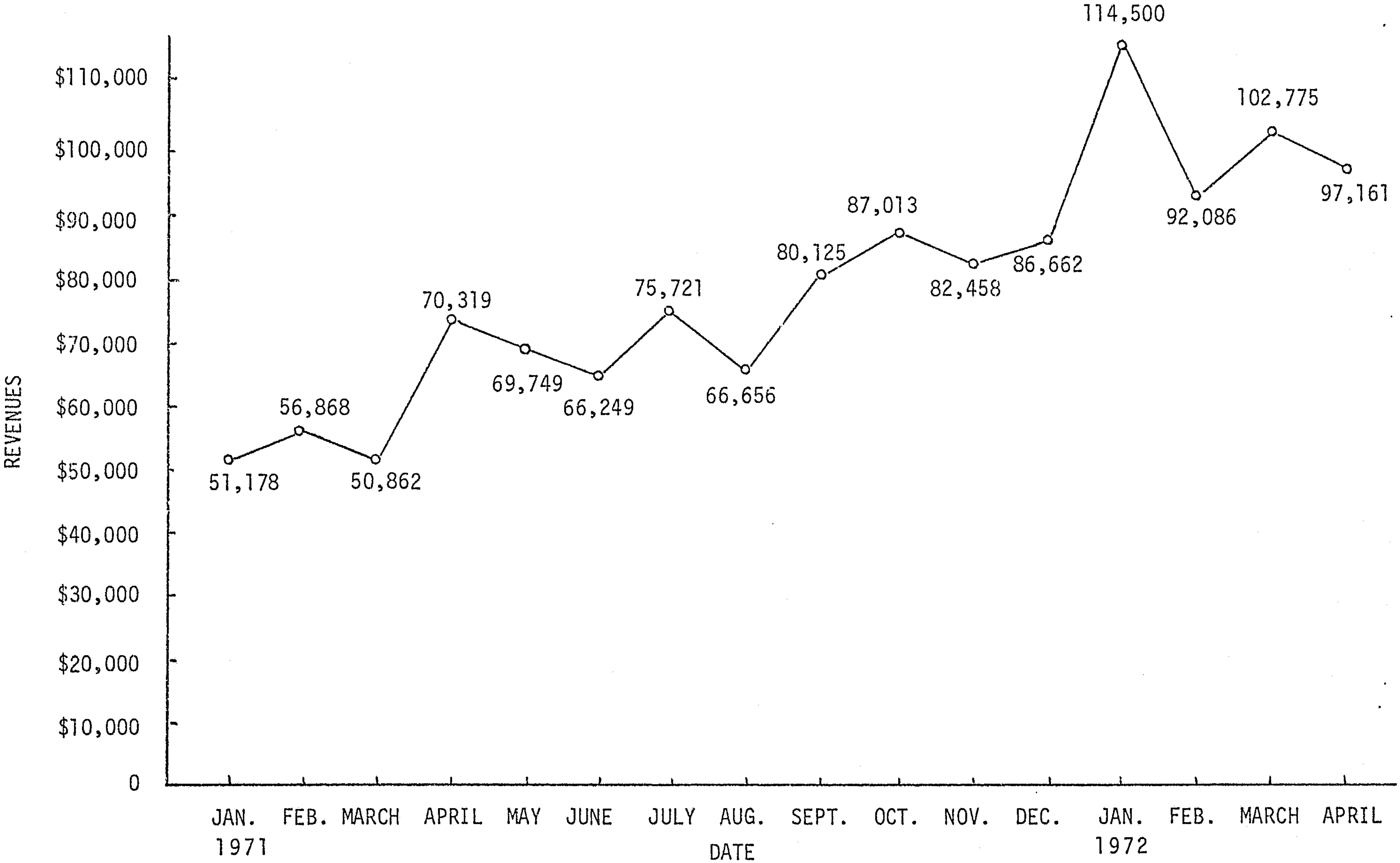
7. Letter to author from R. C. Klewer, Management Systems Analyst, City of Tulsa, April 20, 1972.

Figure 3-2: Traffic Income during the First Year of Operation for the Tulsa Traffic Citation System



a technical point of view are $22,000 ($2,000 for personnel and $20,000 for computer time).

If only the financial benefits and costs are taken into consideration, it is clear that benefits (increased revenues in the first year of $260,000) outweigh costs ($64,000 to establish and operate the system the first year).[8] No effort has been made to quantify such nonfinancial benefits as the increase in administrative control mentioned earlier or the potential costs of resistance to implementing the system. This simple analysis illustrates nevertheless the beneficial impact of the routine computer application on Tulsa's traffic citation system. Furthermore, the beneficial ratio of the Tulsa system can be expected to improve with time because the traffic citation system is only one part of Tulsa's total computer effort. As other applications are implemented, they will complement the traffic citation system.

b. Police patrol and inquiry applications. One of the computer applications used most by law enforcement agencies is police patrol and inquiry. This application, which is usually real-time, is established to provide the patrol officer with the rapid retrieval of information important to his work. Although advanced computer technology is often utilized, the task performed is a straightforward retrieval of information and the application is therefore still considered to be routine.

A number of cities throughout the country have had great success in

8. Although informative, these figures should be considered as rough estimates. For example, a detailed accounting is not included of personnel utilized in the Court Clerk's office before and after the system, although this would actually increase benefits achieved.

using the computer in this area. Two excellent illustrations are Kansas City, Missouri, and Los Angeles, California.

(1) Kansas City. In Kansas City, Missouri, the police department has established a regional system for real-time inquiry of information which links more than 53 criminal justice agencies. Its primary objective is to aid the patrol officer in the street.

On July 1, 1968, the telecommunications systems became operational and action was initiated to furnish information to officers in the field. Less than a year later, on May 5, 1969, the telecommunications services of the police department computer were made available to all regional area law enforcement agencies, as well as those civil agencies involved in the criminal justice process. These real-time applications of the Kansas City facility were known as the ALERT System (Automated Law Enforcement Response Team). When the system was established, the primary objective was that information requests from officers in the field should receive a response within ten seconds. Since 1969 a number of modifications and new computer applications have been added and the system is now called ALERT II. This section of the report will only focus on the police patrol and inquiry aspects of the ALERT System, though.

The system works effectively. An officer calls by radio to the communication center with a request for information. Each dispatcher has a video display cathode ray tube (CRT) terminal in front of him. The dispatcher makes an inquiry of the system which queries not only the Kansas City computer but the FBI's National Crime Information Center (NCIC) computer in Washington, D.C. A response is received, and a report is radioed back to the officer. According to the former assistant chief, James Newman, the entire process averaged about three to four seconds. (observations made while riding patrol with the Kansas City police confirm his estimate.) Before the computer was installed, it took about 35 minutes to retrieve and relay these data.

The patrol officer can inquire about three categories of information:

- wanted information -- warrant, pickup, stolen vehicles, stolen property;
- criminal index, abstract, and status -- current address, status, organized activists; and
- information forewarning of probable danger from individuals (armed, dangerous, mental, suicidal, expected to resist arrest), or at a particular address (history of previous disturbances at a certain address).

In 1974 the computer system serviced 53 criminal justice agencies which served a population of approximately 1.5 million citizens across eight counties in eastern Kansas and western Missouri. Over 80 local and remote data communication terminals were operational and linked into the automated network. During November 1969, the police computer was interfaced directly to the FBI computer in Washington through a high-speed microwave communications system.

During 1975, officers in the Kansas City Police Department made an average of 309,000 inquiries per month or 250 inquiries per officer per month. In 1969, the first full year of computer use, a total of 21,700 "hits" or identifications were made, the three largest categories being city traffic warrants, stolen cars, and parole violators. Just as an illustration as to how the use of the system has grown over the years, in 1971 the number of all on-line inquiries, both administrative and operational, from all user agencies was 3.9 million. By 1974 the number had risen to 7.8 million.

(2) Los Angeles. In Los Angeles, the Automated Want/Warrant System (AWWS) was established through the joint efforts of the Los Angeles Police Department (LAPD) and the City Data Service Bureau. It has proved to be a great success. Prior to computerization, the Los Angeles Police Department had several thousand outstanding warrants and wanted persons entries on hand. These warrants had to be accessed manually, and this process could take 15 minutes per warrant or even more under unusual circumstances. Although the system worked quite well in the apprehension of important criminals, many minor warrants were never served, partly because police officers in the field were reluctant to keep persons they stopped waiting for an extended period of time only to find that in many cases they were "clean." The result was that the files continued to grow, manual searches took longer, and officers continued to be reluctant to detain people in order to make a warrants check.[9]

In 1965 the LAPD initiated an in-depth study of its want/warrant files in order to remedy this situation. An extensive survey of both support and field personnel revealed six major problem areas:[10]

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9. "Los Angeles Police Department Automated Want/Warrant System," Datamation, June 1970, pp. 242, 243.

10. Los Angeles Regional Automated Want/Warrant System, document published by the Los Angeles Police Department, ca. 1971, p. 4.

- The lengthy response time for a manual search increased the jeopardy to a field officer involved unknowingly in a contact with a dangerous person.
- Each inquiry required an average of eight minutes' processing, which restricted active patrol and generated a reluctance to make want/warrant inquiries.
- File maintenance tasks were extremely involved and cumbersome.
- The warrant load was increasing faster than could be adequately handled manually.
- Storage space for cross-index files and hard copy warrants was becoming critical.
- Because of limited time, the requesting officer could make use only of LAPD warrants.

Discussion with other law enforcement agencies in Los Angeles County revealed that these problems were not unique. Numerous "want/warrants" were not being served because each agency maintained its own separate file of warrants for its own jurisdiction, and a routine check was confined to that particular agency's file. According to report, it was not unusual for a citizen to be arrested, serve a sentence, and be released in one jurisdiction while law enforcement agencies in other parts of the county still had outstanding warrants for him.[11]

In response to these problems the Los Angeles Regional Automated

11. Ibid.

Want/Warrant System (AWWS) was developed and became operational on September 2, 1969. The average time for a response to the field with AWWS was cut to eight seconds from the previous time of eight to fifteen minutes. In capsule form, the system was designed to perform the following functions:[12]

- allow each field and station officer to search a centralized file for all outstanding wants/warrants in the system;
- allow inquiry from either a visual display device (CRT) or teletypewriter;
- respond to an inquiry in seven to ten seconds;
- allow a requestor to specify a terminal to which a printed output would be sent;
- allow on-line file maintenance and record update capability from any of the terminal devices;
- provide a built-in expansion capability to accommodate law enforcement agencies in the county; and
- operate reliably on a 24-hour basis, seven days a week, with minimal interruption.

In most cases these objectives were met and even exceeded by the Automated Want/Warrant system. Working in a manner similar to Kansas City's system, AWWS could be used to check for such items as outstanding warrants (traffic and criminal), stolen cars and other property, motor vehicles with excessive parking violations.

AWWS also follows the suspect beyond arrest. When a person is booked

12. Ibid., p. 6.

and processed, the booking information is sent to the police department's records division. A fingerprint search is made, and if an arrest record is found, any aliases are also checked against the AWWS files and any additional warrants are transferred to the concerned correction facility.

The AWWS is tied to other related computer systems. These include the California Highway Patrol "AUTO STATIS" system (a statewide auto theft system), the California Department of Motor Vehicles (used to check vehicle registration information, determine owners, and so forth), and the FBI National Crime Information Center (NCIC).

Initially, the system was utilized solely by the LAPD, but plans were made from the beginning to expand the utilization of the system to other law enforcement agencies in the region. The Long Beach, California, police department was the first municipal police department to gain access to AWWS, entering warrants into the AWWS and paying for their access to the system.

Urged by a narrow definition of success -- technical impacts -- it seems that AWWS has been very helpful. For example, in the first year of use the number of arrests made on outstanding warrants jumped significantly. In the first quarter of 1970 this number was more than 75 percent higher than for the first quarter of the previous year.[13]

In the 1976-77 fiscal year, the average for monthly inquiries to

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13. "Los Angeles Police Department," Datamation, p. 242.

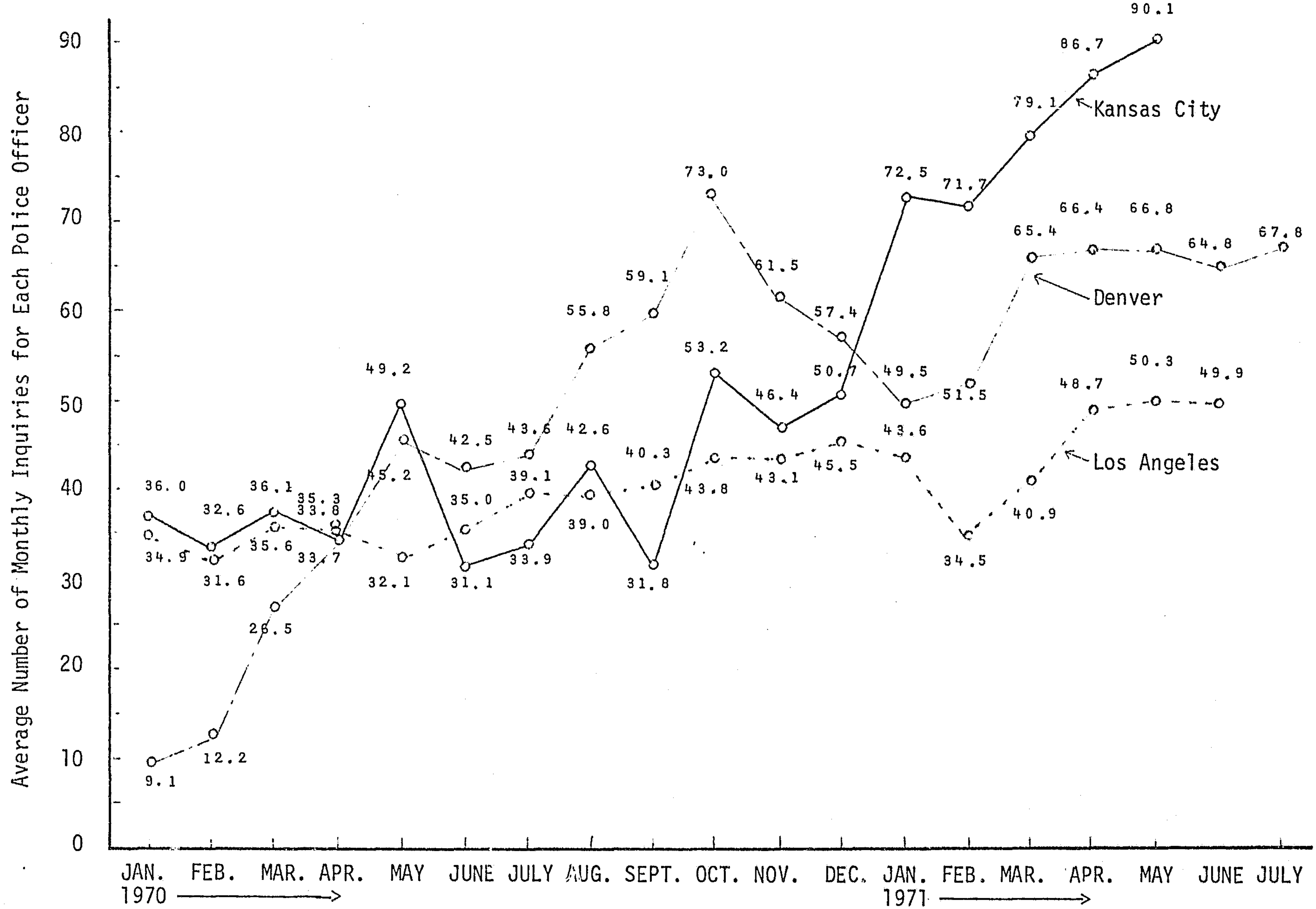
AWWS were 250,000 for the LAPD and 259,000 for other user agencies. Estimates for this same period were that "hits" or positive identifications were made on 25 percent of the person inquiries and 18 percent of the vehicle inquiries (with about 28.6 percent of all inquiries made being for persons and 71.4 percent for vehicles).

(3) General evaluation of police patrol and inquiry systems. Police officers in the field have responded well to rapid inquiry systems. Once they discover that the systems are available and will provide them with better information in reduced time, use of the data rise quickly. This is illustrated by reviewing the use in the early years of operation of patrol and inquiry data in three cities, Kansas City, Denver, and Los Angeles, as displayed in Figure 3-3. Since the exact definition of "inquiries" varies rather substantially from department to department, this chart should not be used to make direct comparisons among the three cities. But it does indicate a constant pattern: an increased use over time by police officers in the field of real-time police patrol and inquiry systems.

Referring back to the four-part framework for evaluation outlined in Chapter I, a number of police patrol and inquiry systems have met the first test -- the establishment of an operating, working system. In addition, a number of positive technical and service impacts have been achieved.

Three very important technical impacts have resulted from the improved data inputs, outputs, and processing of computers. These concern information, time, and safety. First, great improvements have taken place in the type and availability of information. In order

Figure 3-3: Rise in Computer Inquiries per Police Officer as Illustrated in Selected Cities[a]



a. This chart should not be used to compare cities. Exact use of inquiries varies somewhat substantially between cities. The chart does indicate a general rise in use in all three cities in the early years of operation.

to make data entries into an automated system, precise forms and a series of regular procedures for data entry and verification are necessary. With this demand, the quality of information has improved. In Kansas City, for example, each item of information is key punched twice in order to verify input data. Such care leads to greater accuracy and consistency. Also, it is relatively easier to maintain automated computer files than manual files, particularly in large cities like Los Angeles.

Police patrol and inquiry applications provide access to information previously unavailable and enable a much wider distribution of information. A number of police departments now have instant access to regional, state, and national law enforcement information. Terminals placed in administrative and investigative branches of police departments (such as the auto theft section, the records section, or the detention section) provide rapid inquiry capability to those branches.

Second, real-time computer systems for inquiry are great time savers for both the police officer and the citizen who has been stopped. Instead of a 15- or 20-minute wait for a records check, such a check can be made instantly and innocent people sent on their way. The potential effect is an improvement in police/public relations. The old adage, "time is money," is also applicable in assessing the benefits of this type of computer system. A dollar value is harder to place on the time saved by the citizen who is detained than on the policeman's time.

In Kansas City, for example, it was estimated that in 1970, $735,000 was spent to run the entire computer facility, not just the real-time inquiry portion of the system. In the same year a total of 1.67 million on-line inquiries were made to the ALERT system. If it is assumed, for the sake of illustration, that 20% of these inquiries were tactical and each of the tactical inquiries saved a police officer eight minutes, then a total of around 44,500 hours of police service was preserved through the use of the inquiry aspects of the computer system. Assuming that these hours "saved" were converted to police activity, it seems that the Kansas City community could have received as much as $200,000 worth of additional police services as a result of time saved by the use of the inquiry aspects of the police computer system; in other words, 27 percent of the department's costs to operate their entire computer facility could have been saved.[14]

Naturally, such a comparison falters rapidly if carried to the extreme. With a computer the number of inquiries far exceeds the number made with a manual system. Also, many of the requests for data from such an inquiry system are administrative rather than tactical. However, it does demonstrate a point. Police time is saved through the use of real-time inquiry systems, and this time saved may represent additional police services.

Finally, computer systems for police patrol and inquiry provide

14. In 1970 the average patrol officer salary was $9,000 per year, or about $4.50 per hour. 44,500 hours x $4.50 per hour equals $200,250. $120,250 ÷ 735,000 = 27 percent.

the policeman with greater safety in performing uncertain tasks. Police work involves uncertainty, which in turn involves risk. To the extent that the use of the computer can help reduce this risk, it will assist in the performance of law enforcement work.

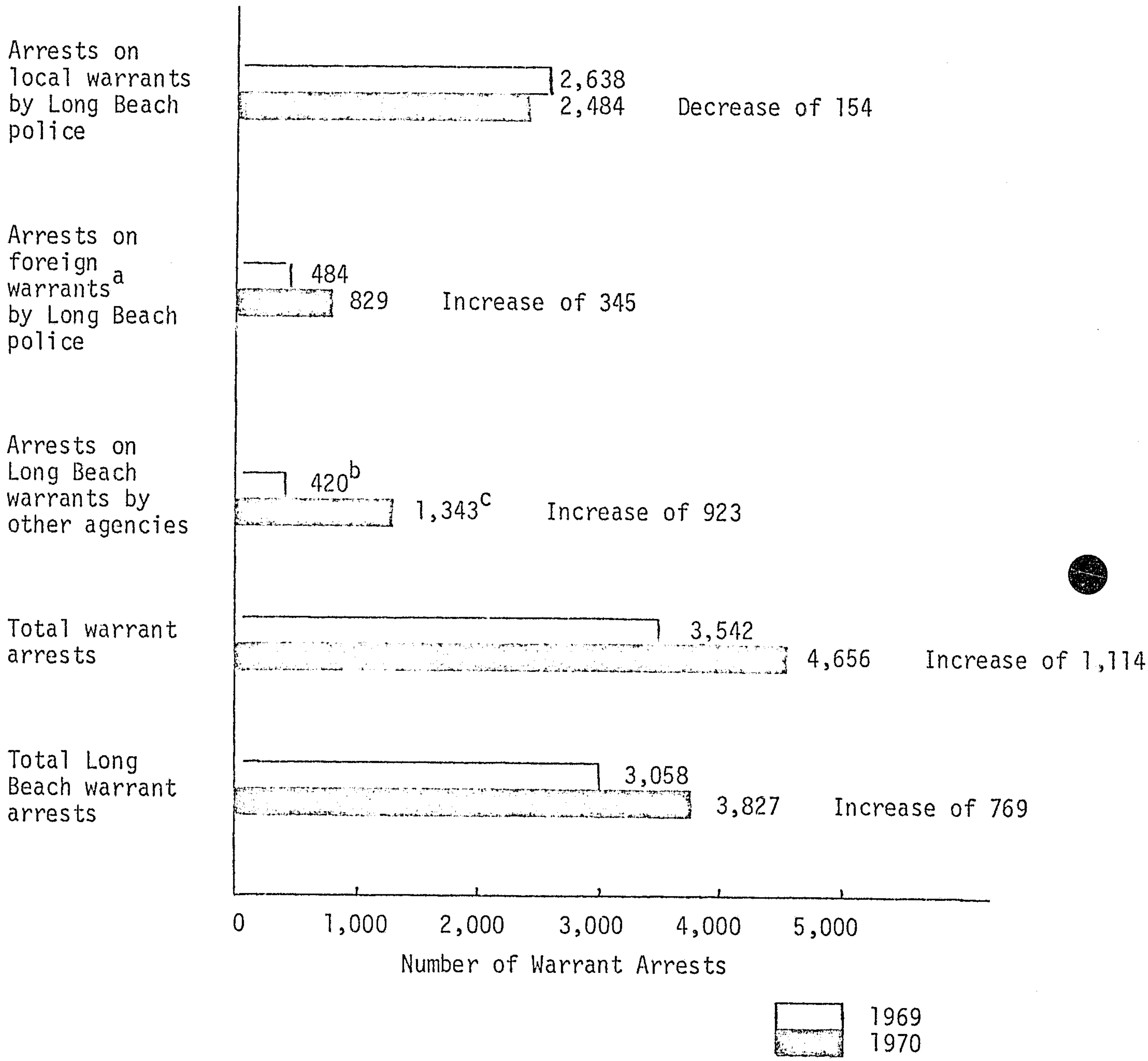
Computers are used to reduce uncertainty in regard to stolen automobiles and other property, to suspicious persons, and even to dangerous locations. Whenever a vehicle appears suspicious or is stopped for a moving violation, the officer can discover in a matter of seconds if the vehicle is stolen or considered dangerous or if its occupant is wanted. The policeman can know whether a car has been stolen or the owner is wanted even before he approaches the driver of a stopped car. The same principle applies to dangerous persons. Moreover, some systems allow the officer or the dispatcher to check a particular location to see if any problems have occurred at that address recently. In Kansas City such an application was installed after a tragedy occurred in the department. Several years ago an officer was sent to a house early in the day in response to a disturbance complaint. The situation seemed to be settled, and the officer left. Later in the day another call went out for the same location, but this time a different patrol officer was assigned to respond. Not knowing that there had been any previous trouble, he approached the house with little precaution. This time, though, the persons involved had obtained a gun, and the responding officer was shot and killed. The Kansas City department felt that if the second policeman had known of the previous complaint he would have approached the situation differently and his life might have been spared.

Real-time inquiry systems not only provide technical benefits to the police, but they also have achieved service impacts through improved efficiency and increased apprehension ability. The precise improvement, of course, will vary from police department to police department.

When rapid inquiry systems are available, police officers make a greater number of inquiries regarding stolen property and suspected persons. Figure 3-3 demonstrates this fact in three police departments. If an inquiry can be answered in a few seconds, policemen are willing to make checks, whereas there was reluctance to inquire of manual systems and then "waste time" waiting for a response. Further, with regional, state, and national networks for rapid inquiry it is possible for different law enforcement jurisdictions to coordinate operations and make arrests for one another. The police patrol and inquiry system of the police department in Long Beach, California, illustrates the improved efficiency and apprehension ability which results from the use of such a system.

On March 23, 1970, the Long Beach police department became a part of the Los Angeles regional Automated Want/Warrant System (AWWS). On June 8, 1970, the Long Beach department started entering information in the system regarding outstanding Long Beach warrants. Figure 3-4 illustrates the increase in the number of warrant arrests that resulted: (an increase in total warrant arrests of 1,114 or 31.5 percent, over 1969, and an increase in Long Beach warrant arrests of 769, or 25.2 percent). This increase occurred almost solely as a result of the increase in arrests of people for Long Beach warrants by other law enforcement agencies, since the number of local warrant arrests actually decreased slightly in 1970.

Figure 3-4: Impact of Automated Want/Warrant System in Long Beach, California



a. Outstanding warrants in cities other than Long Beach.

b. Estimate for year from Warrant detail supervisor.

c. Only for six months: June-December 1970.

The cost to the Long Beach police department of utilizing the AWWS in 1970 was estimated at $50,000 per annum, including equipment and a "rental fee" paid to the city of Los Angeles. On the benefits side, it was estimated that the revenue from the various warrants for 1971 was around $375,000. (The actual revenue for half this period, January 1, 1971, through June 30, 1971, was $187,576.)[15] Based on an increase in the number of Long Beach warrant arrests of 769, this would indicate increased benefits in the neighborhood of $75,375. The use of automation in this case shows a positive relationship between the benefits achieved and the costs incurred, particularly at this simple level of analysis.[17]

However, even in the area of real-time uses for police patrol and inquiry (one of the most straightforward uses of computer technology), there are significant differences in costs and benefits between cities. In one city, for example (City A in Figure 3-5), a real-time computer system for police patrol and inquiry had been in operation for five years as of 1970. Yet, owing to a series of complications, the average time required to get information back to the policeman in the field was as

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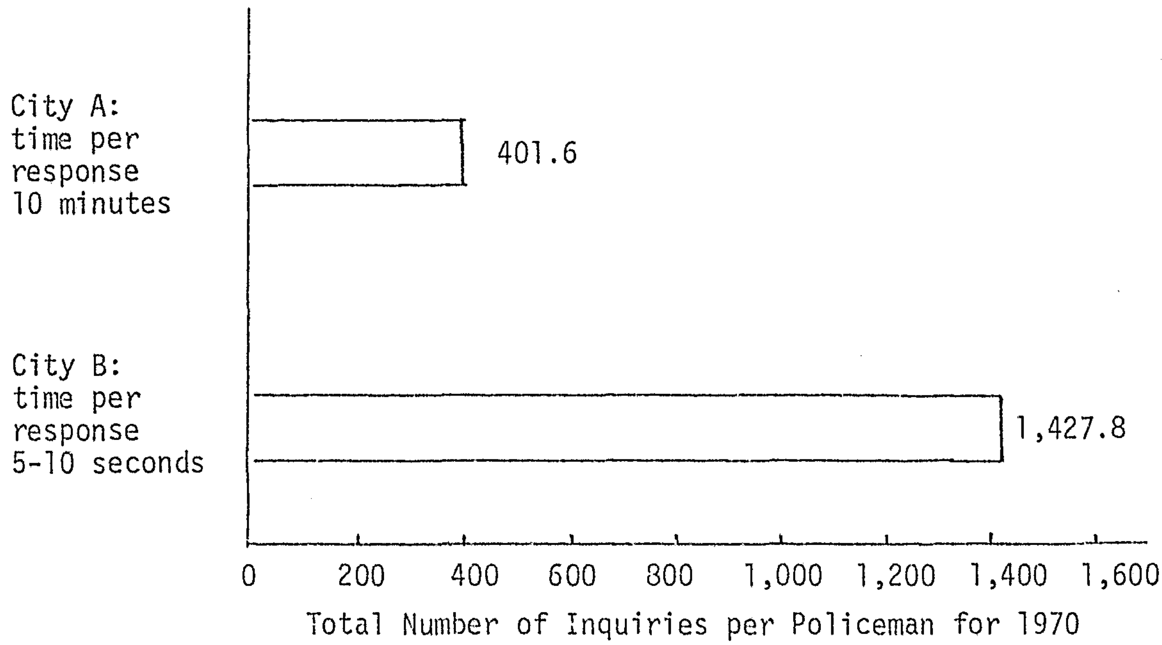
15. Memorandum, "Semiannual Automated Want/Warrant System Statistics," dated July 18, 1971, to William J. Mooney, Long Beach, California, chief of police, from Officer S. R. Eakin, AWWS coordinator.

16. The figure 769 (the increase from 1969 to 1970) ÷ 3,827 (total Long Beach warrants) yields an increase of 20.1 percent. 20.1 percent x $375,000 = $75,375.

17. The actual financial benefits are even greater given that the number of people in the warrant detail in the police department has been reduced since the implementation of AWWS. The majority of warrants are now handled by the patrol division instead.

Figure 3-5: Computer use in two cities of similar size in 1970



much as ten minutes instead of ten seconds. This slow response naturally led to a disenchantment with the system. In a second city of similar size in the same state (City B), where a system had been in operation for only two years, particular emphasis had been placed on rapid response, and replies to inquiries from patrolmen were consistently returned in from five to ten seconds. Because of the difference in response time and greater acceptance in the second city, computer use in City B, as measured by average inquiries per uniformed policeman, was almost three times greater than in the first city. (See Figure 3-5.) Such variations between police departments suggest two things: first, that since such differences exist, it will always be difficult to generalize about the impact of automation; and second, that if a police department is planning to utilize information, it should take the time and effort to ensure proper implementation. Otherwise, what has benefited one department will prove to be a waste of money in another.

c. The CJIC System of Santa Clara County, California. The availability of federal money has prompted the establishment of a number of complex computer-based information systems serving criminal justice. The costs for developing many of these systems have come from federal sources, while local contributions have been used primarily to cover personnel costs. once the federal dollars have been spent, however, the local jurisdictions have had to assume the operating costs. In some instances, as, for example, in the case of the Criminal Justice Information Control (CJIC) System of Santa, Clara, California, this final responsibility has caused the local jurisdiction to question whether the benefits really justify the costs.[18]

Late in 1969, the Board of Supervisors of Santa Clara County, California (the fifth largest county in California, with a population of 1.1 million), decided to seek funding from LEAA to implement a comprehensive criminal justice information system. At that time, each jurisdiction within the county was limited to its own information base, whereas criminal activity often crossed jurisdictional boundaries. In order to overcome this problem the county sought to develop a single computer-based information system that would store, process, and disseminate information related to adults arrested and booked anywhere in the county. The system was designed as one of the nation's first defendent-tracking systems. The ten objectives of CJIC were to:

- serve as an integrated intergovernmental information system;
- support daily criminal justice operation;
- support comprehensive criminal justice planning;
- use modern data-processing technology;
- use or initiate modern administrative techniques;
- promote system transferability;
- establish and maintain effective relations among criminal justice agencies;
- provide improved management skills and tools;

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18. For a discussion of this issue with respect to the CJIC System in Santa Clara County, see Theodore R. Lyman, "The Comprehensive Criminal Justice Information System: A Policy Evaluation," paper presented at the 1976 Urban and Regional Information Systems Association (URISA) Annual Conference, Atlanta, Georgia.

- support related and criminal justice projects that required or shared CJIC data; and
- safeguard security and privacy.[19]

Because of the county-wide nature of the project, there was an implied decision on the part of the county that once federal funds were expended, the county would assume full operating costs. The development costs for CJIC were close to $4.5 million, and, as of 1976, the operating costs were approximately $1.3 million per year, with the county paying all costs except those of the lines, terminals, and modems for the non-county agencies (the cities).

In 1975, with federal funds expended, questions arose regarding the performance of the system and whether the benefits really justified the escalating costs. Stanford Research Institute (SRI) was hired to perform an evaluation. Because there was a lack of "hard" data, interview techniques were utilized and an effort was made to give objectivity to subjective information.[20] It was decided that to some extent the system was achieving eight of its ten objectives. The other two -- that CJIC would support comprehensive criminal planning, and that the system would use or initiate modern administrative techniques -- were

19. Ted Lyman et al., An Evaluation of the CJIC Information System of Santa Clara County, Final Report (Menlo Park, Calif.: Stanford Research Institute), January 1976.

20. For a discussion of methodology see Lyman et al., An Evaluation of the CJIC Information System of Santa Clara County.

judged to be only "marginally achieved."[21] In terms of cost performance, the assessment of CJIC was largely inconclusive. "The identifiable cost-offsets fall far short of the $1,300,000 annual system costs... However, if a realistic value could be associated with each CJIC benefit (admittedly impossible, for each benefit could never be identified), the system would be marginally cost effective."[22]

On the basis of this evaluation, the county decided to maintain the system, but at roughly the same cost level rather than at an increased level as had been proposed. As long as the cities could participate in the system at only the cost of lines, terminals, and modems, it was fine. If the cost rose, many cities were expected to break away from CJIC.

The experience of CJIC points to two important lessons. First, since federal funds can be "seductive," cities considering computer-based information systems should examine not only the short-term development and implementation costs but the long-term operating costs and benefits. Second, the CJIC experience points out both the difficulty of and the need for evaluation. Although it may not be possible to reach absolute judgments based on cost-benefit analysis, millions of dollars are spent on large-scale systems and regular evaluations are required in order to make police decisions and to determine possible modifications to improve performance.

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21. Ibid., p. 11.

22. Ibid., pp. 11-12. In addition, a number of changes were recommended for the system, which the evaluators felt would make CJIC most cost-effective.

C. The Potential Impact of Computer Technology

We have already discussed some of the technical and service impacts of routine computer applications. In addition, important "power shifts" may occur when computer technology is introduced. Although it is still far too early to determine the final nature of such shifts in power, influence and structure, the topic is far too important to ignore. An interview with the Kansas City Chief of Police, Joseph McNamara, in 1974, raised several important issues related to power shifts.

The Kansas City Police Department has been outstanding in the area of computer use. It is noted not only for the operational excellence of its system, but also for the department's acceptance of the system. In 1973, over 575 visitors from all over the world visited the Kansas City computer facility. When Chief McNamara was queried by telephone in 1974 as to what computer problems he considered most significant in Kansas City, his answers were unexpectedly different from those received from other police administrators. They point to a "second generation" of potential problems to be faced by other police departments as they advance in the application of information technology.

McNamara's first point was that the Kansas City system had raised enormous problems relating to security and privacy. More than 225 terminals and 53 agencies are involved in the Kansas City ALERT II System. Thus size alone created difficulties in controlling access, instructing operators, and maintaining all of the required security precautions. This fact suggests that even though regional, state, and national information networks are established in order to reap the benefits of data-sharing, unusual precautions must be taken if control over invasion of privacy is to be maintained.

Second, McNamara felt that the computer indirectly had hurt the manpower situation in his department. Because of the rapid feedback on stolen cars, outstanding parking tickets, and unregistered vehicles, officers are now making more field stops and arrests for such relatively minor offenses as unapid parking tickets. Manpower is being drained from what the chief believes are more important areas of law enforcement activity, such as crime prevention and service and order maintenance activities. Thus, he said, the department was trying to develop a new set of "decision rules" as to when and how to allot time.

Each of these issues -- the danger of invasion of privacy and the power impacts, whether subtle or direct, that the computer might have on police work -- will be addressed below.

1. The Issue of privacy. A number of valid law enforcement purposes can be served by the creation of criminal justice information systems, but computerization of law enforcement records is potentially harmful. In the absence of strict rules on the acquisition, storage, and dissemination of information, the computer's tremendous capabilities may result in the invasion of individual privacy. If this occurs, it will be perhaps the most important power snift resulting from computer technology.

In rebutting criticism of their system, some law enforcement officials argue that their data banks are necessary if the police are to

23. As part of the NSF-RAND project, Ms. Katherine Gardner prepared a background memo on "Police, Computers, and Privacy Issues." Although space does not permit a full reprint of that memo, she is credited for many of the initial ideas and thoughts printed here.

reduce crime and maintain order. Some officials seriously believe that if an individual has not committed an illegal act, he or she has nothing to fear even though the reputations of innocent individuals (along with their credit ratings or jobs) may be threatened or destroyed by the improper sharing of police records with government agencies and private institutions or a malfunction of the system. Surveys have indicated that employment agencies refuse to recommend individuals with arrest records, whether or not their arrests were followed by convictions.[24] This suggests that an important principle of criminal justice -- the right to a presumption of innocence -- may be subject to erosion. As one critic of the growing number of domestic intelligence data banks has said,

> the trouble is that people with records don't simply disappear from the face of the earth, they continue to live in our cities, many of them in our black ghettos. Having used their records to keep them out of our places of employment, we still have to live with them.[25]

Of course, many of the undesirable practices and problems associated with the record-keeping uses of the computer were known in the era of paper records and manual transmission of information. But the inherent inefficiencies of manual police files provided some built-in protection

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24. Congressman Don Edwards of California reported that a recent survey has shown that 75 percent of all employment agencies in New York City refuse to recommend an individual with an arrest record whether or not it was followed by a conviction. Another survey of 75 employers indicated that 66 of them would not consider employing a man who had been arrested for assault and acquitted. (U.S. Congress, House Committee on the Judiciary, Security and Privacy of Criminal Arrest Records, Hearings before Subcommittee No. 4 of the Committee on the Judiciary on H.R. 13315, 92nd Cong., 2nd Sess., 1971, p. 1.)

25. Aryeh Neier, "Have You Ever Been Arrested?" New York Times Magazine April 15, 1973.

against the misuse of sensitive personal information. If an offense was not too serious, the individual could move to a new location and, like the bankrupt businessman, start over with a clean slate.

What the electronic revolution has done is to remove many of the protective inefficiencies and to erode the traditional boundaries between different types of record-keeping systems. The increased capacity to store and retrieve information about the individual and to move it rapidly from one point to another has given law enforcement officials a powerful new resource for exercising control over individuals and groups and has magnified the adverse effects of record-keeping on the life of the individual.

Various technical and mechanical security devices exist which may be used to safeguard the rights of the individual in law enforcement's computer age, but that is not the main point of this discussion. The critical question is, "What do law enforcement agencies really need to know?" Often, the less important questions of "What information can be collected?" and "Once it has been collected, how can it be protected from unwanted use?" have served as the initial guidelines. Both society and the law enforcement community must consider carefully the extent to which additional information will actually assist in controlling the nation's crime problems. Technical and operational problems relevant to privacy and security should be addressed only when the basic policy questions have been adequately answered.[26]

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26. One of the most complete and most recent works on this topic is U.S. Department of Health, Education, and Welfare, Records, Computers, and (continued...)

Important strides have been made towards achieving public participation in the value-oriented discussion which must accompnay increased computer use by the police and other institutions. Numerous Congressional committees have met, and exhaustive hearings have been held.[27] In addition, a National Presidential Commission on Privacy had been established, and extensive deliberations continue. Still the issue of privacy is unlike most other difficulties encountered by police in their computer operations in that it generally does not appear to be a real problem to the department until an outside group defines it as such. In 1974, in response to both the telephone interviews and the mailed surveys, only one police department viewed the issue as a problem. In the majority of communities, the local police computer system is unlikely to become the object of much adverse publicity. Nevertheless, the lack of vocalized public concern should not give the department an excuse to avoid dealing with the issue. Achieving total efficiency at catching criminals is a Pyrrhic victory if it is done through infringing on, or threatening the constitutional rights of, citizens.

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26. (continued)
the Rights of Citizens, Report of the Secretary's Advisory Committee on Automated Personal Data Systems (Washington, D.C.: U.S. Government Printing Office, 1973). Also, see Security and Privacy Considerations in Criminal History Information Systems, Project SEARCH, Committee on Security and Privacy, Dr. Robert Gallati, Chairman, Technical Report No. 2, July 1970.

27. See "Report of the Task Force on the Storage of and Access to Government Statistics," (Washington, D.C.: U.S. Government Printing Office, 1966); and U.S. Congress, Senate Committee on the Judiciary, Federal Data Banks, Computers, and the Bill of Rights, Hearings before the Subcommittee on Constitutional Rights of the Committee on the Judiciary, 92nd Cong., 2nd Sess., 1971.

2. Other potential power shifts. One of the purposes of the two surveys was to discover whether the introduction of computer technology was causing decision-making to become concentrated exclusively in the upper echelons of the command staff. It seemed logical that, as more and better information regarding a patrol unit's daily activities and its relative performance became available to the chief and his staff, they would be in a much better position to make judgments regarding how such units should function. In reply to the question whether the decisions reached in police departments were being based increasingly on quantitative information as the result of the availability of the computer facilities, 47 percent of the respondents indicated partially, 37 percent indicated yes, and only 16 percent said no (see Table 3-4). Respondents were also asked if changes had taken place in the amount of control or influence exercised by different people or divisions as a result of putting the computer to use. In most instances, the results of the 1974 survey were similar to those of the 1971 survey (Tables 3-5 and 3-6). In both years, the research and planning division and the data processing division were the two primary recipients of the perceived shifts in "power benefits," and the chief of police came in third. Interestingly, almost no one was perceived as having lost influence because of the computer, although some did gain significantly more than others.

However, when departmental spokesmen were asked in the telephone interviews whether decision-making was becoming more or less centralized, a sizable number (10 out of 15) stated that they believed decision-making was becoming more decentralized. Several indicated, however, that the move toward decentralization did not result from the introduction of computers, but from the adoption of "team policing." Other departments gave a different rationale for the decision to decentralize, saying that although the computer provides the command staff with necessary information, it was not sufficiently detailed to enable them to supervise and command the operations of the individual units on a day-to-day basis, much less on a minute-to-minute basis. (As one chief put it, "Sometimes I ask myself whether I'm decentralzing decision-making simply because I don't have enough information about what is going on.") Consequently, the emphasis in these departments was often placed on summarizing the statistics and crime patterns, and then on getting such information down to the patrol supervisor and district commander to help them in their deliberations. Such data were not always received with enthusiasm. In many departments the patrol supervisors did not understand the relationship between the various statistics on crime and service times and what was actually happening in the streets. They had been supervising the district's units successfully for years without benefit of such data.

What does all this mean regarding the power impact of computer technology on police structure? Some evidence exists for centralization, influences, while other indicators point to decentralization. In reality, both have occurred. If a chief is interested in increasing his control and is capable of understanding and utilizing quantitative data, computer technology will serve his purpose. If, on the other hand, the predominant focus of the department is on decentralization, the computer can be used to move in that direction. The computer has less influence in such situations than the prevailing spirit, attitude, and capability of those in the upper levels of the department. Computers and other

Table 3-4: Question: Has the Computer Created Pressure to Quantify?

Response	Number of departments	Percentage of Total
Total	155	100.0
Yes	58	37.4
No.	25	16.1
Partially	72	46.5

Source: 1971 ICMA Survey.

Table 3-5: Change in Control or Influence as a Result of Computer in 1971

Level or division	Number of departments reporting (A)	More influence		No change in influence		Less influence	
		Number	% of (A)	Number	% of (A)	Number	% of (A)
Chief of police	109	51	43.6	66	56.4	0	0
Assistant chief or chief's direct staff	105	46	43.8	58	55.2	1	1
Precinct district or division commanders	109	46	42.2	60	55.0	3	2.8
Research and planning	110	64	58.2	45	40.9	1	.9
Data processing	100	62	62.0	36	36.0	2	2.0
Patrolmen in the field	111	41	36.9	68	61.3	2	1.8
Other personnel	17	6	35.3	11	64.7	0	0

Source: 1971 ICMA Survey.

Table 3-6: Change in Control or Influence as a Result of Computer in 1974

Level or division	Number of departments reporting (A)	More influence		No change in influence		Less influence	
		Number	% of (A)	Number	% of (A)	Number	% of (A)
Chief of police	137	55	40.2	82	59.8	0	0
Assistant chief or chief's direct staff	126	45	35.7	81	64.3	0	0
Precinct district or division commanders	127	47	37.0	76	59.8	4	3.2
Research and planning	134	71	53.0	61	45.5	2	1.5
Data processing	123	57	46.3	65	52.9	1	.8
Patrolmen in the field	127	36	28.4	88	69.3	3	2.3
Other personnel	49	7	14.3	42	85.7	0	0

Source: 1974 ICMA Survey.

technologies do not cause centralization or decentralization. Instead, they are powerful tools which can be used by people to move in either direction. Centralization may still be the more common result, but not necessarily.

The impact of the computer on police work does not stop with the centralization or quantification of decision-making. Two types of power shifts may result from computer use.

First, the use of information technology may tend to emphasize certain aspects of police work rather than others. Although such emphasis may be unintentional, the department may be pushed in a certain direction that will produce an important shift in power and may even have a negative effect. Kenneth Landon has argued, for example, that computer technology has strengthened the grip of traditional social policies and lessened the public demand for a fundamental rethinking in such areas as police, welfare, and health. Although public debate and research could select the computer effect which is desired, this is not happening; rather, the status quo has been fostered.[28]

Chief McNamara's example of such an unintended power shift in Kansas City has already been cited. As the real-time computer which provides information to the officer on the street in just a few seconds has been utilized, the number of car stops and "hits" has risen to the point where it has limited the patrolmen's time for such other important police activities as crime prevention, order maintenance, and service calls.

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28. Kenneth C. Landon, Computer and Bureaucratic Reform: The Political Functions of Urban Information Systems (New York: John Wiley, 1974).

This dramatic rise in number of inquiries is not unique to the Kansas City police department. Others have found their inquiry volume so heavy that they have had to add more terminals and even, in one case, another radio channel. Fifty-eight percent of the departments responding to the 1974 survey indicated that since the implementation of their EDP equipment the patrol officers' functions or the manner in which they carried out their tasks had changed. It became clear during the telephone interviews that in saying this, most departments were referring to the impact of their police patrol and inquiry applications and the resulting increase in the number of car stops and outstanding warrant checks being made by their officers. While such activities have resulted in the apprehension of additional criminals and in technical and service benefits, as cited earlier, they also offer the potential of subtly refocusing police activity and of increasing the hostility between the police and community as the number of stops rises, particularly in a minority section of town where such interrogrations are felt to be harassments.

Even more important than the unintentional shifting of the focus of activities in a police department is a second subtle impact of computer use. The computer is, of course, a hardware approach to improving police activity. Yet many contend that the basic problems of the police are not questions of hardware but rather are "soft" or people-oriented problems. The police today face a number of basic questions: What is the purpose of police work -- to fight crime, to provide social, or order maintenance service? Who should serve as a police officer? Who should control the police operations? To ignore such questions is to ignore a crucial part of law enforcement. However, during the past decade when LEAA funds have been available, the tendency has been to look to hardware as a solution. But the answer does not lie in hardware; it lies in basic value judgments and in people. To the extent that the hardware approach diverts attention from the real issues, new computer applications may have a negative influence.

In talking about an Oakland computer application (terminals in the car), one sergeant remarked:

> The computer terminal in the car is an effort by the police department to professionalize from a hardware approach. This may be OK, but the more we concentrate on hardware, the more often we move away from the basic people and judgment issues. The real police problems don't have technical solutions. Instead, it's the people who are screwed up; and we need more people-to-people-type efforts in police department, such as improvements in communication, increased motivation, productivity modifications, better interpersonal relations, etc. In short, instead of hardware resolutions, we need policy resolutions of the basic issues of the police force. The result of the computer may be to take our minds off the real issues.

D. Conclusions

During the last decade, the use of computer technology by the police has grown significantly, and automation has become a reality in law enforcement work. Certainly much of this growth can be attributed to the availability of federal dollars to help finance costs. A determination as to whether this expense has been appropriate must rest upon an evaluation of the impacts (including the benefits and costs) of computer use. This issue may be impossible to resolve to everyone's satisfaction, but it can at least be considered.

In Chapter I a four-part framework for evaluating computer technology was outlined:

- Does the application "work" -- that is, does it stay in operation over a period of years -- and does it do what its implementors said it would? For example, does it get information back to the officers in the field in seven seconds? Does it allow response to 95 percent of the calls without delay?
- What have been the technical impacts, if any, of the system, and has police activity in a narrow sense changed as a result of the application? For example, has the number of arrests or recovered stolen cars increased, or has the revenue of the city increased?
- Has the application had any service impacts? Has it brought a reduction in the crime and traffic accident rates? Has it improved the overall satisfaction of citizens with police service?
- Have there been any power shifts as a result of the system?

Although success varies greatly from department to department, routine computer applications have often succeeded at the first level: They have generally worked. Numerous police patrol and inquiry applications and crime statistical files are in operation around the country today, and in many cases they have done what their sponsors said they would do. Seven-second retrieval to the man in the street in Kansas City and Los Angeles has been a reality for several years. In addition, in a narrow "technical impact" sense, a number of routine applications have proved to be cost-effective. Although full-scale cost/benefit analyses have not been made, illustrations have been presented of the technical benefits of such applications: $180,000 additional revenue in Tulsa as a result of the first year's operation of a new automated traffic citation system; an increase in the number of warrant arrests in Long Beach; and the rapid rise in Kansas City of the number of inquiries per police officer concerning stolen cars or wanted persons.

The broader service impacts and power shifts resulting from routine applications are less straightforward. Clearly, a number of positive impacts have resulted, but some unexpected implications have also surfaced -- for example, the potential manpower drain resulting from overaccentuating car stops. In addition, although federal dollars have fostered a number of worthwhile and creative projects, they have also been a "seductive stimulant," in some cases allowing questionable projects to move forward. Further, questions of privacy remain as an area for potential power shifts. Overall, though, the success of routine applications is relatively clear, and, with the exception of unexpected power and service shifts and unresolved privacy issues, the results are generally positive.

The results of nonroutine applications are far less clear at all four levels of evaluation. The sharp increases predicted in the surveys for computer-aided dispatch and criminal investigations between 1971 and 1974 did not occur. Among the nonroutine application areas, only resource allocation experienced a serious rise, either in an absolute sense or on the basis of the three-year increase. However, even in the case of resource allocation applications, it appears that while a number of police departments are using data provided to them by the computer to make deployment decisions, only a few are utilizing advanced mathematical or operations research techniques to do so. With this in mind, the next two sections of the report will focus on the implementation of nonroutine applications of computer technology. When implementing such nonroutine applications, though, a police department should not lose sight of certain unintended power implications. In particular, it is important to keep in mind that the real solutions to the basic issues which face the police will not come about through hardware efforts alone. At some point these questions must be faced and resolved at the more basic policy level, a people-to-people level.

In conclusion, although computer technology certainly has influenced police activity and will continue to do so, it would be a mistake to think that computers will play a major role (at least in the short run) in revolutionizing the police or solving many of the major problems they face. The conditions of police departments are, to a large extent, determined by the conditions of society. As a consequence, the computer will have only a marginal impact on their problems. Improved efficiency, shorter response time, better investigation of crimes, and improved management may result. But the broader law enforcement issues, such as the prevention of crime, the handling of offenders, and police-community relations must still be resolved in the larger social context. Further, the general nature of each department and the variations from city to city will have a major impact on the use and acceptance of the computer. In many departments, in fact, the traditional nature of the police force will have a larger effect upon computer operations than the computer will have on the police.

CHAPTER IV

THE USE OF A COMPUTER-ASSISTED PATROL DEPLOYMENT MODEL IN THE ST. LOUIS METROPOLITAN POLICE DEPARTMENT

by Scott Hebert

Since the inception of municipal police departments in the U.S., special commissions composed of leaders of commerce, government, and the criminal justice community have been formed periodically to study the problems of policing and to suggest ways to improve crime control. For at least the last hundred years, a principal thrust of the recommendations of such commissions has been that police departments should model themselves after what has been seen as the more efficient and effective operations of the military and business. Such recommendations have often included admonitions to follow the lead of business and the military in exploiting the latest developments in science and technology. In fact, the 1967 President's Crime Commission devoted a chapter of its final report to an endorsement of greater exploitation of technology by criminal justice agencies. Among its other recommendations, the Crime Commission advocated the application of computers and operations research techniques to the law enforcement field.

This chapter, and the two which follow, examine the actual experience of three police departments in introducing into their operations the technology advocated by the Crime Commission--computer-assisted resource allocation models. The chapter will first review early resource allocation efforts and the impetus for the deployment project in the St. Louis department experimentation, implementation, and expansion of the resource allocation system in St. Louis on a city-wide scale will then be described, and the last section will outline the deemphasis of the project.

A. The St. Louis Metropolitan Police Department and its Early Resource Allocation Efforts

In 1976, the St. Louis Metropolitan Police Department (MPD) was composed of 2,081 commissioned police officers and 565 civilians.

Approximately fifteen percent of the department's officers are black, as compared to over forty percent of the city's population.[1] The St. Louis force is headed by a chief of police who reports to a policy-making civilian Board of Police Commissioners appointed by the governor of Missouri. (The mayor of St. Louis Serves as an ex-officio member of the Board, but has no direct authority over the department.)

The MPD is organized into four major bureaus: field operations, investigation, service, and inspection. By far the largest of the four in terms of personnel is the Bureau of Field Operations, responsible for the department's patrol force. For the purposes of patrol operations, the city is divided into three area commands, designated Areas I, II, and III, each made up of three districts and directed by a major.[2] The district,

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1. F. W. McFarlan and T. C. Raymond, "The St. Louis Police Department," ICH 12C51 (Cambridge, Mass.: Intercollegiate Case Clearing House, 1967), p. 2; and U.S. Department of Commerce, 1970 Census of Population and Housing, PHC(1)-181 (Washington, D.C.: U.S. Government Printing Office, 1972).

2. During part of the time period examined by this case, specifically the years 1956-1968, the police department divided St. Louis into two "area" commands, each under the direction of a major. The North Area consisted of five districts, while the South Area had four districts.

however, is the chief operational unit of the department. Each of the nine districts has its own stationhouse commanded by a captain.[3] A lieutenant is responsible for the district's manpower assigned to each eight-hour shift. To assist the "watch" lieutenant in overseeing the patrol units, the beat areas in the districts are grouped into precincts, each of which is supervised by a sergeant.[4]

Until the 1950s, the St. Louis MPD's patrol operations had changed relatively little since the department's establishment. For example, while the department had approximately 30 precinct sergeant cars in the early 1950s, the patrol force was still composed primarily of foot patrolmen--about 285 to each of three rotating shifts[5]--who covered the city's 351 footbeats.[6]

In 1953, the Board of Police Commissioners asked the St. Louis Governmental Research Institute to examine how the department's existing patrol plan and force might be more effectively utilized. Applying some of the concepts being advocated in the police administration literature, the Governmental Research Institute staff redrew the boundaries of the footbeats on the basis of workload and recommended that the department expand its motorized patrol capabilities. The Board accepted the

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3. The sworn complement of the districts in 1976 ranged from 94 for the First District (with 6 percent of the city's crime) to 235 for the Third District (with 17 percent of the city's crime).

4. St. Louis Metropolitan Police Department, <u>1973 Annual Report</u>, p. 18; McFarlan and Raymond, "St. Louis Police Department," pp. 2-3; U.S. Department of Commerce, <u>1970 Census</u>.

5. In rotating shifts the watch to which a group of officers is assigned is changed at regular intervals.

6. Interview between Scott Hebert and Grant Buby, St. Louis Governmental Research Institute, July 1974.

recommendation, and within six months had doubled the size of the department's motorized force to 60 units. The Board also requested the Research Institute to recommend whether such cars should be manned by one or two patrol officers. After considerable study, the Institute concluded that in order to maximize coverage by the patrol force, all patrol units except those assigned to high-crime areas in the evening should be one-man cars.

In 1958, following the reorganization of the department, increased motorization of the patrol force and the granting of additional recreational time to police officers by the state legislature, the Board of Commissioners decided to review the patrol plan again. This time, however, they hired O. W. Wilson, the well-known police administrator who headed the School of Criminology at the University of California, to do the job. Wilson developed a new patrol plan for the department in which the allocation of manpower to the various geographic units was made on the basis of a hazard formula. This formula considered the respective proportion of service calls, inspections, and the area covered in calculating the distribution of patrol units. At this time, too, the department instituted a fourth watch (of 26 one-man patrol cars) from 6 p.m. to 2 a.m. in some districts in order to provide additional manpower during the period of greatest need.[7]

The Wilson formula served as the department's principal deployment technique until May 1966, when the Board of Commissioners submitted a grant application to the Office of Law Enforcement Assistance (OLEA), proposing the development of a much more complex method of allocating resources. The approach outlined in the application indicated that the department was

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7. Governmental Research Institute, "Study of Distribution of Patrol Services in the St. Louis Police Department," 1958, pp. 1-2.

attempting to go much further than it had previously to make manpower availability conform to externally-generated service demands (as represented by mathematical projections) over time and space. Instead of its regular deployment schedule--under which a district assigned an equal number of men to the three regular watches and, if desired, a smaller number to an auxiliary fourth watch--the department proposed varying the number of personnel on duty by time of day and day of week, according to estimated need, in an experimental district (District Nine). In addition to varying manpower, the beat configuration within the district would be changed according to the time of day and day of week. All this would be accomplished by using computer-generated predictions of crime and call-for-service rates. Furthermore, during the test, the district's patrol force would be functionally split, with certain units designated for call-for-service assignments and other units performing patrol duties.[8]

B. The Impetus for the Department's Resource Allocation Experiment

According to a number of sources, the individual most responsible for the department's resource allocation efforts during the 1950s and 1960s was the president of the Board of Police Commissioners, "Colonel" Samuel Priest, a prominent local businessman. As Board President, Colonel Priest possessed considerable power in setting policies for the department. Moreover, unlike many commissioners, not only did he work full-time at his

8. St. Louis MPD, "Application for Grant for Resource Allocation of Police Manpower Project," May 22, 1966.

Board duties, but he "made a point of assuring that the commissioners' policy was followed."[9] During the 1950s, believing that the department was too fragmented, Colonel Priest had spearheaded an effort to replace officers with civilians in certain "nonessential" assignments. As a result of his actions, about 100 officers were transferred to patrol duties. He was also instrumental in convincing the Board to hire O. W. Wilson in 1958, and he led the campaign to create a planning division and a mobile reserve.[10] Although Colonel Priest worked for the abolition of the motorcycle division and the consolidation of the districts, these efforts met stiff resistance from the rank-and-file, and achieved only limited success.

In 1963, at a law enforcement conference, the Director of Planning of the St. Louis MPD met Robert Schumate, who (along with Richard Crowther of the University of Indiana) had developed a prototype of a computer-assisted system for police manpower allocation and was demonstrating the system to representatives of various police departments. When the planning director mentioned this encounter to Colonel Priest, Priest arranged for a meeting with the two operations researchers. The commissioner felt that an allocation system such as the one suggested by Crowther and Schumate, although requiring several years of development work, might greatly benefit the department. Nearing the end of his term, Commissioner Priest moved to persuade the Board to purchase an advanced computer system. It was his belief that the availability of such equipment in the department would

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9. Interview between Scott Hebert and "Colonel" Priest, St. Louis, April April 1975.

10. The Mobile Reserve is a detachment of patrol units and men, protected from any other function, which is deployed by the Bureau of Field Operations in accordance with topical crime problems.

insure the eventual implementation of the proposed resource allocation application.[11] In getting the Board to agree and the department to install the data processing equipment, however, Priest was forced to "do a lot of banging over the head," which, according to a number of sources, created lasting resentment toward the computer system and its proponents.

The computer was installed in November 1964, and shortly thereafter Colonel Priest left office. The first applications to be developed on the new equipment were vehicle registration, real-time arrest and booking, and bench warrant files. Crowther's and Schumate's proposal concerning manpower allocation was shelved for about two years. However, the acquisition of the computer had proven to be very expensive (approximately one million dollars), and to help justify the use of the new system, the department began to explore other application areas. Late in 1965, the Board and representatives of the department held a series of meetings with Crowther and Schumate during which it was agreed that the department would begin to design a computer model for predicting calls-for-service.[12] The department also began to formulate plans for an experiment with the system in which the performance of a test district (District Nine) using the resource allocation model would be compared with the performance of a control district (District Seven).

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11. Interview between Scott Hebert and "Colonel" Samuel Priest, St. Louis, 1975.

12. St. Louis Metropolitan Police Department, "Allocation of Patrol Manpower Resources in the St. Louis Police Department," vol. I, p. 23.

C. The Fifth District Program

While the details of this two-district test were being worked out, an experiment involving a manually calculated version of the proposed resource allocation method was carried out in the Fifth District. The commander of the North Area, in which the Fifth District was located, felt the current patrol plan was inadequate. In his words, "instead of a patrol plan, this department had a 'called-for-service' plan that superseded preventive patrol and prevented commanders from properly deploying their forces to combat and prevent crime."[13] To free units from the control of the radio dispatcher at headquarters, the Ninth Area commander (a major) recommended the functional separation of the district's patrol fleet into call-for-service and preventive patrol units.

With the assistance of a sergeant from the Crime Analysis Section, the major analyzed District Five's past experience in call-for-service demands and crime statistics, paying particular attention to the time of day and day of the week for such occurrences. After six weeks of research and calculations, they were able to put together what they felt was a feasible schedule for splitting the district's call-for-service and preventive patrol force. In late February 1966, the major sought permission for the adoption of his pilot program in the Fifth District. Approval from the chief and Board of Commissioners was received shortly thereafter, and the pilot program was instituted in the Fifth District on March 16, 1966.

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13. "Six Months Progress Report of Fifth District Pilot Program--Recommendations for Future," (Memo from Major Robert W. Matteson to Lt. Col. James E. Chapman), Sept. 26, 1966, p. 1.

As part of the pilot program, the beat structure of the Fifth District was redesigned to center the call-for-service cars in the areas with the greatest reported request rate. The district's duty schedule was also revised, significantly increasing the number of officers assigned to the second watch, reducing the number of men assigned to the third watch, and eliminating the fourth watch. The patrol force was split into call-for-service units and preventive patrol units, with the latter to be freed from dispatch control and deployed by the district commander. Of the district's 12 regular patrol cars, the major's calculations indicated that between three and eight might be needed for service assignments at any one time, depending on the watch. Both the preventive patrol and the call-for-service detachments were made up of a mix of one- and two-man units.

To heighten the efficiency of the call-for-service units, the principle of "stacking" service calls at the car level was to be permitted--that is, assigning more than one low-priority service call to a two-man call-for-service patrol unit, which would handle the calls in turn. According to the initial proposal, the decision whether to "stack" the call was to be made by a district sergeant in the dispatching room. This sergeant would also approve or disapprove the use of preventive patrol units for emergency service calls when the call-for-service units were busy.

An interesting feature of the Fifth District test was the short notice given to the commander and officers of the experimental district. The commander of the Fifth District, a captain, was informed of the proposed pilot program only a few weeks before its planned implementation, and after the details of the program had been worked out. His first reaction to the proposal was negative because he felt that things were already going well in his district and a change was not needed. Compared to many other areas in the city in the mid-sixties, the Fifth District had relatively stable workload and demographic characteristics.[14] In fact, this "stability" may have been an important factor in the North Area commander's decision to try out his ideas there. Yet, although the rate of calls-for-service in the district was not expected to deviate much from the past, a safety factor of two additional cars per watch was added in order to compensate for possible errors in the model's predictions and to assure the headquarter's command staff that enough call-for-service units would be available to respond to unanticipated surges in the district's workload.

In September 1966, at the end of six months of operation of the pilot program, the North Area commander submitted a progress report and evaluation to the chief of the Bureau of Field Operations. According to the report, under the program the Fifth District's call-for-service demands had been "adequately handled." The report indicated, however, that during the period of the pilot program, crime in the Fifth District had increased over the corresponding period of 1965. It was argued that this was not really an unfavorable result, since the statistics were in line with the general trend in other North Area districts. The North Area Commander concluded:

> Critically reviewing the Fifth District program, I believe that the separation of the call-for-service and the preventive patrol units is the answer to modern police patrol, and [that] the concept of the pilot program is applicable to this entire department.[15]

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14. Memo from Maj. Matteson to Lt. Col. Chapman, Feb. 21, 1966; and interview between Scott Hebert and Maj. Atkins Warren, St. Louis, July 1974.

15. "Six Months Progress Report," pp. 2-3.

D. The Ninth District Test

In May 1966, when the Board of Commissioners submitted its application for the two-district test to the OLEA, the pilot program in the Fifth District had not yet been evaluated in terms of the effectiveness either of the split patrol approach or of variable manpower scheduling. In the pre-pilot program research, however, the North Area commander, aided by the sergeant from the Crime Analysis Section, had confirmed that peak periods of calls-for-service tended to coincide with peak periods of criminal activity. This finding was interpreted by the Board as support for its plan to split the patrol force in the proposed District Nine test area. The Fifth District experience had also demonstrated that the data collection and evaluation contemplated for the two-district test would require a large staff and a considerable amount of clerical work. This realization, in fact, prompted the department to seek federal assistance.[16]

On June 27, 1966, the OLEA awarded the St. Louis MPD an 18-month grant of $170,482 for its resource allocation project.[17] The grant period was divided into three six-month phases: July-December 1966, January-July 1967, and July 1967-January 1, 1968.

1. Phase I. During Phase I, which ran from July through December 1966, the department began to collect basic data on the test and control districts; undertook the formal design and programming of the computer-generated crime and activity reports; and formulated the operational

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16. St. Louis Metropolitan Police Department, "Allocation of Patrol Manpower Resources," vol. I, p. 23.

17. Ibid.

guidelines for the two districts.[18] By the end of Phase I, a system had been developed for the regular collection of service assignment statistics which were inputted into the computer model in order to generate, through the use of exponential smoothing techniques and queuing theory, predictions of call-for-service workload and service levels. In addition, a program was developed to generate reports comparing the actual call-for-service experience with that which had been predicted. A system was also created to collect crime statistics as input for a number of computer-generated crime reports. The most unusual of these was the SYMAP series, computer-produced crime maps representing crime rates within the test district by gradations of shading.

Additional data were gathered on manpower activities in the test district (Ninth) and the control district (Seventh). To evaluate the preventive patrol function, for instance, a system was developed to collect information on the number of reports written on field interrogation, insecure buildings, and the number of on-view arrests. Finally, to provide a basis for determining actual manpower availability, data were continually collected on the number of personnel absent from duty in the two districts due to vacation, recreation, sickness, or other reasons.

During Phase I, the Board of Police Commissioners established a Resource Allocation Committee to administer and monitor the project's progress. This committee was made up of the Bureau of Services commander, the North and South Area commanders of the Bureau of Field Operations, the Ninth District commander, the Computer Center director, and the Resource

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18. Ibid., vol. I, pp. 24-25.

Allocation Project's director, assistant director, and "implementation officer." During Phase I, three meetings were held, the last one occurring on December 22, 1966. At that meeting the operating procedures to be implemented in the test district on January 1 were presented by the guidelines development subcommittee and were discussed by the committee. On the same day, the guidelines were presented at roll call to the personnel of the Ninth District by project members. In addition to calling for the splitting of the patrol force functionally and "stacking" certain nonurgent calls at the car level, the guidelines indicated that the number of call-for-service beats would change every four-hour period for every day of the week, that there would be no interdistrict dispatching (except in emergencies), and that the preventive patrol units would be deployed by the district on the basis of the computer-produced crime reports. Self-initiated activity on the part of the call-for-service units was to be discouraged.

2. Phase II. Phase II of the resource allocation project, the period during which the actual test was conducted, ran from January 2 to July 9, 1967--a total of nine three-week watch rotation periods.[19] Because of some uncertainty over the accuracy of the mathematical model, the call-for-service beat design of the first two rotation periods in the test district (District Nine) was based on the actual statistics for December 1966. Forecasts were made, however, and after the data for the first six weeks of the test had been gathered, these predictions were found to be accurate within a reasonable margin of error. As a result, a decision was made to base the beat configurations for the third rotation period on a combination

19. Ibid., vol. I, pp. 25-26.

of forecast data and actual data. By the fourth rotation, the computer forecasts were serving as the sole basis for design of the call-for-service beat areas.

During the first rotation period of Phase II, several significant changes were made in the guidelines for the test district.

For one thing, the original guidelines had indicated that the call-for-service beat configuration would be changed every four hours or twice during each eight-hour shift. Besides being extremely confusing for the patrol officers and the dispatchers at headquarters, changes in beat configuration resulted in corresponding changes in the patrol sergeant's supervisory areas. For example, in several instances supervisors erroneously sanctioned officers for being out of their assigned areas. Such occurrences strained relationships between the patrol officers and their sergeants. To alleviate these difficulties, a decision was made to have fixed supervisory areas, and to vary the beat configurations within supervisory area by watch and day only.

Another procedural change was motivated by the discovery that the average service time for dispatcher-directed assignments during the first rotation period was shorter than during the period immediately preceding Phase II. This situation was felt to be a result of the exclusive use of two-man cars in the test district. Subsequently, the number of beats for the second rotation period was decreased, thus increasing the workload of each call-for-service unit.

While the use of two-man units had apparently decreased service time, the commander of the Ninth District believed that the use of only two-man cars in the test area was probably not the most efficient application of manpower. At the same time, he recommended expansion of the list of categories of nonurgent calls to be stacked. On April 25, 1967, several categories of larceny, stolen license, and bogus check incidents were added to the list of "stackable" calls. It was not until the completion of Phase II, however, that the Ninth District commander was authorized to determine the mix of one- or two-man cars.

3. Phase III. Phase III, which ran from July 10, 1967, to January 1, 1968, included evaluating the test and initiating work on a final report. A significant portion of the evaluation was carried out by Governmental Research Institute and by System Sciences, Inc., a consulting group formed by the forecasting model originators.

The technical evaluation performed by System Sciences concluded that the forecasts generated by the mathematical model appeared to be satisfactory for the purpose for which the programs had been developed.[20] In the commentary section of its final report, the Governmental Research Institute also claimed that the computer-generated reports had provided useful data for designing patrol beats with equal workloads and for identifying areas for "productive preventive patrol." The Institute, however, warned against reliance on resource allocation concepts as a means of reducing crime, noting:

> The basic purpose of these concepts, to allocate manpower resources effectively in relation to police needs by time and space, should not be lost in wishful thinking that more effective utilization of resources automatically will result in a lower incidence of crime.[21]

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20. Ibid., vol. II, p. 30.

21. Ibid., vol. I, p. 76.

As evidence of the fallacy of such wishful thinking, the Institute pointed out that Part I crimes not only "increased rather steadily" in the test district during Phase II, but were "substantially higher" during each month of the test year than during the same month of 1966. This situation had occurred even though the utilization of the new resource allocation methods had made a larger proportion of crime prevention strength available at what had been determined, in terms of expected numbers of suppressible crimes, to be the most potentially rewarding times and locations.[22] Rather than concluding that this development signaled the failure of the test effort, the Institute asserted that "because of the crime increases, operating techniques based on the Resource Allocation [concepts] become even more important in enabling the department to allocate its manpower resources more effectively against a growing crime problem."[23] The Institute did not elaborate on what it meant by "more effectively."

Because of the size of the expected impact on patrol operations (as well as on patrol operations decision-making), in its report the Institute stressed the necessity for effective and open communication in implementing innovative resource allocation concepts in a police department. The Institute pointed out that the Resource Allocation Committee, made up of predominantly command-level commissioned officers, had been formed

22. Ibid., vol. II, pp. 37 and 40. Despite the theoretically more favorable deployment of resources, the number of arrests in the Ninth (test) District dropped off sharply relative to the pre-test period, whereas the Seventh (control) District's arrest totals increased. This change in the test district's performance, which may have resulted partly from a decrease in manpower strength during the course of the experiment may also have resulted partly from limitations imposed on self-initiated activity of call-sor-service units.

23. Ibid., vol. I, p. 76.

principally to act as a forum to stimulate and facilitate this communications and education process. Unfortunately, as the Institute's report outlined, the committee had met too infrequently to carry out its functions effectively.[24] (This was especially true during Phase II, when only four meetings were held.)

It is not clear whether the limited involvement of the Resource Allocation Committee with the daily operations of the test denoted its opposition, disinterest, or simply a lack of time. There is some evidence that because of the department's inexperience with computers and the civilian domination of the resource allocation effort, some segments of the force may not have considered the project relevant or even legitimate. In any case, as a result of the committee's limited involvement, many operational policy issues which the test experience might have addressed remained unexamined at the conclusion of Phase II.[25]

Another problem raised by the Governmental Research Institute was overspecialization. The Institute's evaluation noted the tendency of some call-for-service units to abandon preventive patrol activities altogether, justifying this behavior on the grounds that "since they were liable to receive another call-for-service at any time, they could not tie themselves up on duties which would prevent them from handling their normal

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24. Ibid., vol. I, p. 75.

25. The following questions could have been explored by the test but were never addressed:
   1. How should the proportion of one- and two-man call-for-service units be decided?
   2. How much emphasis should be placed on prompt response when it may require dilution of the preventive patrol effort?
   3. Should all preventive patrol cars be two-man units?

assignments."[26]

The Ninth District also experienced difficulty in getting the designated preventive patrol units to occasionally handle service calls during busy periods. In fact, because the preventive patrol units were perceived by some personnel as having the easier task, they were known as "do-nothing" cars and the commander's assignments to the two categories of patrol units at times caused considerable dissatisfaction.[27]

As part of the resource allocation project, an attitudinal study of test and control district personnel was carried out by a psychological consultant from Washington University in St. Louis. Despite the problems noted by the Governmental Research Institute, the psychologist claimed that there was no evidence, as measured by five morale subtests, that the project had any adverse effect on morale in the Ninth District.[28] This finding, if accurate, would indicate that wheatever dissatisfaction there was had been relatively minor, and at least had disappeared before the end of Phase II. However, when the Governmental Research Institute mailed questionnaires to all District Nine Sworn personnel near the conclusion of the test period, the responses to the 16 questions indicated some continuing dissatisfaction with the test conditions. For example, one of the two questions to which the patrolmen's response was more favorable than that

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26. St Louis MPD, "Allocation of Patrol Manpower Resources," vol. I, p. 78.

27. Kent Colton interview with St. Louis police officers, spring, 1971; see also "Resource Allocation Project," (Memo from Lt. Col. Matteson to Col. Bronstron), March 15, 1968, esp. p. 3.

28. St. Louis MPD, "Allocation of Patrol Manpower Resources," vol. II, pp. 47-70.

of the command staff was related to the desirability of rotating officers between preventive patrol and call-for-service units. In answering the questionnaire, moreover, all levels of District Nine personnel gave primarily negative responses regarding the flexible use of manpower, "which they believed created problems in the relationship between patrol personnel and comman and supervisory personnel." A substantial proportion of each group also felt that their workload had increased during the resource allocation project.[29] According to the Ninth District commander, during Phase II, the average number of service calls handled by a unit during a watch rose from four to eight calls, which many patrolmen felt had created too much pressure for them to be able to function effectively.[30]

E. Expansion of the System

Despite the department's difficulties in quantitatively evaluating whether the Ninth District test was "successful" or not, at the end of Phase II the Board of Police Commissioners decided that the "test" patrol methods and the computer-generated reports would remain in effect after June 1967.[31] The question then arose as to whether to extend the resource allocation project to other districts. The Board agreed that more experimentation was necessary, and on August 21, 1967, requested that the chief

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29. Ibid., vol. I, p. 79.

30. Ibid., vol. I, p. 26; also, interview between Scott Hebert and Col. Walsh and Maj. Moran, April 15, 1975.

31. St. Louis MPD, "Supplementary Report on the Allocation of Patrol Manpower Resources in the St. Louis Police Department," January 1969, p. 4.

of police establish a committee to prepare a report suggesting "modifications for the resource allocation system presently used in the 5th and 9th districts. The Board also requested the committee to prepare a "feasibility study for instituting the resource allocation program in the 3rd and 8th districts."[32] In directing the formation of this new committee, the Board was apparently trying to respond to the Research Institute's criticism regarding both the Resource Allocation Committee and the civilian leadership of the earlier effort. The former commander of the North Area, now a lieutenant colonel, was made chairman of the committee and voting participants were all sworn personnel.

The new Resource Allocation Committee held ten meetings during the next month. The first two sessions were devoted to familiarizing the members who lacked resource allocation experience with the procedures which had been followed in the Ninth and Fifth Districts. At the end of the second meeting, the committee reached the consensus that the predictive and evaluative computer-generated reports of the resource allocation system were "important and advantageous." But because the committee could not agree on a uniform patrol plan to be used in all four districts (fifth, ninth, third, and eighth), two different operational plans were developed.

According to the committee's recommendations, the Fifth and Ninth Districts were to operate "by the resource allocation concept of split

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32. Memo from Kenneth Dames, Acting Secretary of the Board of Police Commissioners, to Col. Curtis Brostron, Aug. 21, 1967.

patrol."[33] Depending on the watch and day of week, the Ninth District was to employ one of five beat configurations, whereas the Fifth District would utilize one of four configurations. For each district, sufficient numbers of call-for-service units were to be in service at all times to insure that 85 percent of the calls could be answered without delay. The Ninth District was divided into three precinct areas, each supervised by a sergeant. In the Fifth District, there were to be two sergeants, one to supervise all the call-for-service cars and the other for all preventive patrol units. For both districts, all two-man cars were to remain in service at all times, except for emergencies. In the Fifth District, however, two of the two-man cars were designated "stacking" cars, and could receive up to three service calls of a nonurgent nature. Finally, there was to be no interdistrict dispatch (except for emergencies) in either district, and no use of Mobile Reserve manpower.

The other two districts in the expanded experiment, the Third and Eighth Districts, were to operate under what was termed "the conventional beat and precinct plan." This meant that all units were to perform both call-for-service and preventive patrol functions regularly, and that only one beat configuration was to be used. Before the new test was launched, the beat boundaries of the Third and Eighth Districts were redesigned to equalize workload. The Third District was reorganized to comprise four precincts, and the Eighth District was divided into three precincts. For both districts, stacking was to be employed at the car level, and enough patrol units were to be in service at all times so that all emergency calls

33. "Report and Recommendations concerning Resource Allocation," (Memo from Board-appointed Committee to Col. Curtus Brostron), Sept. 12, 1967.

could be answered without delay. As with the Ninth and Fifth Districts, no interdistrict dispatch was to be permitted except for emergencies. Similarly, in all four districts, self-initiated out-of-service requests were to be restricted except for special instances such as the observation of a crime in progress.

In October 1967, the committee's procedural recommendations were reviewed by the Board of Police Commissioners, which approved their adoption for a test period of 15 weeks beginning October 23. About this time, the Board also approved a change in the watch hours of all patrol personnel. As of October 3, instead of beginning at 7 a.m., 3 p.m., and 11 p.m., the watches were to start at 8 a.m., 4 p.m., and midnight. This change had been recommended by the Resource Allocation Unit's staff, who had determined that "significantly fewer men" were needed on a shift beginning at midnight than on one beginning at 11 p.m.[34]

The four-district resource allocation test began at the end of October and continued until February 1968, when the captains of the districts submitted evaluations to their area majors. According to the captains, all four districts had experienced crime increases, with the Eighth District recording a 24 percent rise over the same period as the previous year.[35] The captains' reports also indicated that all the districts had difficulty in fielding enough units to handle their call-for-service workloads as the result of an insufficiency of vehicles and manpower. In fact, because of manpower shortages, in both the "split"

34. St. Louis MPD, "Supplementary Report," p. 8.

35. See "Resource Allocation Project." See also attached reports from district captains and area majors.

districts (Fifth and Ninth Districts) preventive patrol activity was either extremely limited or curtailed altogether.[36]

Although the manpower shortages reduced the utility of some of the project's computer-generated reports, the district captains generally considered the reports to be useful. Some commanders indicated reservations concerning particular reports, however. While the Ninth District captain considered the predictive report for the number of units needed to handle the call-for-service workload to be useful and strongly recommended its continuance, he found the report giving predictions of the number of service calls to be valueless. He was also not at all impressed by the SYMAPs, arguing that "commanders who read reports daily and know their districts have no trouble in identifying the district crime problem and its location."[37]

According to the district evaluations, the concept of stacking non-urgent calls seems to have been well received by all four commanders. It appears, however, that a number of the districts had difficulty in putting that concept into operation. For instance, the Fifth District, which had specific two-man "stacking" cars, found that the dispatchers would stack calls with the wrong units.[38] On the other hand, in the Third District, which did not have specified units for stacking purposes, there was some difficulty in getting units to accept such assignments.[39] The commanders also

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36. Memo from Capt. Thomas Moran to Maj. Eugene Camp, Feb. 5, 1968; memo from Capt. Atkins Warren to Maj. Adolph Jacobsmeyer, Feb. 9, 1968.

37. Memo from Capt. Moran to Maj. Camp. Feb. 5, 1968.

38. Memo from Capt. Warren to Maj. Jacobsmeyer, Feb. 9, 1968.

39. Memo from Capt. Walter Dorn to Maj. Camp, Feb. 21, 1968.

felt that the value of this approach was limited because of the constraints on calls that could be stacked, and advocated further expansion of the list of stackable activities.

The captains' evaluations also revealed a significant morale problem resulting from the new watch hours which had been established just before the test period. Apparently the new hours required officers to go to and from work in peak rush-hour traffic. In addition, there was considerable resentment in the test districts because of the new recreational schedule that had recently been established.[40] Although both of these changes had been recommended by the resource allocation staff in an attempt to bring manpower availability more in line with demand, quite a number of the command staff felt that the potential benefits of the changes had been nullified by the lowering of morale. In fact, after receiving the results of a district survey which showed personnel unanimously against the new watch and recreational schedule, the department allowed District Eight to reinstate the old schedule.[41] According to the commander, this action resulted in the highest morale ever experienced in District Eight, but, at the same time, it represented an extreme violation of test conditions.

As part of their evaluation, the district commanders were asked to recommend which patrol and beat pattern--"conventional" or "split"--would be more appropriate for city-wide implementation. The captains of the two split districts recommended that the split plan be implemented city-wide,

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40. For instance, see memo from Capt. Warren to Maj. Jacobsmeyer, Feb. 9, 1968.

41. Memo from Capt. Thomas Brooks to Maj. Camp, Jan. 29, 1968.

whereas the commanders of the two districts with the so-called "conventional" beat plan recommended implementation of a modified version of that plan. This development is interesting in two respects.

First, as already mentioned, because of insufficient manpower the two split districts had been unable to maintain a significant preventive force. Thus, the captains of these districts were recommending an approach which, for a variety of reasons, had not been put into successful operation.

Second, when one reads the individual district evaluations, it becomes apparent that the "modified" conventional plans recommended by the Third and Eighth Districts were essentially split patrol plans.[42] Both commanders recommended a system with a separate preventive patrol force to be deployed at the discretion of the district commander. For the call-for-service units, on the other hand, only one beat configuration would be used.

In forwarding the district captains' evaluations to the Resource Allocation Committee, the area majors added their own comments and recommendations. The new commander of the North Area, in which Districts Five and Eight were situated, indicated that though he tended to agree with the commander of the Eighth District (who had recommended the split patrol plan), he felt that the department did not yet have enough experience to make a definite decision.[43] The commander of the South Area, on the other hand, recommended retention of the conventional beat plan. It should be noted, however, that the definitions of the patrol plan

42. Memo from Capt. Dorn to Maj. Camp, Feb. 21, 1968; and memo from Capt. Brooks to Maj. Jacobsmeyer, Jan. 29, 1968.

43. Memo from Maj. Jacobsmeyer to Lt. Col. Matteson, March 12, 1968.

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alternatives used may have been confused by the commander of the South Area. For instance, he pointed to the recommendations of the District Three commander as support for his position when, in fact, the "modified conventional patrol plan" recommended by that captain was essentially a split patrol plan.[44]

In his cover letter transmitting the computer evaluations to the chief of police on March 15, 1968, the lieutenant colonel in charge of the new resource allocation committee argued that because these reports "did not contain definite and specific recommendations for future operation," he felt compelled to submit his own recommendations. Basically, he recommended that the department proceed city-wide on an individual district basis, "following the conventional beat and precinct pattern plan employed in Districts Three and Eight, and utilizing all the computer-produced reports now currently in use in both districts." The lieutenant colonel claimed that his objections to following the split function concept were based on three factors: the morale problem created in part by resentment toward those who got the "easier" preventive patrol assignments; overspecialization; and the fact that the preventive force would always be seriously handicapped by the failure to maintain adequate manpower requirements. He further recommended that variable beat boundaries be established in all districts according to the watch and day of the week, since "experience under the program has indicated a definite need for this type of beat structure."[45]

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44. Memo from Maj. Camp to Lt. Col. Matteson, March 12, 1968.

45. Memo from Lt. Col. Matteson to Col. Bronstron, March 12, 1968.

F. City-Wide Implementation of Resource Allocation

Not until five months later was action taken on the committee's recommendations of March 1968. On August 30, following reorganization of the department from two area commands to three area commands, the chief of police ordered the lieutenant colonel to "re-activate the committee, update the report, and submit a firm recommendation."[46] The lieutenant colonel reconvened the Resource Allocation Committee in early September and held six meetings over the next month and a half. At the end of that time, the committee produced a new set of recommendations which closely resembled those which the lieutenant colonel had proposed in the March report. As part of its program, the committee also recommended a return to the old watch and recreational schedule. The proposed date of implementation of this program was January 1969.[47]

Between October 1968 and January 1969, the Board accepted the committee's general recommendations and appointed a major (formerly the commander of District Five) to coordinate city-wide implementation. He held a series of meetings with the districts' command staffs in order to familiarize them with the features of the resource allocation plan, to help them develop their beat configurations, and to get their suggestions on how the patrol plan might be modified. As a result of those meetings, a final version of the city-wide operational guidelines emerged.

According to these final guidelines, the number of beats in a

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46. Memo from Lt. Col. Matteson to Col. Brostron, Nov. 1, 1968.

47. Ibid.

district was to vary depending on the day and the watch. Precincts, however, were to have fixed boundaries as well as approximately equal workloads. The district patrol force was not to be formally functionally split, but the district commander was given the authority to use extra manpower as necessary. The department recognized that in many instances such extra manpower would be placed on patrol duty in "overlay" units, in which case the district commander would have the authority to detach such units from radio control.

As part of the city-wide resource allocation program, each district was to have two designated stacked units to handle the nonemergency calls-for-service. Moreover, the activities of the department's Complaint Evaluation Section, established in 1968, were to be expanded. This section was made up of specially trained officers who screened all calls to police headquarters from the public in order to determine which ones represented legitimate demands for police service, which could be referred to other agencies, and which could be stacked or handled over the telephone.

Since much of the success of the new patrol plan was considered to depend on limiting the amount of self-initiated activity which took officers out of service, the operational guidelines placed restrictions on such activity.[48] Self-initiated out-of-service requests were to be limited to situations requiring "immediate action on the part of the officer, such as crime in progress, moving traffic violation, or other incidents no officer could reasonably ignore." The two-man units were to make a self-initiated request only when the incident required the use of both officers.

48. St. Louis MPD, "Operational Guidelines for Resource Allocation Patrol Plan," Dec. 1968, esp. p. 3.

Finally, all computer-based reports were to be reproduced and furnished to each of the nine districts. These would include daily activity reports of each unit, to be used by the district commander in his required daily review of the patrol plan.

The major who had been appointed to coordinate the city-wide resource allocation program continued his activities for one year. Although there was considerable resistance by officers who did not understand the concepts of the new program and were threatened by the changes being made--particularly certain older district commanders who were so disturbed by the proposed changes that they elected to retire[49]--the major apparently was able to achieve basic adherence to the procedural guidelines by the districts. A large part of his success was undoubtedly attributable to his rank in the department hierarchy and to the emphasis which the Chief and the Board of Commissioners placed on the program. In addition, the major made considerable use of the local media to create public support.

As had been the experience with the two-district and four-district tests, if the resource allocation program resulted in a more effective deployment of manpower, it was not apparent from the crime statistics for the first year of the city-wide program. In 1969, 47,164 index crimes were reported, an increase of 20.8 percent over the previous year.[50] Nor had city-wide clearance rates for the index crimes changed markedly. One

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49. Interview between Scott Hebert and Maj. Atkins Warren, July 1974; and interview between Scott Hebert and Capt. Glenn Pauly, April 1975.

50. St. Louis MPD, "1969 Annual Report," pp. 18-19. The preceding two years had shown similarly large increases in index crimes.

bright spot, however, was the Complaint Evaluation Program, which had brought about a 16 percent decrease during 1969 (as compared with 1968) in the number of calls-for-service requiring the dispatching of a car. This result was significant because from 1958 until the establishment of the screening program, the annual number of radio calls had been steadily increasing.[51]

G. De-Emphasis of the Resource Allocation Project

In February 1970, the chief of police retired and was replaced by a 30-year veteran of the force who had been South Area Commander during the department's four-district allocation experiment. This change was followed by the reassignment of many command officers. Among those transferred was the major who had coordinated the city-wide resource allocation effort, and who now became the commander of Area III. His old position was eventually filled by the ommander of the Planning and Research Division, a lieutenant who earlier had worked with the North Area commander to develop the manual resource allocation project for District Five. Although he had had wide experience with the system, the lieutenant did not have the authority to order the district commanders to use the computer-generated reports and to follow the resource allocation guidelines. As a result, although he was a strong advocate of the deployment model, his role was essentially limited to availing computer reports to those captains requesting them.[52]

51. Ibid., p. 34. Radio calls decreased in 1965 by only 1 percent.

52. Interview between Scott Hebert and Lt. Glenn Pauly, July 1974.

These developments may not have resulted from an administrative decision to de-emphasize the resource allocation program, but the effect was the same. By 1971, it was essentially up to the district commander whether or not the resource allocation program would be used by the district. Although some commanders continued to adhere to the program's operational guidelines, a number clearly did not. In fact, one district captain who was interviewed in regard to the program in mid-1971 replied, "Resource allocation? Oh, I thought we gave that up!" [53]

In 1972, the resource allocation program was further modified. At that time the department decided to shift from the use of beat configurations which changed according to watch and day of the week to the use of two beat structures--a summer configuration and a winter configuration--for each district. This action was justified on the grounds that workload no longer varied enough over the day or week to justify the complexities of variable beats. Moreover, sudden and relatively large demographic changes in some districts had negatively affected the forecast accuracy of the resource allocation model.[54] Interestingly enough, despite the general abandonment of the sophisticated resource allocation procedures from late 1970 on, the reported incidence of crime in St. Louis decreased steadily from 1970 through 1972.[55]

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53. Kent Colton, "Police and Computers: The Use, Acceptance, and Impact of Information Technology," (Ph.D. dissertation, MIT, 1972), p. 270.

54. Interview between Scott Hebert and District Three officers, April 1975; and interview between Scott Hebert and Hugh Donnelly, St. Louis, April 1975.

55. St. Louis MPD, "Annual Report"[s] for 1970, 1971, and 1972.

The resource allocation program was not the only project to be affected by the change in priorities of the new administration. For one thing, the new chief of police believed in the use of specialized units--the kinds of units which a decade earlier Colonel Priest had worked hard to eliminate. Since manpower in the department had remained constant, it was necessary to take officers away from other assignments in order to fill such units. The Complaint Evaluation Section was hit hard by the new priorities and resulting transfers and, partly as a consequence of understaffing, its productivity declined. Calls resulting in the dispatch of a patrol car (which had been relatively stable for four years) increased by 25 percent during 1973.[56]

By 1975, only one of the nine district commanders was requesting and utilizing the computer-generated resource allocation reports to assign manpower, and that was the recent city-wide coordinator who had been promoted to captain and reassigned as commander of District Three.[57] Early in 1976, however, he again transferred and shortly thereafter retired. A new captain was assigned to the Third District and, as of September 1976, was not requesting or using the computer reports. In fact, while there is some variation between districts and traces of the overall philosophy and intent of the experiment remain, the St. Louis police department currently utilizes a deployment schedule similar to that in operation before the

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56. St. Louis MPD, "1973 Annual Report," p. 17. Because detailed information on service-call statistics was lacking, I was unable to determine how much of the 1973 increase was due to an actual increase in calls legitimately requiring a patrol unit and how much was due to the drop in the Evaluation Section's productivity.

57. Interview between Scott Hebert and Capt. Glenn Pauly, April 1975.

resource allocation experiments, with three shifts of essentially equal strength, and two auxiliary watches.

Thus, while the computer-assisted deployment technique was implemented and utilized by the St. Louis MPD for several years, ultimately it was abandoned. The case suggests that the rejection of the sophisticated technique cannot be explained by a single factor. Rather, it appears to have been the result of a variety of factors, including:

- the change in department priorities accompanying the appointment of a new chief of police and new members on the Board of Police Commissioners;
- the negative impact on morale of frequent changes in watch times and beat configurations;
- the conflict between theories of policing held by many officers and those inherent in the deployment model;
- the lack of demonstrable positive effects on crime control;
- changes in demographic patterns which reduced the accuracy of the model's predictions;
- the alleged decrease in the fluctuations of crimes on an hour-to-hour and day-to-day basis.

These factors and their implications will be examined in more detail in the concluding chapter of this section, Chapter 7.

CHAPTER V

THE INTRODUCTION OF SOPHISTICATED ALLOCATION TECHNIQUES IN THE BOSTON POLICE DEPARTMENT

by Scott Hebert

This chapter examines two efforts by the leadership of the Boston Police Department to make use of operations research techniques to improve the allocation of patrol resources. The first half of the chapter concentrates on an attempt to develop a computer simulation model of the BPD's patrol operations. As we shall see, the model was never implemented, in part because of a change in administration. The second half of the chapter focuses on the initial experience of the department in utilizing a less sophisticated deployment model introduced by the subsequent administration.

A. The Boston Police Department

In 1962, the International Association of Chiefs of Police (IACP) completed a survey of the Boston Police Department (BPD).[1] This survey had been undertaken at the request of the city of Boston, which had recently regained control of the police department of 77 years of state rule. At that time, BPD personnel numbered 2,595, almost all of whom were sworn officers. This meant that there were 4.2 police officers for every 1000 residents, the highest ratio for any U.S. city with a population greater than 250,000.

1. International Association of Chiefs of Police (IACP), <u>A Survey of the Police Department of Boston, Massachusetts</u> (Washington, D.C.: IACP, 1962).

The IACP report on the survey indicated that the BPD was inadequately organized with poorly deployed manpower. The report noted that the BPD had retained the old nightwatch organizational pattern, with a large number of district stations, even though the existing district boundaries did not reflect equalized workloads.[2] Moreover, while the department had a high ratio of officers to population, the time of many of these officers was spent in performing functions (such as licensing taxis) which were seen as being unrelated to law enforcement, the task which the IACP and other police professionalists felt should be a department's primary focus. The per capita cost of "police service" in Boston was $26.36, almost $10.00 more than the 1962 median cost for cities with a population over 500,000. This, according to the IACP report, was the result of the non-law enforcement duties assigned to the BPD, and the inefficient way in which the department was managed. The report, claiming that the department was characterized by divided authority, excessive spans of control, and poor supervision, concluded that the BPD was "probably the most decentralized [police] organization in the country."[3]

During the next several years, the new administration of Boston Police Commissioner Edmund L. McNamara attempted to implement a number of the reforms which the IACP had recommended. For example, on January 3, 1963, the department was completely reorganized into four bureaus, each headed by a superintendent who reported directly to the police commissioner. This action resulted in a much more streamlined and coherent formal organizational

2. Thomas A. Reppetto, "Public Safety Service Needs of the Future City of Boston," (Boston, Mass., October 1971), p. 18.

3. IACP, A Survey of the Police Department of Boston, Massachusetts, p. 143.

structure. In addition, the inspectional function, which the IACP had previously characterized as grossly inadequate, was given full bureau (line) status.

Moreover, even before the publication of the Quinn Tamm study (as the IACP report was known locally), the police commissioner had taken steps to begin the consolidation of the department's stationhouses and to relieve police officers of non-police tasks.[4] In these efforts, however, he encountered serious local opposition. Citizens and businesses feared that closing down the local stationhouses would mean a decline in the quality of police service and they made their views known through their political representatives. Also, because of the feeling that the low pay scale of the police made them one of the cheapest sources of labor for performing municipal duties (such as census-taking and licensing), it appeared that the city administration under Mayor John Collins would oppose any attempt to eliminate police department responsibility for such functions.[5] In the face of such opposition, little success was realized in thse two areas. Moreover, police officers stationed in the districts which had traditionally enjoyed a large degree of autonomy, began to resist many of the commissioner's efforts at reform.

Thus, while the McNamara administration was under great pressure to demonstrate that reform was taking place within the department, the opposition of the various groups in the city and in the department itself made it difficult for the commissioner to implement many of the IACP recommendations. Nevertheless, in an apparently noncontroversial area--the

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4. See Edmund L. McNamara, "Discussion of Implementation of IACP Survey Recommendations," The Police Yearbook (Washington, D.C.: IACP, 1967).

5. Reppetto, "Public Safety Service Needs," pp. 26-29.

department's reports and record system--McNamara and his administration believed that reform was possible.

B. Computer and Other Technological Development (1960-1970)

The records system used by the BPD in the early 1960s had evolved slowly, with little attention given to its overall design.[6] Each time somebody had wanted to collect a new piece of information, the records section had responded by designing a new form. As a result, there were literally hundreds of different forms, many of which contained largely redundant information. Filling out all the proper forms for an incident was an arduous and time-consuming task for the patrolmen. Moreover, the data from these reports were all compiled by hand by clerks at the stations and headquarters, which increased the chance of error.

This system of record-keeping was so inadequate that in 1958 the FBI refused to accept the accuracy of the department's crime statistics.[7] As a result, the department switched from compiling statistics by hand to the use of unit record equipment. The purchase of more sophisticated data processing equipment was suggested at the time by several computer vendors, but the department administration had felt that such equipment was not necessary.[8]

In 1962, following the advent of the McNamara administration and the

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6. Arthur D. Little, Inc., Reports, Records, and Communications in the Boston Police Department: A System Improvement Study (Washington, D.C.: LEAA, May 1968), p. 13.

7. Reppetto, "Public Safety Service Needs," p. 18.

8. Notes from an interview by Kent Colton with Deputy Superintendent John West, Boston Police Department, Spring 1971.

publication of the IACP report, the department was again approached by vendors. This time the response was more favorable. By 1964, McNamara had signed a letter of intent for the lease of an IBM 360 Model 30 computer with 32k bytes of core memory, which the department's Data Processing Advisory Committee subsequently approved.

It is difficult to analyze all the reasons behind the decision to acquire the computer. One motivation may have been the desire to use the computer as a visible symbol of reform and modernization. In the report which the department's planning division prepared as justification for leasing the computer, however, the potential money-saving aspects of electronic data processing equipment were stressed. In particular, the planning division envisioned using the computer in connection with payroll preparation, inventory and budget control, and fleet maintenance control. The division's report also implied that use of the computer, by providing the potential for timely analysis of crime trends, as well as fuller, easier access to information, would be likely to result in more effective performance by the department. The report must have been fairly persuasive, for although there was some doubt on the part of the City Council regarding what this action meant in terms of helping to solve crime, in 1965 the department received city approval for the leasing of the computer.[9]

The BPD's efforts to implement a new record and reporting system were facilitated at this time by the establishment of the Office of Law Enforcement Assistance (OLEA) in the summer of 1965. As the federal government's response to the rising crime rates of the first half of the decade, the OLEA was empowered to distribute grants to encourage comprehensive planning by the states,

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9. Ibid.

as well as experimentation in innovative approaches to crime control by local law enforcement agencies. One avenue which the federal government was particularly interested in exploring was the use of technology in combating crime.[10]

By the fall of 1966, the OLEA had set up a regional office in Boston. At that time, the BPD was expecting delivery of its computer within the year. In October, representatives of the department went to the regional OLEA office to discuss whether and how the agency could help the BPD to develop its records and reporting system. As a result of this meeting, it was agreed that the department would request a grant to study the Boston reporting system and to devise a design for an integrated information system. A key objective of this study would be "to determine the most efficient method and means for acquiring, storing, retrieving, and disseminating information" of use to the department.[11]

Subsequently, the department approached a consulting firm for technical assistance in carrying out this study. Following OLEA approval of the BPD's grant request, the consultant developed a general plan for the new information system. According to the plan, the central feature of the new system was to be what was termed a "command and control system"--essentially a combination of a computer-assisted dispatching system and a management information system.[12] In mid-1967, the department requested an OLEA follow-up grant to proceed with further design work and implementation of the system. This second application

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10. This interest in technology, which was specifically expressed in the Report on Science and Technology of the President's Commission on Law Enforcement and Administration of Justice in 1967, is also discussed in Chapters I and VII of this report.

11. From the BPD's notes on the meeting.

12. Arthur D. Little, Reports, Records and Communications.

was also approved, as were the requests for two additional grants which were required before the consultant was able to produce a quasi-operational prototype system. (The development of the "command and control system" will be discussed in Chapter X of this report.)

In the meantime, despite McNamara's various attempts at reform, Boston's mayor, Kevin White (who had assumed office in January 1968), still seemed dissatisfied with the department's performance.[13] In 1969, he formed a committee, the Task Force on the Police, and instructed its members to evaluate the department's operations and come up with a list of recommendations for additional improvements. The final report of the Task Force reiterated many of the criticisms which the IACP had raised seven years earlier,[14] and intimated that little had been done to significantly improve the department's operation. One area criticized in the Task Force report was the dispatching system.[15]

The police commissioner's annual report for 1969 (issued in January 1970) demonstrated that the McNamara administration had taken the mayor's Task Force report seriously. In fact, for almost every aspect where the Task Force had been criticized, the department reported that some type of reform had taken place.[16] The department's technological projects figured prominently in the list of reform activities. The Command and Control system, for example, was cited

13. Boston Magazine, October 1973, p. 74.

14. Reppetto, "Public Safety Service Needs," pp. 33-34.

15. Further attention was directed to the department's dispatch operation in subsequent months. According to the Boston Globe (Nov. 19, 1970; p. 35), a neighbor's call had reported screaming in the apartment of a Massachusetts State Representative; but because the message was inaccurately relayed by the department, it was not discovered until two hours later that the representative and his wife had been murdered.

16. Boston Police Department (BPD), 64th Annual Report of the Police Commissioner for the City of Boston for the Year Ending December 31, 1969, Document No. 28, pp. 4, 9.

as one of the ways in which the department was trying to improve supervision as well as reduce response time to emergency calls. The report also stated that the department was continuing to explore ways in which technology could be utilized to help the department allocate its resources more effectively.

C. The Decision to Develop a Patrol Force Simulation

In December 1970, Dr. Richard C. Larson, a professor at MIT, contacted the BPD's Director of Planning and Research, a former fellow student at MIT's Operations Research Center. Larson offered to demonstrate a general patrol force simulation model which he had developed while working with the New York City Police Department (NYPD) at the NYC-Rand Institute. The planning director, who had been following Larson's work for several years, agreed and the demonstration was held early in January 1971. The director brought with him the president of a small consulting firm which was performing a study for the BPD concerning the requirements for a car-locator system.

The computer simulation model which Larson demonstrated generated hypothetical incidents throughout the city randomly in time and space. Each incident had an associated priority number, with lower numbers indicating the more important incidents. As each incident became "known," the computer program attempted to "assign," or "dispatch," a police unit to the scene of the incident, depending on the availability of patrol cars as predicted by the simulation model. In some cases, assignment could not be made because all the model's hypothetical patrol units were already servicing an incident. In such cases, the incident joined a queue of incidents awaiting "dispatch." The call was then "dispatched" by a computer program as cars became "available."

While simulating the operation of the patrol force, the model tabulated several measures of effectiveness, including average travel time, average queue length and duration, and approximate workloads of patrol units. As the user adjusted the district boundaries and the resource deployment and dispatch patrol variables, the simulator predicted the performance of the patrol force under each set of constraints.

At the end of the demonstration, the planning director expressed interest in the benefits which the BPD might gain from the simulation and suggested that Larson join with the small consulting firm to develop a Boston-specific version.[17] The director believed the department could possibly utilize the simulation in a number of ways. For one thing, he thought the model could be used to evaluate possible changes in patrol assignments, such as adding patrol units or changing dispatching priorities. He was especially interested in the capability the system offered for theoretically evaluating the impact on patrol operations which the addition of a car-locator system would have. He also believed that by working with the computer model it would be possible to design sectors on the basis of information which was updated regularly, rather than on long-term averages.[18]

In addition, the simulation model may have attracted the interest of the McNamara administration because, like the command and control system, it represented some of the latest "state of the art" efforts in the area of police technology. Moreover, work with the command and control system had shown that in some ways it was easier to implement technological innovations in the BPD

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17. Interview between Scott Hebert and Richard C. Larson, Cambridge, Mass., Jan. 17, 1975.

18. BPD, "Patrol Force Simulation Model Report," pp. 10-11.

than other reforms. For one thing, federal grant monies were available to assist with the costs, and this meant that the department would not be required to cut into other areas of the budget or to seek large sums from the city. Further, because most members of the force did not understand the technology and had paid little attention to it during the developmental stages of the command and control system, there had been little of the resistance from the rank and file or command staff that had characterized some of the BPD's earlier reform efforts.

D. Progress on the Boston-Specific Model: LEAA Grant #70-107B

Within a few months, the BPD's planning director was able to secure a grant of $32,888 from the Law Enforcement Assistance Administration (LEAA), which had replaced the OLEA, for the initial work on developing the BPD version of the simulation. Under the grant, the small consulting firm was to develop new parameters and algorithms suitable for modification of the general simulation model so that it would match the BPD's operational system, geography, and statistics.[19] In particular, the planning director was concerned that the model be able to simulate Boston's priorities for incidents, estimates of patrol car response speed, patrol car service time, call rates from each sector, and geographic patrol sector boundaries. Once this was accomplished, the simulation program was to be converted into PL/1 computer programming language suitable for the police department's recently upgraded IBM 360/40 computer system. The agreement with the department also specified that the

19. Ibid., pp. 5-9.

consultant was responsible for designing the output documents "for easy interpretation by the Boston Police Department." At the end of the project, the consultant was to supply the simulation program to the BPD along with documentation and an operating manual for the model.

During the contract period, the consulting staff had little contact with members of the department other than the planning director. The director apparently felt that such restraint was necessary because otherwise the commissioned officers in Boston's traditional police department might have been "turned-off" by the technical (and civilian) orientation and language of the consultants.

In August 1971, at the end of the contract period, the consulting firm demonstrated the Boston-specific model for the planning director. Although he thought the patrol force simulation was still too difficult to use and needed a number of modifications, the planning director was generally satisfied with the progress achieved on the model. He was also pleased with an earlier report from the consultants which examined the utility and feasibility of the department's acquiring an Automatic Vehicle Monitoring System (AFM). Accordingly, the planning director was receptive to the idea of requesting an additional grant to undertake further work in both of these areas.[20]

As a result, in September 1971, the consultants submitted a formal application to the department for "consulting and systems engineering services." Two of the four major tasks outlined in the application concerned the patrol

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20. Interview between Scott Hebert and James Williamson, Wellesley, Mass., March 1974; see also, Urban Sciences, Inc., A Study of the Application of an Automatic Vehicle Monitoring System to the Operation of the Boston Police Department (Wellesley, Mass.: Urban Sciences, July 1970).

force simulation.

In one project task called "Computer Application Studies" the consultants proposed to simplify the operation of the patrol force simulation to enable a person without knowledge of data processing to specify variables for the simulation. The consultants also indicated that they would be designing a display console terminal input system to create an interactive version of the model, and that they would examine the feasibility of a number of new applications for the simulation, including "on-line" data base updating, "real-time" operation of the model, "real-time" dynamic patrol allocation, and use of the simulation as a training tool. The estimated fee for the work in this project area was just over $42,000.

Under another project area, "Patrol Force Simulation-Phase II," the consultants proposed three sub-tasks. The first of these was concerned with improvements in the internal program efficiency of the model and focused on achieving reductions in run times and core space requirements. The second sub-task addressed possible improvements in the model's "realism," such as modification of the computer program to better simulate the use of patrol wagons, as well as incidents involving multiple dispatches, interdistrict dispatches, and changes in call rate and vehicle response speed as a function of time. The final sub-task involved various improvements in the collection and printing of statistics to improve the clarity and usability of the model's output. The estimated fee for these three tasks was $34,000.

E. Change in Departmental Administration

Approval by the LEAA state planning agency (SPA) of the BPD's latest grant request was obtained quickly, and the contract work started before the end of September 1971. Despite several unexpected delays, work on the 13-month grant generally progressed according to plan until late spring 1972. At that point, however, the planning director, the most important actor in the BPD's technological development projects, resigned from the department. The director's action was prompted by Mayor White's announcement that he was not going to ask Commissioner McNamara to serve for another five-year term. At the end of his term, McNamara accepted a position as head of a private security firm. Following his resignation, the planning director, who had been one of McNamara's key aides, also joined the security firm.

The consulting firm's project staff were profoundly shocked by the departure of the planning director with whom they had worked almost exclusively. They now realized that the simulation package was still aimed, in large part, at someone with the director's level of technical expertise. To rectify this situation, they intensified their efforts to simplify the operation and output of the simulation.

As for the department, after the departure of those at the top, a power struggle began among certain higher ranking officers who were interested in preserving or improving their positions in the forthcoming administration. Because the planning director had not worked his way up through the ranks, some very powerful members of the command staff had been jealous of his relationship with McNamara and the power which the commissioner had vested in him. Hence anything associated with the former administration, and especially with the director, became tainted, including the simulation package. While the acting commissioner appointed a deputy superintendent to coordinate the department's technological projects, he did not share the former planning director's commitment to utilizing such sophisticated tools. Given the difference and the uncertain political environment in the department, it is not surprising that the deputy superintendent carried out his coordinating responsibilities in a caretaking fashion, rather than acting as a forceful advocate for technology.

Nonetheless, after some effort, the staff of the consulting firm was able to persuade the deputy superintendent to organize a class to familiarize members of the command staff with the simulation model. Despite the considerable work by the consultants to simplify the model, many of those in attendance felt the presentations were "way over their heads," and class attrition was high.[21] On the basis of the command staff's reaction, the training effort was discontinued. In September 1972, final reports on the Patrol Force Simulation and the Computer Application Study projects were submitted, and the relationship between the department and this particular consulting firm was terminated.

F. Evaluation of the Technological Projects

In the meantime, back in April 1972, representatives of the Massachusetts LEAA SPA had decided to evaluate the BPD's resource allocation, communications, and information system projects which had received federal funding. The individual in charge of monitoring the SPA's technology-oriented grants had left the agency's staff early in 1972. His replacement found it extremely difficult to make sense out of the half-decade of grant awards and reports, and

21. Interview between Scott Hebert and Richard Larson, Cambridge, Mass. Jan. 17, 1974.

decided to enlist the aid of an outside consultant to help in this task.[22] In August 1972, a national consulting firm was hired to perform the review.

The staff of the national consulting firm engaged in a two-stage study of each of the 11 specified project areas.[23] First, they calculated the results in each project area and compared them to what they decided were the original stated goals for the project. To do this, they carried out a review of written materials and project documentation which were made available by the SPA and the BPD. Second, to begin developing an assessment of the operational impact of the various projects, the firm's staff observed the operations of, and interviewed personnel from, four bureaus in the department: Field Operations, Special Operations, Inspectional Services, and Central Services. Additionally, they met with representatives of the SPA and the mayor's office to discuss perceptions of the federally funded projects. The final report did not indicate whether the evaluation staff had interviewed McNamara, the planning director, or the relevant staff of the department's previous consultants.

The April 1973 evaluation report produced by the national firm was very critical of the attempts at technological modernization made by the former commissioner and the original consultants. In fact, the Findings Summary of the report (the part of the evaluation that would get the most exposure) concluded that with the exception of the installation of new radio equipment, the 11 projects had not achieved their stated objectives.[24] However, detailed

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22. Interview between Scott Hebert and Steven Long, Governor's Committee on Law Enforcement and the Administration of Justice, Boston, Mass., Fall 1973.

23. Touche Ross & Company, A Review of Information System Projects and Related Operations in the Boston Police Department (Boston, Mass.: Touche Ross & Company, April 1973), pp. 1-3.

24. Ibid., pp. 1-4.

data presented in subsequent sections of the reports give the impression that, for at least four of the projects, the contract objectives had been met, in the sense that the previous consultants had completed the required reports, computer programs, and/or renovations.[25] But as the command staff's rejection of the simulation model demonstrated, the completion of the specified products did not necessarily guarantee that the technology would be implemented or have the expected impact on department performance.

In addition to noting the poor reception given to the simulation model by the BPD commissioned staff, in their report the national consultants faulted the simulation package for not including optimization procedures to suggest new or modified strategies. The planning director had been aware of this limitation in the model even before the department contracted for the work, however, and indicated that he had viewed the simulation as just one part of a larger computer-assisted resource allocation decision-making system which would be developed later.[26]

The evaluation also claimed that the simulation did not develop new sector or district boundaries, allocate cars among districts, or allocate men by tour of duty.[27] This statement is true only in the sense that the simulation did not, for instance, "draw" district boundaries for the model user. Rather, as previously stated, the user had to provide the boundary parameters and the characteristics of the other variables, and then the model would calculate

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25. The four projects were: the AVM study, the geographical data base file development, the command and control center reconstruction, and the simulation model development.

26. See BPD, "Patrol Force Simulation Model Project," p. 11.

27. Touche Ross, Review of Information Systems Projects, pp. 3-23.

its estimate of the probable patrol performance under those conditions. After that the user could choose the boundary (or car deployment, or manpower allocation) pattern which had the "best" (rather than the optimal) projected performance. This method of operation was, of course, more complicated for the user.

As part of its report, the national consulting firm made a series of suggestions concerning the department's future resource allocation efforts. One of its principal recommendations was that the department should postpone further use of the simulation model until what the firm referred to as "basic resource allocation problems" had been resolved. In this regard, the report urged the department to analyze its policies and resources, select a target service goal, (e.g., a dispatch delay of x minutes or less for 95% of the incoming calls for service), and then calculate by shifts the number of cars needed to meet the specified goal. Upon the completion of a review of manpower duty assignments to determine the department's ability to field the necessary number of patrol cars, the consultant indicated that the BPD should undertake a complete redesign of sector and district boundaries, so as to balance workload and permit the achievement of the selected service goal.[28]

In addition to these recommendations, the consultant's evaluation of April 1973 congratulated the BPD's new data processing director for making the decision to standardize the language of the department's computer programs. The programming language that was selected was ANS COBOL. The report did not mention, however, that the data processing director's action had rendered the original simulation package essentially useless unless it was completely reprogrammed.

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28. Ibid., pp. 3-24.

G. Resource Allocation Efforts under the New Administration

In May 1973, the new Boston Police Commissioner's administrative staff presented him with a list of 18 projects, as part of a proposal for an extended program for modernizing the department. According to BPD sources, Commissioner Robert diGrazia then chose the 'paperwork simplification' and 'resource allocation' projects as the first of the 18 to be implemented because "they had specific boundaries, were clear and readily grasped both conceptually and technically, and were programs which offered something to the men in the field.[29]

Shortly thereafter, the diGrazia administration selected the national consulting firm which had done the April 1973 evaluation to perform the resource allocation project. The consultant was given two main tasks to carry out: first, to document the assignments of the sworn personnel of the Bureau of Field Services and to recommend a reorganization of those assignments in order to provide more officers for street patrol; and second, to assist the BPD in developing new sector boundaries for its districts, as well as to design and implement a reallocation of personnel among the districts. The consultant, in other words, was to do the resource allocation work which it had recommended that the Boston Police Department undertake in its earlier evaluation.

On September 5, 1973, the consulting firm presented its city-wide resource allocation implementation plan to the commissioner, and on September 18, 1973, deGrazia briefed the department Command Staff. In developing the implementation

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29. Mary Ann Pate, "Change Processes: An Analysis of the Paperwork Simplification and the Resource Allocation Projects in the Boston Police Department," unpublished rough draft of Interim Report, July 1974.

plan, the consultant had assisted and supervised the Bureau of Field Services in using a queuing formula to determine how many sectors and units would theoretically be needed in each district to answer 95 percent of the service calls without dispatch delay. The firm had also directed the Bureau of Field Services in redrawing each district's sector boundaries to equalize workload.[30] At the September 18 meeting of the Command Staff, the new manpower assignments and sector maps were presented to the district captains. Actual implementation of the proposed assignment changes began several days later.

Two days after the implementation of the plan began, however, the Boston Police Patrolman's Association (BPPS) filed a grievance with the city's Office of Labor Relations. The union charged that by rearranging patrol sectors, diGrazia's plan violated the contract because the administration had changed working conditions without consulting the Labor-Management Committee of the Association (as required by their contract with the department). Further, they charged that in one particular district a number of patrol sectors had been eliminated, and the size of the remaining patrol areas had been increased. This, they claimed, endangered the health and safety of those men required to patrol the enlarged area.

Eventually, the Labor Relations Office ruled that the union had failed to provide sufficient facts to substantiate their accusations, and the grievance was dismissed for "lack of prosecution." In the meantime, the consulting firm continued to assist the department in implementing the reallocation plan. The total city-wide resource allocation was accomplished in two phases which spanned a seven-month period. The redistribution of personnel and implementation of the new sector boundaries for the first seven districts, (1, 2, 3, 4, 5, 13,

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30. The first set of calculations was done manually, although the consulting firm planned to implement a computerized version of the technique for the next round of redeployments.

14) was completed by September 1973, and for the last four districts (6, 7, 11, 15) by March 1974. According to a member of the consultant's staff, the delay in implementing the reallocation plan in the second set of districts was partly the result of difficulties in reassigning patrol officers with "political connections" to districts which were less desirable in terms of the number of paid details which were available.

H. Impact of the Redeployment

When diGrazia assumed the job of commissioner of the BPD in the fall of 1972, an average of 200 calls for service had been going unanswered during each eight-hour shift, largely due to a lack of patrol units to be dispatched to the incident. According to the "Phase I--Resource Allocation Project" final report, during the period from October 1973 to March 1974 a 26 percent increase in the number of patrol vehicles fielded had been achieved, and average city-wide "Zero-Car-Availability" (ZCA) had decreased from 25 percent to 5.9 percent.[31] It should be noted, however, that these successes were not solely the result of implementing the redistribution plan; rather a combination of influences seems to be involved. For one thing, in late 1973, the department began receiving new shipments of marked vehicles. Another factor which undoubtedly helped the BPD to alleviate its vehicle availability problem was the drastic reduction in the number of vehicles awaiting repair which was accomplished by the department during the same period.

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31. Touche Ross & Company, Boston Police Department Patrol Force Resource Allocation Project, Final Report (Boston: Touche Ross & Company, May 1974), pp. 40-44.

While dispatch delay may have been dramatically reduced, the available crime and arrest data for Boston for the period following the reallocation suggests that the new deployment scheme had not brought about an apparent improvement in either of these measures of patrol performance. In fact, as Table 5-1 shows, the number of reported index crimes increased considerably during 1974 and the first quarter of 1975, and Part I arrests declined in 1974 by 33 percent as compared with the 1973 level.

Moreover, although the department has not been releasing "car availability" statistics, there has been some indication that after March 1974, the ZCA rate may have increased. Some individuals in the department administration suggested, by way of explanation, that the consulting firm's workload calculations may have been in error because its staff may not have understood the BPD's recreational schedule.[32]

On the other hand, a member of the consulting firm indicated that their efforts had been hindered by the reluctance of the BPD Command Staff to make projections regarding probable increases in crime and service rates. Consequently, in its calculations, the consultant was unable to consider future incident rates and distributions which may have led to discrepancies between the actual demand for services and the resources available in an area. There is also some evidence that at least a few of the district commanders were less than fully cooperative with, or committed to, the effort to reduce ZCA. The consultant's May 1974 final report notes:

> Another area of concern was the practice of certain Districts in fielding, at the

32. Interviews by Scott Hebert with members of the Boston Police Department.

Table 5-1: Boston City-Wide Crime and Arrest Experience

	Number of Service Calls	(%)	Number of Index Crimes	(%)	Number of Index Crime Arrests	(%)
1971	235,319		47,940		11,747	
1972	216,846	(-7.9%)	43,379	(-9.6%)	12,079	(+2.8%)
1973	268,532	(+23.8%)	52,511	(+21.0%)	10,263	(-15.1%)
1974	272,734	(+1.5%)	65,730	(+25.1%)	6,882	(-33.0%)
First Quarter 1974			13,613			
First Quarter 1975			18,126			

> beginning of the tour, its planned number of units, then, shortly after roll call, releasing certain units to court or other duties. This practice effectively reduced the level of actual vehicles fielded while indicating the higher number [planned] on the vehicle availability sheet. This practice has been partially controlled by listing those vehicles, with the times at which they were taken off the air, on the bottom of the daily zero car availability reports.[33]

The uncooperative behavior exhibited by some district commanders may have been a result of the resentment that some command-level officers felt toward the process by which the department's resource allocation project (and the new modernization plan) had been developed. It seems the new projects were formulated largely by the commissioner's civilian aides, with little input from the commissioned command staff or the districts.[34]

At the time that this research was concluded, it was still too early to assess the long-term results of the diGrazia administration's resource allocation project. In February 1975, the BPD and the national consulting firm were discussing whether, and how, new assignments should be made. Since the patrolmen's new contract with the city was expected to change their recreational schedule, a final decision was postponed pending contract negotiation and ratification. The case suggests, however, that the BPD administration still has a long way to go before acceptance and continued use of the new techniques will be assured.

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33. Touche Ross & Company, Boston Police Department Patrol Force Resource Allocation Project, Final Report (Boston, Mass.: Touche Ross & Company, May 1974), p. 50.

34. This approach is especially interesting given that the national consulting firm had argued (in its April 1973 evaluation) that the lack of involvement of career personnel in the developmental stages was one of the principal reasons why the earlier technological projects had failed.

Editor's Note

This case study was written during Spring 1975 on the basis of research completed the previous February. Since that time, the BPD and the national consulting firm have continued their efforts to improve the department's resource allocation methods.

Both the consultant and Robert diGrazia (who resigned from his position as Police Commissioner in late 1976), have commented on the timing of the study. diGrazia indicated that "your evaluation of the Resource Allocation Project was conducted too early to determine whether the system has achieved long-term acceptance." A representative of the consulting firm has also indicated that when they completed the project, they were informed by the Project Director that the system was working well. The author agrees with diGrazia's comment, but, since limited resources have precluded updating the case, it is not possible to comment on the consultant's statement.

However, even without updating, the case has already served to point out a number of important factors in analyzing the impact and implementation of new information technology. These factors include: (1) the problems involved in getting operational law enforcement officers [particularly in a traditional department] to deal with the complexity of new technology; (2) the importance of vendors and the competition aroused by vendor self-interest in the process of transferring technology; and (3) the difficulty of measuring the actual impact such new methods might have on improving police services and operations. All three of these factors will be discussed in greater detail in Chapter VII and other chapters of this report.

CHAPTER VI: THE USE OF RESOURCE ALLOCATION MODELS IN THE LOS ANGELES POLICE DEPARTMENT

by Scott Hebert and Kent Colton

The previous two chapters have examined the attempts of the St. Louis and Boston police departments to introduce sophisticated resource allocation models into their decision-making. This chapter will trace the experience of the Los Angeles Police Department (LAPD) in implementing a resource allocation model very similar to the one used in St. Louis. The process of implementation began in 1967, but a change in the police department's service strategy placed constraints on the model's utility for deployment decision-making, and led to the transformation of the original package into a computerized historical reporting system.

A. The Introduction of LEMRAS to the LAPD

Following their work with the St. Louis Metropolitan Police Department, the consultants responsible for designing St. Louis' computerized resource allocation model developed a modified, somewhat improved version of the computer package for the IBM Corporation. IBM planned to lease the revised resource allocation system to other police departments at a relatively low cost as a part of the overall computer service provided by the company. Called LEMRAS (Law Enforcement Manpower Resource Allocation System), the resource allocation package, like the St. Louis model, utilized both exponential smoothing techniques to predict the number of events which would need police service by type of event and location, and queuing theory to predict the number of patrol units which would be required to service these events within desired constraints on queuing delays.[1] In order to generate interest in their new computer package, IBM decided to carry out a few demonstration projects. One of the departments approached with an offer of free experimental use of the allocation package was the Los Angeles Police Department.

In September 1967, the Board of Administration of the Data Service Bureau for Los Angeles City approved the use of the IBM resource allocation package (LEMRAS) on an experimental basis in the Van Nuys Division, one of the city's five valley divisions.[2] One reason for selecting Van Nuys as the division in which the experiment would be carried out was the comparative ease of data capture in the valley. Because of the city-wide volume of radio transmissions and the interference caused by the San Fernando Mountains, the Van Nuys Division had its own communications and dispatching center. More important, the LAPD had recently established a new key-punching system in the valley facility for compiling information on daily field-activity message logs. Such a capability was essential in order to fulfill the data requirements of the allocation model.

LEMRAS-generated predictive and historic data were first provided for the Van Nuys Division in January 1969, but because of data conversion problems the system did not go into operation until March 23.[3] After

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1. Unlike its St. Louis predecessor, LEMRAS allowed the user to specify priority service for certain types of calls; see J. S. Kakalik and S. Wilhorn, "Aids to Decision-Making in Police Patrol," R-593-HUD/RC, (Santa Monica, Calif.: RAND Corporation, February 1971), p. 58.

2. Los Angeles Police Department, "Evaluation of the Law Enforcement Manpower Resource Allocation System," October 1969, p. 1.

3. Ibid.

LEMRAS had been in operation in the test division for four months, the Advanced Systems Development Section (ASDS) of the LAPD's Advanced Planning Division began to evaluate the impact of the new allocation technique on the division's performance. The ASDS' evaluation was issued in October 1969.

1. Evaluation of the Van Nuys Experiment, October 1969. The evaluation began with an analysis of the predictive accuracy of the LEMRAS model. This analysis focused on the fourth and sixth deployment periods of 1969 (March 23 - April 19, and May 18 - June 14).[4] After totaling for both periods the predicted number of events for each day of the week, and then comparing these figures with the actual number of events, the ASDS concluded that the model's predictions had been 95 percent accurate for these particular time aggregates. (See Table 6-1.)

The ASDS also examined the Van Nuys dispatch delay experience. In 1968, prior to the implementation of LEMRAS (July 27 - August 2, 1968), the Valley Services Division of the LAPD had carried out a survey of dispatch delay. This survey showed that 92.6 percent of the calls-for-service were being responded to "without delay" (which, according to the LAPD, means a delay of five minutes or less from the time the call was received by the complaint board to the time of dispatch). According to a later survey by the ASDS, during a one-week period following the implementation of LEMRAS (April 12-19, 1969), a 95.2 percent without-delay deployment performance had been achieved.[5]

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4. Ibid., p. 3.

5. Ibid.

In the ASDS evaluation of October 1969, the impact of the LEMRAS package on the Van Nuys' crime experience was analyzed in three different ways. First, the actual number of Van Nuys Part I crimes (less homicide) for the three-month period following the implementation of LEMRAS was compared with the amount of crime that had been projected for that period by the Jet Propulsion Laboratory in Pasedena, California, which used ten years of data. According to this comparison, crimes in the Van Nuys division were down 17.9 percent from the predicted level. Crimes in the rest of the valley and in the city as a whole were down 14.6 percent and 2.8 percent, respectively.

Second, the report compared the actual crime and arrest data for April - June, 1968, with the experience for the same three months in 1969, after LEMRAS implementation. Van Nuys crimes were down 2.3 percent compared to a valley decrease of 2.0 percent and a city increase of 3.4 percent. Part I crime arrests were up in the Van Nuys division by 16.0 percent over the same period in 1968, compared to an increase in the rest of the valley of 11.0 percent and in the city of 14.5 percent.[6]

As the third measure of LEMRAS' impact on crime control, the ASDS analyzed the performance of the Crime Repression Units. During the LEMRAS experiment, the Van Nuys division had employed a split patrol approach, with patrol vehicles designated either as call-for-service units or crime repression units. The latter units, the preventive patrol force, were the "extra" vehicles the district commanders felt were not required for for answering calls-for-service either because of LEMRAS recommendations

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6. Ibid., pp. 3-4.

or other considerations. In reviewing this experience, a sample of officer observations of crime and field interviews for the first week in June, 1969, was compared to the same week in 1968.[7] The ASDS report noted that the week's total number of recorded officer observations had increased from 721 to 941, and the number of field interviews had increased from 614 to 876. In addition, felony arrests resulting from officers' observations had increased from 13 to 37, and misdemeanor arrests from 19 to 69.[8] The ASDS believed that the introduction of LEMRAS was at least partly responsible for the apparent improvement in performance.

On the basis of these analyses, the ASDS concluded that LEMRAS was an effective and valuable tool, and recommended it be extended to the four remaining valley divisions (North Hollywood, Foothill, West Valley, and Devonshire) during the ten months from January 25 to November 29, 1970.

It is debatable, however, whether the evidence presented in the October evaluation was compelling enough to justify this recommendation. The analyses just cited present an incomplete and possibly misleading picture. For instance, while the LEMRAS model realized an accuracy of 95.6 percent over the deployment periods examined, for any particular day or hour the predictive error could have been considerably greater -- representing potential resource allocation problems for district

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7. No information was available concerning the numbers of preventive patrol units fielded in June 1969 and June 1968.

8. Los Angeles Police Department, "Evaluation of the Law Enforcement Manpower Resource Allocation System" October 1969, p. 4.

commanders.[9] Moreover, for their analysis of dispatch delay, the ASDS staff had looked at only one week of data for the pre-test period and one week for the test period, a very small sample of the division's experience. Also, the ASDS were comparing two different times of the year without presenting any evidence to show whether the rates of calls-for-service or the numbers of available units (or other variables) for these periods were comparable or representative.

Perhaps the most important weakness of the report was its failure to substantiate a "cause and effect" relationship. Even though the reported crime control performance of the Van Nuys Division in 1969 had generally improved relative to 1968,[10] the ASDS evaluation failed to demonstrate that this situation (or the small improvement in dispatch delay) was a result of the use of the LEMRAS package. The report gave little or no attention to the potential influence of other factors, such as employment or demographic changes. Nor did the ASDS staff present any data showing the extent to which the model's recommendations were actually followed by the Van Nuys Division. Without such documentation, it is not possible to assess how much of the apparent improvement in performance can be attributed to the LEMRAS project.

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9. The October 1969 evaluation, however, did not address itself to behavioral issues, and contained no information regarding Van Nuys officers' attitude toward the new allocation techniques.

10. In 1969, while the Van Nuys Part I crime rate, as compared to 1968, declined by 5 percent and its Part I arrest rate increased by 7.1 percent, its total arrest rate declined by 11.2 percent.

2. Second Evaluation of the Van Nuys Experiment. The LAPD administration apparently did not share the ASDS' level of confidence in the October evaluation, for no action was taken to expand the use of LEMRAS over the following months. In March 1970, however, the ASDS issued a second evaluation of the Van Nuys/LEMRAS experiment. This report compared the patrol activity of the division in June 1969 with that of June 1968 since there had been a feeling in the department that the October 1969 evaluation may have been based on an overly narrow timeframe.

For its second study, the ASDS surveyed the Van Nuys patrol officers' daily field-activity reports for June of 1968 and 1969, as well as the radio-telephone operators' logs for the same periods, in order to measure changes in the number of radio call arrests. This analysis showed that the number of calls-for-service in June 1969 was 10 percent lower than the number in 1968. Officer observations, however, were 51 percent higher in June 1969 than in the previous year, while field interviews were 39 percent higher. More important from the point of view of the department, felony arrests stemming from officer observations had increased 132 percent over June 1968, and misdemeanor arrests had risen 144 percent. Radio-initiated felony arrests for June 1969, on the other hand, had declined by 5 percent when compared to 1968, and misdemeanor arrests had fallen by 13 percent. Total arrests for the period under observation were up 33 percent as compared to June 1968. On the basis of these data, the March 1970 report concluded that "LEMRAS permits a specialization of patrol units which enhances the crime repression capability of the [Van Nuys] division."[11]

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11. Los Angeles Police Department, "Comparative Survey of Patrol Activity, Van Nuys Division, June 1968 vs. June 1969," March 1970, p. 3.

The second evalution made by the ASDS suffered from some of the same methodological and analytic shortcomings as the earlier report. For one thing, the second evaluation did not explain why only one month was examined, or how representative that month was of Van Nuys' experience with LEMRAS. Moreover, although arrests had increased significantly for June 1969 as compared to June 1968, again there were no data as to the extent to which LEMRAS-generated allocation recommendations were actually followed. In addition, little information was provided regarding changes in other potentially significant variables over the test period,[12] making it difficult to conclusively attribute performance improvements to LEMRAS.

Although such issues remained unresolved, the LAPD apparently found the second evaluation more convincing, for in its fiscal 1971 budget the department requested funds to extend the LEMRAS allocation system to the four other valley divisions. According to the Los Angeles Times, the cost in salaries and computer time for the first year of LEMRAS had been $65,000.[13] For expansion to the other valley divisions, an additional $65,000 would be required, and a request for the necessary funds was

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12. Among the other factors which might have been considered was whether the watch commanders had been exerting special pressure on their officials to make more arrests during the test period. (This possible explantion of the increase in arrests was advanced by a former member of the St. Louis Metropolitan Police Department's research and development staff.) The March 1970 evaluation, however, did try to assess the impact of variations in the available manpower over the two periods examined. The report noted that during the test period Van Nuys had experienced a 4 percent increase in available manpower (compared to a city-wide average increase of 9.5 percent), but summarily concluded that the impact of such personnel was limited and probably could not account for more than 20 percent of the increase in observations and arrests.

13. Kenneth Hansen, "Computerized Police Deployment Praised," Los Angeles Times, July 10, 1970.

included in the department's budget presented to the Los Angeles CIty Council. In July 1970, however, the City Council cut the requested funds from the police budget proposal.

B. Request for Federal Funding

When the City Council rejected the department's request for funding, the ASDS began to consider other sources of support. In May 1971 the LAPD submitted a formal grant application to the California Council on Criminal Justice, the state's LEAA planning agency. In its application, the department proposed a two-year program for extending the LEMRAS system city-wide, to all 17 patrol divisions. For the first year's work (which would involve implementing the basic system in each division), the department requested $304,489. The department's own contribution for this period was estimated at $222,503. While the department's figure appears large, especially since the City Council had balked at $65,000, the grant application indicates that the bulk of the contribution was to be made up from a percentage of the salaries and benefits of existing personnel in the department who would be working on the project. The second year of the program was expected to cost an additional $450,000, half of which would be contributed by the department.

The department stated in its application that by providing the 17 division commanders with the LEMRAS system it hoped to realize a number of specific objectives.[14] For example, the department expected that city-wide

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14. Los Angeles Police Department, "Grant Application to California Council on Criminal Justice for City-Wide System Expansion," May 1971, pp. 23-24.

implementation of LEMRAS would "dramatically reduce" the time and manpower required to analyze the call-for-service workload, cutting these requirements from five man-months to several hours. The department also believed that the system would "enhance the decision-making capabilities of police administrators by providing them with a great amount of management information more frequently. At the time of the grant application, only 10 percent of the information that LEMRAS was capable of providing was available to the division commanders in the existing departmental reports. Moreover, workload studies were only undertaken by the department on a semiannual basis and were soon outdated. With LEMRAS, however, it was expected that such information could be provided on a monthly basis, if not more frequently.

In addition, the department envisioned that city-wide adoption of the system would provide "enforceable uniformity for the performance of call-for- service activity." By providing data on actual service times, LEMRAS was seen as giving patrol supervisors and police administrators a standard by which they could judge whether the time taken to handle a call by a particular unit was efficient or reasonable.

Further, the department felt that the improved workload and manpower estimates provided by LEMRAS would permit an effective specialization between call-for-service and crime prevention patrol resources throughout the city. Specifically, the department expected that LEMRAS would result in the "reallocation" of at least one patrol unit per division from call-for-service activities to crime prevention functions. This increase in the size of the crime prevention force -- and the increase in the patrol force's productivity resulting from its "improved deployment" -- were expected to increase the volume of patrol observations and field interviews by at least 25 percent and to increase patrol-initiated felony and misdemeanor arrests by at least 50 percent. By such preventive patrol performance, the department hoped to "arrest the rise or effect a reduction in Part I Crimes of burglary, auto theft, and other crimes amenable to suppression by patrol forces."[15]

Finally, the grant application argued that LEMRAS would be an important step in the department's development of a capability to analyze manpower assignment policies and special needs during periods of unusual occurrences. The application pointed out that LEMRAS could potentially serve as an important component of the city's Emergency Command Control Communications System (ECCCS), which was to be developed over the next decade.

In interviews with the authors, members of the ASDS indicated that at the time of the application they had also felt it was important to respond to a pre-determined percentage of calls-for-service without dispatch delay, and expected LEMRAS to help in this process. This point, however, was not included in the grant application as an explicit project objective.

1. LEMRAS Expansion -- Phase I. The California Council of Criminal Justice approved the LAPD's grant request for LEMRAS expansion, but it made some significant changes in the schedule which the project was to follow. During Phase I, instead of expanding city-wide, the department was only to institute the LEMRAS system in the four other San Fernando Valley divisions. (This intermediate step was, of course, what the ASDS had recommended in October 1969.) Upon successful completion of Phase I, the system would be

15. Ibid., p. 24.

implemented in the remaining twelve divisions during Phase II.

Phase I of the LEMRAS system expansion ran for a year and a half, from January 1972 through June 1973. The final report on Phase I prepared by the Planning Division of the LAPD revealed a striking shift in emphasis in the objectives of the resource allocation project.[16] As previously noted, in the original grant application almost no attention had been paid to the potential value of the resource allocation system in reducing dispatch delay per se. Instead, the primary focus had been on freeing patrol units from call-for-service duties in order to carry out specialized preventive patrol assignments. In the report on Phase I, however, answering service calls without delay (or with minimal delay) was explicitly presented as the principal objective of the project. This objective was described in terms of a service-level goal of responding to 95 percent of the calls "without delay" (meaning a delay of five minutes or less from the time the call was received by the complaint board to the time of dispatch). Furthermore, the report, unlike the grant application, did not include specific expectations for changes in arrest or crime rates among the project objectives.

The final report on Phase I devoted considerable attention to the accuracy of the LEMRAS allocation model's forecasts of calls-for-service and manpower requirements. For each of the five valley divisions, the report compared the total number of actual events with the total number of events forcast by the system during deployment periods four, five, and six

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16. Los Angeles Police Department, "Final Report Phase I, Automated Deployment of Available Manpower Project," June 1973, pp. 1-2.

in 1973.[17] (See Tables 6-2 and 6-3.) Data were also presented for each of the valley divisions on the number of watches which had experienced certain levels of predictive error. (See Tables 6-4 and 6-5.) As the figures in these tables show, some improvement in the forecast accuracy was achieved over the three deployment periods. However, even for the last period, the call-for-service predictions for almost 40 percent of the valley divisions' watches were in error by more than the "acceptable level" of 10 percent set by the department.

As shown in Table 6-5, the accuracy of the predictions for both call-for-service and officer-initiated activity were similarly unfavorable. The ASDS staff attributed these high error rates to the status of the data files at the end of Phase I.[18] It seemed that the LEMRAS package required at least one year of data to achieve optimum accuracy in forecasting, whereas the files for all the valley divisions except Van Nuys had been established less than six months before the end of Phase I. As more historic data were gathered, the accuracy of the predictions was expected to improve. Tables 6-6 and 6-7 present additional data on the length of delays and their distribution among categories of calls.

In addition to the technical difficulties involved in LEMRAS' data requirements, the final report noted that ASDS encountered several other system-related problems during the course of Phase I. For example, the reports produced by LEMRAS proved to be "voluminous to watch commanders, with

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17. Each deployment period covered four weeks, and the first period began on January 1. Deployment periods four, five, and six, therefore, covered a 12-week period extending from the end of March through much of June.

18. Ibid., pp. 5-6.

pertinent information scattered throughout many pages."[19] This unexpected quantity of data worked against the valley commanders' acceptance and use of the new system and consequently one of the initial objectives of the system -- to enhance the decision-making capabilities of the department -- was negated. In response to this situation, the Planning Division programmed a new set of evaluation reports and streamlined others to assist the valley division users. Also, the ASDS staff, in conjunction with the Los Angeles Data Service Bureau, made extensive modifications to the original LEMRAS software package. Because of these major modifications, and the negative opinion of LEMRAS which some division commanders held, the Planning Division elected to change the name of the resource allocation system to ADAM (for Automated Deployment of Available Manpower).

The section of the Phase I report on operational impact focused on changes in the valley divisions' dispatch delay, reflecting the shift in LEMRAS project objectives. However, the results in this area were not particularly encouraging. As Table 6-6 indicates, at least 30 percent of the calls-for-service in the valley were averaging a 20-minute dispatch delay, which does not include the time it takes for the assigned unit to get to the scene of an incident. When considering high-priority calls, the situation was considerably better, and as Table 6-7 shows, a large majority of high-priority calls were assigned to a car "without delay." However, even for this category, the 95 percent service level was never achieved. Moreover, without more data it is difficult to determine whether the relatively positive service-level performance for high-priority calls should be

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19. Ibid., p. 11.

attributed to the use of LEMRAS or to other factors, such as pre-empting service on low-priority calls.

Although the Phase I final report omitted any data on changes in the crime or arrest rates of the divisions employing the LEMRAS package, this information was given in the department's annual reports. The 1973 crime and arrest statistics issued by the LAPD indicated that the number of Part I arrests made by the five test divisions dropped an average of 5.4 percent during 1972, the first year in which the LEMRAS/ADAM system was operational throughout the valley. The reported number of Part I crimes in the valley during 1973 also declined, by an average of almost 7 percent, but this was the city-wide experience as well. Thus, as compared to the implicit and explicit objectives of this phase of the LEMRAS project, the system's apparent effect on arrests was less than anticipated and its effect on crime was inconclusive. If the assumptions underlying these objectives (regarding the effects of response time and preventive patrol on crime control) were correct, then this situation might have resulted, at least in part, from the inability of the LAPD to achieve its 95 percent service-level goal or to free units for preventive patrol. As the LAPD stated in a later evaluation report, "The forecasts called for such a large number of units that only one area, North Hollywood, had sufficient manpower to deploy according to system forecasts and still have crime prevention units left over. The service level achieved by North Hollywood was approximately 20 percent below the 95 percent goal.

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20. Los Angeles Police Department, Advanced Planning Division, "Automated Deployment of Available Manpower System Evaluation (July 1, 1975 - December 31, 1975)," p. 11.

2. LEMRAS/ADAM Expansion -- Phase II. Although the results of the Phase I effort had been mixed and clear indicators of success were lacking, the ASDS began Phase II in July 1973. According to the department's plans, Phase II was to be divided into two parts. During Phase II-A, the necessary data capture was to be initiated, and initial ADAM predictive and historical reports were to be produced for the 12 remaining non-ADAM divisions. Phase II-B was to be devoted to developing the capability to distribute forecasts city-wide on a regular basis.

At the beginning of Phase II-B, in order to facilitate expansion of the system to the 12 divisions outside the San Fernando Valley, the ADAM staff held discussions with command-level personnel in each of the geographic areas concerning the information available through the system and its possible uses. Training sessions were also held with complaint board personnel and radio-telephone operators to acquaint them with the data needs of ADAM and to impress upon them the importance of attention to detail in the compilation of the radio message logs.

The department also hired a consultant to study the mathematical model of the ADAM system and recommend modifications for improving the forecast accuracy. The contract with the consultant called for: "detailed analysis of the current mathematical queuing model used [both] for predicting citizens' calls-for-service and officer-initiated activity, and for estimating required deployment needs; design of alternate models capable of being programmed and incorporated into the ADAM System; and analysis of the probable impact of the alternatives on the ADAM System."[21]

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21. Los Angeles Police Department, "Final Report, Phase II-A, A.D.A.M.," Fall 1974, pp. 5-6.

As part of its effort to achieve its objective of optimizing manpower utilization city-wide, the ASDS, "with the cooperation of the department's Office of Operations,"[22] also developed a proposal which recommended replacing the existing method of manpower allocation <u>among</u> the divisions with a newly designed historical report generated as part of the ADAM computer package. (So far, LEMRAS/ADAM had only been used for manpower allocation <u>within</u> divisions.) The existing method used a deployment formula based on ten weighted factors, including the number of calls-for-service, crimes, arrests, street miles, and population density, and through this formula calculated a number for each of the 17 divisions which indicated the percentage of the total uniformed force that were to go to that area. The ASDS Planning Division proposed that this formula be discontinued, and that ADAM-generated service workload percentages, which (according to the division) more accurately reflected actual man-hours expended, be employed as the basis of determining manpower allocation to the divisions.

Although this proposal was put forward in 1974, a final decision was not made by the department until April 1975. The primary cause of this delay was a shift in the police service philosophy of the LAPD.

C. The Basic Car Plan, Team Policing, and the Redirection of ADAM

In March 1974, midway through Phase II-A, the administration of Chief Davis instituted a shift in police service philosophy which was to have a

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22. Ibid., pp. 7-8. The Office of Operations is the section of the department that has overall responsibility for the patrol force. It is equivalent to the St. Louis Metropolitan Police Department's Bureau of Field Operations.

critical impact on the utility of the city-wide ADAM allocation model. The department's new approach, "team policing," grew out of its "basic car plan," which had been adopted back in 1969.

1. The Basic Car Plan. The basic car plan was based philosophically on what the LAPD termed the "territorial imperative" concept. According to this concept, if one specific patrol car was made responsible for a certain geographic area for 24 hours per day, the officers assigned to the car around the clock would gain a knowledge of the area and community and thus be able to perform better. The basic car unit was made the responsibility of one supervising officer, and each basic car was expected to spend at least 50 percent of each tour in the area to which the vehicle was assigned, either answering calls-for-service, patrolling, or working with the local community. The original implementation of the basic car plan established basic car districts within each of the 17 geographic areas in Los Angeles, with boundaries based on workload studies so that the districts represented the least number of patrol cars needed in a geographic area during an average day. This minimum basic car plan was fielded every day on every watch, and all available police personnel were fielded in additional patrol cars as supplements to the basic cars.

It should be noted that there were significant philosophical differences between the deployment policy relating to ADAM and the policies which underlay the basic car and team policing approaches. As the discussion of the Phase I report pointed out, the emphasis of the revised LEMRAS/ADAM system was on responding to calls-for-service as rapidly as possible and allocating resources to meet that objective. The basic car plan, on the other hand, focused on an area of the city and on maintaining police presence and association in that area. Responding to calls was important, but it had a lower priority.

As might be expected, conflicts soon arose between the basic car and resource allocation programs in Van Nuys, where both were operational.[23] Under the resource allocation project, if a basic car was available, a waiting service call would be assigned to it, even if it did not occur in the car's assigned area. As a result, it was estimated that the Van Nuys basic cars were responding to calls outside their areas about 30 percent of the time, making it extremely difficult for them to spent half their working hours with people in their assigned areas. Yet, if the dispatcher had not been allowed to assign a certain number of calls to basic cars outside of their areas, the number of units needed to handle the division's call-for-service workload with minimal delay would have increased considerably, which would in turn have required further reductions in the crime repression (preventive patrol) force. An LAPD evaluation report summarized the apparent incompatibility between the ADAM System and the basic car plan by listing three "tenets of the Basic Car Plan which appeared to have a potentially adverse effect on response to calls-for-service:

- Basic Car Plan officers were designated as fixed-post positions.
- All Basic Car Plan Units required deployment of two officers around the clock.
- Basic Car Plan Units were restricted to their areas of assignment

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23. Kent Colton, "Use of Computers by Police: Patterns of Success and Failure," Urban Data Service, vol. 4, no. 4 (April 1972), pp. 14-15.

except in an emergency."[24]

2. Introduction of Team Policing. In spite of the philosophical conflict between the basic car and resource allocation programs, both continued to be developed through 1972 and 1973. While the ASDS continued work on the resource allocation system, other sections of the department expanded the basic car plan and began to experiment with an additional but related organizational concept called "team policing."

The most extensive and significant of these team policing efforts was the Team 28 experiment carried out during 1972 and 1973 in a three-square-mile subsection of the Venice division. This subsection encompassed a population of 26,256, made up primarily of middle- and lower-middle-income families. To create an environment "conducive to the maximum effectiveness" of the program, a great deal of emphasis was placed on community involvement of the team officers through small neighborhood watch meetings and crime prevention education activities. Another significant characteristic of the experiment was the attempt to produce generalist rather than specialist police officers who would not only impart crime prevention information to the community but also train one another in their respective functional specializations during the course of their activities. Accordingly, 38 sworn personnel, representing a cross-section of uniformed, traffic, and investigative officers, were assigned to Team 28. The primary constraint upon these officers was that they were to remain in the "team area" unless required to respond to emergency calls outside it.[25]

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24. Los Angeles Police Department, Advanced Planning Division, "Automated Deployment of Available Manpower System Evaluation, July 1, 1975 - December 31, 1975," p. 25.

25. LAPD, "An Evaluation of the Team 28 Experiment," April 1974, pp. 10-16.

The Venice experiment was initiated during the second quarter of 1972. In June 1972, grant funds to combat burglary, amounting to over $250,000, were obtained from the California Council of Criminal Justice as part of its Crime Specific Burglary Program. The department applied these monies to the Team 28 project, which allowed the experiment to continue through July 1973. The funds were used primarily for salaries and overtime pay for team personnel, rental of storefront space, and the purchase of equipment.

According to the department's evaluation of the experiment, "community attitudes in the test area were positively influenced by the community involvement programs of the experiment, and police attitudes also reflected a more positive attitude toward the community."[26] In addition, the team policing area realized a 31.29 percent reduction in burglaries, compared to a 22.4 percent reduction in the adjacent control area. The experimental area also did better than the control area in regard to burglary/auto theft, with the former achieving a 20.9 percent reduction compared to the latter's increase of 3.45 percent. Both areas did equally well in reducing auto theft, with each experiencing a reduction of about 12 percent. The control area, though, did much better than the team area in reducing roberies, with a 30.4 percent reduction compared to the team area's 14.2 percent reduction.[27]

During 1973 and the first quarter of 1974, team policing experiments were conducted in all 17 geographic divisions of the city, although none

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26. Ibid., p. 3.

27. Ibid., pp. 95-96.

was as extensive or as fully documented as Team 28. Finally, in March 1974, Chief Davis made the formal decision to implement team policing city-wide. As stated by the LAPD, "implementation of Team Policing was the next step in the evolution of the 'territorial imperative' concept. The city was divided into 66 police team districts, normally comprised of one or two of the previously-described Basic Car Plan areas. Dispatch policy concerning calls-for-service was promulgated in adherence to 'territorial imperative,' i.e., all team units were kept inside their team area except in emergencies."[28]

This action prompted the ASDS to carefully reconsider its work on the ADAM System, and in March 1974, the project staff presented a report to the LAPD Review and Concurrence Authority (RCA) recommending a redirection for the system. The report outlined four conditions that would be necessary if the existing ADAM allocation model and its related system were to be "operationally meaningful and cost-effective":

- The manpower pool of an area had to be free from territorial constraints to handle any call in the area.
- The manpower pool of an area had to be large enough to warrant the operational costs of an automated predictive system.
- The forecast workload had to be accurate enough for the predictions to properly reflect manpower needs as a function of call-for-service workload.
- The call-for-service load of the area being examined had to

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28. Los Angeles Police Department, Advanced Planning Division, "Automated Deployment of Available Manpower System Evaluation, July 1, 1975 - December 31, 1975," pp. 25-26.

fluctuate significantly in order to warrant periodic forecasting.[29]

In analyzing these four conditions proposed by the ASDS, the police department found difficulties with each.

The first and second conditions both conflicted with the basic car plan, which required that the basic cars be fielded 24 hours a day whether the workload justified it or not. The fact that the basic cars were supposed to be dispatched to incidents outside their designated areas only in times of emergency also threatened the forecast effectiveness of the ADAM system, since the model assumed that any unit deployed could respond to any incoming call of the division. Before city-wide team policing, the basic cars had made up roughly 25 percent of the geographic areas' patrol forces, so prior to 1974 most patrol vehicles could answer incidents anywhere in a division, regardless of their priority level. But with the move to complete city-wide team policing, almost the entire manpower and vehicle pool of a division came under the territorial constraints that previously had only applied to basic cars.[30]

Regarding the third condition -- the accuracy of workload forecasts -- the statistics already cited have indicated that the forecasts were not accurate on a day of week and watch basis. (See Tables 6-4 and 6-5.) Although forecasts had improved somewhat as the Phase I experiment had progressed, the department found that "the accuracy for the individual days of

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29. Los Angeles Police Department, "Redirection of Goals and Objectives for the ADAM System (ADAM Presentation to the Review and Concurrence Authority)," March 8, 1974, p. 3.

30. Ibid., pp. 5-6.

the week and the individual watches was unacceptable. Fluctuations of plus or minus 75 percent were commonplace."[31]

Finally, concerning the fourth condition, analysis of statistical data from the five valley areas revealed that "individual geographic areas do not experience significant call-for-service fluctuations from one deployment period to another."[32] The valley data indicated that, for the five divisions, the mean percentage of change between periods (for ten consecutive deployment periods) ranged from 2.7 percent to 6.8 percent. There did seem to be evidence of substantial <u>seasonal</u> fluctuations (10 percent or more), but because of the small manpower pools of team policing (between four and six units per watch per team), the ASDS discovered that these seasonal fluctuations "result[ed] in insignificant variation in the number of units required to service the workload."[33] Even when the ASDS examined four-month periods for the valley divisions, the deployment recommended by the ADAM system varied by only 0 to 2 units in most timeframes. For example, for the three deployment periods between September 30, 1973, and January 10, 1974, the recommended number of units for Foothill's Team 23 varied by only 0 or 1 unit over 97 percent of the time. Thus, ASDS indicated, "once workload requirements for a watch are determined, there is no need for an automated deployment system" with regular forecasts.[34]

Although the ASDS concluded that the ADAM system as a dynamic resource allocation tool was no longer meaningful under the new team concept -- that

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31. Ibid., p. 14.

32. Ibid., p. 4.

33. Ibid., p. 5.

is to say, that the ADAM model and its allocation recommendations were not appropriate (or accurate) for the LAPD -- it still believed that many of the computer-generated historical reports could play "an important supportive role for team policing, be a valuable analytical tool in evaluating the impact of an experimental program on deployment, and provide valuable information for Communication Division Studies."[35] Therefore, the ASDS recommended retaining that part of the computer package that generated historical reports and using it as the foundation of an automated management information system. As an example of the possible value of ADAM as a management information system, the ASDS cited the use of call-for-service volume reports by valley division analytical offices in formulating team boundaries during Phase I. Moreover, they claimed that after the 17 areas had accumulated data for one year, ADAM historical reports could be used to compare the relative call-for-service volumes of various areas as one criterion for redistributing manpower among divisions or teams. Finally, they argued that the "ADAM Delay Analyses" and "Unit Workload" reports would enable team officers to monitor both the efficiency of their units in handling calls and the degree of team adherence to the "territorial imperative" concept.

According to the ASDS estimates, the transformation of the ADAM computer system from a deployment forecast system to a management information system could be accomplished by the end of Phase II-A, in June 1974. To enhance the utility of the computer package as a management tool, however, they recommended that the funds which the department had intended to seek

35. Ibid.

for Phase II-B work be utilized to develop a geocoding system. The proposed geocoding system would be used to match the address on dispatch records maintained by the department to reporting districts. The Planning Division argued that this capability would benefit the ADAM project because the management reports which the redirected system would be producing were dependent on the accurate assignment of reporting district information. In making this latest proposal, the ASDS noted that a significant portion of the radio message logs lacked just such location informtion. The cost of developing the geocoding system was placed at $108,202.

On March 8, 1974, the department's Review and Concurrence Authority (RCA) agreed with the recommendations presented by the ASDS, and a redirection of the ADAM system was initiated. Workload forecasting was suspended, along with the dynamic deployment aspects of the system. The final decision to discontinue use of the dynamic model was based on three factors:

- continual problems with the computer software due to the complexity and inadequacy of the predictive aspects of the model to forecast workloads and consider officer-initiated activities;
- difficulties in the capture and preparation of data; and
- changes in police department deployment policies to team policing.[36]

The RCA, however, accepted the ASDS proposal that the computer programs for generating historical data on calls-for-service workload and self-initiated activities be retained, and concurred with the ASDS proposal (made during Phase II-A) that these historical data be used in developing

36. Los Angeles Police Department, Advanced Planning Division, "Automated Deployment of Available Manpower System Evaluation, July 1, 1975 - December 31, 1975," pp. 21-25.

a new workload formula for deployment planning purposes.

3. Phase II-B. Phase II-B, which followed the decision to redirect the ADAM system, ran from July through December 1974. One of its primary goals was to develop a Geographic Base File (GBF) geocoding capability.

It had been determined at the beginning of Phase II that such a file, adaptable to the immediate requirements of the ADAM system, was already available to the department: the Dual Independent Map Encoding (DIME) File for Los Angeles County. The DIME File program essentially involved the translation of geographic information, such as street addresses, and of crime statistics reported by police districts, into a form that could be understood and manipulated by a computer. This allowed the management information system to take individual pieces of information, such as specific police incidents, and to aggregate them in a variety of ways, thus providing, for example, the total number of incidents in a particular police district during a particular time of day. In July 1974, the Los Angeles County Regional Planning Commission agreed to let the ADAM project staff extract the Los Angeles City portion of the DIME File. Work on the DIME File continued throughout the Phase II grant.[37] Once the file was

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37. The task of adopting and updating the city portion of the DIME File was divided into four phases. During the first three phases, reporting numbers were assigned to the street segments already in the DIME File. During the fourth phase, all new post-1970 street changes not originally in the file were added. Reporting district designations were then appended to all these additions. After the DIME File segments had been assigned a reporting district number, data records derived from the communications message logs were run through the address matching (ADMATCH) edit routine system developed by the U.S. Bureau of the Census. After processing the ADAM source data by the edit routine, the ADMATCH system automatically appended reporting district numbers to all the records which contained street addresses. While the first such ADMATCH computer run was carried out by the ADAM staff on November 25, 1974, the address match rate for the source documents "37 (continued...)"

established, the primary problem was to update it and keep it current. As of 1976, the DIME File was being maintained by the Los Angeles Data Service Bureau, but since city resources were limited and there had been a budget freeze, the updating process had fallen behind.

During Phase II-B the project staff also devoted time and effort to redesigning and modifying the computer-generated administrative reports which would provide historical information on call-for-service workload and performance in servicing calls. A variety of reports were developed so that the output would be useful to specific members of the police department. In order to support team policing, for example, a report was developed to indicate the number of "crossovers" -- incidents in which a policeman from one team would be called to another team area to service a call.

In addition, the ASDS continued its efforts to improve the ADAM allocation model. This was done in spite of the earlier decision that the dynamic allocation model was not appropriate for the LAPD team policing environment.

Much of the Phase II-B work on the allocation model focused on the problem of officer-initiated calls. It was felt that the failure of the LEMRAS/ADAM dynamic model to consider officer-initiated calls had been a primary source of inaccuracy in the forecasts. During Phase II-A, in

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37. (continued)
was 81.6 percent; that is, 81.6 percent of the source documents contained legitimate address information which could be matched by the system with a reporting district number. Nine subsequent source data runs were made with an average match rate of 84.9 percent. Prior to acquisition of the GBF and ADMATCH systems, the average match rate achieved by manually appending reporting district numbers to message logs had been 65-70 percent.

fact, a consultant had been hired to study the mathematical model and to recommend ways to improve its accuracy. Now the consultant's final report was given a thorough technical review by both the department and the city's Data Service Bureau. Both concluded that the report was unsatisfactory because it did not meet the provisions of the contract.[38] Among other things, the department claimed that the consultant had neither identified "areas of incongruity of the model with the real world situation confronting the department," nor described those characteristics of ADAM data which rendered the existing predictive model inadequate, especially for the forecast of officer-initiated activity.[39]

About the same time that the consultant was hired, Dr. Jan Chaiken, a mathematics professor at UCLA and an employee of the Rand Corporation, approached the department about developing a class project at UCLA that would deal with emergency service systems, response time, and queuing theory. In response, the department gave Dr. Chaiken and his class permission to make an evaluation of the ADAM system. During the summer of 1974, the UCLA class presented its report to the department.[40]

The report did not limit itself to reviewing the existing LEMRAS/ADAM model. Instead, much of it was devoted to advocating an alternative dynamic model which the class believed would be superior to the LEMRAS/ADAM

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38. Los Angeles Police Department, "Final Report Phase II-B, A.D.A.M.," March 31, 1975, pp. 6, 10-11.

39. Ibid., pp. 7-8.

40. Larry Glazer, Victor Hernandez, et al., "Analysis of the Los Angeles Police Department's Patrol Car Deployment Methods," UCLA Public Systems Analysis class, June 1974.

technique. The UCLA program, unlike the ADAM model (which, according to the LAPD, treated officer-initiated activity as unrelated to the number of units deployed), operated on the assumption "that the amount of officer-initiated activity performed by a radio car would vary according to the amount of call-for-service workload." The class calculated the number of affected cars needed in each division for each tour and then applied a correction factor (because of cars unavailable due to officer-initiated activity and "housekeeping" duties) to determine the number of "actual" cars needed to achieve the "effective" number of units.

Using this model, the class discovered that to achieve the objective of answering 95 percent of calls without delay, the size of the patrol force would have to be doubled. Accordingly the class recommended that the department set more modest objectives. As of summer 1976, the original response time objective had not been relaxed.[41]

In their report, the UCLA students also compared the number of car-hours actually available in the five valley divisions (during deployment period 2) with the number listed on the ADAM print-outs as being required to obtain a 95 percent probability of no dispatch delay. (See Table 6-8.) The class discovered that the car-hours assigned to the entire valley area approximately equaled the number called for in the program. However,

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41. The department, however, has established three levels of priority assignments: Priority 1 for emergency dispatches; Priority 2 for calls which involved a high priority but still required the police officer to obey traffic laws when proceeding to the scene; and Priority 3 calls, including all other police activities. Response delay was being monitored by the various priority categories, with the realization that delays should be smaller for higher-priority calls and greater for lower-priority calls.

the distribution of car-hours between the five areas did not match the need as predicted by the model. The class then sought to determine whether there were justifiable reasons for the differences between the various divisions in car-hours actually assigned. On the basis of their analysis, the class concluded:

> ...we can see that West Valley and Foothill show a low patrol frequency and high average travel time. These two divisions justify assignment of excess cars in order to improve their patrol frequency and travel time expectations. Conversely, there is no way evident to justify the relative excess of cars assigned to the North Hollywood Division.[42]

Perhaps more important, the class determined that, independent of whether a division was relatively over-allocated or under-allocated (in terms of the aggregate ADAM predictions), within each division, on the average, "the increase in cars on duty during the busiest hours was less than it should have been," and the reduction in cars on duty during slow hours was also inadequate. Although the class conceded that it was easier for patrol commanders to make small variations in the number of cars on duty than to make large changes, they argued that this practice was undesirable because it resulted in longer dispatch delays than necessary. In fairness to the division commanders, however, it should be noted that the basic car requirements considerably constrained their ability to follow the recommendations of the LEMRAS/ADAM models.

Following the submission of the UCLA report, Dr. Chaiken concluded his direct work for the LAPD, but he continued his efforts to develop resource allocation models. Although these efforts were not specifically

42. Ibid., pp. 28, 31.

directed toward the Los Angeles police, the ultimate product may eventually be used by the department. Under the auspices of the Rand Corporation in Santa Monica, Dr. Chaiken had already participated in the design of a resource allocation system for the New York City Police Department.[43] Using the essential features of both the New York system and the UCLA model, Chaiken and the staff at Rand subsequently developed a new general-purpose patrol car allocation model which became known as PCAM (Patrol Car Allocation Model).[44] At the conclusion of Phase II-B, the ADAM staff studied the new model and decided that they would recommend implementing PCAM as a part of the resource allocation planning for the LAPD. (There is some question as to why the staff came to this decision, since the LAPD appeared to be committed to team policing and the PCAM model was likely to exhibit many of the ADAM's limitations in relation to the team policing environment.)

Meanwhile, after receiving authorization from the RCA, the ASDS had developed procedures whereby the newly designed ADAM historical data reports could be used to deploy personnel among divisions by day of week and by watch. The new ADAM reports presented data on the man-hours expended in each district, including breakdowns on such factors as service calls, self-initiated activities, and crimes.[45] By June 1974, the necessary

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43. This model was based on the resource allocation algorithm presented in Chapter 5 of Richard C. Larson's Book, Urban Police Patrol Analysis (Cambridge, Mass.: MIT Press), 1972.

44. For more detail on PCAM see Jan Chaiken and Peter Dormont, "History of Patrol Car Allocation Programs," Appendix A in Patrol Car Allocation Model: Users Manual, R-178612 (Santa Monica, Calif.: Rand Corporation, 1975). PCAM is programmed in FORTRAN and is available in a batch or an interactive version.

45. Los Angeles Police Department, "Final Report, Phase II-B, ADAM," p. 7.

computer programs were fully operational, and the ASDS recommended that, effective January 1, 1975, the Office of Operations adopt the use of computer-generated historical reports as a replacement for the existing hazard formula utilized for patrol deployment among divisions.

The Office of Operations, however, did not concur with the ASDS recommendations. Its staff preferred that, instead of replacing the existing Patrol Bureau Formula with the ADAM reports, the new deployment system should be based both on the ADAM reports and on components of the old hazard formula.[46] On March 10, 1975, a formal decision to implement such a compromise system was announced. But even then, further delays occurred, and the new system was not initiated until July 1, 1975.

D. Evaluation of ADAM, July-December 1975

Although the ADAM Phase II-B proposal ended in December 1974, some grant money was available through April 1975, when all resources from the federal grant would be expended. If the historical reporting system was to move from a developmental status to an operational mode, additional resources would be necessary. The police department therefore asked the City of Los Angeles for $44,000 for final implementation. The Mayor turned down the request for two reasons: because city expenditures had to be reduced to avoid a budget deficit,[47] and because the police department had

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46. Interviews, Scott Hebert with Officer-in-Charge, interdivision deployment, April 1975, and Kent Colton with ASDS staff, July 1976.

47. This response is interesting in light of the fact that the LEMRAS/ADAM project had been introduced as a measure which would potentially increase the efficiency of the LAPD.

expressed "an ambiguous position in regard to the acceptance of ADAM's purported ability to replace the manual preparation of the Patrol Bureau Formula."[48] In response, the department stated that ADAM was a viable, operational program, and made a renewed case to the Mayor and the City Administrative Officer. On April 16, 1975, the department received an appropriation of $15,000, which would carry it up to July. (The City Administrative Officer had advised the Mayor that the entire sum of $44,000 was not required.) In his letter announcing the reinstatement of the ADAM project in the Proposed Budget for Fiscal Year 1975-76, the Mayor noted that such action should not be viewed as a complete acceptance of the ADAM system. He also asked that a six-month pilot program be instituted to determine the true benefits and costs of the system, as well as user opinion concerning ADAM's ability to provide desired information. Criteria for evaluating the pilot program were to be provided by the City Administrative Officer, who was also to conduct the final evaluation and submit his recommendations to the Mayor and City Council. The evaluation was to run from July 1 through December 31, 1975, and the city funds allocated for the operation of the system during that period.

In preparation for the pilot program, the ASDS prepared a detailed "Users Manual" on the ADAM historical reports. The manual outlined the method for carrying out a division workload study and for shifting resources among the various police teams.[49]

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48. Letter from Tom Bradley, Mayor of Los Angeles, to the Los Angeles Board of Police Commissioners, May 8, 1975.

49. Los Angeles Police Department, Advanced Systems Development Section, Advanced Planning Division, Automated Deployment of Available Manpower (ADAM) Users Manual (Los Angeles, 1975).

In addition, the Office of Operations completed its new formula for interdivision deployment of excess manpower among the 17 divisions. The first factor of this formula measured the areas' percentages of city-wide patrol workload or "proportionate need" and used four pieces of information from the ADAM reports: calls-for-service, officer-initiated activity, reported time unavilable for administrative reasons, and data concerning selected crimes. This "proportionate need" factor received a weighting of ten in the overall formula.

Each of the other six factors, which were incorporated from the previous hazard formula, received a weighting of one. They consisted of property loss, traffic accidents, casualties, anf fatalities; stolen vehicles recovered by area, Los Angeles City population in that area, street miles, and population density. All seven factors were totaled by area, and then the area's "percentage of the city's workload" was calculated.

It is important to remember, however, that deployment both within each division and among the 17 divisions was carried out within the context of team policing. Thus, the 66 LAPD teams were to remain as fixed posts, and the new allocation techniques utilizing the ADAM reports were only to be used to deploy the additional resources, termed the "deployable pool." In the summer of 1976, for example, the LAPD had 3,860 uniformed officers, 3,160 of whom were assigned to fixed posts in team areas. This left a deployable pool of 700 men to be allocated among the various divisions. Each quarter, the Office of Operations was to recalculate the proportionate need among the various divisions, and shift officers from the deployable pool among the divisions. Similarly, each of these 17 divisions was encouraged to carry out a division workload study and to use ADAM historical reports to allocate people from their deployable pool by watch hours and by day of week so as to improve their performance in responding to calls-for-service.

The six-month evaluation report, which was prepared by the ADAM staff in March 1976, comprised four sections.[49] The first focused on the evolution of the system; the second examined changes in the resposne to calls-for-service during the pilot program; and third explored the attitudes of user personnel and their acceptance of the system through a series of interviews held at the beginning and end of the test period; and the fourth analyzed some of the costs and benefits of the system.

According to the evaluation, the six-month period had permitted the output and distribution of two ADAM quarterly reports. These reports (for the third and fourth quarters of 1975) were distributed to the 17 divisions. They requested that each division carry out workload studies based on the formulas described above, and proposed executing appropriate changes in deployment. Interviews had been conducted with the area management teams, district team leaders, and analytical officers for each of the 17 divisions approximately two weeks after the quarterly reports had been published and distributed. In addition, the staff of the Office of Operations had been interviewed to see how they felt the system was working. According to the ASDS report, the pilot program 'demonstrated that it [the adam historical reporting system]

49. The Mayor had originally stated that the evaluation could be conducted by the Chief Administrative Officer. Instead, it was conducted by the ADAM staff. Although there is no reason to suppose that they would have altered the facts, it would have been difficult to eliminate all biases and an independent evaluation might have provided a more objective judgment.

is an effective patrol deployment planning tool,"[50] and on the basis of the six-month evaluation, the City of Los Angeles and the LAPD decided to continue to use the ADAM system.

Specifically, the ASDS report found that:

° Calls-for-service had increased by .53 percent during the first seven deployment periods of 1975, as compared with the same period in 1974. Service level had decreased during the same deployment periods by an average of 1.1 percent per period, but after implementation of ADAM the lower service-level trend had been reversed. Deployment periods eight through thirteen had shown an increase of 8.2 percent in calls-for-service in 1975 as against 1974. At the same time, service level had increased very moderately by an average of .7 percent per deployment period.

° An even greater improvement had occurred in the average minutes of delay for those calls not dispatched within five minutes of receipt. The average delay of calls during the last six months of 1974 had been 29.1 minutes -- a reduction of 2.6 minutes or 8.9 percent.

° As a result of the workload studies completed with the ADAM system data, 156 uniformed patrol officers had been redeployed within geographic areas. The increase in service level and the decrease in delays had followed this redeployment.[51]

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50. Los Angeles Police Department, Advanced Planning Division, "Automated Deployment of Available Manpower System Evaluation, July 1, 1975 - December 31, 1975," p. 3.

51. Ibid., pp. 4-7.

On the surface, these numbers appear positive, and in some respects they may be. However, it is important to place them in perspective.

First, the apparent improvement in service level between 1974 and 1975 was so small that it is difficult to tell whether the change was statistically significant.

Second, there is the problem of establishing a causal relationship. A number of factors may have contributed to the reported changes in patrol force workload and performance -- changes in the type of call-for-service, overall community attitudes, police enthusiasm with team policing, more efficient communications and dispatch, and so forth. The ADAM reporting system may have been one of the causal factors, but it is difficult to imagine that its influence would have been very great, for only 156 men (approximately 4 percent of the uniformed force of close to 4000) were transferred during the period of evaluation. In fact, as Figure 6-1 shows, the improvement in dispatch delay began during deployment period four, before city-wide implementation and evaluation of ADAM, which suggests that other factors were at least partially responsible for the changes in performance.

Finally, even if we could say with confidence that the use of ADAM historical reports was responsible for the apparent improvements in patrol performance, the system's impact on the quality of police service was still very limited. Specifically, more than 50 percent of the calls-for-service had incurred a dispatch delay, and for an average of 26 minutes.

In addition, the evaluation report also discussed acceptance of the ADAM pilot program by the police management teams. Of the 17 division management teams that were interviewed, 16 stated that they had attained familiarity with the ADAM system by the end of the evaluation. Ten division commanding officers said that they had instructed their team leaders to set service-level goals for 1976 on the basis of historic ADAM data. Also, 42 of the 66 district team leaders at the end of the evaluation period said that they were actively using the ADAM quarterly reports for deployment planning, in contrast to 28 team leaders who had been using the reports at the beginning of the period. To the staff this seemed to indicate a trend toward increased use of the system by team leaders. In addition, analytical officers found the system to be a significant improvement over the old uniform deployment formula for computing workload studies. Of the 17 analytical officers, 14 said they had a good working knowledge of ADAM, and all 17 stated that they had completed at least one workload study using the ADAM data. Moreover, the ASDS reported that ADAM had permitted the completion of an area workload study in one man-day -- a saving of 14 man-days over the old method.

Once again it is important to review the findings more thoroughly. For example, while 16 of the 17 division management teams stated that they had a good familiarity with the ADAM historical reports by the end of the pilot program, confidence on the part of the management team had increased very little during the experimental period. In addition, while the ASDS report noted that 15 of the 17 divisions had formulated an area policy regarding use of the ADAM historical reports, in only 10 of these 15 (or 58 percent of the LAPD divisions) did this policy require team leaders to set service-level goals for 1976 on the basis of the ADAM statistics. Moreover, the evaluation revealed that, while 42 teams were using the ADAM reports to some extent for deployment planning, by the end of the pilot period, 24 still were not. This means that over one-third of the teams did not use the ADAM historic reports, even though a fairly intensive effort must have been made to encourage their support during the evaluation period.

Finally, the evaluation report indicated that implementation of the ADAM system had eliminated the preparation and processing of the Daily Field Activities Reports (DFAR), which had been needed to prepare the previous patrol bureau quarterly report. The annual cost of this old report was estimated at $257,686. The LAPD evaluation report stated that these savings more than offset the annual ADAM operating expense of $124,319. However, most of the costs attributed to the old system were based on time spent by patrol officers in roll call, training, and coding the old DFARs. While many of the costs for the ADAM system were "new" costs to the police department, the dollars saved came primarily from patrol officer time. Although such savings may have financed additional police time in the field, they did not result in a spending reduction for the LAPD.

E. Status of the ADAM Reporting System

Early in 1977, the ADAM historical reporting system was a part of LAPD operations. The officers in the ASDS seemed satisfied with the system and looked forward to its continuation. In addition, the Officer-in-Charge of Deployment in the Office of Operations expressed satisfaction with the new deployment formula, both in terms of the ease of calculating proportionate workloads for the divisions and the overall operations of the historical reporting system.[52] However, it is important to remember

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52. Kent Colton interviews with LAPD staff, July 1976.

that the system now in operation is very different from the one originally concerned when the LEMRAS project began. The current ADAM system is not a dynamic resource allocation model which includes forecasts of workload demand. Rather, it is a management information system which keeps track of service workloads, responses to calls-for-service, and crime activities in the LAPD. These historical reports are used to facilitate hand calculations, which in turn are used to allocate and deploy excess manpower. Further, it is not mandatory for each division to carry out workload studies based on the ADAM system. According to the ASDS staff, in the summer of 1976 six divisions were using the ADAM reporting system "very effectively," with all non-fixed-post deployment based on the system's workload reports. Another six developed workload studies using the system, but less extensively. Finally, five divisions did not appear to be utilizing the system at all.[53] This is not surprising, for as the experience in St. Louis has shown, if pressure for use is not maintained by the ranking command staff, there is no assurance that a new system will continue in operation.

In order to encourage use of the system, the ASDS was preparing, at the end of 1976, a series of charts each quarter in order to track the following activities: (1) the number of units deployed in each of the divisions by time of day; (2) the average number of calls-for-service per hour; and (3) the average number of minutes per hour when no units were available to respond to calls. (Figure 6-1 displays such a chart for the Venice District.) These charts gave the ASDS a way to track the divisions'

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53. Based on Colton interviews with LAPD staff, July 1976.

progress in comparison with overall objectives. If an area's performance declines, it appears that the ASDS will attempt to pressure the division into improving its deployment and utilizing ADAM. The final decision, though, still remains with the division commanders of the 17 geographic areas, and the real test question is: "Will the ADAM system still be in use, say, in five years' time?"

Further, the use of the ADAM reporting system still conflicts with the team policing concept. Since team policing calls for a fixed number of posts, at most the use of the ADAM reporting system will have only a marginal impact on workload distribution. If the PCAM model is ever implemented, this conflict will become even more apparent, particularly when the question of geographic allocation arises. Essentially, the PCAM system would offer two options. First, the model could be used to allocate cars to very small geographic regions (team areas), but this would not work very well. For example, PCAM will never allocate fewer than two cars to a region because of the underlying queuing formula assumptions that capture economics of scale for numerous cars but not for a single car. Second, the model could be used to allocate cars to precincts, even if the precincts were divided into team areas. But then nobody would have the authority to compel compatible decisions by the team commanders so that the sum of the team allocations may not equal the desired precinct allocation suggested by the model.

In 1977, although the ASDS was planning to implement the PCAM model, the process has been very slow. This slowness of pace has been aggravated by a budget crunch within the city. Even if the PCAM model were to be implemented, it would still serve only as an advisory source of information to each of the division commanders, and the conflict with team policing would remain.

The experience of the LAPD in terms of the conflict between team policing and ADAM demonstrates an important point regarding law enforcement technology. Technology is not value-free. Each new technique or piece of equipment brings with it implicit assumptions about the role of police and the effective strategies for fulfilling that role. In resource allocation it is critical that police departments, municipalities, and the citizens they serve recognize this fact and analyze the implications of the technology on the nature of police operations before proceeding with implementation. A decision should be made first concerning the basic criteria for allocating resources, and a deployment program should be selected to reflect this strategy. In the case of the LAPD, the decision was made to utilize the philosophy of team policing as the primary criterion for deployment. ADAM, therefore, has had to operate within that context and its constraints.

Table 6-1: LEMRAS Forecasted Event Data for the Van Nuys Division Compared with Actual Event Counts

Totals for Deployment Periods IV (March 23 - April 19) and VI (May 18 - June 4),[a] 1969

Day of Week	Actual	Event Count Predicted	Accuracy
Sunday	815	847	96.1%
Monday	746	739	99.1
Tuesday	716	689	96.1
Wednesday	754	741	98.2
Thursday	745	766	97.2
Friday	782	783	99.9
Saturday	892	848	94.8
Sunday	775	877	86.8
Monday	692	744	92.5
Tuesday	654	702	92.7
Wednesday	616	729	84.5
Thursday	701	721	97.1
Friday	659	742	87.4
Saturday	889	823	92.6
Total	10,436	10,751	95.9

a. The October report did not explain why only these two deployment periods were examined in the analysis of predictive accuracy.

Source: Los Angeles Police Department Evaluation of LEMRAS (October 1969), Appendix "A," Table No. 1.

Table 6-2: Calls-for-Service Only (1973)

Division	Period	Actual Events	Predicted Events	Percentage Error[a]
Van Nuys	4	5,786	5,288	- 9
West Valley	4	4,960	4,527	- 9
North Hollywood	4	3,921	3,659	- 7
Foothill	4	3,965	3,472	-13
Devonshire	4	2,600	2,465	- 6
Total, 5 Divisions	4	21,232	19,411	- 9
Van Nuys	5	5,572	5,781	+ 4
West Valley	5	5,297	5,519	+ 4
North Hollywood	5	4,285	4,023	- 6
Foothill	5	3,913	4,051	+ 4
Devonshire	5	2,617	2,831	+ 8
Total, 4 Divisions	5	17,399	18,182	+ 5
Total, 1 Division	5	4,285	4,023	- 6
Van Nuys	6	5,857	6,143	+ 5
West Valley	6	5,530	5,664	+ 2
North Hollywood	6	4,247	4,456	+ 5
Foothill	6	4,112	4,217	+ 3
Devonshire	6	2,618	2,649	- 1
Total, 4 Divisions	6	19,746	20,480	+ 4
Total, 1 Division	6	2,681	2,649	- 1

a. A minus sign indicates an underestimation of events, a plus sign indicates an overestimation of events.

Source: Los Angeles Police Department Final Report on A.D.A.M., Phase I, p. 24.

Table 6-3: Calls-for-Service and Officer-Initiated Events (1973)

Division	Period	Actual Events	Predicted Events	Percentage Error[a]
Van Nuys	4	8,122	6,085	-25
West Valley	4	7,960	5,864	-26
North Hollywood	4	5,965	4,588	-23
Foothill	4	5,817	4,204	-28
Devonshire	4	4,341	3,240	-25
Total, 5 Divisions	4	32,205	23,981	-26
Van Nuys	5	8,431	8,104	- 4
West Valley	5	9,080	8,811	- 3
North Hollywood	5	7,351	6,054	-18
Foothill	5	6,325	5,990	- 5
Devonshire	5	4,791	4,674	- 3
Total, 5 Divisions	5	35,978	33,633	- 7
Van Nuys[b]	6	7,505	7,911	+ 5
West Valley	6	9,196	9,505	+ 3
North Hollywood	6	7,117	7,412	+ 4
Foothill	6	6,344	6,594	+ 4
Devonshire	6	4,937	4,706	- 5
Total, 4 Divisions	6	30,062	31,422	+ 4
Total, 1 Division	6	4,937	4,706	- 5

a. A minus sign indicates an underestimation of events, a plus sign indicates an overestimation of events.

b. Van Nuys does not include Sunday totals for Period 6 due to faulty computer print-out.

Source: Los Angeles Police Department Final Report on A.D.A.M., Phase I, p. 25.

Table 6-4: Calls-for-Service Only (1973)

Divisions	Period	Total Number of Watches[a] A	Number of Watches with Error Rate 0-10% B	11-20% C	21-30% D	31%+ E	Number of Watches Predicted Greater than Actuals
Van Nuys	4	21	10	9	1	1	6
West Valley	4	21	12	8	1	0	5
North Hollywood	4	21	13	5	2	1	6
Foothill	4	21	8	8	4	1	4
Devonshire	4	21	9	8	3	1	8
Total, 5 Divisions	4	105	52	38	11	4	29
Percent, 5 Divisions	4	100%	50%	36%	10%	4%	28%
Van Nuys	5	21	13	6	1	1	13
West Hollywood	5	21	16	4	1	0	16
North Hollywood	5	21	11	7	3	0	6
Foothill	5	21	14	5	2	0	16
Devonshire	5	21	14	1	3	3	13
Total, 5 Divisions	5	105	68	23	10	4	64
Percent, 5 Divisions	5	100%	65%	21%	10%	4%	61%
Van Nuys	6	21	17	4	0	0	17
West Valley	6	21	13	7	1	0	12
North Hollywood	6	21	11	8	1	1	14
Foothill	6	21	14	5	1	1	11
Devonshire	6	21	9	8	2	2	8
Total, 5 Divisions	6	105	64	32	5	4	62
Percent, 5 Divisions	6	100%	61%	30%	5%	4%	59%

a. Total number of watches = 3 watches/day x 7 days/week.

Source: Los Angeles Police Department Final Report on A.D.A.M., Phase I, pp. 26-27.

Table 6-5: Calls-for-Service and Officer-Initiated Events (1973) for Watches

Divisions	Period	Total Number of Watches[a] A	Number of Watches with Error Rate 0-10% B	11-20% C	21-30% D	31%+ E	Number of Watches Predicted Greater than Actuals
Van Nuys	4	21	1	5	10	5	0
West Valley	4	21	0	4	11	6	0
North Hollywood	4	21	1	7	11	2	0
Foothill	4	21	1	2	7	11	1
Devonshire	4	21	3	5	6	7	1
Total, 5 Divisions	4	105	6	23	45	31	2
Percent, 5 Divisions	4	100%	6%	22%	43%	29%	2
Van Nuys	5	21	16	4	1	0	8
West Valley	5	21	17	4	0	0	8
North Hollywood	5	21	5	8	7	1	1
Foothill	5	21	16	5	0	0	7
Devonshire	5	21	6	9	5	1	9
Total, 5 Divisions	5	105	60	30	13	2	33
Percent, 5 Divisions	5	100%	57%	29%	12%	2%	31%
Van Nuys[b]	6	18	18	0	0	0	18
West Valley	6	21	15	6	0	0	15
North Hollywood	6	21	17	3	1	0	13
Foothill	6	21	15	4	1	1	14
Devonshire	6	21	7	9	3	2	7
Total, 5 Divisions	6	102	72	22	5	3	67
Percent, 5 Divisions	6	100%	71%	21%	5%	3%	66%

a. Total number of watches - 3 watches/day x 7 days/week.

b. Sunday watches of Van Nuys excluded due to faulty computer print-out.

Source: Los Angeles Police Department Final Report on A.D.A.M., Phase I, pp. 28-29.

Table 6-6: Calls-for-Service Incurring a Dispatch Delay and the Average Length of Delay

Division	Period	Not Delayed[a] Number of Events (A)	Not Delayed[a] Percent	Delayed Number of Events (B)	Average Delay in Minutes	Total Events[b] (C)
Van Nuys	4	3805	65.7	1981	22.0	5786
	5	3563	63.9	2009	23.7	5572
	6	3874	66.1	1983	21.1	5857
West Valley	4	3432	69.1	1528	19.5	4960
	5	3613	68.2	1684	21.1	5297
	6	3946	71.3	1584	21.0	5530
North Hollywood	4	2718	69.3	1203	19.6	3921
	5	2948	68.7	1337	21.6	4285
	6	3018	71.0	1229	20.8	4247
Foothill	4	2697	68.0	1268	23.6	3965
	5	2557	65.3	1356	25.9	3913
	6	2845	69.1	1267	22.7	4412
Devonshire	4	1738	66.8	862	21.8	2600
	5	1726	65.9	891	21.1	2617
	6	1845	68.8	836	21.2	2681

a. Not delayed is interpreted to mean five (5) minutes or less between the time a call was received and the time it was accepted by a unit.

b. C = A + B.

Source: Los Angeles Police Department Final Report on A.D.A.M., Phase I, p. 31.

Table 6-7: Percent of Calls-for-Service Dispatched without Delay[a] by Priority Calls

Division	Period	PRIORITY CLASS[b] 1	2	3	4	5	6	7	8	9
Van Nuys	4	89.7	85.1	80.8	71.7	52.6	73.5	46.3	49.3	93.3
	5	92.7	82.9	77.9	64.7	53.0	64.1	57.4	50.6	94.1
	6	96.7	86.0	82.8	70.2	52.8	64.2	57.4	50.4	100.0
West Valley	4	93.6	81.8	81.4	71.4	59.2	77.8	57.6	55.8	88.0
	5	90.1	83.2	85.2	69.0	57.6	73.6	63.9	51.8	97.3
	6	94.7	90.2	82.6	73.3	60.8	73.2	64.7	61.5	100.0
North Hollywood	4	90.0	86.4	82.4	75.8	56.2	70.2	53.8	58.0	92.1
	5	90.4	82.3	80.1	75.6	60.9	66.6	60.8	64.7	100.0
	6	92.6	86.9	86.8	74.7	58.0	65.5	63.8	57.6	100.0
Foothill	4	86.5	81.6	80.0	71.6	56.4	75.4	52.7	39.3	100.0
	5	81.8	83.1	83.5	65.9	51.8	54.7	57.8	48.9	95.6
	6	82.3	82.8	82.8	71.8	56.5	42.5	67.0	50.8	97.4
Devonshire	4	90.3	69.4	80.8	68.7	57.4	79.1	50.8	50.7	88.[illegible]
	5	90.0	82.8	80.4	65.7	57.4	76.0	59.0	48.6	97.6
	6	91.17	85.2	83.0	72.2	58.5	62.5	63.5	51.2	100.0

a. Without delay is interpreted to mean five (5) minutes or less between the time when a call was received and the time it was accepted by a unit.

b. Calls are divided into 9 different priority codes, with class # 1 representing the top priority.

Source: Los Angeles Police Department Final Report on A.D.A.M., Phase I, p. 30.

Figure 6-1: Workload and Service Performance Data

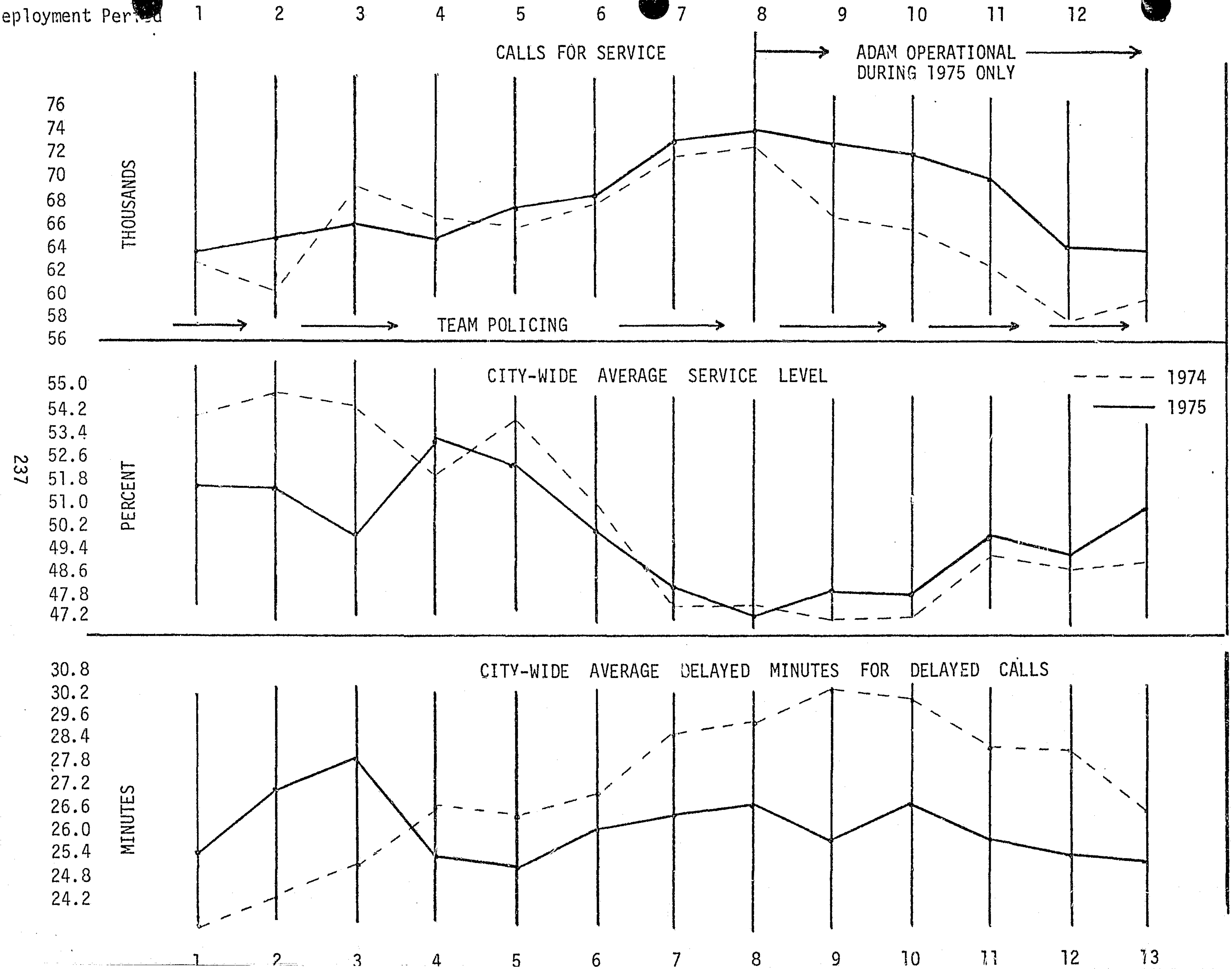

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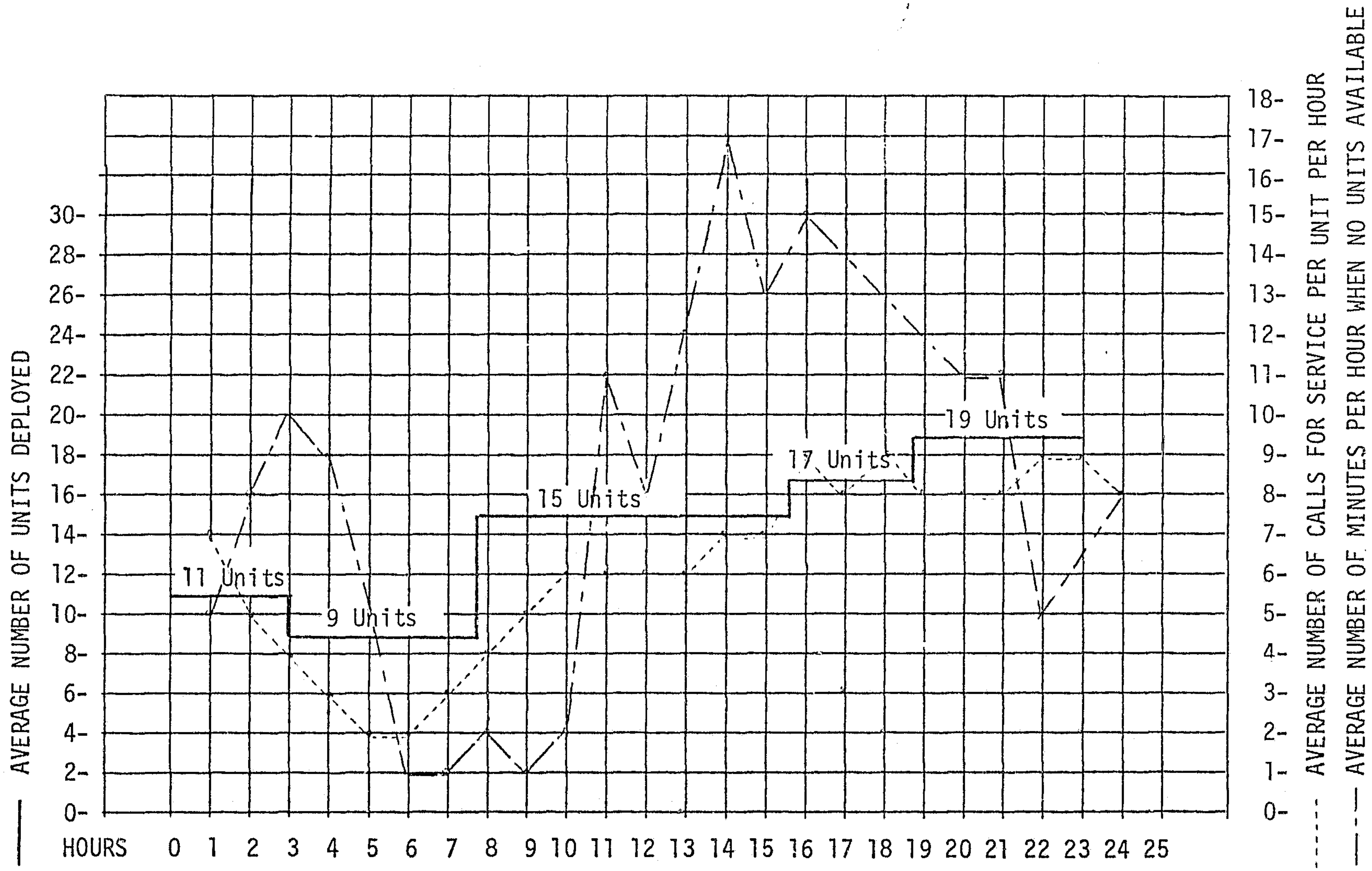
Figure 6-2: Venice District Patrol # 5, 1976



CHAPTER VII

POLICE USE AND ACCEPTANCE OF ADVANCED DEPLOYMENT TECHNIQUES: FINDINGS FROM THREE CASE STUDIES

by Scott Hebert and Kent Colton

Chapters IV, V, and VI presented the case studies of three police departments that attempted to introduce new resource allocation techniques into their patrol operations. These cases demonstrated the technology's difficulty in achieving clearcut, long-term acceptance. In fact, only one of the efforts examined came close to meeting the standard proposed for the first level of evaluation outlined in Chapter I, that is, that the technology has been in operation in the department for a period of years and that it technically functions as implementers said it would.[1]

In St. Louis, for instance, none of the district captains is currently requesting the computer-generated resource allocation reports, and the Board of Police Commissioners and the command staff are doing little to encourage the system's use. In Boston, the patrol force simulation model was abandoned several years ago, and serious questions have been raised regarding the less complicated manual resource allocation procedures implemented on an experimental basis in 1974.

In Los Angeles, on the other hand, the ADAM historical reporting system which was implemented in June, 1975 is still in operation in 1977. Los Angeles is, therefore, the only case which

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1. The research for the case studies in Chapters IV and V was concluded in Spring 1975. Accordingly, the conclusions are based on the departments' experiences up to that point in time. Kent Colton was able to visit the LAPD in the summer of 1976, however, which permitted the detailed updating of Chapter VI.

begins to meet the first "test" of having an operating system. However, the LEMRAS/ADAM dynamic deployment model was dropped in 1974. Moreover, the current ADAM package no longer includes forecasts of future needs. Rather, the LAPD's deployment recommendations are based on manual calculations utilizing computer-generated reports of historical data. Technical benefits have been achieved from computerized reports in terms of reducing the manpower required to analyze workloads, but the service impacts are still unclear in terms of the influence the system has had on the response without delay to calls-for-service. Finally, one of the original service objectives of the LAPD's resource allocation effort -- to improve crime prevention -- has essentially been abandoned.[2]

The lack of acceptance of the new resource allocation techniques in two departments during the periods examined and the difficulties encountered in the third cannot be explained by a single factor. Rather, the problems in each case resulted from a confluence of factors, behavioral as well as technical. The first section of this chapter will explore some of the patterns of implementation that were common to the three cases. In the final two sections, the authors will present their individual interpretations of the implications of the three cases for future efforts to implement similar police technology.

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2. The Advanced Planning Division of the LAPD is still considering the possibility of utilizing the Patrol Car Allocation Model (PCAM). However, as discussed in Chapter VI, the extent and timing of this implementation remains uncertain. Also, there are still questions about the compatability of PCAM in the team policing environment.

A. Patterns of Acquisition, Use, and Acceptance

Five aspects of the implementation process in the three cases will be discussed: the decision to implement the technology, the attitude of the headquarters command staff towards the technology, the attitude of district and division commanders, the response of patrol officers and field supervisors, and changes in support for the new deployment techniques.

1. The decision to implement the technology. One characteristic of the resource allocation efforts which contributed to the difficulties which arose was the narrow base of interest and support for the advanced deployment techniques in each of the organizations. Rather than being an "idea in currency"[3] which filtered its way up through the ranks and gained widespread support, the resource allocation technology was brought from the outside and "sold" to a few high-level department "executives" (in many cases civilians) who often made the decision to implement the technology with little consulation.[4] As top-level managers, these

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3. For a further discussion of the diffusion of innovation and the means by which ideas evolve through organizations, see Donald A. Schön, Beyond the Stable State, W. W. Norton and Company, Inc., 1971, pp. 80-115.

4. One of the more interesting features of the attempt to introduce the technology into the three departments was the active role which the models' builders/vendors played in generating interest in their new techniques. For example, in Los Angeles and Boston, it was the vendor/builder who initiated discussions regarding the possible implementation of the sophisticated allocation techniques. In St. Louis, the department first heard of the computer-assisted allocation technology through the attendance of one of its personnel at a conference where the builders of the model were demonstrating their system for local law enforcement agencies in an attempt to get the departments to experiment with the deployment system.

executives dealt daily with questions of efficiency and optimization and therefore were used to the abstractions embodied in the models. They believed the builders' reasoning that the use of the models might permit a reduction in dispatch delay and many felt that the new techniques might result in higher arrest rates and less crime.

In each of the cases, however, considerations other than the desire to improve patrol deployment influenced the administration's decision to acquire the technology. Although such multiple objectives are not unusual and may encourage initial support, they may also dilute acceptance later in the implementation process. In Boston, for instance, the simulation model promised to provide information which could be used to make the districts and their patrol units more accountable to headquarters, an important concern for some members of the administration but one which would generate resentment among some in the rank and file. Implementing the simulation package would also permit the Boston Planning Director, who had been trained as an operations researcher, to apply and remain involved in the latest developments in his field. Moreover, there was considerable public pressure in Boston on both the McNamara and diGrazia administrations to produce a symbol of modernization, and the sophisticated resource allocation programs represented such reform.

The image of the organization appears to have been a consideration in the other departments' deliberations as well. For example, in Los Angeles the LAPD had the reputation of being one of the most innovative departments in the law enforcement community. Experimenting with the latest developments in police science (such as the computer-assisted resource allocation models) enhanced that reputation. In St. Louis, the underutilized state of the newly acquired and expensive computer, and the possible public reaction to such "waste," apparently was a factor in the department's decision to move ahead with the resource allocation computer application.

Perhaps the most important factor in the department's deliberations over implementation of the technology, however, was the ability to share its cost. If the vendors had not offered the computer package free, or if federal funds had not been available, the resource allocation efforts probably would not have been undertaken in the three departments. In Los Angeles, for instance, the City Council balked at appropriating the $65,000 which would have made the LEMRAS System operational throughout the Valley divisions. Similarly, the St. Louis MPD indicated in its application to the LEAA that the cost of the project would have been prohibitive without federal subsidization. And in Boston, the federal funds which were received represented approximately half of the total discretionary funds available to the Commissioner of Police. Without outside funding, it would have been difficult to support the project.

While some of the departments' top "executives" were initially enthusiastic about the possibilities offered by the new deployment techniques, the reactions of other personnel, and especially other ranks, in the department were more mixed. This was true of the headquarters command staff, the district and division commanders, and the patrol officers and field supervisors.

2. Attitudes of the headquarters command staff towards the technology. As already mentioned, the decision to implement the advanced technology was often made with little consultation with the respective headquarters command staffs. In Boston, under the diGrazia administration, this situation apparently resulted in resentment towards the resource allocation

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projects on the part of some command officers who felt that their views, based on years of experience, should have been solicited. In general, however, headquarters staff who had not been required to sit on a project-related committee paid little attention to the deliberations over the technology. Like many bureaucracies, police departments subscribe to the theory of "monocratic responsiblity:" praise and blame are attached to jurisdictions, and career rewards are conferred or denied according to the successes and failures which occur within jurisdictions.[5] The result is strong personal identification with organizational subunits and subfunctions and a corresponding lack of identification with other jurisdictions within the organization. Therefore, few officers except those in the planning and research department or those responsible for allocating manpower in the field operations bureau were likely to concern themselves with patrol deployment beyond following the directives of their superiors.

As for those headquarters command officers who did participate in the deliberations to implement or expand the resource allocation systems, few emerged as strong advocates of the new technology. There seem to have been several reasons for this. First, some command officers did not see their department as having a "resource allocation problem," and considered the existing techniques to be adequate. In addition, many of the command officers were veterans of twenty or more years, and, in general, they had not had much formal education in administration or much exposure to the latest management techniques. Certainly, few had the background in mathematics necessary to understand the operations of the models. As a result,

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5. Victor A. Thompson, Bureaucracy and Innovation, (Tuscaloosa, Ala.: University of Alabama Press), pp. 22-26.

a number of the command officers failed to understand or perceive the relevance of the technology. This fact is illustrated by the difficulties the consultants had in trying to train the line officers of the BPD in the use of the patrol force simulation model.

For those members of the headquarters command staff who were involved in the resource allocation projects, the concepts embodied in the new techniques often conflicted with the traditional theories of policing. For instance, many members of the St. Louis command staff who were interviewed expressed concern over the new allocation procedures because the idea of varying the number of beats by time of day and day of week violated the principle of fixing a patrolman's responsibility to a certain "territory" -- a central concept of police administration theory.

Nonetheless, while many members of the headquarters command staff in the three departments apparently had at least some reservations about the technology, they rarely seemed to offer any real opposition during the formal deliberations over the resource allocation projects. Instead, they tended to pursue the "politically" safe course of following the lead of their superiors.

3. <u>Attitudes of the district and division commanders toward the new deployment techniques</u>. In all three of the police departments, but especially in St. Louis and Los Angeles, the resource allocation and computer packages were intended as tools for the division and district commanders. Yet the departments often extended little effort to involve the affected commanders in the development of the operational procedures, or, perhaps more important, to train them in the proper use of the new techniques.

In St. Louis, the commander of the Fifth District was informed of the proposed pilot program only a few weeks before its planned implementation and after the guidelines of the program had already been laid down. Similarly, in Boston when a new consultant was hired by the diGrazia administration to assist in analyzing and reallocating the department's manpower, the consultant did not demonstrate the new allocation techniques and the deployment plan for the district captains and their staffs until just a few days before the assignment changes were to be made. (It is ironic that in an earlier evaluation report, the same consultant had strongly criticized the previous commissioner and his planning director for their failure to involve career departmental personnel in the planning and implementation of the modernization efforts.)

The LAPD's decision to implement the LEMRAS/ADAM dynamic deployment system in the various divisions apparently was made with little input from the affected divisions. On the other hand, once the decision to extend the model to the valley division had been reached by the department administration, the ADAM staff held discussions with the commanders of the various geographic areas and their aides to explain what information would be available from the system and how it could be used. Yet, interviews with command and supervisory personnel from the valley divisions revealed that even this training effort was inadequate and a considerable amount of confusion and ignorance persisted after the meetings. The LAPD Advanced Planning Division eventually recognized this problem and when the department subsequently implemented the ADAM historical reporting system, they exercised much greater care in training the relevant personnel.

In Boston and St. Louis, the deleterious effects of the insufficient training for distric commanders was especially pronounced. For instance, the abstractions and technical jargon used in presenting the new deployment techniques were "over the heads" of some of the district commanders, and the officers who did not understand the techniques being advocated often felt threatened. In fact, as the St. Louis case study pointed out, several district commanders felt so threatened by the new procedures that they chose to retire prematurely when the decision was made to implement the advanced techniques city-wide. Even in Los Angeles, many division commanders found the computer printouts intimidating, uninterpretable, or too long to be useful.

Moreover, there were indications in all three cities that members of the district and division command staffs developed unrealistic expectations regarding the resource allocation systems, in part as a result of inadequate training, but also encouraged by overly-optimistic claims regarding the technology. Consequently, the officers had not been prepared for the program "bugs" or system down-time which inevitably characterize technological development projects. In regard to this disillusionment, some LAPD officers who were interviewed stressed the importance of emphasizing the "experimental" nature of such projects at the outset, and felt that the failure to do this had hurt the acceptance of LEMRAS/ADAM when problems and difficulties appeared.

There were a number of other factors which negatively affected the capacity or inclination of division and district commanders to use the new resource allocation techniques. In several of the three departments studied, district commanders were evaluated, at least in part, on their ability to keep their areas 'quiet' -- that is, to keep down the number of complaints or public pressures emanating from the jurisdiction. One way in which commanders tried to accomplish this was by placating an influential citizen or business person who complained by assigning an extra unit or two to his or her neighborhood. Since there were times when available patrol cars were scarce, strictly following the resource allocation models made this desired procedure difficult.

The St. Louis resource allocation experience clearly exemplified the conflict between the model's recommendations and public pressures for more police protection. Under the resource allocation project, the number of police officers who would service the Second District, a high-income area which had a relatively low incidence of crime, was to be reduced. When this was discovered, many local residents who perceived that crime in the district was on the increase became upset. Citizen groups threatened to march on the district headquarters if a greater number of patrolmen were not allocated to the area. As a result, the area major and district commander decided that the area would be given a greater number of units than were required by the resource allocation program.

Another factor which contributed to the hesitancy to employ the technology was that the new techniques sometimes recommended larger variations in patrol strength available over the 24-hour day than many commanders desired. Even though certain times of the day, such as the early morning hours, generally experienced little workload, district command staff frequently preferred to have nearly equal manpower assigned to each watch so that an adequate number of units would be available just in case of emergency.[6]

In Los Angeles, for example, after the LEMRAS/ADAM system had been

6. According to Dr. Richard Larson, Associate Professor of Urban Studies and Electrical Engineering, MIT, this pattern of "risk minimization" was also evident in the New York Police Department's attempt to utilize advanced deployment techniques. (Based on an interview between Scott Hebert and Richard Larson, 1975.)

extended to the five Valley divisions, the division commanders tended to field more units during off-peak hours than the model recommended. Some of the commanders were not worried about the possibility of a major disturbance during normally slow periods; rather, they claimed that since the dynamic deployment model often underestimated the time which would be required to service incidents, it sometimes recommended too few cars. Some commanders also complained that the LEMRAS/ADAM system did not take into account such factors as court time, which meant that the manpower recommendations of the computer model for the day watch were consistently too low. Because of this loss of confidence in the model's predictive accuracy, support among the division commanders for the program dropped. According to LAPD Advanced Planning Division staff, it was only after a new project director was appointed that the resource allocation effort began to move forward again. This director was a civilian, but one who had previously served as a police officer, and, therefore, had more credibility among the patrol force personnel. Moreover, he made a special effort to consult with appropriate command staff in the Office of Operations and the various divisions. The result of this consultation was the Advanced Planning Division's decision to redirect its ADAM system from dynamic deployment to historical reporting. Further, in the historical reporting system specific consideration was given to officer-initiated activities, the time needed to service incidents and other factors such as court time.

4. <u>Attitude of patrol officers and field supervisors toward the technology</u>. A very important factor influencing the opinions of district and division commanders toward the resource allocation projects was the impact which the new deployment procedures had on the morale of the field officers. And even before the new deployment procedures were implemented,

at least three features of the resource allocation projects seemed to make a bad impression on many members of the sworn force, especially field officers.

First, there was the civilian domination of the projects. Not only were most of the technology's advocates (both external and internal) civilians, but also in each department the initial efforts at implementing the techniques were put under the supervision of a civilian. While the decisions to appoint civilians as project directors in St. Louis and Boston were quite justified on the basis of comparative expertise with data processing and mathematics, in both cases the appointment of civilians had a detrimental effect on the receptivity of sworn personnel towards the resource allocation efforts. Particularly in the more traditional departments of Boston and St. Louis, it was apparent that many in the sworn force greatly resented civilians in the department either because they threatened to take away the less strenuous or more desirable inside jobs (which would otherwise have accrued to the older or best-infirmed officers), or because they earned higher pay, or, as in the case of the Boston Planning Director, because they exercised great influence in the department even though they had not worked their way up through the ranks and did not know what it was like to be a "street cop." In Los Angeles, it seems that this opposition to civilian involvement was overcome, but only, as indicated earlier, by a civilian who had served previously as a police officer.

Second, the fact that the resource allocation projects were based in the research and planning divisions of the respective departments also seemed to contribute to misgivings on the part of field officers. In Boston and St. Louis, especially, members of the force viewed the planning section with a certain skepticism. Field officers often believed that individuals in research and planning, both civilian and sworn personnel, possessed a different ethos from that of the rest of the force. Whereas most facets of the department command structure emphasized tradition and routine performance of duties, the research and planning section was comparatively experiment-oriented. For the "officer in the street," who likewise placed a high value on predictability in their work, changes proposed by the research and planning staffs were often threatening, and the resource allocation projects were no exception.[7]

A third factor which, at least in St. Louis, heped to create a poor first impression was the computer orientation of the resource allocation project. Because of their limited contact with data processing systems, it was difficult for the field officers to understand what the computer did and how it related to their work. Consequently, a number of officers considered the computer system (which had cost the department over a million dollars) a waste of money. Since the new deployment models were identified with the computer system, the negative opinions of the computer were transferred to the models.

In the opinion of at least some field officers in the three departments, the actual experience with the new deployment procedures only served to confirm the initial misgivings which they had felt in response

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7. Field officers often became especially aroused when they were put through what they perceived as the trauma or inconvenience of a change in procedures instituted by the research and planning section only to discover a short time later that the change had been discontinued by the department. In each of the departments visited, this situation had occurred prior to the resource allocation projects. It not only had produced a general resentment toward the planning staff, but had also led to the attitude that reforms instituted by that staff may only be temporary.

to the administration's proposal to implement a new allocation system.[8] In many of the situations examined, the jobs of field officers became more difficult or unpleasant as a result of the new procedures which accompanied the resource allocation projects. For example, the "Maximum Patrol Plan" instituted in Boston in September 1973 eliminated many desk jobs, and required older officers, who make up a relatively large percentage of that department's manpower, to return to the less desirable street duties. The new allocation plan also necessitated many transfers between districts. Some of the patrolmen who were transferred disliked the move because it meant reassignment to a "busier" district, or one which had less overtime. Some felt that they had been shifted because they lacked political connections. Others were upset because the transfers required them to establish a completely new set of relationships with supervisors and fellow patrolmen.

In St. Louis, as a result of the limited pre-test training provided to the Ninth District's field personnel (whose only orientation to the complex experiment was a presentation of the new guidelines at roll call by members of the resource allocation staff ten days before implementation of the project), the patrol supervisors and officers of the experimental district experienced considerable confusion with the varying sector boundaries. Patrol supervisors, erroneously believing a unit was lingering out of its assigned area, would reprimand patrol officers. Such encounters

8. The opinions expressed in the next few pages are based on a limited number of interviews with officers in the three departments in question. Due to limited resources, no effort was made to solicit opinions through formal means such as a survey. Rather, interviews were based on time and officer availability.

not only tainted the feelings of those involved towards the new procedures, but also undermined the relationship between patrol officers and the command and supervisory personnel.

Some St. Louis field officers were also upset about the fact that, whereas theoretically the resource allocation project was supposed to benefit the patrol officer by creating more balanced, equitable sectors, over the course of the experiment the call-for-service teams were expected to handle twice as many calls per tour as they had prior to the test. This increased workload placed added pressure on the officers, and reinforced their perception that the split-function patrol approach was inequitable. In addition, although the revised recreational schedule which had been developed by the resource allocation staff (to meet the manpower recommendations of the deployment model) promised more efficient allocation of resources, it represented a significant inconvenience to the rank and file who now had to battle rush-hour traffic and wait longer for week-end time off.

The amount of field officer opposition to the resource allocation efforts resulting from difficulties that the new procedures created varied widely from department to department and district to district. For example, although the Los Angeles patrol officers seemed to grumble and joke about the inconveniences of the LEMRAS/ADAM deployment approach, they generally cooperated with the experiment apparently because of their pride in the innovative orientation of the LAPD. In some of the Boston and St. Louis districts, though, where the patrol officers possessed a more negative view of change, the field officers' reactions against the new deployment procedures were quite strong and vocal, and to a considerable extent influenced their superiors' attitudes toward the project. As

Rubenstein has pointed out, a district commander

> "...is an administrator who must enforce the regulations that are funneled to him from headquarters, but at the same time he must also seek to protect his men, who frequently resent what they consider arbitrary and capricious changes in their operating procedures [and who can employ various techniques for effectively sanctioning their supervisors]. He balances his obligations by aligning himself with his men, demonstrating to them in their presence that he is a 'good guy,' and requiring their adherence to changes only after indicating that he is helpless to do otherwise in the face of superior authority."[9]

Accordingly, it is not surprising that the cases yielded several examples of commanders petitioning headquarters to modify or nullify certain aspects of the resource allocation projects which the patrol officers found particularly upsetting. Nonetheless, as long as the department administration actively supported the projects and was willing to sanction subordinates for non-adherence, the district and division commanders were still required to demonstrate basic compliance with the resource allocation effort, no matter how much they or their officers disagreed with the new procedures.

5. Changes in support for the new deployment techniques. Particularly detrimental to support for the resource allocation projects were changes in the administration and personnel of the departments. These changes often brought in new chief executives with competing theories of policing and a new organizational agenda. When this happened, the new executives

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9. Jonathan Rubinstein, City Police (New York, N.Y.: Farrar, Strauss, and Giroux, 1973), pp. 30-31.

often exhibited distrust of on-going efforts in the department which had been initiated by the previous administration. Consequently, the experimental deployment projects were given a lower priority.

Changes in the administration of the various departments also brought considerable transferring and promotions of other personnel. The continuity of the resource allocation projects was often broken as a result of such transfers, and individuals who had not been involved in the earlier resource allocation efforts or trained in the new techniques were appointed to supervisory and command position. This further reduced utilization of the technology.

Finally, and perhaps most important, support for the projects waned because of the failure of the technology to demonstrate clear success in achieving the initial objectives of the projects. Advocates for the technology in the three departments had built up expectations that the new procedures would result in concrete benefits in terms of reduced dispatch delay, increased arrests, and lower crime rates. When such results did not materialize in a concrete and conclusive fashion, support for the system among the administration and command staff faltered.

In Los Angeles, the eventual reaction was to terminate use of the LEMRAS/ADAM deployment model and to shift attention to the ADAM historical reporting system. In St. Louis, though, when the district and division commanders realized that their superiors were no longer taking a special interest in their compliance with the new deployment procedures, they began to follow their own feelings regarding the new techniques, and use of the new procedures was made voluntary by the department administration. While some commanders continued to employ the advanced techniques, in general the procedures were given less and less weight relative to other considerations in deployment decision-making, and were eventually abandoned.

B. Implications for Future Efforts to Improve the Performance of Criminal Justice Agencies

by Scott Hebert

1. The record of the technology. Over the last decade, the U.S. law enforcement community has exhibited a growing interest in the application of technology to the problem of crime control. In particular, many reformers feel that a great potential exists for improving the deployment of patrol resources through the analytic capabilities offered by high-speed computers and operations research techniques.[10]

The case studies contained in the preceding three chapters were undertaken as a means to examine the actual experience of police departments with such advanced resource allocation techniques. The record of the technology, as reflected by these particular cases, is not an encouraging one for advocates of the advanced techniques, however, During the time periods that were examined, four of the five efforts involving new deployment techniques failed to achieve organizational acceptance.[11] In each case, the

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10. For example, see Chapter II of this volume.

11. The five efforts include: (a) the St. Louis Metropolitan Police Department's Resource Allocation project, (b) the Boston Police Department's Patrol Force Simulation project, (c) the Boston Police Department's Resource Allocation project, (d) the Los Angeles Police Department's LEMRAS/ADAM Dynamic Deployment Model project, and (e) the Los Angeles Police Department's ADAM Historical Reporting System project.

inability of the technological efforts to realize acceptance was the result of a variety of factors, both technical and behavioral. But perhaps the most important factor was the allocation projects' general failure to stimulate and maintain demonstrable improvements in the departments' patrol force performance, particularly in the area of crime control.

Even in Los Angeles, where the latest deployment project is receiving continuing support from members of the department administration, the available data regarding the technology's impact on performance is inconclusive. In part, the acceptance of the technology in this instance can be explained by the close resemblance of the new technique to the previous Patrol Bureau Formula. Unlike the other resource allocation efforts examined (which all involved sophisticated mathematical techniques such as queuing theory and exponential smoothing), the LAPD's new deployment procedure is still basically a hazard formula utilizing historic data. In addition, it should be noted that use of the new LAPD deployment procedure is currently left ot the discretion of the division commanders, and a significant number (over 25 percent) have elected not to employ the new techniques.

The general findings of the resource allocation case studies contained in this volume appear to be consistent with the results of independent research that has been published recently by the RAND Corporation.[12] The RAND staff examined the efforts of ten police departments to implement advanced deployment techniques similar to those described in the Boston,

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12. Jan M. Chaiken et al., Criminal Justice Models: An Overview, R-1859-DOJ (Santa Monica, Calif.: Rand Corporation, October, 1975).

St. Louis, and Los Angeles cases. The research staff found that the techniques were operational in only two of the departments, and even in these instances the technology apparently was receiving far less use by decision-makers than the models' designers had anticipated. In addition, the factors cited by the RAND study to account for the technology's lack of use are very similar to those advanced in Part I of this chapter.[13]

Despite the findings of this chapter and the RAND study, however, I expect that over the next several years that there will be a growing number of attempts by police departments to introduce advanced deployment techniques such as those examined into their operations. There are several reasons for this belief. One factor is the scarcity of data regarding the actual experience of departments with such techniques, especially information about unsuccessful efforts. As a rule, organizations do not advertize their failures, and aside from this report and that of the RAND Corporation, there have been very few publications that have taken a critical look at the experience with the technology.

A second factor is the active advocacy that is being carried on by the models' designers and by EDP vendors, who have offered use of the resource allocation packages at very low prices in order to encourage acquisition by departments of the necessary computer and support equipment.

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13. In addition to its research on the police, the RAND study examined the experience of other criminal justice agencies with computer-assisted models. The total picture which emerges from this work is fairly negative. Of thirty-nine efforts in the criminal justice area which were surveyed, the research staff concluded that the models actually were being utilized in only seven instances. Unfortunately, the RAND study did not attempt to assess the technology's impact on organizational performance in those agencies where the techniques were actually operational.

The initial cost of the technology for police departments has been reduced further by the Law Enforcement Assistance Administration's willingness to assume a large share of the expense for the technology's development or modification to fit the characteristics of particular departments.

The effect of endorsement of the technology by the LEAA, the President's Crime Commission, and other "professional law enforcement" opinion leaders cannot be overestimated. Such endorsement causes the technology to be identified with professionalism and progress, not only by local law enforcement officials, but also by the citizenry.[14] Consequently, at the very least, the technology becomes a comparatively easy way for a department to acquire the trappings of "professionalism."

Few department administrators are so cynical that they would introduce the technology primarily for its public relations value, however. Most will make the decision on the basis of a belief in the professionalists' logic concerning the technology's potential for reducing crime. For those with a strong faith in the professionalists' reasoning, even exposure to the disappointing experience of other departments may not be persuasive. Advocates of the technology, for instance, can always dismiss the apparent failure of the new techniques to improve crime control performance thus far by pointing to the inadequacies of statistics on reported crimes as accurate indicators of performance (a very real problem).

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14. One of the problems of the police reform movement in the U.S. is the lack of a clear definition of "professionalism" as it applies to the police. In general, when police reformers speak of professionalization, they are advocating: (a) the insulation of the department from political influence, (b) the creation of a centralized command and control structure, (c) an emphasis on the agency's law enforcement mission and (d) the exploitation of the latest training and technology. In the following discussion, the term "professionalist" will be used to refer to those individuals or groups who subscribe to this approach to improving the quality of police service.

Nonetheless, in spite of the best intentions of the departments at the time that they decide to implement the advanced allocation techniques, I feel that the crime control record of the technology will not improve appreciably in the near future. I conclude this because the reasoning underlying the Crime Commission's belief in the technology's crime control potential is unrealistic in several critical respects.

2. Errors in the professionalist's logic. In The Challenge of Crime in a Free Society, the President's Crime Commission made several assertions. First, while they indicated that it wouldn't be easy, the Commissioners expressed confidence that it was possible to win the "war on crime" which they had declared. Further, the Commission argued that in this "war," the most effective approach would be to provide the established criminal justice agencies with additional resources, in the form of more and better patrolmen, prosecutors, and judges, and the latest scientific and technological developments to support them. For their specific recommendations regarding the technology that criminal justice agencies should acquire, the Commission relied heavily on the suggestions of its Task Force on Science and Technology.

In its report to the Crime Commission, the Task Force had outlined the findings of a systems analysis of police operations which it had undertaken to identify potentially effective crime control strategies.[15] Starting with the assumption that the principal function of criminal justice agencies is to reduce crime, the Task Force had reasoned that the police

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15. See Task Force Report: Science and Technology (A Report to the President's Commission on Law Enforcement and the Administration of Justice), prepared by the Institute for Defense Analyses (Wash., D.C.: U.S. Government Printing Office, 1967), p. 3.

primarily prevent crime through deterrence. A deterent effect is achieved, its argument continued, when the probability of apprehension is high enough to create too great a risk of penalties for a would-be offender to be willing to commit a crime. In the Task Force's view, the problem of crime control therefore became a technical one. That is, how does the department best deploy and utilize its resources so as to create the maximum possible apprehension probability? Since apprehension probability seemed to be inversely correlated with patrol unit response time to calls-for-service, the Task Force concluded that departments should concentrate on implementing procedures and equipment which would be likely to reduce response time. As examples, the Task Force recommended computer-assisted command-and-control systems and various operations research techniques, such as the advanced deployment models.

Upon reflection, it seems possible that if certain constraints were satisfied, use of the allocation techniques recommended by the police professionalists could result in some improvement in a department's dispatch delay performance. The constraints, however, are formidable. First, the model employed must be an accurate representation of the particular department's patrol operations. Second, there must be enough patrol units available to follow the recommended manning schedules. Third, the patrol commanders' actual deployment decisions must closely approximate the model's recommendations. Finally, there cannot be any sudden demographic shifts or changes in workload patterns.

The experiences of the three departments examined earlier in this volume testify to the extreme difficulties involved in meeting these constraints. Yet, even if these constraints were met, the magnitude of the change in dispatch delay would still depend on how poorly the department's patrol units had been allocated prior to the introduction of the new deployment technology. In addition, because of the way high-priority calls, such as crimes-in-progress, are currently handled by many departments (for instance, preempting service on a low-priority matter rather than placing the emergency call in a queue), it is conceivable that most of the improvement in dispatch delay resulting from the use of the technology would accrue to non-emergency calls which don't require a fast response. Moreover, even if the improvement accrued to some emergency calls, the reduction in dispatch delay still might not be enough to have a noticeable impact on apprehension rates if the average response time initially had been very large (as in the Los Angeles case).

Nevertheless, let us assume for the moment that, through the use of a computer-assisted deployment model and other tactics, a police department was able to increase its apprehension rate by 50 percent (in the real world, a highly unlikely event). What would be the probable effect of such a change on the incidence of crime?

According to the professionalists, an increase in apprehension rate principally affects crime by causing potential criminals to perceive an increased risk of incurring punishment for their illegal activities.[16]

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16. Another possible way for deployment models to affect apprehension is by indicating which units are unnecessary for call-for-service duties, and, therefore, can be released to perform preventive patrol. Of course, this view assumes that the department in question has an excess of cars over the number needed to insure reasonable response time performance, a situation which the Boston, St. Louis, and Los Angeles departments rarely, if ever, realized. It also assumes that preventive patrol is effective at apprehending criminals and deterring potential offenders, a position which various theoretical and empirical studies (including the famous Kansas City study) have tended to discredit.

However, the threat of arrest may not deter a potential criminal unless there is an expectation that conviction and imprisonment are very likely to follow. In fact, only about half of the individuals arrested actually appear in court.[17] For example, many cases are dropped or dismissed because the prosecutor or judge feels there is insufficient evidence to substantiate the charge. This illustrates a critical point that the Task Force's analysis of police operations failed to acknowledge: a police department's ability to achieve the organizational goal of crime control is dependent, at a minimum, on the actions of the other criminal justice system agencies.

Let us suppose, however, that the 50 percent increase in the apprehension rate led to a proportional increase in conviction rates. We would probably be optimistic in estimating that twenty percent of all reported crimes are currently followed by conviction.[18] A 50 percent increase, therefore, would raise the conviction rate to 30 percent, changing the risks of being penalized from one in five to three in ten, for reported crimes. If one considers that at least half of all crimes go unreported, then from the criminal's point of view, the risk has increased from two in twenty to three in twenty.

According to Lehman, the threat of punishment is unlikely to be a particularly effective lever with the disaffected and disenfranchised of society, who feel that they have little to lose. Consequently, the

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17. Warren Lehman, "Crime, the Public, and the Crime Commission: A Critical Review of The Challenge of Crime in a Free Society," Michigan Law Review, (Vol. 66; May 1968) p. 1521. Also see President's Commission on Law Enforcement and the Administration of Justice, The Challenge of Crime in a Free Society (1967), pp. 247-248.

18. Lehman, p. 1521.

marginal increase in risk that we have posited, if it is perceivable at all, in all probability will have little influence on such individuals. We also cannot expect the marginal increase to have much of an effect on crimes of passion, since the perpetrators of such offenses are not in a rational state of mind to consider conviction probabilities. For both of these categories of offenders, it seems that a more promising approach would be to make the necessary counseling services or social and economic opportunities available before cumulative frustrations lead the individual to commit a criminal act.

On the other hand, there undoubtedly are potential offenders who operate in the rational fashion postulated by the Crime Commission staff, and who would modify their behavior in reaction to an apparent increase in the chance of apprehension and punishment. The responses of this group of individuals to a perceived increase in risk could be very different than that anticipated by the Crime Commission, however, Rather than curtailing their criminal activities, such individuals might simply move their base of operations, or focus on crimes which are less susceptible to apprehension. They might even respond to the police's technological developments with sophisticated hardware of their own, such as police radio scanners to determine when a patrol car has been dispatched to their location.

Another way, in theory, whereby an increase in apprehension rates could lead to an improvement in respect for the law is through the rehabilitation of those individuals who are actually convicted. Once again, however, the police's action of arrest generally is not sufficient in itself to bring about the desired change in crime control performance. The principal responsibility for rehabilitation currently lies with other components of the criminal justice system, especially correctional institutions. Moreover, the overall record of the criminal justice system in the area of rehabilitation is very poor. In fact, there is considerable evidence which suggests that by exposing a person to the violent and dehumanizing conditions of correctional institutions and by labelling the individual as "criminal" in the eyes of prospective employers, the criminal justice system actually decreases the likelihood that the offender will be able to "go straight."[19] And, rather than improving this situation, the data processing technology and information system networks recommended by the Crime Commission may only he making matters worse by insuring that the mistakes of an individual's past will follow him to the grave. As former senator Sam Ervin has noted:

> The new technology has made it literally impossible for a man to start again in our society. It has removed the quality of mercy from our institutions by making it impossible to forget, to forgive, to understand, to tolerate...[20]

Thus, even in the unlikely event that the deployment and computer technology permitted the police to achieve a dramatic increase in apprehension rates, it is very probable that we wouldn't see a significant

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19. This seems to be especially true for youthful offenders. See for instance, Howard S. Becker, Outsiders: Studies in the Sociology of Deviance (New York: The Free Press, 1963); Aaron V. Cicourel, The Social Organization of Juvenile Justice (New York: John Wiley & Sons, 1968); and Richard Quinney, The Social Reality of Crime (Boston: Little, Brown, & Company, 1970).

20. As quoted in Richard Quinney, Critique of Legal Order (Boston: Little Brown, & Company, 1974), p. 130. Ervin continued with a warning about the tendency of the technology to centralize power: "The undisputed and unlimited possession of the resources to build and operate data banks on individuals, and to make decisions about people with the aid of computers and electronic data systems, is fast securing the executive branch officials a political power which the authors of the Constitution never meant any one group of men to have over all others."

reduction in crime as a result. The lesson here is that crime is a very complex phenomenon -- the product of a plethora of social, economic, political, and psychological forces -- which is not likely to be amenable to the comparatively crude and inflexible technical solutions advocated by the Crime Commission and its Task Force on Science and Technology.

3. The positivist approach and the realities of the criminal justice system. The Crime Commission's prescription for reform, with its emphasis on working through existing institutions, increasing rationality and centralization, and exploiting science and technology, strongly reflects a "positivist" orientation.[21] The positivist approach to social problems, however, characteristically has exhibited a number of shortcomings. To begin with, the fundamental objective of the positivist is not the establishment of social justice, but the creation of an orderly society. This emphasis would not be so disquieting if it were not for the positivists' concurrent acceptance (born of positivism's lack of reflexibility)[22] of

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21. Ibid., pp. 2-5.

22. Ibid, p. 3. Quinney writes in this regard: "...what is ignored in this [positivistic] approach to explanation is an examination (or even an awareness) of the philosophical assumptions by which the observer operates. There is neither a recognition that the nature of explanation depends upon the kinds of things investigated nor that explanation requires a description of the unique context in which events occur. Likewise, the positivist refuses to recognize that to assess and make statements about human behavior is to engage in a moral endeavor. Instead, the positivist regards his activity as being 'value free.'

The intellectual failure of positivism is that of not being reflexive. It makes little or no attempt to examine or even question the metaphysics of inquiry, to turn the activity of explanation back upon itself. The positivist refuses to be introspective. His concern is to get on with the task of explaining, without considering what he is doing. Positivistic thought is of a particular kind; it is calculative thinking as described by Heiddeger: 'Its peculiarity consists in the fact that whenever we plan, research, or organize, we always reckon with conditions that are given.'"

the status quo. In the case of the Crime Commission, this meant that there was little or no questioning of the established order, the existing institutional framework, or the conventional wisdom. As Quinney has pointed out, "The legal order [was] taken for granted... Little attention [was] devoted to its questions about why the law exists... or what a just system would look like."[23] Rather than examining the basic inequities of society, then, the Crime Commission concentrated on improving the techniques of social control which may only serve to reinforce those inequities.

To see whom the criminal justice system penalizes, we need only examine the population of the nation's prisons -- the poor, the racial minorities, the uneducated, the offspring of broken homes. Palella has written:

> Both the substance of the law, in that those in power determine what acts are to be considered criminal, and the enforcement of the law, in that officials enjoy a wide latitude of discretion, allow those who are responsible for more serious crimes to be free from prosecution. Slum lords, war mongers, anti-trust violators, and those who are responsible for air and water pollution, unsafe products, exorbitant prices, and other crimes of truly serious social consequences do not suffer the stigma, humiliation, and devastation of being defendants in criminal adjudications. It is rather those who are trapped by social conditions that cause poverty that are found to endure the criminal process.[24]

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23. Ibid., p. 4.

24. Charles Palella, "Non-legal Criteria and Illegitimate Functions of Urban Criminal Justice" (Antioch College, unpublished thesis; Spring, 1975) p. 2. For example, the staff of the National Moratorium on Prison Construction (a Washington-based reform group) has pointed out that while 40 billion dollars a year is lost through white collar crime, most criminal justice resources are devoted to fighting street crime, which accounts for a $2.5 billion annual loss. Moreover, the group notes: "Corporate crime is seldom discovered. And, when it is, the offender rarely goes to prison. For example, only 18 percent of all convicted embezzlers go to prison (for an average of 15 months). For the rest, there are numerous alternatives. 89 percent of all convicted robbers go to jail (for an average of 10 1/2 years)..."

The rhetoric that our criminal justice system provides "equity under law" and "equal justice for all" is contradicted by the actual functioning of the system. The wealthy white is much more likely than the poor black to be diverted from the criminal justice "pathway" prior to arrest or adjudication.[25] Moreover, should a case go to trial, the rich can purchase the necessary legal services to insure the adjudication conforms to the adversarial ideal and all aspects of due process are respected. The poor, on the other hand, lacking financial resources to obtain adequate representation,[26] become victims of the "administrative ethic" that dominates the orientation of many courts, especially those that serve urban neighborhoods. Under this ethic, the smooth functioning of the system becomes the principal objective of the court's officials, and the protection of

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25. The following is an example of differences in the criminal justice system's treatment of wealthy and poor offenders:

> "According to a study at the University of Michigan ...middle and upper income white boys commit more crimes of robbery, burglary and car theft than do lower income whites ...only eight percent of the middle and upper income class offenders in the study were arrested; only four percent end up in the courts, and a tiny one percent are committed to institutions... The reason is that for middle and upper income kids we have all kinds of diversions like sending them to military academies and giving them psychiatric help. Those who are committed are nearly always poor." (Milton Rector, head of the National Council on Crime and Delinquency, as quoted in the Boston Phoenix, May 14, 1974.)

26. According to Knowles and Prewitt, the judicial system is:

> "...although based on the idea of equal protection for all, in fact largely dependent on financial considerations. With regard to justice, as with other American commodities, the more one can pay, the better product one gets... Because a greater proportion of black than of white defendents is poor, the economic bias is racist." (Lewis Knowles and Kenneth Prewitt, eds. Institutional Racism in America. Englewood Cliffs, N. J.: Prentice-Hall, 1969.)

individual rights is often sacrified in the interest of administrative efficiency and order. For instance, the use of plea bargaining is encouraged, which destroys the adversarial nature of the trial and replaces the presumption of innocence with one of guilt.[27]

Even in cases where the disadvantaged receive the services of a public defender, the other members of the court can and do employ powerful incentives to prevent the defense counsel from deviating from the informal arrangements of the court. The public defender has to deal with the same clerks, prosecutors, and judges on a daily basis, and in the interest of future clients, cannot jeopardize long-term relationships with any of these officials. Consequently, the public definder will:

> ...not cause any serious trouble for the routine motion of the court conviction process. Laws will not be challenged, cases will not be tried to test the constitutionality of procedures and statutes, judges will not be personally degraded, police will be free from scrutiny to decide the legitimacy of their operations, and the community will not be condemned for its segregative practices against Negroes...
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> In 'return' for all this, the district attorney treats the defendant's guilt in a matter-of-fact fashion, doesn't get hostile in the course of the proceedings, doesn't insist that the jury or judge 'throw the book' but rather 'puts on a trial' (in their way of referring to their daily tasks) in order to, with a minimum of strain, properly place the defendant behind bars. Both the prosecution and the public defender thus protect the moral character of the other's charges from exposure...[28]

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27. Plea bargaining is a particularly undesirable practice in that it penalizes the innocent while treating the guilty more leniently than might be warranted.

28. David Sudnow, "Normal Crimes: Sociological Features of the Penal Code in a Public Defender Office," 12 Social Problems (Winter 1965), p. 273.

In other words, while the criminal justice system may provide the poor with legal assistance in order to maintain an appearance of equity, challenges to the existing institutional framework are not tolerated.

Nor is this pattern limited to the criminal law. In the 1960's, when the Legal Service Program (LSP) of the Office of Economic Opportunity brought the first effective use of the civil law to attack the causes of poverty, the response of those in power was to criticize and restrict the functions and procedures of the reform lawyers.[29] The tactics which the LSP lawyers had been utilizing, however, were not unlike those that had commonly been viewed as acceptable and responsible legal practice on behalf of corporate clients.

Therefore, despite the official rhetoric to the contrary, one has no choice but to conclude that the law and the criminal justice system are not impartial. Rather, they are political institutions which often reflect racism and other social inequalities, and tend to protect dominant economic interests. It has been stated that:

> The myths of criminal justice, ...are the myths of American Democracy. Such treatment of individuals as occurs in our criminal process would not exist in a country that was truly dedicated to the ideals of freedom, equality, and individual dignity.[30]

4. The direction that future reform efforts should take. From the foregoing discussion, I think that it is clear that the crime control question cannot properly be addressed independent of the broader issues of criminal and social justice. It is also apparent that the actual

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29. Palella, supra note 14, pp. 2-6.

30. Ibid., p. 38.

functioning of the criminal justice system is in many ways neither just nor legitimate. Yet the reform efforts undertaken in the years since publication of the Crime Commission report have given comparatively little emphasis to this aspect of the criminal justice system's problems. Instead, these efforts have largely concentrated on improving the efficiency of the law enforcement apparatus through the introduction of modern management techniques, sophisticated technology, and improved communications between agencies. Given the poor record of these efforts, I think it is time to reconsider our priorities and approach to improving the criminal justice system.

One factor which contributes to the illegitimate functioning of the system is the wide discretion afforded criminal justice personnel in the exercise of their authority. While the principles of due process and legality would suggest regularity in the system's treatment of offenders, in practice these principles are "subordinated in favor of a wide freedom of the official to make decisions within the area of his competence."[31] This growth in discretion within the criminal justice system is a consequence of the recognition that "the rigid application of laws without regard to the unique circumstances of particular cases would result in manifest injustice."[32]

However, as the American Friends Service Committee has noted, "the power to make exceptions in the delivery of legal sanctions is humane only to those who gain the sympathy of the system or those who have the power

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31. Sanford H. Kadish, "Legal Norms and Discretion in Police and Sentencing Processes" 75 Harvard Law Review 904 (1962), p. 905.

32. Palella, p. 25.

to merit special favor."[33] In general, the criteria used by criminal justice personnel in their decision-making at each discretionary stage are isolated from judicial review or other restraining checks. As a result, members of the police are able to pursue selective and discriminatory enforcement of law. Likewise, court officials are free to employ the discretionary powers surrounding charge determination, bail, and sentencing to coerce those defendents who lack funds or political clout into plea bargaining for the sake of administrative efficiency and expediency.[34]

A principal goal of future reform efforts, therefore, should be elimination of the illegitimate exercise of discretion by criminal justice personnel. Traditionally, police agencies have attempted to control the discretion of members of the force through the creation of centralized organizations with strong command-and-control orientation. However, because of insufficient supervisory resources (even with the use of technological aids), countervailing administrative pressures, and differences

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33. American Friends Service Committee, Struggle for Justice, (New York: Hill and Wang, 1971), p. 134.

34. It has been stated that:

> "...prosecutions are often withheld, sometimes on the basis of political, personal, or ulterior influence, without guiding rules as to what will or will not be prosecuted, without meaningful standards stemming from either legislative bodies or from prosecutors themselves, through decisions secretly made and free from criticism, without supporting findings of fact, unexplained by reasoned opinions, and free from any requirement that the decisions be related to precedents. Furthermore, decisions of a top prosecutor are usually unsupervised by any other administrative authority, and decisions not to prosecute are customarily immune to judicial review. Even a capricious or politically induced decision to prosecute A but not B, when the evidence against B is stronger and B is otherwise more deserving of prosecution, is typically unreviewable either by a higher administrative authority or by a court." (Kenneth Davis, Discretionary Justice. Baton Rouge: Louisiana State University Press, 1969, p. 224.)

between organizational and community values, this approach has historically proven inadequate. Similar problems have plagued the attempts of court and corrections administrators to effectively regulate the behavior of their personnel.

An alternative that might be tried is the development of independent "oversight" agencies which would be responsible for investigating individual complaints and conducting periodic monitoring projects to determine the general level of compliance with recognized standards of justice. In carrying out its responsibilities, the oversight agency would be expected to make extensive use of volunteer staff from the community in which the organization being evaluated was located. This would serve to both educate citizens about the operations of the criminal justice system and increase the system's accountability to the community.

Another way in which the criminal justice system could be made more just and humane is through the creation of victim compensation programs. At present, the needs of a victim of a criminal act are largely ignored by the system:

> "Although he has suffered most directly in the commission of a crime, his interests are addressed only secondarily, if at all. His primary role in the court process is to serve as a witness. He is required to...[appear at] hearings in a confusing and uncomfortable courtroom, often only to have the case continued; and to testify and therefore be subject to cross-examination; all to the end of protecting an abstract 'state interest'! The inconvenience of the process, coupled with a seeming insensitivity to the needs of the victim, almost constitute a secondary affront. The experience with the court often fails to resolve his problems and leaves him as embittered as a defendent."[35]

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35. Justice Resources Institute, Inc., The Urban Court Program, Boston, Mass. (1976), pp. 2-3.

Special care should be taken to advise victims about what to expect (and what will be expected of them) at each stage of the judicial process. In addition, social services should be made available to them to help ameliorate the trauma of the criminal act and the inconveniences associated with the subsequent investigation and adjudication. Financial compensation should also be available, especially for those individuals who have incurred medical expenses or loss of income as a result of a criminal incident. Whenever possible, the court should require that part of the restitution to the victim come from the offender's resources (either money or services). This should contribute to the victim's perception of justice in the process, and may help the offender to understand the direct human consequences of his deed.[36]

In the corrections area, a number of reform measures appear to be warranted. First, the bail system should be revised so that all but the few individuals who present a high risk of flight or continued pre-trial

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36. Stephen Schafer, "The Proper Role of a Victim-Compensation Program", Crime and Delinquency, (January 1975), pp. 45-56.

Some urban courts have expanded on this idea with the experimental introduction of special disposition panels for certain cases. Made up of the victim, offender (who has already admitted his guilt in court), their legal counsel, and community members, a disposition panel works together to develop an understanding of the causes underlying the offense, the needs of the defendent, and the loss of the victim. After considering all these factors, the panel develops sentencing recommendations which, in addition to actual or symbolic restitution to the victim, may include training or education programs, requirements to perform neighborhood services, and other community reintegration activities. These recommendations are then reviewed and implemented by the bench. (See Justice Resources Institute, The Urban Court Program, supra note 26.)

Unfortunately, there is little documentaiton yet available regarding the effectiveness of these projects to humanize the disposition process without sacraficing the due process rights of the defendent.

criminal activity will be granted release or personal recognizance. The majority of those currently in pre-trial detainment are there solely because they are too poor to raise bail.[37] Both justice and economy demand that such individuals be released pending trial. In addition, clear standards should be developed as to when money bail can still be required and what would constitute a reasonable bail size. Implementation of these standards should be closely monitored. Moreover, a right to immediate appeal of bail decisions should be established.

Second, much greater emphasis should be placed on alternatives to institutionalization of convicted offenders. Admittedly, there is much that we don't know about penology. Hawkins and Morris, however, have pointed out three propositions that are supported by considerable empirical evidence:

> "1. Humanitarian systems of treatment (e.g. probation) are no less effective in reducing the probability of recitivism than severe forms of punishment.
> 2. Money (if not souls) can be saved by revised treatment systems. The cheaper systems are more often than not also more humanitarian.
> 3. Much money is wasted... by the provision of unnecessary security precautions. The public pays very heavily for the marginal gains that may be provided by repressive custodial apparatus and systems."[38]

Prison administrators themselves often concede that the vast majority of people in prison don't belong there. Moreover, by weakening family and economic ties, institutionalization may only be adding to the difficulties

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37. Norval Morris and Gordon Hawkins, The Honest Politicians Guide to Crime Control (Chicago, Ill.: Univ. of Chicago Press, 1970), pp. 112-115.

38. Ibid., p. 121.

involved in reintegration of these individuals back into the community. Consequently, unless strong reasons to the contrary can be demonstrated, the treatment of offenders should be community-based.

Third, there should be an expansion of programs to diminish the social isolation and humanize conditions for those who are imprisoned. Since most inmates are eventually released, a prison experience which leaves the offender more bitter and alienated is not in the community's best interest. To create a better correctional atmosphere, the size of prisons should be reduced, and meaningful educational and vocational training programs developed. Drug treatment, alcoholism, and other social services for prisoners should be strengthened. Inmates should be allowed unrestricted correspondence and frequent visits from family and friends, including conjugal visits from mates. A variety of pre-release options, such as furloughs, halfway houseses and "open" institutions, should be established. In addition, "aftercare" employment and counseling services should be available.[39]

The measures suggested above should be viewed as a first step in a continuing struggle to improve the quality of justice in our criminal justice system. Complete reform of the system will require us to look beyond criminal justice agencies, however. As we have noted previously, the criminal justice system is a reflection of the larger society and the inequities therein. Accordingly, while there is poverty, discrimination, concentrations of wealth and political power, and excessive government secrecy in American society, our criminal justice system will continue to function illegitimately.

39. Ibid., pp. 123-134.

C. Conclusions and Recommendations

by Kent Colton

The case studies in this report have demonstrated the difficulty of actually implementing more advanced resource allocation techniques in police patrol operations. Moreover, the implementation problems encountered in the three cases do not seem to be isolated instances. Rather, there is evidence that such difficulties are commonplace, as illustrated by the study on criminal justice models by the RAND Corporation cited earlier in this chapter.[40]

Many of the difficulties that have been identified in this study and in the RAND study do not appear to be technical; rather, they are related to environment, institutions, and to questions of organizational objectives. Past experience has demonstrated both a misunderstanding of the nature and environment of technological change, and a failure to properly manage innovation. To the extent that innovations are brought in from the outside, are funded only from federal resources, and fail to achieve a broad base of support within a police department, the likelihood for successful implementation will always be small. Further, once the decision to implement technology is made, careful attention must be given to the process of managing change. The case studies in Boston and St. Louis present illustrations of some of the problems that arise, including, for example, inadequate training, failure to involve key command staff, overly optimistic promises that could not be met, civilian domination of projects,

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40. Jan M. Chaiken, et al., Criminal Justice Models: An Overview, op. cit.

failure to consider the reactions of the rank and file, and lack of recognition of conflicting objectives. If resource allocation deployment efforts are to achieve operational success, careful sensitivity is required to such behavioral and institutional issues. One of the primary reasons the ADAM historical reporting system in Los Angeles was eventually implemented was because the LAPD was able to overcome some of their problems and oversights along these lines.

Chapter XII is devoted to a more detailed discussion of implementation. However, even if implementation obstacles can be surpassed, the question remains as to the overall benefit and utility of such resource allocation efforts. Because of their failure to achieve operation over the long term, the case studies in this report provide few insights along these lines. Further, the modeling techniques used in these three cases are now outdated, and more recent efforts to utilize computer technology in police resource allocation go far beyond the St. Louis, Boston, and Los Angeles examples. Two of the most prominent illustrations are the Hypercube Queing Model[41]

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41. The theoretical development and computer program design of the hypercube model began in 1971. Principal work on the model has been carried out by Dr. Richard C. Larson at MIT and has been supported by the National Science Foundation in a grant to MIT entitled "Innovative Resource Planning in Urban Public Safety Systems." Additional reserve on the hypercube model has been funded under a contract to the New York Rand Institute from the U.S. Department of Housing and Urban Development. A number of documents which describe the hypercube model have been prepared. Some of the more prominent include:

Richard C. Larson, "Computer Program for Calculating the Performance of Emergency Service Systems: User's Manual (Batch)," Technical Report No. 14-75, Innovative Resources Planning Project, NSF Grant GI 38004, Operations Research Center, MIT, Cambridge, Mass., March, 1975.

Jan M. Chaiken, Hypercube Queing Model: Executive Summary, The New York City Rand Institute, R-1688/1-HUD, 1975.

and the Patrol Car Allocation Model (PCAM).[42] Rather than forcing the user to consider only a limited number of factors, such as responding to calls-for-service, as with the St. Louis and LEMRAS systems, these models allow the user to outline a wide range of performance measures as a part of their decision process. For example, the hypercube model requires police administrators to specify a number of policy objectives for each command area or beat. These are stated in terms of constraints. For instance, average travel time for urgent calls should not exceed four minutes. Other objectives can involve preventive patrol, administrative considerations, workload imbalances, or other factors deemed important. The procedure determines the minimum number of units required for each beat, so that all objectives are fulfilled. If the total number of units to be allocated is insufficient to satisfy objectives, then the method computes the deficiency and requires a more modest set of objectives. The model, then, can be used in a variety of applications to allocate resources such as designing police beats, distributing ambulance services for

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42. Much of the research and development on the Patrol Car Allocation Model (PCAM) has been under the direction of Dr. Jan M. Chaiken at the Rand Corporation. With the help of funding from the U. S. Department of Housing and Urban Development and the National Institute of Law Enforcement and Criminal Justice at the Law Enforcement Assistance Administration. A description of the model is found in the following documents:

Jan M. Chaiken and Peter Dormont, Patrol Car Allocation Model: Executive Summary, The New York City Rand Institute, R-1786/1-HUD/DOJ, September, 1975.

Jan M. Chaiken and Peter Dormont, Patrol Car Allocation Model: Users' Manual, The New York City Rand Institute, r-1786/2.

Jan M. Chaiken and Peter Dormont, Patrol Car Allocation Model: Program Description, R-1786/3.

emergency response, developing a police allocation plan with overlapping beats, and examining the consequences of alternative prevention patrol strategies.

Based on a recent survey, 32 law enforcement agencies have requested and received the computer programs for the hypercube model. Of these, 25 appear to have actually tried to use the model, although only seven indicate that they have actually made manpower and district changes as a result of the hypercube recommendations. Regarding the use of PCAM, 28 police departments have received the computer program for the model. Twelve of these same departments indicate that they have used the model or are using it, and an additional seven state that they are likely users in the future.[43] Such data indicate growth in the use of these two models, but the actual results of the efforts in these cities must still be evaluated.[44] In looking to such evaluation, though, we must be realistic. At best, we can hope to examine the impact of models on police process -- e.g. improvements in dispatch time because more cars are available to respond, better distribution of workloads, improved officer attitudes, etc. However, when it comes to "result-oriented" measures or, more specifically, to impact on crime, our expectations should be limited. The three cases in this report have demonstrated the difficulties in relating

43. Jan M. Chaiken, "Implementation of Emergency Service Deployment Models in Operating Agencies," Rand Paper No. P-5870, Santa Monica, Calif., May 1977, pp. 13-18. (Paper presented at the Joint National ORSAITIMS meeting, San Francisco, Calif., May 10, 1977).

44. The National Science Foundation is currently funding a project to evaluate aspects of the hypercube model. The grant is to The Institute for Public Program Analysis, St. Louis, Missouri. An evaluation report is expected to be forthcoming in 1977.

crime statistics to technological innovations. In Section B of this chapter, Hebert correctly pointed to the failure of the allocation projects to demonstrate improvements in the departments' patrol force performance, particularly in the area of crime control. Perhaps a greater failure was our original expectations in the 1960's that we might be able to establish such linkages. Criminal activities are based on a wide range of factors only a small portion of which are influenced by police activity. Changes in deployment patterns may have some modest influence, but criminal statistics are far too imprecise to measure these differences or to isolate the portion of the change attributed to police allocation as opposed to changes, for example, in the weather or the unemployment rate.

The failure to link innovation to an effective war on crime may lead some to conclude that technological innovations should be abandoned. I agree that we should not look to technology as our saving grace. We must continue to try to address the basic inequities in our society and to reform the many dimensions of the criminal justice system. However, such reform, if it comes, will take time. Further, a determination as to a reordering of priorities depends on one's perspective and requires political judgment. We might all agree that inequities should be removed and the problems of the poor resolved. A decision as to the actual distribution of limited resources, though, depends on a much tougher choice, influenced by who you are and your perspective towards change. Unfortunately, there are no simple solutions. As James Q. Wilson has pointed out:

> Those who argue that we can eliminate crime if only we have the 'will' to do so, whether by ending poverty (as the Left argues) or by putting more police on the street and more gallows in our jails (as the Right believes), seriously mistake what we are capable of under even the best of circumstances, and place the blame for the failings precisely

(continued)

> where it should not be -- on our willpower, and by implication, on our governing morality. I argue for a sober view of man and his institutions that would permit reasonable things to be accomplished, foolish things abandoned, and utopian things forgotten.[45]

Ever since the Crime Commission, and even before, there are those who have argued for the advance of technology with the naive hope that money spent on police equipment might solve our problems and bring down crime rates. I disagree with that limited perspective. On the other hand, there are those who feel that, since technology has failed to achieve this same, impossible objective of reducing crime rates, all such innovation should be abandoned in search of a more basic solution to our criminal justice dilemmas. I also must reject that view. Rather, it seems the truth must lie somewhere in between. Technological change will not solve basic issues, but if properly implemented, it may achieve modest objectives in the process of police operations. Although we must realize the impact will only be marginal, the benefits may well justify the costs. Obviously, we must be careful so as to not delude ourselves as we proceed, but it does seem appropriate for police departments to devote time and talent to achieve the most effective deployment of their manpower in order to meet service objectives and to equalize workload responsibilities. Crime indicators, though, should not be the only measure of performance. As pointed out in Chapter I, much of police work is devoted to service and order maintenance activities. Multiple criteria are necessary to evaluate success.

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45. James Q. Wilson, Thinking about Crime, (New York: Vintage Books, 1975), pp. 222-223.

What then can be said about past and future efforts to utilize computer technology in police resource allocation? Four conclusions and recommendations seem appropriate.

1. Many of the early predictions and promises concerning computer-aided resource allocation systems have not been met, and our expectations for the future should be altered accordingly. At one time, some advocates argued that the use of computers and technology might result in the almost daily reallocation of police units. An officer reporting for duty would simply call in and be assigned to patrol or to answer calls in an area designated through the analysis of available data and the aid of modeling technology. It seems very apparent that this type of "fluid patrol" is not going to occur, at least in the short or middle run. This is illustrated by the St. Louis experience. At one point in the St. Louis resource allocation project, patrol beats were changed every four hours. Such a practice has long since been abandoned for two reasons: behavioral factors worked strongly against such shifts which were confusing and unsettling to the officer on patrol, and the benefits were questionable, especially since workload needs did not seem to warrant such dramatic action.

Past experience, then, should appropriately temper our future expectations. Rather than looking for the long-term implementation of computer-aided resource allocation to redesign police deployment patterns on a daily, monthly, or even quarterly basis, we should expect the use of modeling techniques on a more limited, almost one-time basis, where police departments use computer technology to redesign their patrol structure once and then wait for several years before using the model again.

2. Despite the disappointments of the past, police computer modeling efforts should not be abandoned. We should continue to seek improved

methods for police resource allocation, but with a more realistic perspective. All police departments must deploy their resources in some manner or other. The two ICMA surveys in 1971 and 1974 demonstrated that there was an increased use of quantitative data in attempting to make manpower decisions. According to one chief of police: "I used to feel that the only criteria in police work was to get more officers on the street. Now I have come to realize that other standards of performance should also be considered. There is more to resource allocation than seat-of-the-pants observations." If the right criteria are built into the models, technology may assist in more effectively identifying and responding to future needs.

Further, in order to develop police models, detailed review and analysis of the criminal justice system is required. Use of the technology may aid the operations of the police, not because the model per se will improve the system, but because law enforcement personnel may become more educated and involved in the decision-making process. However, if this education process is to be meaningful, it must be two-way, not only involving the model builders, but extensively involving the model users as well. It is difficult to involve law enforcement decision values in such a process, not only because of differences in style and approach, but because the complex world of policy management faces immediate demands. The police commander who faces day-to-day decisions is often unable or unwilling to afford the luxury of model building and analysis.

The last few years have seen the development of several new and more flexible approaches to computer-aided police deployment such as the Hypercube or PCAM models. However, in designing and implementing such models, hopefully, we can learn from the past so that our expectations will be realistic and we will remember that the quality of the outputs of the model are highly dependent upon inputs, design, and assumptions.

3. As computer modeling work is continued, evaluation is essential, and careful consideration should be given to a more systematic program to evaluate such technology. Any claim about the impact on performance of advanced deployment models will largely remain speculation until more careful research and evaluation is carried out. Hopefully, over the next decade we can learn to test our ideas. Rather than simply spending federal resources to fund our hopes and fears, let us evaluate our efforts.

The time seems appropriate to develop a more systematic program of evaluation for resource allocation efforts, and the Law Enforcement Assistance Administration should consider designing such an experiment to test alternative resource allocation strategies. It is only through such an experiment that we will be able to determine whether, or to what degree, the development and implementation of such police technology is warranted. If such evaluation is forthcoming, though, it must be independent; and pre-test conditions must be analyzed, implementation monitored, and the effects of the technology reviewed. The evaluation must be multi-disciplinary with attention paid to the local citizenry's perception of changes in the overall quality of service in all three dimensions of police performance -- law enforcement, service, and order maintenance. We have already highlighted the inability to relate such innovations to changes in crime statistics, though, and success or failure will need to be measured in more process-oriented and attitudinal terms, such as evaluating the impact on workload distribution, the response to calls-for-service, and officer and citizen satisfaction.

4. Finally, and perhaps most important, there is no one best way to allocate law enforcment resources. Rather, there is a range of alternative

strategies, and each implies a different, sometimes subtle, set of consequences. Whether the criteria is based on response to calls-for-service, remaining in a patrol beat, maintaining public visibility, or preserving consistent patrol strength in case of emergency, the computer cannot prescribe the ideal method. When embarking on the implementation of innovation, it is important to review and understand these consequences of alternative policing strategies and to realize that the use of technology is not value-free. The experience in the LAPD is especially informative in demonstrating this point. Team policing and the resource allocation model, ADAM, represented two separate philosophies of police work. ADAM placed priority on responding to calls-for-service, generally irrespective of patrol beat assignments. Team policing focused on serving an area of the city and keeping patrol officers in that area to prevent crime. The conflict became apparent when ADAM was implemented in the team policing environment. The problem was not the ADAM system, per se, rather, there were two different strategies involved with very different objectives.

Any resource allocation system is obviously based on some basic set of criteria or decision rules used to deploy police forces. To obtain the best results, a department must select rules that match their basic objectives. A department must be especially careful in buying pre-programmed packages from a vendor that relies on a set of decision rules which are essentially unknown to the department. The result may be unexpected or yield the wrong consequences. Certain criteria -- for example, responding to calls-for-service -- may become the emphasis when, indeed, they do not have the highest priority. Emergency response to calls-for-service comprise only a small portion of the actual work of the police, yet it is possible that such measures can become the primary criteria for allocating resources if departments fail to think carefully about their deployment strategy.

Earlier, it was stated that if the right criteria were used, technology might assist in meeting future needs. However, in deployment manpower, there is no single criterion which will bring magic results. Goals and objectives vary, depending on the focus or emphasis which is desired. There is more to police work that crime-related activities; service and order maintenance functions are also of primary importance. Unless the use of computer technology can reflect this reality, oversights may develop and subtle and undesired impacts may arise.

CHAPTER VIII

THE IMPLEMENTATION OF A COMPUTER-AIDED DISPATCH SYSTEM BY THE SAN DIEGO POLICE DEPARTMENT

By Kent W. Colton

A. Computer Technology and Police Command and Control

The potential for computer technology to assist in the police command and control process was first highlighted by the President's Commission on Law Enforcement and Administration of Justice in 1967. Studies at that time suggested that such technological systems might achieve cost-effective reductions in police response time. Some hypothesized that command and control innovations might even improve apprehension rates and thus serve as a deterrent to crime. As part of their Task Force Report: Science and Technology, the Commission identified the police department's communications center as the focal point for directing and controlling police activities. The various dimensions of responding to a call-for-service were identified from the time a citizen recognizes the call and reports it to the police to the time a police vehicle arrives on the scene. (See Figure 8-1 for a display of the police emergency response system in the St. Louis Metropolitan Police Department. This figure is also found in Chapter XI.) In addition, the Crime Commission pointed out a number of command and control problems that limited police effectiveness.[1]

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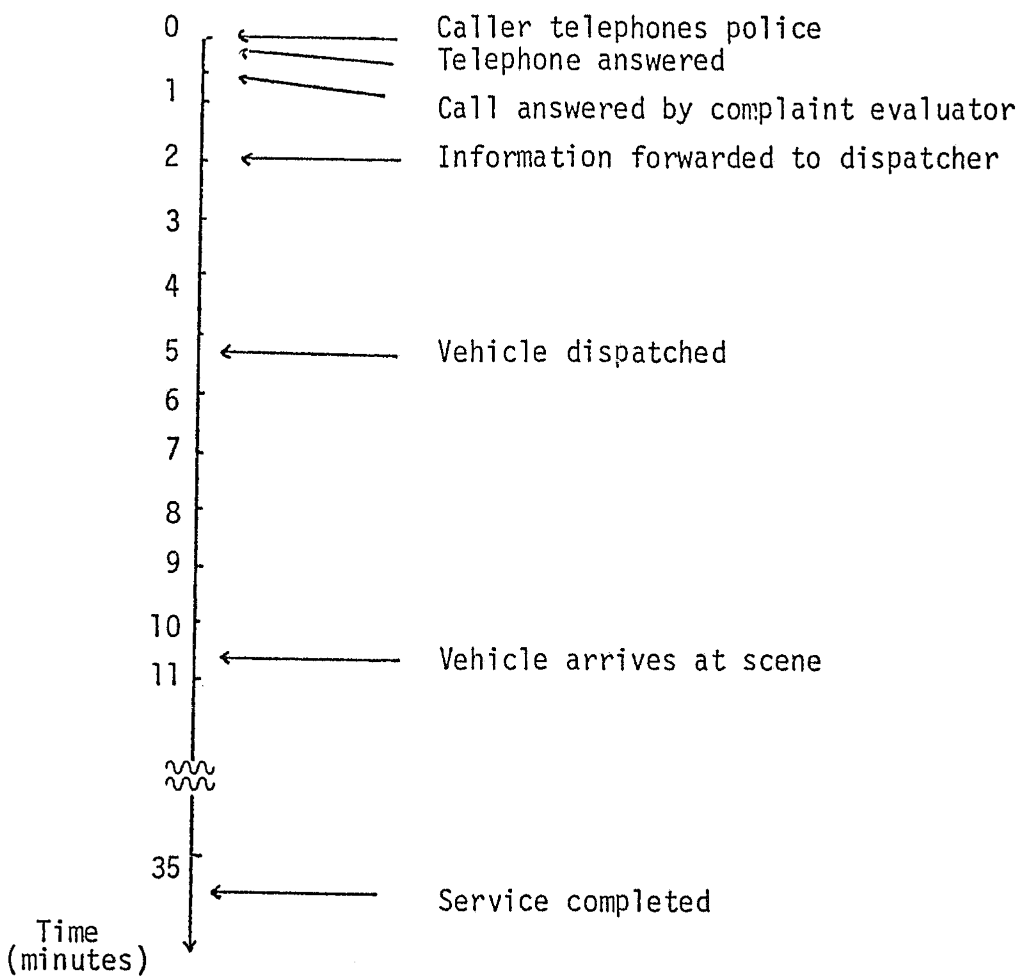
1. The President's Commission on Law Enforcement and Administration of Justice, Task Force Report: Science and Technology, Prepared by the Institute for Defense Analyses, Washington, D.C., 1967, pp. 21-28.

Figure 8-1: Police emergency response system: measured mean response times (St. Louis Metropolitan Police Department, District 3)



- A great deal of information flows through a communications center, but little can be readily recalled to provide feedback on the results of actions.
- The location of patrol cars is only crudely known.
- The communications center is a significant part of response time; if processing improvements could be made, delays in response might be reduced.
- In many police departments radio congestion presents a significant problem for communication between the dispatcher and the officer in the field.

In an effort to improve and modernize police communications and control, a variety of technological innovations have been proposed and in some cases installed. Computer-aided dispatch (CAD) systems provide the framework for bringing together many of these new pools through the partial automation of the call answering, processing, and dispatching activities of a police communications center. With CAD, technology automatically matches the address of a call-for-service and the police patrol beat are automatically matched through a computerized geographic file, and instant recall of dispatch data is possible.

CAD in and of itself does not track the location of police vehicles, though, so automatic vehicle monitoring (AVM) and automatic vehicle location (AVL) systems have been suggested. As defined in this report, AVM systems provide a police dispatcher with real-time location estimates of each vehicle in a fleet and, through its monitoring function, provide additional vehicle status information (e.g. "in pursuit," "enroute to scene," "driver door open"). An AVL system provides only location estimates without additional status information.

Other technological changes have also been considered or implemented in the command and control area. These include mobile and portable digital terminals to allow officers in the street to communicate digitally with the dispatch center's 911 emergency telephone numbers, and improved radio equipment with such innovations as dynamic channel assignments.

Some of these innovations in command and control are routine: technology basically replaces a previously manual activity such as digital terminals or the automated transfer of information from the telephone operator to the dispatcher. However, command and control innovations also provide the framework for a number of nonroutine activities, such as tracking and monitoring vehicle location, automatically timing the length of calls and raising a "flag" if a call takes over a specified time (say, 30 minutes), or providing new information to be used for management. Command and control then not only pertains to the ability of the dispatcher to deploy vehicles, but also pertains to the police administrator's control over and modification of patrol operations.

In this study, four case studies of command and control areas have been documented. Their purpose is to examine the implementation process, and, where possible, to begin to assess the use and impact of such technology.

The first three relate to the implementation of systems. This chapter describes the experiences in San Diego, Chapter IX outlines the efforts in New York City, and Chapter X documents the Boston case. Chapter XI relates to vehicle location and is a case study of the beginning phase of the first full-scale effort to implement an AVM system in a major urban police department, St. Louis, Missouri. General conclusions concerning these four cases and other applications of computer technology will be outlined in Chapters XII and XIII.

Naturally these four cases represent only a small sampling of the command and control innovations that have been tried in the United States. As such, the findings will not be conclusive; rather, they serve as a beginning in examining the many dimensions of such innovations.

B. The First Attempt at Computer-Aided Dispatch in San Diego

San Diego's first attempt to implement a CAD system, begun in 1967, was funded jointly by the Law Enforcement Assistance Administration (LEAA) and the City of San Diego. Although the system was established to service three city departments -- police, fire, and water utility -- it was expected to be expanded later to the entire metropolitan area. The project failed for three reasons:

First, users of the system were involved very little in its design and implementation. The project director was appointed by the city, and a task force was established with a representative from each of the three operating departments (a lieutenant in the case of the police department); but virtually no dialogue took place between the task force and the user agencies. For example, no questions were put to the head of the Police Communications Section, and no studies were conducted to outline the flow and workload of the communication process. According to one police department spokesperson, "The director of the CAD project felt he was a data processing expert. He had his own plan for the system, which he intended to implement.[2]

The second reason for the project's collapse was failure to establish and maintain a specific schedule. Timing changed frequently, causing general confusion.

Third, hardware purchases were made without detailed specifications requiring vendors to conform to agreed standards. Since the hardware was purchased without consultation with the user departments, the system bore little relation to real needs and requirements.

At last the assistant project director became uneasy about the CAD project and decided to discuss it with the San Diego City Manager. The City Manager called in an outside consultant to review the project, and, on the basis of his recommendations, the project was stopped in February 1972. The project director was fired and the lieutenant who had served as the liaison officer between the police department and vendor was asked to retire. Over a million dollars had already been spent on the project. Because the resources had been so poorly handled, much of the money was returned to the LEAA.

C. A Second Effort to Implement CAD

Because a number of communications problems continued to plague the police department after the first CAD effort had been halted, in November 1972 a captain from the Patrol Division was asked to review the communications system. This marked the beginning of a second effort to

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2. Interview between Kent W. Colton and Inspector Kenneth N. Fortier, San Diego Police Department, July 20, 1976.

establish a CAD system in the San Diego Police Department.

1. Analysis of the old system. The first step in the review was a detailed systems analysis to identify communication needs. The analysis uncovered a range of problems.

First, the facilities for the communications center were found to be crowded and inadequate. The center was housed in police department headquarters, built in 1938, and there was little room for expansion. While the city-wide standard for space was 100 square feet per employee, each employee in the Communications Section was confined to about 25 square feet of space. The air-conditioning was insufficient and the noise level was extremely high.

Second, the telephone system had special problems, including an overloaded switchboard and not enough operators. The result was poor telephone service. A survey made in 1972 showed that at times citizens were required to wait as long as 80 to 90 telephone rings for the police department operator to answer. Once the operator did answer, he or she talked to the citizen for an average of three minutes before referring the call to the dispatcher.[3] The system was so overloaded that those familiar with the Communications Section called on the section supervisor's private lines in order to avoid excessive delay.[4] One factor contributing to the workload problem was that the rate of telephone calls to the police department had increased so rapidly that the Communications Section couldn't keep up with the demand. Table 8-1 indicates an increase of more than 30 percent in the number of calls between 1968 and 1972, with an increase of only 24 percent

4. Kenneth N. Fortier, "Implementation of a Computer-Aided Dispatch System for the San Diego Police Department," unpublished M.A. thesis, San Diego State University, 1976, p. 20.

Table 8-1: Telephone Calls to and Personnel Assigned to San Diego Police Communications Section, 1968-1972

	1968	1969	1970	1971	1972	Total Net Increase
Number of Telephone Calls	1,011,494	1,169,941	1,229,529	1,214,584	1,321,704	310,210
Percentage Increase	14.4%	15.6%	5.1%	-1.2%	8.8%	30.6%
Number of Personnel	58	64	64	69	72	14
Percentage Increase[a]	9%	10.3%	0%	7.8%	4.3%	24%

a. Part of the increase in personnel occurred in areas not related to telephone/dispatch. Personnel figures include supervisors, clerical personnel, and additional radio operators, as well as security and public information counter personnel. There were no such positions in the Communications Section in 1968.

in the number of personnel positions assigned to the Communications Section. And many of these new positions were not related to telephone response.

Third, the dispatch system was essentially manual. In order to determine the beat assignment for a particular call, the operator made a manual check of the map to match the incident's address to the appropriate beat. A conveyor belt then carried the information from the telephone operator to the dispatcher, who assigned a field unit to respond to the call. The radio system for communicating with officers in the field was also overloaded; it had only three operational channels with as many as 60 patrol field units per channel. Field units were often dissuaded from radioing headquarters because the channels were overloaded .

Finally, the old communications (telephone and dispatch) systems provided very little information for managers. Although data regarding communications activity were keypunched, the information was taken from handwritten dispatch cards which were difficult to read and subject to wide interpretation. Further, the reports prepared from the data were printed as listings of statistics rather than as reports that would be more useful to management.[5]

2. Designing and implementing a new system. To the reviewers it seemed clear that improvements were needed in the Communications Section. Gradually a threefold strategy evolved that included: first, improving the technical and personnel dimensions of the telephone system; second, designing and implementing a new CAD system; and, third, moving the location of the telephone and CAD systems to new, spacious

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5. Interview between Kent W. Colton and William Kalender, Chief of Police of the San Diego Police Department, July 19, 1976.

premises.

a. Telephone system. Much of the San Diego city government was already on a centrex telephone system, which provided direct lines to various city departments. Placing police department on the centrex system eliminated its need for the old switchboard. Additional telephone lines were put in, raising the total number to 25. Even more important, a "call distributor" was installed to allow for the queuing of incoming calls, thus assuring that the calls would be addressed in the order in which they arrived at police headquarters. Calls were directed to the next available complaint operator by means of a fluttering light that indicated which call should be answered next. The additional telephone lines reduced significantly the number of busy signals. In addition, the budget request beginning July 1973 asked for money for a significant increase in telephone personnel -- 24 new positions.[6] To better employ the additional personnel, a new system for handling incoming calls was established. Primary operators were set up to handle all incoming calls, but a screening process was developed whereby they could determine if the call would require the dispatch of a police officer. If so, the primary operator continued with the communication until completion. If dispatch was not required, the call was transferred to a secondary operator who completed the processing for the call -- by taking a report, for example. In order to implement this "primary-secondary" system, exercises were conducted. A standard telephone approach was developed, and the operator, instead of allowing the conversation to wander, was instructed to ask specific questions, such as: "Do you

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6. "Fiscal Year 1974 Budget Request," San Diego Police Department, 1973.

need a police officer?" or, "What sort of problem are you reporting?" based on this new technique and the ability to transfer calls to secondary operators, two goals were set: (1) to lower the telephone talk time to 60 seconds per call; and (2) to answer 90 percent of all incoming calls within 20 seconds.[7] In order to facilitate the achievement of these goals, a 90-hour workshop for police dispatch clerks was established, and all new dispatch clerks were required to complete training before assuming their duties.

b. The CAD system. While the telephone system was being modified and new operators were being hired and trained, plans were going forward to establish an entirely new CAD system. In April 1973, a systems analysis of the police department dispatch operation began. It included a review of the department's priority system for calls-for-service. In the past there had been no special priority system, even though some calls clearly of an emergency nature required direct response while others permitted less haste. Priorities were grouped logically into five categories, as Table 8-2 shows. Such grouping proved helpful in the dispatch process, particularly in responding to and analyzing higher-priority calls.

When the system analysis had been completed, police department personnel worked closely with the communications and electrical division of the city to develop a detailed, functional Request for Proposal (RFP) for a CAD system.[8] Before putting the RFP out to bid, however, the city

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7. Raymond L. Hoobler and Kenneth N. Fortier, "A Computer-Aided Dispatch System for the San Diego Police Department," Police Chief, October 1975, p. 23.

8. The RFP was issued in August 1973, with proposals to be returned no later than October 2, 1973. See "The City of San Diego, San Diego Police Department Communications Improvement Program, Bid-8008."

Table 8-2: Priority Codes for the San Diego Police Department

Priority Code Number	Description
1	Officer needs assistance (11-99). All lifesaving calls (11-40; 11-83).
2	All crimes in progress or just occurred where a possibility of apprehension of suspect exists. Alarms. Incomplete calls for help. Lost children of 'tender' years. Bomb threats and 415's involving weapons.
3	Disturbance. Non-injury accidents blocking traffic. Meet with Shore Patrol for UA/AWOL check. Prowler call. Child abuse (not in progress). In-custody persons from private agencies (i.e., shoplifters). Drunks. Lost children not of 'tender' years. Parking violations with traffic blockage. Kites in flight pattern (Balboa Park).
4	Take a report of a cold crime (suspects not know, or at least not in vicinity). Provide transportation (could change, based on location or agency). In-Custody persons from other enforcement agencies. Checks for 'suspicious persons.' Blocked driveways (people not trying to leave). Disturbances, loud party or music.
5	Abandoned vehicles. Recovered property. All remaining service assignments. All parking violations not covered above. Motorcycle disturbance calls that would normally be referred to Trail Safe.

decided that in order to avoid extensive cost overruns and the problems of the first CAD failure, it would determine exactly how much money would be available for the project. The City of San Diego had already decided to use federal revenue-sharing funds for the new system, and a total of 1.2 million dollars was available. Since the police department's radio communication required improvements, $400,000 of this amount was allocated for the purchase of new four-channel radios. Of the remaining $800,000, over $100,000 had already been committed for other aspects of the communications system, including the telephone improvements just described. Approximately $670,000 was available, therefore, for the RFP for computer-aided dispatch.[9] The RFP was issued in August 1973. Eight bids were received, and on December 20, 1973, the City of San Diego awarded a contract to Motorola Communications and Electronics, Inc., for a complete installation of the system at a total fixed-price contract of $650,000. The system began operating in a test mode in November 1974, and in January 1975 the police department took over operation. In August 1975, the police department concluded that the various test criteria for the system had been met, and final payment was made to the vendor. (Installation of the new system will be discussed later.)

c. Communications Center and CAD. In the process of establishing the new CAD system, the Communications Center was moved from police department headquarters to a more spacious facility in the sub-basement of the City's Operations Building, approximately one mile away. In 1977 the police

9. Interview between Kent W. Colton and Inspector Kenneth N. Fortier, San Diego Police Department, July 20, 1976.

communications system in San Diego was still operating as it had been set up in 1975. It revolved primarily around positions for primary operators, who received and processed telephone calls, and for dispatchers, who actually dispatched the calls to the officers in the field. In addition, there were secondary operators to whom calls which did not require a unit to be dispatched were referred.

The CAD system had slots for twelve primary operators and six dispatchers. The twelve operator positions were fully equipped with cathode ray tube (CRT) screens, a full complement of telephone lines, and Alpha Numeric Keyboard terminals on which to enter information into the computer system. The radio dispatch positions were also equipped with a CRT screen, an Alpha Numeric Keyboard terminal, and a two-way voice radio capability to communicate with the officers in the field. The six dispatch positions included: four primary dispatch positions, each responsible for specific beats or geographic sections of the city; one inquiry station which handled requests for information from field vehicles; and one position for future growth.

When a call was received, the new CAD system generally worked as follows. The primary operator received the call from a citizen requesting police service. The operator hit a key on the keyboard and the system displayed a "pre-programmed incident form." Information concerning the address and details of the required dispatch request was entered on the "form." The system then provided research via a "street-to-beat file" in which the computer linked the address of the incident to the police beat, the census track, the radio frequency, and the appropriate dispatcher. In addition, the computer assigned an incident number. The complaint operator then simply pressed a button on the keyboard and the information was transferred automatically to the screen of the appropriate radio dispatcher. Calls were then queued for the radio operator according to the priority and age of the waiting calls, which meant that the oldest, highest-priority call was first in line for dispatch. Besides transferring the "incident form" with the information from the primary operator, the computer system also "recommended" five available police field units which might be assigned to handle the incident. Since the system included no means to track the location of police cars, "recommendations" were based first on the availability of cars, and, second, on the geographically closest beats to a particular incident. The radio operator then chose which officer or officers to dispatch, and a normal voice dispatch followed.

The San Diego Police Department was particularly proud of the system's "street-to-beat" search capability and ability to give specific dispatch recommendations. In addition, computer capability enabled the dispatcher to keep an ongoing record of the latest incidents in progress. The system listed and displayed recent calls at the bottom of the complaint operator's screen. This feature reduced duplication in dispatching calls, as, for example, in the case of multiple telephone calls about a major traffic accident.

In order to provide access to other information sources, the CAD system was linked directly to the real-time inquiry systems of the county, the California Law Enforcement Telecommunications System, and the National Crime Information Center (NCIC) in Washington. If a patrol officer needed information concerning stolen vehicles, vehicle registration, outstanding warrants, or dangerous individuals, for example, he could call the dispatch information operator who could inquire directly through his CAD terminal of these other systems.

To facilitate the transfer of routine information from field personnel to the dispatch center, 20 mobile data (MODAT) units had been installed on an experimental basis when the system was first implemented. These units, which were placed in 20 patrol cars, provided patrol officers with the capability of sending pre-coded digital messages to the Communications Center, using non-voice, digital-coded tones. The officer simply pushed the appropriate button, and the dispatcher knew whether the car was in service, en route to an incident, or out of service.

The communications system also provided management information for the Communication Center and the police department as a whole. As a result of the modifications made to the telephone system, a special system, entitled the Force Administrative Data System (FADS), was established, which collected telephone statistics enabling the department to closely monitor the number of calls, telephone handling time, telephone talk time, and so on. This FADS information, coupled with the CAD's management information, provided valuable data for the police department. The actual nature and use of these reports will be discussed in greater depth later in this chapter.

3. Objectives of the new communications system. Although the precise goals for all aspects of the new communications system were not outlined before the system was implemented, the following five objectives (which will be used later in this chapter as a baseline for evaluation) were laid down:

- to answer 90 percent of all incoming calls within 20 seconds, and to limit normal telephone conversations to a maximum of 60 seconds;
- to improve police response, especially by shortening the response

time for priority calls-for-service (with a predicted 30 seconds saved simply through the added "street-to-beat" research capability of the new system);

- to use better information in the overall operation and management of the police department;
- to improve the overall working conditions of the Communications Center; and
- to improve communication with field units through the new radio system and the MODAT digital units.

D. Implementation Approach of the San Diego Police Department

One of the most intriguing aspects of the San Diego case study is the police department's overall approach to implementation. Insights gained from the San Diego experience may profit other departments that are planning the installation of information technology.

In implementing its CAD system the San Diego department emphasized user involvement. Perhaps this focus resulted from the lessons learned during the first, unsuccessful attempt to establish such a system. At any rate, the initial step in implementing the second system was to set up a city task force (directed by a police captain) of personnel from various areas within the police department and other municipal agencies. In addition, because the support of the Chief and those in command positions within the department was considered essential, it was solicited throughout the project. Finally, a real effort was made to consider the ideas of the telephone operators and dispatchers regarding the design of the system. When new telephone procedures were being designed, "gaming" sessions were held during which selected telephone operators offered suggestions. Moreover, the final format of the "incident form" for the CAD system and the blueprint of the new Communications Center were carefully scrutinized by a number of operators as well as dispatchers.

The department's overall approach to user involvement is described in the following excerpt from an article on San Diego published in Police Chief:

> In many systems, much emphasis is given to equipment and, in some instances, not enough importance is placed upon people within the user group ultimately required to operate the system. Throughout this project, input from radio dispatchers, complaint operators, and sworn police supervisory staff was not only solicited, but scheduled and required before proceeding to the next step in the "critical path," CRT "page" layouts, etc., were also designed with operator input. An important point considered in implementation of the San Diego CAD system was that ultimately it was people, not machines, who would make the system successful. The most efficiently designed system to move a citizen's request for police service from input to a police field unit was prone to delay if somewhere along its path an untrained operator or one not knowledgeable as to work standards, system's goals, etc., took an excessive amount of time on a telephone call.[10]

Early in the implementation of the CAD program, a great deal of emphasis was placed on training the operators and dispatchers who would be involved. Once new procedures were designed, a 90-hour training academy for police dispatch slerks was established through a local community college. Funding for this effort came through the California Commission for Peace Officer Standards and Training (POST). The curriculum included a general orientation to law enforcement; an outline of specific

10. Hoobler and Fortier, "A Computer-Aided Dispatch System" p. 24.

dispatching procedures; a discussion of miscellaneous items, such as laws and ordinances, community relations, and first aid; and a complete review of all reports, forms, and procedures necessary to operate the new system. Perhaps the most useful session was that in which complaint operators and dispatchers simulated working situations and developed expertise in handling probable situations. Although it is customary for dispatchers in most police departments around the country to receive on-the-job training, this training academy for communications personnel is unique.

Another important aspect of the San Diego approach was the interaction between the police department and the vendor. Five features of this interaction are particularly noteworthy. First, the department prepared a very specific and detailed RFP outlining in full detail the system to be installed and the specifications to be met.[11] The RFP was prepared by police department personnel and by a communications engineer from the City of San Diego's Communication and Electrical Division to encompasse both a technical and a police department perspective. Second, the RFP required bidders to qualify in order to submit a bid: qualifying was based on the demonstration of prior experience in the design and successful implementation of a CAD system in the law enforcement environment. Third, potential bidders were required to accept a "turnkey" contract in which they agreed to assume full responsibility for all elements of the CAD system, including the hardware, software, radio communication, communication console equipment, and the necessary interface between the telephone sub-system and the CAD system. By imposing the

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11. The citation for the original RFP document is as follows: "The City of San Diego, San Diego Police Department Communications Improvement Program," Bid-8008, City of San Diego, August, 1973.

turnkey requirement, the San Diego Police Department made one vendor responsible for the performance of the entire system. Fourth, a fixed price was written into the legal and binding contract, as mentioned earlier. And fifth, payment was tied to successful implementaion, and bidders were advised that no payments for any portion of the system would be made until the entire system was completely installed and operational, with a determination as to operational contingent upon the passage of certain specified acceptance tests. In other words, no partial payment would be made until the project had been successfully implemented.[12]

The vendor was selected on December 20, 1973. Before the final contract was awarded, a 14-hour negotiating session had occurred in which the detailed specifications of the system were outlined along with the specific acceptance tests to be used in determining successful completion of the system. (Table 8-3 outlines the areas of agreement specified at the meeting.) Precise specifications were outlined, such as the time that would be required for the system to make a "street-to-beat" check, the amount of downtime that would be allowed, the precise storage requirements of the system, the maintenace requirements, and the time to be allowed for various input/output transactions.

Since the vendor had already established CAD systems in several other police departments, building the system was a matter of modifying previous efforts. By November 1974, the system was operating in a test mode, and in January 1975 formal operation of the system began. According to contract

12. Kenneth N. Fortier, "Implementation of a Computer-Aided Dispatch System for the San Diego Police Department," op. cit., pp. 35-36.

Table 8-3: Tentative Agreement Outline

1. Statement of work.

   A. Tasks.

   B. Milestones.

2. Functional specifications.

3. Deliverable products.

   A. Hardware to be delivered and statement of completeness, including all option.

   B. System software to be delivered (other than applications): disk pack, compilers, system generators, etc.

4. Schedule -- detailed, including clearly identified milestones.

5. Installation.

6. Test plan -- including specific acceptance criteria.

7. Documentation to be furnished -- list of required documentation outlined.

8. Training -- special number of personnel for which training and expenses are paid for by contractor.

9. Payment.

10. Warranty.

11. Project management outlined -- city must consent if a change occurs later.

12. What the City of San Diego is expected to provide.

13. Quote options to add CRT's, backup CPU for a fixed price for a fixed period of time.

14. Monthly progress reports.

provisions, however, no payments were made until the acceptance tests were completed in March 1975. Only 80 percent of the payment for the system was made in March, though, because at the time the contract was signed, an additional condition had been negotiated whereby the final 20 percent was not to be handed over until after 90 consecutive days of satisfactory system operation. "Satisfactory" was defined as system performance according to agreed-upon specifications 95 percent of the time. It took almost half a year for this final condition to be met, and therefore final payment was not made until August 1975.

The San Diego case study illustrates the importance of specifying the mutually acceptable criteria by which both parties can determine that the system is operating successfully. This seems like an obvious procedure in dealing with vendors, but it does not always occur in cases of technological innovation implementation. In fact, such a provision could have been omitted in San Diego if federal revenue-sharing monies, as opposed to funds from such sources as the LEAA, had not been forthcoming. With revenue-sharing monies the city officials had complete freedom to postpone payment as long as they felt necessary. A city with an LEAA grant faces quite a different situation. Since its grant will expire at a particular time, payment must be made by the expiration date even if the new system is not operating properly. An expiration date can sometimes be extended, but both the bureaucratic effort required to do this and the fear that a delay in meeting the deadline will put the city in a bad light when future LEAA contracts are to be awarded may make an extension an undesirable alternative.

E. Evaluating the CAD System in San Diego

The resources available for the preparation of this case study did not permit a detailed cost-benefit analysis of the San Diego CAD system. Therefore I can only evaluate the system by pointing to some of its benefits and problems.

In 1977 the CAD system in San Diego was working and was expected to continue working for some time. The first criteria for evaluation outlined in Chapter I -- establishing an operating system -- had been met. In fact, in the first six months of 1976, the system's average downtime was only 1.98 percent per month.

As outlined earlier, five objectives were discussed for the communications project -- to improve:

- telephone service;
- police response, especially through shortening response time for priority calls-for-service;
- information to be used in the overall operations and management of the police department;
- overall working conditions of the Communications Center; and
- communications with the field through the new radio system and the MODAT digital units.

Each will be discussed below.

Data collected before and after implementation of the new communications system showed significant progress had been made in achieving the first goal -- to improve telephone service. Prior to its installation, calls sometimes required 80 or 90 rings before the phone was answered. According to data from the Force Administrative Data System (FADS), in 1976 the average time needed to answer the telephone was 2.5 seconds, well the original goal of answering 90 percent of all incoming calls within 20 seconds. A further goal set at the outset of the project was to reduce the average talk time per call to 60 seconds. Between January and June of 1976 the average talk time per call was 77 seconds, 28 percent above the initial goal, but significantly below the average of more than three minutes before the communications project began.

Between the two periods January and June 1975 and January and June 1976, the number of total calls for the police department increased by 2 percent. Yet because more reports were handled by secondary operators than by primary operators, the number of calls dispatched decreased slightly, thereby relieving the overall workload for field units. When the new telephone system was installed, complaints from the public regarding brusque treatment from the telephone operators increased because the operators were trying to speed up conversations and make callers be more specific. Once this technique was mastered, complaints declined. Between January and June 1975, 71 complaints were received from the public; between January and June 1976, this dropped to 32.

Telephone operators reported that the system helped to equalize the workload among themselves. Under the old system, operators would take as many calls as they wanted, depending on their mood or motivation. Some worked hard and very fast, while others were slower and more lackadaisical. The new automatic call distributor insured an equal workload for all personnel.

The second goal of the communications system was to shorten the response time to calls-for-service. Overall data on response time indicate that some improvements may have been achieved through the operation of the new system;

however, these data do not lead to firm conclusions. Although the CAD system could capture detailed information regarding the amount of time between receipt of a call and the arrival of an officer at the scene, no comparable data were kept prior to the new system. Several benchmark studies were conducted in July 1974 and March 1975, but since response rates depend on so many variables -- such as the total number of calls, the time of year, the number of police cars available -- it is difficult to make valid comparisons from such a limited sample. Still, the numbers are worth reviewing.

Table 8-4 lists response time data by priority classification for five periods: (1) June 1974, (2) January-June 1975, (3) March 1975, August 1974 and (5) July-December 1975. Column I presents results of a benchmark study conducted by the San Diego Police Department for a short period during July 1974. The study included estimates for telephone handling time, telephone talk time, and travel time. Travel time was estimated using a random sample manual counting procedure. Data from this study are not statistically sound but do provide a range for comparison. Column II provides information from the CAD system which is statistically sound but do provide a range for comparison. Column II provides information from the CAD system which is statistically valid for a six-month period. Unfortunately, similar data are not available for another year, and there are major limitations in trying to make direct comparisons between response time for January-June and July-December of the same year. Column III is from a benchmark study for a two-week period in late March. Column IV is from another benchmark study for a two-week period in late March. Column IV is from another benchmark study and represents a short period of time in August 1975. Column V is based on data from the CAD system for a six-month period in 1975.

Taking the data problems into account, it is probable that travel time

Table 8-4: Summary of Five Response Time Studies by Priority

Priority[a]		Column I July 1974	Column II Jan.-June 1975	Column III March 1975	Column IV August 1975	Column V July-Dec. 1975
One	THT[b]	1.23	1.58	1.43	1.32	1.34
	ULT[c]	2.14	2.32	1.41	1.40	1.27
	TT[d]	5.89	4.96	5.19	4.62	4.22
Total		9.26	8.86	8.03	7.34	6.83
Two	THT	1.12	1.58	1.43	1.32	1.34
	ULT	4.93	2.75	1.97	1.82	1.81
	TT	5.89	5.28	4.97	4.70	4.15
Total		12.05	9.61	8.37	7.84	7.30
Three	THT	1.23	1.58	1.43	1.32	1.34
	ULT	8.83	5.70	5.61	4.47	5.22
	TT	6.86	6.00	7.53	7.09	7.16
Total		16.92	13.28	14.57	12.88	13.72
Four	THT	1.23	1.58	1.43	1.32	1.34
	ULT	12.13	8.17	15.82	13.00	9.89
	TT	9.42	12.00	11.00	10.38	11.36
Total		22.78	21.75	28.25	24.70	22.59
Five	THT	1.23	1.58	1.43	1.32	1.34
	ULT	13.22	13.19	13.03	13.54	11.71
	TT	11.28	11.00	11.44	10.73	12.33
Total		25.73	25.77	25.90	25.59	25.38

a. See Table 8-2 for a description of priority codes.

b. Telephone Handling Time.

c. Unite Locate Time.

d. Unit Travel Time

decreased somewhat. There were several possible reasons for this. First, because the quicker response to priority 1 and 2 calls, lower-priority classifications (especially priority 4) experienced a slow-down in response. This was natural because low-priority calls were "stacked" in favor of high-priority ones. In addition, it appears that the CAD system facilitated more rapid processing of calls. Unit locate time (ULT) generally decreased across the five columns in Table 8-4, especially in the first three priority areas. Telephone handling time (THT) remained relatively constant, however. The new telephone system was installed before June 1974 (Column I), and many of the benefits from it were reaped by the time the CAD system was fully implemented.

In evaluating response time benefits, some qualifications should be borne in mind. The three times (THT, ULT, TT) listed in Table 8-4 make up only part of the overall response time from the time a crime occurs to when the police arrive. Significant time may elapse before a call is even reported to the police. Such considerations modify response time impact when one realizes that a drop in response time of 30 seconds or one minute is only a small portion of the overall time required for an incident to be identified, reported, and arrival of a police officer. In addition, one must be careful in attributing all changes in response time in San Diego exclusively to the new CAD system. A number of other dimenstions of the overall communications system in flux at the same time may have contributed significantly to change. For example, the Communications Center received a large increase in personnel with the installation of the new system, which makes it difficult (if not impossible) to tell whether improvements in response time resulted from the new system or simply from the increase in staff.

Besides the goals regarding telephone operations and police services, the CAD system sought to achieve a third goal -- to improve information to be used in the overall operations and management of the department. The system included a link to a number of data files (such as for outstanding warrants and stolen vehicles) and it provided a valuable data base of management information. Before the installation of the system, the department received reports concerning police operations and workload, but these reports left much to be desired. The handwritten dispatch call cars used as sources of information were often difficult to read, were subject to a wide range of interpretation, and failed to record level of priority and response time. Since reports prepared from this data base were printed as straight statistical summaries, little thought had been given to designing them for management. With the installation of the CAD system a wide range of new reports were developed. A set of reports was designed to aid the department in effectively deploying personnel throughout the city, in measuring workload by time of day and day of week, and in determining overall response time.

While these reports include important management information, certain problems have been identified regarding the use of this information. Personnel are informed that a wide range of reports is available, but there is no regular schedule for circulation or distribution. Moreover, the quantity of reports is so enormous that it creates a potential for information overload. If CAD's management information is to have optimal impact, a new set of reports pointing out exceptions to the standards and and highlighting items of special note will be necessary. Although the potential management improvement exists, it is still unclear at this point in mid-1977, who really uses the reports and whether maximum impact will be achieved.

Other problems have accompanied the implementation of the new system which relate to the fourth objective -- to improve the overall working and operating conditions of the Communications Center. The greatest technical difficulty appeared to be the slowness of the system in responding to inquiries. To change the status of an incident, a dispatcher had to "call up" the "incident form" to the CRT screen and locate the item to be modified on the form. This process involved a time span in the range of 10 to 12 seconds, about 2 seconds for the form to appear, and 8 to 10 seconds to make the change. During an emergency, though, even this length of delay could be crucial. Further, no one knew when the system was going to go down. Although the amount of downtime was very small, the Communications Center had a poor manual back-up system which required physically running from the telephone to the dispatch section of the center; and since the dispatcher had no place to put the dispatch cards when they were delivered, it was difficult to stay on top of the situation. Because of these impediments, there was pressure for a new back-up system.

The most significant problems in implementing the CAD system, though, seem to be of a behavior and morale nature. Since one of the demands of the new system was for greater space, the Communications Center was moved from police headquarters to a new facility in the sub-basement of the City's Operation Building. But the new location was more than a mile from police headquarters, and the personnel in the Communications Center sometimes felt that they had been isolated and dumped into a "subterranean" environment. Further, the system was so highly automated that a number of the staff became bored because the machine controls had taken over many duties. Prior to CAD installation, when a telephone call came in, any of the operators could simply reach over and pick up the phone; after installation, they had to wait until a call was assigned to them by the automatic call distributor. The CAD system destroyed the personal touch, and many of the people who had been involved in the earlier dispatch process found difficulty in adjusting to this. Of the approximately 65 employees of the Communications Center when the new system was installed, 15 left, and most of them were not replaced. For the few new recruits, the press of work required "on-the-job" training, and time did not permit them to receive the 90-hour training program at the academy.

Some steps were taken to help alleviate the morale problems. For example, in order to relieve boredom, operators were allowed to bring reading material to the job. (This helped to resolve boredom, but during slack times visitors sometimes wondered whether the Communications Center was underworked.) Finally, the new people who were hired knew only the new system and carried over no expectations from the past. Another step to mprove morale was to reclassify pay scales of radio dispatchers and telephone operators. Earlier, both positions had been classified and paid at the same level. After reclassification, dispatchers received an increment in pay because of the additional demands of their jobs and the CAD's new "tedious" procedures.

In regard to the fifth objective -- to improve communications through a new radio system and mobile digital units -- it seemed that the new radio system was well received, but the reaction to the mobile data (MODAT) system was mixed. The problems with MODAT were both technical and behavioral. Whenever an item was transferred over the MODAT unit, an audible "turkey gobble" was heard on the radio. This irritated and distracted the communicators. In addition, field supervisors questioned the use of MODAT because it diminished their control over officers. Before, when an officer arrived at the scene, he or she would signal the dispatcher by radio and the supervisor would then learn of the arrival. After the MODAT unit was installed, when a digital signal was sent the dispatcher was informed, but the supervisor remained "in the dark." As a result of these problems, the department decided to maintain only the 20 units currently installed rather than expand.

F. Conclusions

As of mid-1977, San Diego's CAD system was working well. Problems still remained and resources did not permit a complete cost-benefit analysis. Nevertheless, the system was operating.

Just as important in the context of this report as the ultimate operation of the system, is the process of implementation followed by the San Diego Police Department. Those involved in the project placed great importance on human factors. A major effort was made to involve the user in the design, and training of dispatch and telephone personnel was emphasized. Even with this approach, the greatest problems which surfaced were still the "people questions" of morale and motivation. In addition, the San Diego Police Department developed a very effective way to work with the vendor in managing the implementation of technology. Specific criteria to measure success were outlined at the outset of the project, and the vendor was held to these criteria. This was an important step because if police departments fail to set realistic specifications for their new projects, the vendor may demand payment prior to proving adequate performance. Further, the leverage of the San Diego Police was greatly enhanced by its power to withhold payment. Although I would not urge complete flexibility on the part of other funding agencies (such as the LEAA), they should reconsider beefing-up the bargaining power of police departments to permit more effective control over the implementation and management of new technology.

Third and finally, the San Diego case demonstrates that when a department is seeking improvements, all aspects of a system -- in this case the communications system -- and not just new computer technology, must be viewed. The CAD system seems effective, but many of the improvements that the San Diego Police Department has experienced have come from the new telephone system, a system which cost far less than the CAD installation. The most expensive innovations don't necessarily produce the greatest benefits.

CHAPTER IX

SPRINT: COMPUTER-ASSISTED DISPATCH IN THE NEW YORK CITY POLICE DEPARTMENT

J. Mark Schuster and Kent W. Colton

On May 10, 1976, the New York City Police Department (NYPD) went on line with the newest version of its Special Police Radio Inquiry Network (SPRINT). Called "SPRINT II" or "Enhanced SPRINT," this revised system combines computer hardware, computer software, and telephone hardware into a command and control operation that forms one of the most advanced applications of computer technology to police communications in the country. SPRINT II was the result of a SPRINT Development Phase initiated in 1973 to update and improve the SPRINT system, parts of which had been in operation as early as 1968.

Although it is difficult to extrapolate the unique experience of New York City to other cities, the SPRINT system does provide a useful case study of the possibilities and problems associated with the use and implementation of computer-aided -- or, as it is called in New York, computer-assisted -- dispatch. As we pointed out in Chapter II, the rate of the actual implementation of computer-aided dispatch (CAD) systems has been far below initial police predictions. In the 1971 survey, conducted as a part of this study, sixty-one police departments indicated that they would install a CAD system within the next three years. However, when a sceond survey was conducted in 1974, only fifteen departments had operating CAD systems.

New York City, then, was one of the first police departments to implement this use of information technology. Not only is the SPRINT system working 24 hours per day, it has been in existence for seven years. The first criterion we have used for reviewing the use of computer technology -- whether the innovation operates over a period of time -- has clearly been achieved.

In addition, the system has been in existence long enough that many refinements and adjustments have been incorporated into its operation. Such improvements expand the potential of SPRINT to do more than simply rapid, automatic "routine" aspects of the dispatch process but to begin to serve as a management and planning tool. For example, the Management Information Services Division (MISA) of the New York Police Department, which, among other things, is responsible for providing computer systems support to the Communications Division, is beginning to tap the rich SPRINT data base by compiling information on the computer system's operation and by automatically printing management reports on unit allocation and availability, speed of dispatch, and the like. Even though some similar reporting has existed since 1969, the improvements in the system, particularly in software, help present data in a format readily accessible for management decisions.

Three obvious questions remain: How much impact, if any, will SPRINT have on the activities of the police department and even though data are united, how do the benefits of SPRINT compare to the costs?

To address these and other issues, this chapter is divided into five parts: a brief history and outline of the early system development; a description of the first SPRINT system; a review of some important implementation factors involved in SPRINT; a discussion of the enhancements in the SPRINT II system; and some final thoughts evaluating the system.

A. History and Early System Development

A brief history of the NYPD Communications Division indicates that the police department has always tried to stay at the forefront of technological innovations in communication. Before beginning a detailed discussion of how computerized information technology, as embodied in SPRINT, affects the communications and response capabilities of the New York police, it is interesting to take a brief look at the evolution of police communications in New York.[1]

1. The history. In 1651 the "Rattle Watch," a group of citizen-watchmen, used a loud wooden ratchet device to signal alarms while policing their neighborhoods. A "more efficient method of alarm" was introduced in 1741; a bellman swung his lantern and sounded his bell in emergencies. The New York City Police Department has always kept up to date. In electronic communications the telegraph was introduced in 1845, directly connecting all precinct station houses to central headquarters; in 1858 the Dial Telegraph, which enabled police officers to spell out words on a pushbutton console, eliminated the need to learn Morse code; and in 1880 the New York City telephone directory included the first telephones installed in the Bronx, linking patrol officers to the station house by requiring them to "ring" the station at predetermined intervals.

The first communication system that allowed some flexibility in contacting the patrolman on the beat was the "flash-light call system" of 1914: "A recall light, suspended about 25 feet above the street level on a single

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1. For a description of this evolution, see New York Police Department, "The Communications Division," reprinted from SPRING 3100, July-August 1968.

box pole, was activated by the precinct desk officer when he wished to contact the cop on post via the signal box. A civilian could also make the light flash and attract the attention of the officer by pressing a button affixed to the pole."[2] Telephone booth posts were also adopted in 1914. Two officers were stationed at the booth -- one to man the phone and one to respond via bicycle to the scene of the incident.

Truly mobile communications were instituted in 1916 when the first police car was equipped with a wireless radio. This radio required a 30-foot mast supporting an antenna that was as wide as the automobile. More recent innovations in police communications implemented by the New York City Police Department include the first police radio station -- installed in 1920; the first teletype communications system linking headquarters and stations established in 1922; radio receivers in all police cars implemented in 1931; and the two-way radio system set up in 1937. With two-way radios, mobile units could transmit as well as receive messages for the first time. However, all police vehicles did not have two-way radios until 1950.

A single, citywide police emergency telephone number, 440-1234, was adopted in 1964. Again, the police department utilized the latest available technology -- in this case telephone technology -- to minimize dispatch and response time.

Throughout this rapid evolution of police communications in New York City three important factors prompted the police department to continually modify and replace its communications systems. The first is simply the rapid growth in the demand for police services. The law enforcement experience in New York City is, and always has been, removed by orders of magnitude from

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2. Ibid.

similar experiences in other cities. The daily volume of emergency calls and resulting paperwork has always been staggering -- 15,000 calls per day were received soon after the emergency "911" number first became available in 1968.[3] In short, New York always had a need for improvements in the efficiency of the dispatch process.

The second reason for change is the perception, on the part of the police as well as the general public, that improved response times were desirable. The demand for speedier response was highlighted by the 1967 Report of the President's Commission on Law Enforcement and Administration of Justice.[4] This report concluded that the national average of gathering, evaluating, and disseminating information related to each dispatch normally was 1 to 5 minutes and thus accounted for 20 to 50 percent of the total response time. The Commission therefore proposed that improvements in communications handling could result in marked improvements in response time.[5]

The third motivating factor is the pride that develops in the upper echelons of the police department after the implementation of the most modern innovations.[6] Considerable prestige is accorded those at the "cutting

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3. Richard Larson, "Improving the Effectiveness of New York City's 911," in Drake, Keeney, and Morse (eds), Analysis of Public Systems (Cambridge, Mass.: MIT Press, 1972), pp. 151-180.

4. The President's Commission on Law Enforcement and Administration of Justice, The Challenge of Crime in a Free Society (Washington, D.C.: U.S. Government Printing Office, 1967), p. 251.

5. Later in the chapter we will discuss more recent studies that have raised questions about the overall length and nature of response time and the impact that technological innovations might have on response time.

6. This motivation was indicated in personal interviews by Mark Schuster with members of the New York City Police Department, including Inspector James McSloy, Captain Daniel Cawley, Captain Ed Six, all of the Management Information Services Division, and Sergeant Gene Muntzner, Communications Division, on May 18, 1976.

edge" of technology. With new computer technology becoming available, the police department wanted to decide how it could best be used in New York.

2. The Joint Study Group. In 1965 Police Commissioner Leary formed a Joint Study Group to investigate how the police department could benefit from using computer technology. Representatives from the Data Processing, the Planning, and the Communications Divisions of the police department, as well as four IBM representatives including an IBM sales manager, were members of this committee. The Joint Study Group considered all possible computer applications appropriate for the Department.

Its final report identified thirteen different areas for possible computerization:

1. Special Police Radio Inquiry Network (SPRINT): The computer-assisted dispatch system, which is described in detail below.

2. Vehicle Information File: A file of data on stolen automobiles that could be referenced for such information as registration, ownership, color, and make.

3. Crime Analysis: A file containing information on various types of crimes could be used to identify patterns and trends in the occurrence of those crimes.

4. Personnel Files: An automated system to keep track of departmental bookkeeping as well as sick leave, vacation time, personnel scheduling, and such special skills as pilots' licenses and foreign language speaking ability.

5. Telecommunications Network: A system to improve the efficiency of communications through automatic monitoring and switching of incoming calls.

6. Stolen Property File: A data file on stolen property including the general descriptions of the items and serial numbers.

7. Criminal Name File: An "alias" file that includes information on the names commonly used by known criminals.

8. Fingerprint Identification: A centralized, computer-coded fingerprint file for automatic fingerprint identification.

9. Resource Allocation: Mathematical modeling techniques to assist in resource assignments to meet anticipated work loads.

10. Library: A reference file containing all departmental protocols as well as laws, regulations and procedures often required by police officers.

11. Fleet Accounting and Maintenance: Centralized records on the cost and condition of the vehicles owned by the police department, allowing for better planning of repairs and replacement.

12. Program Conversion from 1401 Computer: Revision of programs used on the computer previously owned by the police department.

13. Election Returns: Automated collection and reporting of election returns.

In considering these recommendations, Commissioner Leary identified two basic options -- (1) "commercial" applications and (2) computer-assisted dispatch -- only one of which could be adopted at that time.

In Commissioner Leary's terminology, commercial applications included those types of computer usage which were common to the operation of a wide range of institutions and not designed specifically for the police. They included several such "routine" applications as administration (personnel records, payrolls, fleet accounting, and maintenance), traffic control, and criminal investigation (crime analysis, criminal name file, and fingerprint identification).[7] Computer-assisted dispatch, on the other hand, was a communications-oriented application that would allow emergency telephone operators to quickly transfer emergency information to police dispatchers through computer terminals. In addition, it was proposed that the second CAD path include a basic police patrol and inquiry application. Certain data, such as the stolen property file and the vehicle information file,

7. Chapter II makes a distinction between "routine" and "nonroutine" computer applications. The reader should note that the commercial applications referred to by Commissioner Leary generally can be classified as "routine" use of computer technology.

could be directly accessed by dispatchers responding to requests for information from field units.

The benefits associated with the various commercial or routine applications could be substantiated, at least partially, by the previous experience of vendors. Some analysis, though, had to be done to identify the expected benefits of the proposed CAD system. Four major benefits were expected.[8] First, the public relies on certain indicators to measure the efficiency of police service; among these is response time -- the period elapsed from the time an act requiring police service occurs and the arrival of the police officer at the scene. The Joint Study Group expected that computer technology could be used to minimize dispatch time, a major component of the response time. In New York it was estimated that the 3- to 5-minute dispatch time under the decentralized handwritten dispatch system could be reduced to between 1 and 1.5 minutes under the proposed computer system. The second and third expected benefits of the CAD system were the availability of better information on the dispatch process and the use of this data to improve management of the monumental amounts of paperwork and record keeping involved in the Communications Division. The fourth anticipated benefit was improvement in the overall control of the dispatch procedure. Workloads would be more evenly distributed, problems could be more quickly identified, improved operating standards and procedures could be implemented, and available resources could be automatically identified.

3. The commitment to computer-assisted dispatch. In 1967 Commissioner Leary decided to implement computer-assisted dispatch as the first major

8. The analysis of the original objectives of the SPRINT system were derived from personal interviews with members of the NYPD. The primary interviews are listed in Note 6.

computer application within the New York City Police Department. The four goals implicit in that decision were the benefits discussed previously: (1) lower response rates through a reduction in dispatch time, (2) availability of better information, (3) improved management of information both to simplify record keeping and to make better data available for management decisions, and (4) increased control over the entire dispatch procedure, which was becoming increasingly unwieldy under the manual system.

Two specific modules were selected for immediate development: the Special Police Radio Inquiry Network (SPRINT) and the Vehicle Identification File (VIF), a subsystem of SPRINT that featured a police patrol and inquiry file of New York City stolen vehicle information which could be accessed by the radio dispatchers. Eventually a data link to the National Crime Information Center (NCIC) was also added.

The 1968 capital budget for New York included nearly $5 million in city funds designated for the development of SPRINT and VIF. Of this total $1.7 million was for software development and the remainder was for hardware purchases. No resources from the Law Enforcement Assistance Administration (LEAA) or its predecessor, the Office of Law Enforcement Assistance (OLEA) were involved in catalyzing this computer installation. Federal money has often been a primary stimulant for technological efforts; however, it has sometimes shaped the project in a different direction than the community might have chosen if it used only its own funds. When the grant ends, the loss of federal money sometimes results in the dismantling of projects where the local community had little long-term commitment. Neither factor affected the New York City program. The system chosen and funded was a response to a felt need and a firm commitment within New York City government, which is reflected by the city's willingness to pay for the system.

Contracts with outside suppliers were signed in December 1967, with the expectation that the centralized SPRINT computer-assisted dispatch system would be in place by January 1970. While the police department was considering its future computer needs, the telephone company was also working on the improvement of emergency telephone communications. In January 1968, AT&T announced that the long-awaited 911 emergency assistance number was available. This new centralized number quickly became an integral part of the SPRINT system, replacing the previous centralized number, 440-1234. The 911 number made the commitment to computer-assisted dispatch even more visible and innovative, helping to improve the public image of the NYPD.

Other noncomputer improvements in the communications system were also being developed at the same time. As early as 1964, Police Superintendent of Telegraph William J. Kanz had submitted a plan for centralizing and coordinating the communications and dispatch functions of the police department.[9] Sections of this plan meshed particularly well with the proposed SPRINT system. The department also improved internal communications by converting a Centrex telephone system that allowed general direct dialing to any extension and thereby eliminated the main switchboard and operators.

4. Centralized dispatch and 911. Both prior to SPRINT and later in coordination with SPRINT, the Police Department had decided to consolidate its dispatch functions. By 1967, plans were under way to centralize emergency requests and dispatch for all boroughs in one room at Manhattan headquarters. On July 1, 1968, Mayor John Lindsay and Police Commissioner

9. New York Police Department, "The Communications Division," op. cit.

Leary dedicated the first communications and dispatch system that combined the concept of centralized dispatch with the newly available 911 emergency number. SPRINT was added to this system later.

The general operation of the system can be briefly outlined.[10] Incoming 911 calls were automatically distributed to one of twenty-four primary operator positions. A light on the selected telephone console signaled the operator that a call was waiting, and a color code indicated the borough of origin. After determining the nature and priority of the call, the operator had three basic options:

(1) If the incident was very serious, the operator could contact the dispatcher immediately by pressing one of the borough hot line buttons on the console.

(2) If the incident warranted priority attention, the operator would fill out a three-part dispatch form and deposit the slips in the appropriate channel of a highspeed, 12-channel, color-coded conveyor belt that linked the operator positions to the appropriate dispatcher positions. This step was also followed for very serious incidents so that a written record of the incident and its disposition would exist.

(3) Nonemergency and particularly complicated calls would be transferred to one of 24 secondary operator positions for processing. These secondary operators could also process priority calls when the system was congested.

Each dispatcher used an electrically controlled car file--system of slots with switches that triggered a series of car availability lights when dispatch forms were inserted--to update information on the illuminated map of the dispatcher's patrol division. The lights indicated which cars were busy on assignment. A dispatcher arbitrarily selected the "nearest" available car to respond to the current call. (Determining the "nearest" unit involved a basically subjective judgment. The unit responsible for the sector in which the incident had occurred was assigned if it was not busy.

10. For a more detailed description, see ibid.

Otherwise, cars from any of the adjacent sectors would be dispatched.) After radio dispatching a Radio Motorized Patrol (RMP), the dispatcher slid the dispatch form into the slot that corresponded to the dispatched vehicle, automatically switching on the assignment light. When final disposition was radioed in from the RMP, the card was removed, the disposition recorded, and the card was forwarded to the citywide radio room supervisor for filing.

This system, which turned out to be only an interim facility, was financed entirely out of the department's capital budget at approximately $1.2 million. The new radio room equipment cost $600,000 and renovations, including the conveyor belt system, cost another $600,000 (The Centrex telephone system cost an additional $105,000.)[11]

Despite the vestiges of the manual system, this new procedure improved the coordination and speed of dispatch and laid the groundwork for a gradual implementation of SPRINT. This interim system was an important precursor to SPRINT in several respects: (1) even though it was not computerized, it familiarized operators and dispatchers with computer formats and coding forms; (2) it provided valuable experience in implementing and testing centralized dispatch; (3) it clarified the division of responsibilities that later were incorporated into SPRINT: (4) its manual aspects were retained as a backup for the SPRINT system; and (5) it paved the way for using civilian personnel in the Communications Division.

The 911 system also led to at least one not wholly anticipated consequence. The opening of the new central communication room (CCR) triggered a flood of incoming calls--15,000 per day during the summer of 1968. These

11. Ibid.

calls included requests for police service as well as calls from individuals who were interested in finding out whether or not the system actually worked.[12] In large part this increased demand resulted from the fact that 911 had been marketed to the citizens of New York as being able to provide an "instant cop."[13] As a result of these rising expectations the system experienced periods of congestion, and complaints were received both from citizens and operating personnel.

Consultants from the RAND Corporation in New York were called in to perform the first of a series of studies to improve operations within the emergency communications system. Larson identified two major problems with the system: (1) not enough personnel were assigned to the turret (telephone) operator positions, and (2) too many calls were being handled as emergencies, thereby generating an unusually large number of patrol car dispatches.[14]

Of the 48 turret operator positions (24 primary and 24 secondary) often only 20 to 30 were manned. Although the number of operators was adjusted by time of day, the variation did not adequately reflect the changing rate of calls received per hour. Changes in daily rates of calls were also not generally taken into consideration in scheduling operators. Therefore, during certain periods of the week (for example on Friday and Saturday nights) large delays were regularly experienced whereas there

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12. Unfortunately, only fragmentary data exist prior to centralization so comparisons are based primarily on impressions.

13. Derived from interviews by the authors with personnel from the New York City Police Department.

14. Larson, "Improving the Effectiveness of New York City's 911," op. cit., p. 157.

were virtually no delays during other periods of the week. After considering existing manpower assignment levels and operating characteristics, Larson recommended a revised operator allocation procedure. This procedure was designed so that it could also be used after the implementation of SPRINT, benefiting directly from its increased statistical collection capabilities. As the assignments of turret operators and dispatchers were changed, this scheduling flexibility was returned.

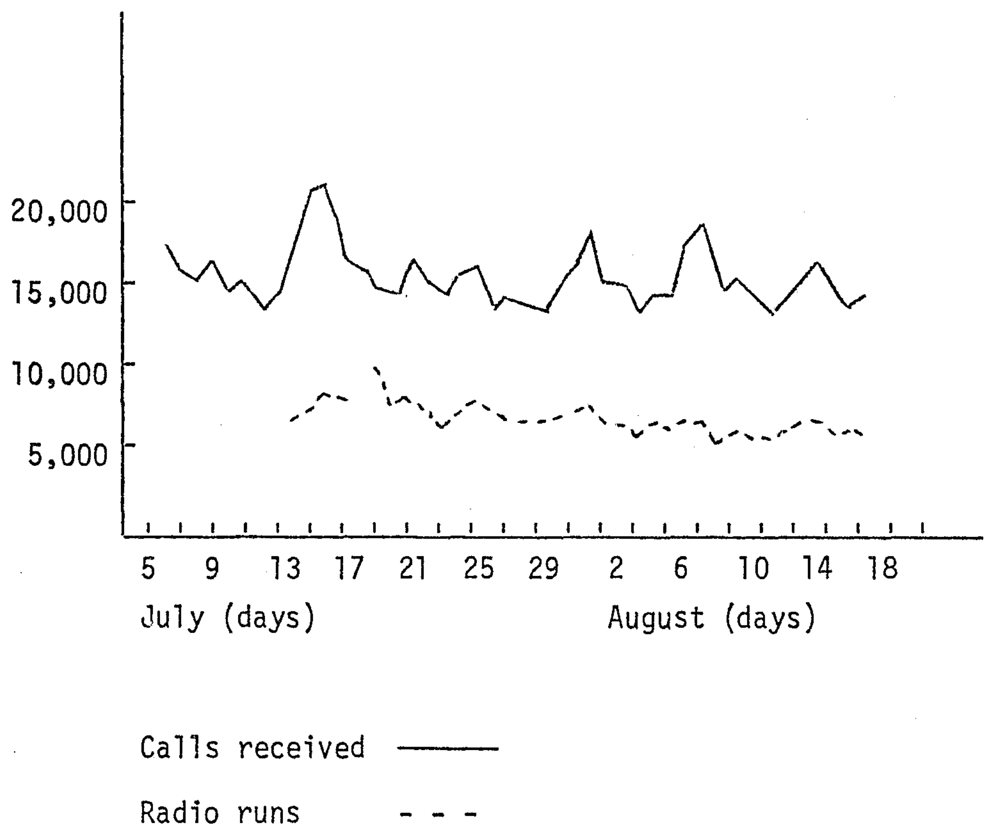
The police department was also concerned that too many emergency calls resulted in dispatches under the new system. RAND investigated possible explanations. When CCR opened, the police department decided that civilian police trainees (at an annual salary of $4,500) would be assigned to the primary positions while uniformed patrolmen (at $11,000) would be assigned to the secondary positions. This decision reflected the belief that emergency call processing was straightforward and that more complicated nonemergency calls should be transferred to policemen at the secondary positions.

Data for the number of calls and the number of radio runs (dispatches) were collected daily during July and August of 1968 (see Figure 9-1). Larson emphasized the following characteristics of these data:[15]

- Emergency calls follow a weekly cycle; most calls are received on Saturdays.
- The number of dispatches per day varies less than the number of calls, indicating that a greater fraction of lower priority calls are received during busy days or, more likely, that the dispatch priorities of the system are adaptive and that cars are not dispatched for some marginal calls during busy days.
- The mean number of calls received per day is approximately 15,000;

15. Ibid., pp. 157-158.

Figure 9-1: Number of 911 calls received and radio runs per day (New York City, July-August 1968)



radio runs average between 7,000 and 8,000. Roughly 50 percent of the calls result in a dispatch. This percentage, however, decreased gradually over the two-month period. There were two likely causes for this decrease: (1) the department had decided not to dispatch cars to certain low priority calls; and (2) the civilian trainees were getting better at screening out nonemergency calls (reports of open fire hydrants, for example).

Thus, the early experience with centralized communications and dispatch indicated how rigorously collected data that were readily available in the centralized system and that had not been available for the old burough dispatch system could steadily help improve the system. This experience also pointed out the importance of the human element in the success of such a system. Operator and dispatcher training and behavioral conventions have a direct and significant influence on system operations.

Numerous incremental changes have been made since the implementation of SPRINT to minimize congestion. Such changes include revised screening procedures (new decision rules for dispatch), gradual elimination of the secondary operator positions, and referrals of certain jobs to local precinct houses.[16] In 1974, the Communications Division reported that dispatches had fallen from a daily average of 7,300 before screening to an average of 6,700 after screening.[17] However, more recent data indicate that since this 1974 low, there has been a return to around 7,000 dispatches per day, and that this range has been remarkably consistent. In 1975, there were approximately 7,100 dispatches per day, and from February 1, 1976, to January 31, 1977 the mean number of dispatches per day was

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16. Pete-Kolesar, "Algorithms for Alleviating Saturation of New York City's computerized 'SPRINT' Police Dispatching System," (New York: New York City RAND Institute [R-1695-NYC], July 1975).

17. New York Police Department, "The New Communications Division," reprinted from SPRING 3100, May 1974.

7,157.[18]

The daily ratio of dispatches to actual calls received between 1974 and 1976 stayed approximately constant at 41 or 42 percent.[19] For example, between February 1, 1976 and January 31, 1977, 17,294 "911" calls were received per day (as compared to an average number of dispatches per day of 7,157), with a ratio of dispatches to calls of 41 percent.[20]

B. The Operation of SPRINT (I)

SPRINT was inaugurated on October 20, 1970, twenty-eight months after the centralized Communications Division was opened and thirty-three months after the initial contracts were signed. Before going citywide, the entire system had been tested on dispatches in Bronx for a full year. The start-up in October 1970, was eight months later than originally scheduled, but considering that SPRINT was the first real time CAD system in the country for a large metropolitan police department, such a delay is not excessive.

The initial SPRINT system resembled the interim conveyor belt system in many respects. In fact, a superficial consideration would indicate that the only change that had been made by implementing SPRINT was that the computer and its peripheral devices--primarily the Cathode Ray Tube displays (CRTs)--had replaced the conveyor belt system for efficiently

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18. Letter from Inspector James M. McGoey, Communications Division, to Kent W. Colton, March 3, 1977.

19. Pranay Gupte, "Calls Swamp Police 911 Emergency Line," The New York Times, 19 August 1976, p. 1, and interview between Mark Schuster and Police Administrative Aid Barney Puleo, NYPD Communications Division, March 9, 1977.

20. See note 16.

transferring incident information from the operators to the dispatchers.

However, several rather sophisticated refinements have been included. Still, the communications and dispatch system in New York City is primarily the product of incremental rather than major changes. For example, the SPRINT system contains no capacity for locating police cars, such as an Automatie Vehicle Locator (AVL) or Automatic Vehicle Monitoring (AVM) system. These systems are discussed in greater depth in Chapter XI. Even with the advent of on-line computers, the operation of the system only changed in minor ways. In fact, it seems that the major modifications in the Communications Division were made as a result of a new set of underlying assumptions about how emergency services should be delivered after centralization (aided first by 440-1234 and later by 911) and civilianization. These modifications were made before any serious work on the SPRINT system.

This is not to say that such "incremental" changes were not traumatic to the personnel charged with operating the system. For example, teaching patrolmen to type so that they could efficiently use the CRTs was sometimes difficult, but it had little effect on the basic logic and operation of the system.[21] The SPRINT system was a further institutionalization of the previous manual systems, many vestiges of which are still in evidence.

Before discussing the various components of the SPRINT system in detail, a brief summary of its operation is appropriate. Figure 9-2 illustrates the information flow through SPRINT.[22]

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21. Personal interviews, New York City Police Department, May 18, 1976. See note 6.

22. James Tien, "A SPRINT Based Dual Radio Network for the New York City Police Department" (New York: New York City RAND Institute [Wn-8002-NYC], December 1972).

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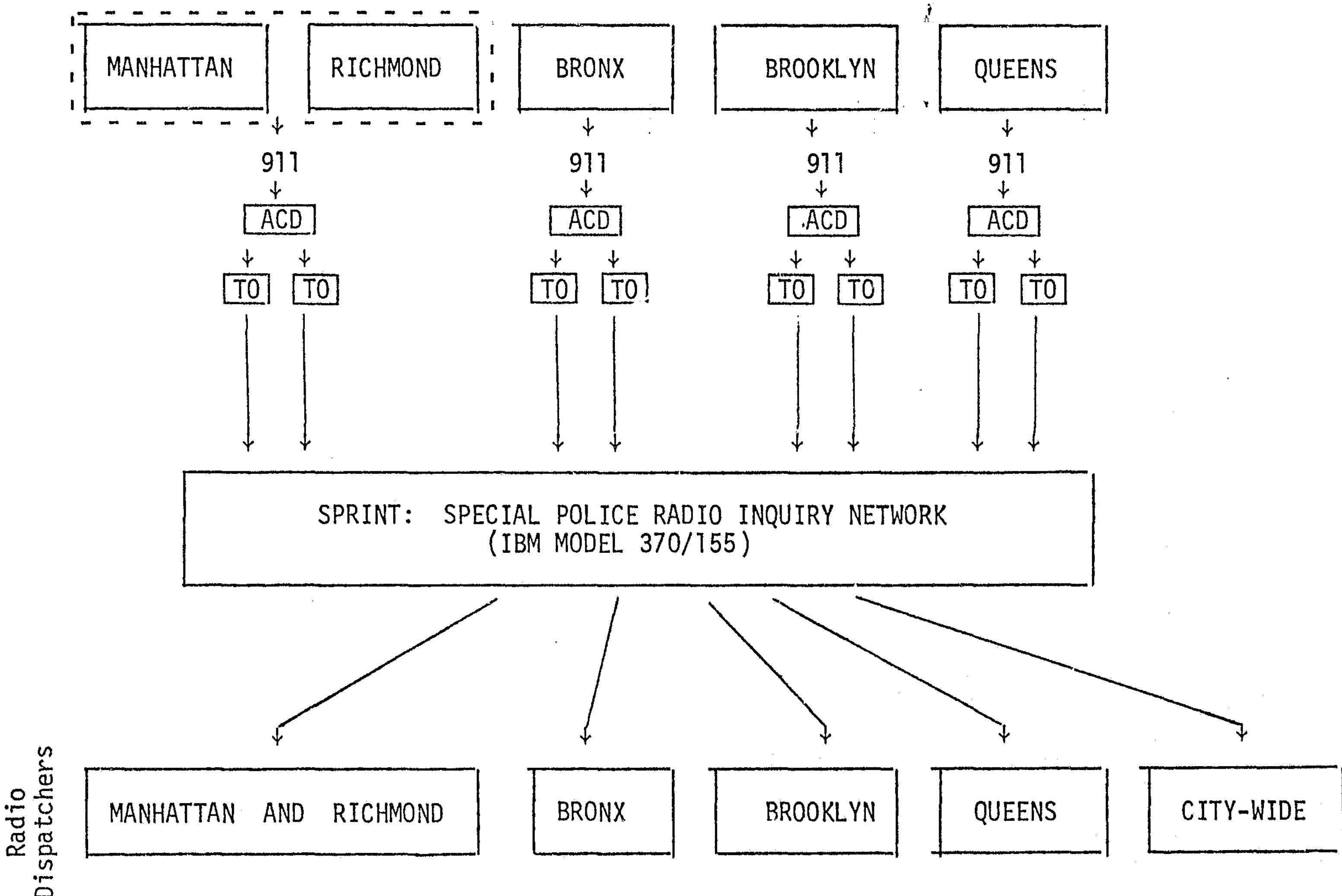
Figure 9-2: Communications Flow with the 1973 NYPD SPRINT System



Note: ACD means Automatic Call Distributor and TO means Turret Operator

Calls coming in on the 911 lines are assigned by the Automatic Call Distributor (ACD), which constantly polls the operator positions that are presently manned and seeks the first available turret operator. The turret operator, using the SPRINT system and the CRT, enters an emergency call message into the computer. This message along with a list of available RMPs is displayed on a CRT in front of the appropriate division radio dispatcher who radios the information to an available RMP. The RMP then responds to the call. When the case is completed, a final disposition is radioed back to the dispatcher who then enters this information into the SPRINT system.[23]

1. The phone system. The Automatic Call Distributor (ACD) allocates the workload among the operators by polling operators' positions until it locates one which is not servicing a call. Originally the ACD picked any operator and indicated the borough of origin for each call by lighting up the specific borough light on that operator's console and by playing a prerecorded message which announced the borough before the caller was actually connected. When the Communications Division moved to the new Police Headquarters at 1 Police Plaza on October 1, 1973, operators were assigned to specific boroughs and, except during system congestion, received calls only from those specified boroughs. This revision allowed operators to become more familiar with the area of the city to which they are assigned. In addition, primary and secondary positions were gradually phased out; all operator positions are not "primary" positions, staffed by a mix of police and civilian personnel.

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23. For a more detailed description of the SPRINT System, see New York City Police Department, "Communications Center," undated brochure, and New York City Police Department, "The New Communications Division." op. cit.

2. Incident description. The turret operator ascertains the nature of the call and enters the relevant information into SPRINT via his terminal if a dispatch or a rerouting of the call is required. This information is typed according to a predetermined fixed field computer format with allowances for free form comments. The Total Incident Display also includes any other details of the incident that the operator deems pertinent.

3. Geocode file. When the operator has completed the incident description, he presses the "enter" key on the terminal, which initiates several automatic error checks. First, the system does a field check to see if all field that it expects to be filled with data are filled. Second, the system corroborates the street address and automatically identifies the precinct and sector of the borough in which the incident is occurring, as well as the hospital area by looking up the address in a geocoded file. This file associates specific street addresses with precinct and sector numbers.[24] (For police purposes, the city is hierarchically divided into areas, zones, precincts, sectors, subsectors, and patrol posts.)

4. Master resource file. Once the precinct and sector of the incident have been determined, the computer checks which units are available to service the call. The Master Resource File contains updated information on all

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24. Three special computer reference files assist this location process and help eliminate human error: the alias, place name, and misspelling files. The alias files cross-reference all streets whose names have been changed. For example, elderly callers may only remember an old name for a particular street but SPRINT will process the call according to the new street name. The place name file includes exact addresses of 13 categories of places including schools, hotels, and parks. The misspelling file includes the most common misspellings of street names and automatically corrects operator spelling errors.

units under SPRINT's control. At the beginning of each eight hour police tour the file is updated by the dispatcher to include only units in operating condition. In addition, as units are dispatched, various programs keep track of their status.

The computer automatically nominates several cars as candidates for dispatch to a particular incident. (Originally it nominated three; now five are selected.) If an RMP assigned to a particular sector is busy or out of service the computer nominates cars in adjacent sectors.

5. Dispatch. The computer next displays a one-line summary message on the precinct dispatcher's CRT. The summary message includes the nature of the call, its location, and the precinct sector cars nominated by the computer. These messages are listed in order of their priority. Originally, priority assignment was on a binary basis -- priority or no priority -- but SPRINT II (see Section D) includes seven different priority levels. The operator can scroll the messages up and down the screen to see every incident presently in his dispatch queue, and he can request the Total Incident Display when he is dispatching a particular job. Using a specific radio frequency, the dispatcher then assigns a patrol unit to the incident.

When this happens, the Master Resource File is updated and the unit is given "on assignment" status. In addition, a clock begins keeping track of how much time the patrol car spends on the incident. If the unit does not respond within a half hour, the dispatcher's terminal displays an "overdue resource" message, reminding the dispatcher to contact the unit to see if further assistance is necessary. The clock restarts every time a unit calls in and an interim message is entered into the computer by the dispatcher. When the call is completed, the patrol car radios the dispatcher with its final disposition and the unit is returned to "available" status.

6. <u>Taped records.</u> The SPRINT system is monitored by a two-level voice taping system. Each turret operator position is equipped with a message repeater that automatically records the last three hours of conversations on a continuous loop of tape. The operator can play back this tape at any time to verify previous conversations. This feature is particularly helpful when the caller is hysterical or speaks very quickly.

All messages received by operators and sent out by dispatchers or patrol units are recorded on master tapes. Five 40-track tapes constantly monitor these communications. The master tapes, which are stored for at least 90 days for future reference and documentation, are often subpoenaed for evidentiary purposes in criminal trials.

7. <u>Other routings</u>. Often emergency calls involve other agencies besides the NYPD. Although dial transfer was partially available previously, SPRINT has the capability to handle a number of automatic routings quickly. For example:

- On a fire call, the operator connects the caller directly to the fire dispatcher who ascertains the appropriate Fire Department response while the police dispatcher is using SPRINT to dispatch a police unit to the fire.
- Requests for ambulances are automatically routed to dispatchers from the New York City Health and Hospital department. They use their own screening procedures in deciding how to dispatch units to such calls.
- Operators can automatically route emergency requests from Spanish-speaking callers to multilingual operators who handle approximately 300 such calls each day.

The system also can provide access to other information files. The Vehicle Information File can be directly accessed by a dispatcher to check on stolen car inquiries. Other files such as the New York State Police Information Network (NYSPIN) and the National Crime Information Center (NCIC) presently require manual off-line requests for searches.

Another routing of SPRINT involves the Central Complaint Desk (CCD), which was established to exercise control over all criminal complaint reports. It was formed in response to pressure from the FBI, which wanted the NYPD to comply with the FBI's Uniform Crime Reporting Standards and to remove the temptation and the opportunity to suppress crime reports. The CCD procedure presently involves a complicated series of checks and balances. The Central Complaint Desk and the Precinct Desk each assign different numbers to each crime (in addition to the separately generated SPRINT job number). Much effort is spent on reconciling these different sets of numbers to ensure that each crime has had final disposition and has been recorded properly.

The RAND Corporation has suggested that a SPRINT-based single-number reporting system replace the CCD procedure. This recommendation (still unimplemented) would make more efficient use of the computer, save manpower, and provide a more complete incident report. In discussing the CCD routing, the authors of the RAND report concluded, "Despite the availability of a computerized dispatch system, the current report control procedure resembles the manual, pre-computer procedure that was established in response to a recommendation made in 1952....[25] Changes in the CCD procedures, even after computerization, have been small and tentative and are an example of how slight an impact the SPRINT system has had on certain aspects of the communications and dispatch functions.

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25. James Tien, Lt. James Mills, and Lt. Samuel Marino, "A SPRINT Based Single Number Reporting System for the New York City Police Department: Preliminary Analysis" (New York: New York City RAND Institute WN-8003-NYC, January 1973); and Bruce Smith, Project Director, "The New York Police Survey: A Report for the Mayor's Committee on Management Survey" (New York: Institute of Public Administration, 1952).

8. Other features. Two other features of the SPRINT system deserve mention: multiple call handling and system backup. Several methods are used to eliminate confusion arising from situations in which multiple callers report the same incident. The operator can route the incident display into a "turret queue" if he feels that the incident will cause multiple calls. This incident then shows up on all borough operators' CRTs. Information can then be added by other operators and automatically transferred to the dispatcher. The dispatcher has the capability to link jobs together if he suspects and confirms that they are the same incident. The dispatcher can also call up and compare the Total Information Displays or can query the computer by street address to get a listing of all active (or past) incidents at that address.

Although the Management Information Systems Division has done an excellent job of keeping the system operating, the possibility of system failure makes a backup system necessary. Constant hard copy information about the status of the system gives fall-back data and a simplified conveyor belt and handwritten dispatch form system (modeled on the interim system) can be placed in operation if necessary.

C. The Implementation of SPRINT I

The SPRINT system was installed in October 1970. This was eight months later than the initial schedule had anticipated, and thirty-three months after the first contracts were signed. However, considering the uniqquness of the system -- SPRINT was, in essence, the first police CAD system to be installed in the nation -- and the fact that almost all technological innovations seem to include time lags, which are often longer than eight months, the delays involved with SPRINT are not surprising. The SPRINT system had been designed initially with certain expected workloads in mind. Much of this design was completed before it was clear that 911 would be not only available but also would dramatically increase the volume of requests for police service. Such volume increases required a reassessment of SPRINT to ensure the CAD system was adequate. One particular component of the system that took a long time to develop, test, and continuously revise is the geographical data base file which links street addresses to the appropriate precincts and districts. For a city the size of New York, developing such a file is a huge job, and, once the initial data base is developed, it requires regular updating as street addresses and locations change.

Perhaps more important in understanding the delays, though, is the fact that SPRINT is a complex system not only from a technical perspective but from a behavioral dimension. The installation of the communications system required detailed interaction between the Communications Division, the Management Information Systems Division (MISD), and police personnel in the field. This type of coordination requires time. Further, personnel in the Communications Division were attached to the old manual system. When SPRINT was first tested in the Communications Center on a trial basis, the system failed. The response from the personnel who were at work at the time was an instant cheer. Time is often required to overcome this type of inertia.

SPRINT has been in operation for seven years though and the system is well established in the New York Police Department. MISD personnel were asked why the implementation had succeeded. Four primary reasons were cited.[26]

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26. Interviews on February 9, 1977, between Kent Colton, Mark Schuster, and Captain Richard Noonan and Sargeant Vito Passannante of MISD, NYPD.

First, SPRINT was developed from a technological system that was already working. It was patterned after an airline reservation system developed by IBM, which allowed an important head start in design and programming. In addition, the NYPD was satisfied with the selection and work of the vendor and with the experience which they brought to the effort. Second, the MISD felt that there had been a consistent commitment from top city officials including the mayor. Third, the police department had made a long-term commitment of their own time and resources to SPRINT. As a consequence, a competent team of police personnel had been assigned to work with the vendor and to maintain the system. Fourth, the human element was not neglected in the implementation process. Personnel in the Communications Division received intensive training. Probably more important, though, over the last seven years an almost complete turnover in the composition of the Communications Division helped ensure acceptance of SPRINT. Whereas in 1970, almost 100 percent of the personnel manning the NYPD communications operation were police officers, in 1977 about 80 percent are civilians. Because the new personnel have been trained only with the new system, there is no longer a problem with attachment to old methods. As one MISD officer put it, "Now the people in communications couldn't do without SPRINT."

D. SPRINT II -- Resource-Oriented Computer-Assisted Dispatch

The major revision of SPRINT, called SPRINT II or Enhanced SPRINT, was the New York Police Department's first comprehensive attempt at improving the operation of the SPRINT system.

The commitment to major revisions in SPRINT was first made in 1973 when a development phase was initiated. Primary needs evident at the time included the need to increase SPRINT's capacity and the desire to keep up with the state of the computer art. Both concerns were evident in the biggest hardware change, a switch from the IBM 360/40 to the IBM 370.

As was the case previously, the development phase was funded entirely out of the city's capital budget. Hardware and software costs were $11.8 million. Software contracts included among others $600,000 to IBM, $1 million to Greenwich Data Systems, $1 million to Action Corporation, and another $350,000 to IBM for systems support. Hardware contracts included $5.25 million to IBM, $1 million to Olivetti, and $200,000 for the purchase of Modems.[27] Again, no LEAA funding was directly involved in the SPRINT system. Although grants for the development of other computer applications have been received by the NYPD from LEAA, they have not been directly related to the SPRINT system.

The SPRINT Development Phase identified twelve desirable improvements in the system. These "enhancements" included both hardware and software changes. On May 10, 1976, the Police Department went on-line with the modified SPRINT system (SPRINT II). Nearly all the enhancements, discussed briefly below, were implemented at that time.[28]

1. Expanded incident codes. This enhancement includes more detailed incident and disposition codes and additional automatic recording of the status of the field units. Expanded incident codes include qualifiers

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27. Ibid.

28. Internal document from Inspector James McSloy, MISD, NYPD. Subject: "Current Development Projects/SPRINT Enhancements." Undated.

indicating whether an incident is inside or outside a building and the type of building (for example, B=bank, C=commercial). By including this information crime patterns can be better investigated and improved preventive measures, such as vertical patrols in certain high-rise buildings, can be implemented. Also, newly included is the supervisor's ability to vary the system's time parameter for flagging overdue resources. Previously this was fixed at 30 minutes.

2. Incident message routing. Improved automatic message routing to other agencies and desks relieves some of the demand on dispatchers. The computer automatically checks a routing field in the Total Incident Display and routes the information to CRTs or printers located in different agencies or at different police desks. One aspect of this enhancement which is not yet fully operational is an extensive Field and Administrative Terminal Network (FATN) which will place terminals in all precinct stations and low priority incidents will be automatically routed to precincts where available patrol units will be assigned on a non-priority basis.

3. CCD and notification. Precinct terminals are now also used by precincts to account for crime complaints independently of the Central Complaint Desk (CCD) in the Communications Division. SPRINT communications to the precinct are handled via a "Front-End Communication Controller" which significantly simplifies reporting crime statistics by eliminating much of the manual cross-checking necessary in earlier systems. As a result, the CCD, one of the least innovative components of the SPRINT system, will be eliminated (see Section B).

4. Split-screen dispatch terminals. Improved software and hardware (larger Raytheon CRTs) allow more information to be displayed on the dispatchers' terminals. An updated list of incidents to be serviced appears

on one side of the terminal and the split screen saves room for dispatcher work space and incident reference on the other side. SPRINT II includes seven different job priority levels that are automatically generated by the computer from the incident code. The jobs are placed in a first-in first-out "queue" within priority levels, and this queue is automatically displayed on the dispatcher's terminal. Thus, neither the turret operator nor the dispatcher needs to sort the job or the queue. This removes the necessity of repeatedly changing the display, and dispatcher time is focused more on dispatch and less on information retrieval. (An internal operational analysis has shown the most used function of SPRINT I to be the "queue caller." As a result of these staff studies the dispatch display was redesigned to minimize such use.)

5. Flexible dispatcher queue allocation. Under SPRINT I, incidents were routed to dispatcher queues according to the precinct of occurrence, and a dispatcher was defined as responsible for a particular set of precincts (which did not have to conform to police jurisdictions). In SPRINT II this precedure has been modified: supervisors can now monitor workloads and redefine precinct routings to dispatchers. Incidents are automatically moved and routed to the applicable queue. This gives the supervisors management responsibilities for monitoring the operators' emergency call queues.

6. Terminal control facilities. This enhancement provides improved information about the current status of terminals -- specifically, what types of information each terminal is presently sending and receiving. Dynamic capabilities are provided to monitor and redefine the type of information being sent to and from each terminal in the system. Split screen terminals, precinct terminals, and terminals in external agencies are included.

7. Dispatcher recovery. Improvements in backup capability include enhanced printer capabilities. All incidents, additional entries, resource assignments, and dispositions are immediately output in printed form. A summary outlining pending incident status and any backlogs is printed periodically for each dispatcher so this information is readily available should the system fail making manual operation necessary.

8. Terminal operator training. For the first time, on-line training facilities are available for turret operators. Any terminal can be designed by the supervisor as a training terminal and trainees process calls that are being handled simultaneously by another, trained operator. This improvement makes all system functions available without disturbing or changing system data or systems operation. Previously, training was conducted on-line, with trainees handling actual calls rather than in simulations.

9. Sensitive/hazardous location file. The location data base file can be modified to indicate particularly sensitive or hazardous locations such as buildings under police surveillance or buildings where tenants are particularly hostile to police activity. Updating can be done on-line by authorized personnel, allowing for the inclusion of the most current information. This information is automatically displayed on the dispatcher's terminal when an incident is reported at one of these locations and the dispatcher informs the field unit about the potential hazards. A limited version of this file was included in SPRINT I.

10. Resource assignment and nomination. This enhancement includes several SPRINT modifications. For example, scooters and foot patrolmen are added to RMPs and are available for SPRINT dispatch. As a result SPRINT II has been characterized as a "resource-oriented" dispatch system, as opposed to SPRINT I which was "RMP-oriented." The change increases SPRINT's ability to

coordinate all police units.

A maximum of ten alternate available resources are listed as backup to the primary nominee. Previously, a primary resource and three alternatives were listed. A different nominating scheme can be implemented for each resource type, which gives precinct commanders better capability to plan dispatch strategy.

For the first time, SPRINT will keep track of multiple incidents assigned to a single resource. In other words, an RMP can be assigned multiple jobs. Further, precinct personnel are allowed precinct-controlled resources which they can dispatch to incidents.

11. <u>Expanded reporting capability</u>. Recently the data in the SPRINT system has been tapped for analysis and management purposes (see Section E). This enhancement expands SPRINT's ability to furnish such information. Selective sampling of the current state and activity of the system can be requested at any time by precinct or by dispatcher. Such information includes terminal status, length and content of queues, resources on duty, resources available, logged records of incident codes, final disposition, duplicate calls, queue delays, service times, and failures to respond.

12. <u>Front-end and inquiry support</u>. SPRINT will eventually communicate with other police data bases through an automatic interface via the Front-End Communication Controller. Links will be made to the NYSPIN, NCIC, DMV, and DCJS systems. This enhancement will eliminate manual off-line procedures presently in use and thereby improve response time. However, this enhancement has temporarily fallen victim to budget cuts because it is primarily dependent upon hardware and outside vendors. MISD has indicated that it might do the necessary programming in-house to speed up the implementation process rather than relying on outside consultants.

Thus, SPRINT II presently includes nearly all the software changes for each enhancement. Although those which required hardware or outside consulting have not been completed because of New York's recent financial crisis, completion is still a department goal for employees of both the Communications Division and the Management Information Services Division.[29]

E. Evaluating the System

The SPRINT system has been in operation for almost seven years. One set of major modifications or enhancements has already been made to the system. In this report one of the criteria for evaluating technological innovation is simply whether the innovation meets the test of use over a period of time. There is little question that SPRINT has met this fact and become an integral part of the activities of the New York Police Department. In addition, from a technical perspective the system seems to be operating well. According to NYPD statistics, SPRINT I was up and in operation 98 percent of time and SPRINT II is working essentially 99.3 percent of the time.[30]

The questions that remain, then, go beyond the operations of the system and raise issues concerning the actual benefits and utility of SPRINT. Have the initial objectives of the system been met? What about service and power structure effects? Do the benefits justify the costs?

The primary obstacle in trying to answer these questions is that good

29. Interviews May 18, 1976 and February 9, 1977.

30. These figures were obtained in interviews at the NYPD on February 9, 1977. The 99.3 percent figure for SPRINT II, refers to the average percentage of time the system is "up." Included in the 99.3 percent figure, though, is some planned down time for regular system maintenance. In other words, the SPRINT II system is out of operation on an unplanned basis only 0.7 percent of the time.

data are not always available, particularly in trying to do a "before-after" comparison of the new dispatch system. Virtually no data were collected and preserved systematically before the implementation of SPRINT. Even information gathered within the last seven years does not always provide adequate answers. For example, in some areas the data do exist within the system but the software to extract the data in usable form does not, particularly for SPRINT I. SPRINT II, on the other hand, yields more extensive information. When the system was first implemented, the overwhelming pressure was to alleviate congestion in the dispatch system. The result was a primary effort to achieve the appropriate changes rather than to gather information to analyze these modifications. The information found on SPRINT operations, then, is somewhat piecemeal and idiosyncratic. RAND studies provide some data although they were generally specific analyses of particular problems and include only data on the time period in question, not for a long span of the system's operation. Other data come from the MSID and the Communications Division, but even they are illustrative of a particular time. Therefore it is extremely difficult to cast the evaluation in the most appropriate one-group pre-test, post-test experimental design. Such limitations do not mean that we cannot make informed observations about the operation of SPRINT, however, it suggests that some of these observations must rely upon subjective information. With this qualifier in mind, the impact of the system can be reviewed.

When the decision to implement SPRINT was made, four objectives seemed implicit: (1) availability of better information; (2) increased control over the entire dispatch procedure; (3) lower response time through a reduction in dispatch time; and (4) improved management of information and management decisions within the department. Each of these will be examined below.

1. Availability of better information. It seems clear that better information is available as a result of the SPRINT system. This is a technical benefit, and written documentation, both in summary reports generated by the system and active incident information within the system, has been greatly improved. The manual aspects of dispatch that were the source of many dispatcher inconsistencies have been minimized by the necessity to conform to rigorous computer formats and requirements. For example, except for the manual system backup, which is very rarely used, all handwritten dispatch slips have been eliminated. The automated files allow the dispatcher to rapidly access police patrol and inquiry information on outstanding wants and warrants and to provide that information to officers in the field. Also, the automatic error checks built into the system have improved the quality of the information being transmitted. These checks were too unwieldly to be included in a reasonable manual system; They can now be done efficiently by computer.

Other dramatic improvements are related to the ability to retrieve information from the system. The stages in the SPRINT dispatch process are outlined in Figure 9-3. Computerizing the dispatch procedure means that data concerning the various stages of the process are stored in the computer, and with proper software development this information can be utilized for systems analysis. As a result, data should become more available than they have been in the past. Improvements in the system can be made on the basis of studies like the operational analysis that led to the split-screen enhancement in SPRINT II. Further, the greater availability of information means that there are more data to use in allocating and managing department resources. The potential exists; the question now is whether it will be used.

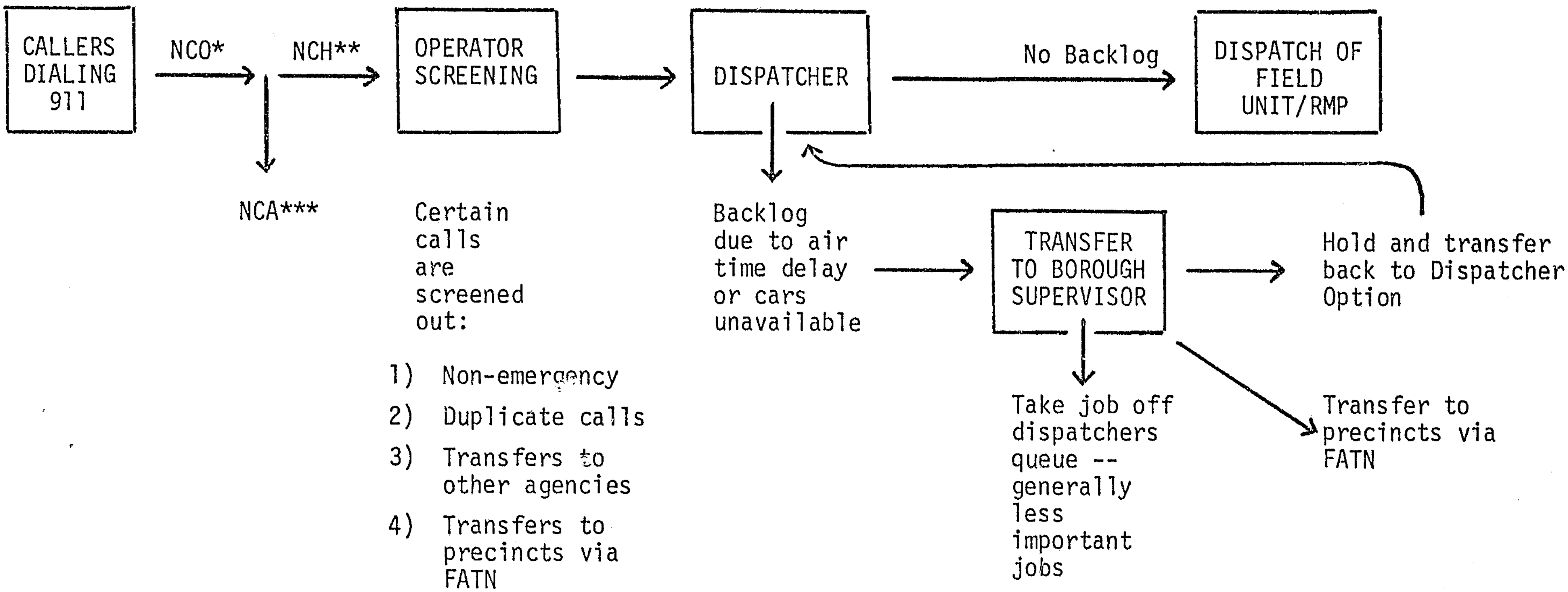
2. <u>Increased control over the dispatch procedure.</u> The availability of better data also means an increased ability for the NYPD to analyze their needs and to understand their communications performance. For example, with SPRINT II, workload statistics are available on the number of calls received, the number of calls abandoned by the caller, the number of calls handled, the number of radio dispatches and the like (see Figure 9-3). For example, the following statistics are available for January 1977.[31]

Number of calls offered	(NCO)	= 474,000 [rounded]
Number of calls handled	(NCH)	= 449,000
Number of calls abandoned	(NCA)	= 25,000
Number of radio runs	(dispatches)	= 200,000
Calls not requiring RMP response		= 249,000

Although these data are not in any sense representative of other months (and, in fact, because of an extra heavy workload on New Years Day, January 1, may be somewhat untypical), they do allow some interesting observations when coupled with other data. First, of the total calls handled, 45 percent received radio dispatch. This average (between 40 percent and 45 percent) has remained fairly constant over the tenure of SPRINT. In addition, the NYPD has found that the average number of calls and dispatches per day has remained remarkably stable for the last few years. As discussed earlier, from February 1, 1976, to January 1, 1977, the department received 17,294 911 calls per day, and made an average of 7,157 dispatches in response. This was roughly true in 1968 according to the data collected by Richard Larson and cited earlier, and it was roughly true in 1972 when a study of a sample week was

31. Interview, NYPD Communications Division, March 9, 1977. See Note 17.

Figure 9-3: SPRINT Dispatch Process



*NCO refers to number of calls offered. NCO = NCA + NCH.

**NCH refers to the calls handled which may lead to possible RMP assignment.

***NCA refers to when the caller hangs up before the operator answers, typically after very few rings.

carried out by the RAND Corporation.[32] SPRINT has therefore removed the haphazard nature of the previous manual data collection system, and the NYPD can speak with some confidence about the communications workload of the department. Although the number of calls increased when the 911 system was first installed, the number of calls and the required field service appears to have remained fairly stable within the last few years.

In addition, SPRINT allows the department to begin to establish standards of performance. For example, the Communications Division collects data on two types of systems backlogs: (1) air time delay, a period of time during which the dispatcher holds five or more jobs in his queue for 30 minutes or longer because of communications delays (that is, cars are available but the dispatcher doesn't have time to call them); and (2) field backlog, where five or more jobs remain undispatched for 30 minutes or more as a result of unavailable RMPs. There were nine air time delay backlogs in January 1977 (most of them on January 1), and 161 field backlogs (about half on January 1).[33] Such backlogs are monitored by the department to determine and correct, if possible, problems that may arise.

The department also collects data on the time to answer 911 telephone calls and the operator talk time. A "customer service standard" to answer 98 percent of the calls within 30 seconds has been set; it appears that the NYPD is meeting this goal. Beginning with the week of January 3-9, 1977, response rates for the first nine weeks of 1977 resulted in the following percentages: 98.4; 98.3; 99.1; 99.5; 99.1; 99.1; 98.2; 98.2; 98.0. According to personnel within the Communications Division,

32. See James Tien, "A SPRINT Based Dual Radio Network," op. cit. and Larson, op. cit. The study by Tien found an average of 17,496 calls to 911 and 6,739 SPRINT dispatches for the week of November 27 - December 3, 1972. Also see Larson, op. cit.

33. Interviews with NYPD personnel, March 9, 1977.

higher echelons exert a great deal of pressure when response time exceeds 30 seconds.[34]

Such performance standards are also useful for the police department in interacting with the mayor's office. As a result of the New York City fiscal crisis, "The Mayor's Management Report" was issued. The objective was for each city department to demonstrate that performance was remaining the same under decreasing resources. Such data as those above will help the Communication Division to document that service is being maintained.

In terms of personnel relations, SPRINT has also helped in establishing accountability because of the organizational constraints such a mechanized system imposes. The flow of information is well-defined and monitored. As one officer in MISD said, "You know more precisely where the work orders are coming from."[35] The amount of work is also being distributed more equitably. Operator workload is distributed by the Automatic Call Distributor, idle cars are identified and nominated for assignment by the system, and various schemes have been introduced to help relieve congested components of the system.

Finally, the new communications system expands the interaction between the Communications Division and field units and provides command staff with greater means of control if they choose to exercise them. For example, RMPs are flagged after they have been on assignment for 30 minutes without communication to the dispatcher. This indicated how the system tracks

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34. Interviews with NYPD personnel, Marcy 9, 1977.

35. Personal interviews, NYPD, May 18, 1976.

dispatches and remote unit response. In addition, CRTs are now available at Precinct Headquarters and commanding officers can overview the precinct activities on a real time basis.

Reactions by police officers to these features have been mixed. On the one hand, the 30-minute flag can be viewed as a safety device that alerts the dispatcher to possible problems; on the other hand, patrol officers sometimes resist being monitored so closely.

3. Lower response time. Has the system improved response time through a reduction in dispatch time? People interviewed at the NYPD seemed to agree that it had, but no real information is available to document this claim. Further, it appears that the original goal of a dispatch time of 1 to 1.5 minutes has not been achieved. For example, in January 1977 the median dispatch time for calls where a crime was in progress was 1 minute, 52 seconds, and for the calls in NYPD's first priority category (including, for example, assistance for a police officer, robberies in the past or in progress, burglaries in the past or in progress), the time was 2 minutes, 34 seconds.[36]

Does this mean that the SPRINT system has failed because dispatch time is above 1.5 minutes, or is 2.5 minutes adequate? The answer is far from clear. Because good comparative data do not exist, it is impossible to measure SPRINT's impact. In addition other external factors have an important effect on response time, such as increased demand for police services,

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36. Median dispatch time is used by the NYPD rather than mean dispatch time because of the sensitivity of the mean to extreme values -- items which took a great deal of dispatch time but may have been justified. The police department does not feel it should be "penalized" by such variations. Data on median dispatch time was obtained in interviews with NYPD personnel on March 9, 1977.

decrease in available manpower through personnel cutbacks, or changes in unit manitenance and availability. Even if better pre-SPRINT data were available, the amount of the change that could be attributed to the new dispatch system would be debatable. Further, recent studies have raised questions about the overall importance of response time in the law enforcement process. If citizens take a long time -- say, 5 or 10 minutes or more -- to report an incident to the police, then saving 15 or 30 seconds in response time through an improved dispatch system may mean little in terms of apprehending the culprit or solving the crime.[37]

Finally, even if SPRINT has had little influence on response time, some aspects of the new system influence the quality of the response system. As improvements are made in hardware and software, the system can do more refined operations such as checking hazardous locations, utilizing special routings for particular calls, and checking the alias, place name, and misspelling files. The response time may stay the same or even increase because of the added check, but the quality of the information contained in the dispatch message is improved.

4. Improved management of information and decisions. SPRINT has made a great amount of information available to the police department. In fact, the system automatically compiles statistics and generates nearly 20 different Output Reports on a daily or weekly basis. Each report is intended for a specific responsibility level in the department, and each could assist department managers to make decisions about resource allocation manpower distribution and productivity. Some examples of these reports include:

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37. For a discussion of response time see, for example, Deborah Bertram and Alexander Vargo, "Response Time Analysis Study: Preliminary Findings on Robbery in Kansas City," Police Chief, May 1976.

- SPRINT Assignment Exception Listing: Prepared weekly by precinct, this report summarizes activities that the department managers consider to be "exceptional" and undesirable. It lists all jobs that took over 60 minutes from dispatch to final disposition, all assignments that moved units from the precinct into another, and all jobs which waited in queue longer than 5 minutes before being dispatched. The precinct captain uses this report to identify and correct problems in precinct operation. This report is an example of how the higher echelon sets performance standards defining unusual system behavior.

- SPRINT Workload Summary: This weekly report by day and tour lists the number of jobs occurring in every sector. It makes automatic comparisons to precinct statistics for the previous four weeks.

- Transactions Report: Generated daily and summarizing activity by terminal, by operator, and by dispatcher, it is used to reassign precinct queues after assessing workload.

- SPRINT Hourly Job Distribution List: This weekly report indicates the workload performed by each precinct sector unit. Also calculated is the average service time for each unit. A 40 percent utilization statistic is used to calculate the expected number of units needed. There are 480 minutes per tour; 120 of these are allotted for meals and coffee breaks. During the remaining 360 minutes the unit is expected to be servicing calls 40 percent of the time or 144 minutes per tour. The rest is allocated to patrol. Individual units are evaluated according to this standard, specified by the Chief of Patrol. Precinct captains use this report to schedule units and document needs for additional resources.

- Monthly Personnel Report: The performance of Communications Division workers is measured by number of hours worked and error percentage in computer use. Errors are summarized by type, and training sessions revised to emphasize those portions of the computer process. Supervisors also use this report for personnel evaluation.

The list of reports is almost endless and relatively flexible, and new types and formats are tested regularly. The more critical question, however, is whether they are really being used. At first, most reports were generated daily by SPRINT, but the commanders were quickly lost in a blizzard of paper. As a result, some effort has been made to tailor the reports to the specific needs of the various segments of the department. In September 1976, the Management Information Systems Division completed a booklet entitled, "SPRINT Output Reports and Resource Allocation," which was designed as a training aid for a "Captains and Above" course on using the computer as a management tool.[38] Because this training was done recently, it is difficult to assess the full management impact of the SPRINT output reports at this time.

Many commanders, for the first time, will have information at their disposal to assist them in making staffing and unit allocation choices. Whether they actually use this information to improve their management choices is still a question. For example, a primary purpose of developing the data is to aid in the resource allocation of police units. Using data from the SPRINT system, the MISD developed a staffing plan for the NYPD using both computer modeling techniques and more manual "back of the envelope" calculations. Although the plan provided a general guide for the department, it was never implemented on a formal basis both because of political reasons within the department (no precinct commander wanted to lose officers) and bec se of personnel (to avoid a major shift of people within the department.)

In summary, one can ask whether the benefits of SPRINT justify the costs. On the cost side, two factors are involved: costs to establish the system and operating costs. Only rough estimates for both are available. In developing SPRINT I, nearly $5 million of city money was allocated, $1.7 million for software and the remainder for hardware purchases. The city's capital budget allocated $11.8 million for the development phase of SPRINT II. Combining the costs of SPRINT I and II, nearly $17 million of city funds have been devoted to the development and installation of the system. Operating costs are a little more difficult to establish, but a rough estimate yields an average annual cost in the range of $900,000 to $1.1 million, not including computer operating costs ($600,000-$750,000 for personnel costs;

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38. New York Police Department, Management Information Systems Division, "SPRINT" Output Reports and Resource Allocation," September 1, 1976.

$25,000-$50,000 for materials; and $275,000-$300,000 for vendor service contracts).[39]

These numbers may seem high, but when placed in context, the magnitude is somewhat diminished. The total 1975 expenditures of the NYPD were approximately $625 million. Thus if the total costs of SPRINT are estimated to be $24 million ($17 million for development plus $1 million for each of the seven years of operation), then total SPRINT costs are slightly less than 4 percent of the police budget for 1975.[40] Put in another way, the annual cost for operating a two-man patrol car around the clock in New York City can be estimated to be in the range of $280,000-$300,000 ($230,000+ for personnel) and $50,000 for automobile costs).[41] This means that the annual costs of operating the SPRINT system ($900,000 to $1,100,000) are comparable to the annual costs of providing four patrol car units 24 hours per day. Further, if the development costs of SPRINT were depreciated over a ten-year life, the annual depreciation would cost about $1.7 milli per year. Total annual costs for developing and operating SPRINT would therefore be about $2.7 million, or equivalent to annual cost of operating ten police patrol units.[42]

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39. Estimates based on discussions with the Management Information System Division, February 9, 1977, and March 9, 1977.

40. Such estimates are only meant to provide a rough comparison of the magnitude of the dollars involved. We realize that in totaling development and operating costs, time frames and discount rates are being ignored.

41. This is based on an estimate of police officers to staff one two-man patrol car around-the-clock. Estimates based on discussions with the Management Information Systems Division, March 9, 1977.

42. $17 million depreciated over a ten-year life would cost approximately $1.7 million per year. Annual operating costs are about $1 million per year. Assuming a cost of $280,000-$300,000 per patrol car, the development costs of SPRINT would be equivalent to the cost of operating 6 patrol cars around-the-clock and annual costs for operating SPRINT would be equivalent to the cost of four patrol cars.

The available information is too rough for this report to reach a final conclusion as to whether the benefits of SPRINT justify the costs. And even if better data were available, it is not clear a definitive conclusion could be reached, because many of the benefits are difficult to quantify and many aspects of such a judgment require value choices. CAD in New York City has automated a number of the routine dimensions of the dispatch process and has provided a wide range of information to assist in the management and control of the police department. On the surfece it seems that the benefits derived from the data could easily match the benefits of ten police patrol units on an annual basis. In fact, the technical benefits of the system alone -- for example, the rapid processing of dispatch information, the linkage of SPRINT to want/warrant files, the assistance to dispatchers in recording and keeping track of data, and the production of a wide range of information -- may justify the expenditures. The New York Police Department has begun to realize the potential of the SPRINT system. However, some of the real benefit of the system will depend on whether the more nonroutine aspects of SPRINT -- such as the actual use of the information available to improve the coperations and management of the Communications Division and the department as a whole -- are actually utilized.

CHAPTER X:

COMMAND AND CONTROL IN THE BOSTON POLICE DEPARTMENT: A TECHNOLOGICAL APPROACH TO REFORM

by Scott Hebert

During the last 50 years, a number of national commissions have been formed to study the problems of law enforcement agencies and determine ways to improve their performance.[1] These commissions, drawn from the elite of government, business, and the criminal justice community, have consistently advocated "professionalism" as the solution to the inadequacies of police service. As part of their goal of police professionalization,[2] the commissions have repeatedly recommended greater exploitation of technology. However, while a considerable amount of space in the police literature has been devoted to advocating technology, surprisingly little information is available about the actual process of introducing such technology into a department's operations.[3] Specifically, very little has been written about why departments decide to select a particular piece of technology, how they

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1. See particularly the National Commission on Law Enforcement and Observance, Report on the Police (New Jersey: Patterson Smith, 1968) and the President's Commission on Law Enforcement and the Administration of Justice, The Challenge of Crime in a Free Society, Task Force Report on the Police, Task Force Report on Science and Technology (Washington, D.C.: Government Printing Office, 1967).

2. According to the reformers, a "professional" department is characterized by a strong command-and-control structure, insulation from political influence, and an emphasis on aggressive law enforcement, efficiency, and the use of the latest training and technology.

3. One of the few publications that deals with the actual implementation of police technology is the Law Enforcement Assistance Administration's Innovation in Law Enforcement, (Washington, D.C.: Government Printing Office, 1973).

use it, how various groups in the department react to the adoption of such technology, and what its impact is on operations. Such questions focus on the diffusion of innovation.

In part, this dearth of information seems to be a result of assumptions that professionalists like the 1967 President's Crime Commission have made regarding police organization and the process of diffusion. Most of the 1967 Commission's recommendations were predicated on the assumption that a department had first organized itself into a system of strong, centralized control (similar to Weber's "monocratic" bureaucracy).[4] According to this model of organization, an order issued by the top police executive is faithfully enforced down through the departmental hierarchy.

In subscribing to this model, the President's Crime Commission saw the diffusion process primarily as an act of communication.[5] The Commission believed that most police administrators shared their deep concern and expectations for improving crime control performance. Because it assumed that departments already would have established a system of centralized control, the Commission felt that all that was required to get local police agencies to decide to introduce the advanced equipment was the endorsement of the technology by prestigious professional bodies such as itself. The implementation process was not perceived as much of a problem once a department had made the decision to adopt the technology and was given

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4. Victor A. Thompson, Bureaucracy and Innovation (Tuscaloosa, Ala.: Univ. of Alabama Press, 1969), p. 15; Task Force Report on the Police, pp. 45-50; The Challenge of Crime in a Free Society, p. 113.

5. For a discussion of theories of diffusion, see Donald A. Schon, Beyond the Stable State (New York: Random House, 1971), pp. 80-116.

little attention in the Commission's final report.[6] The single factor that the Commission staff explicitly recognized as a possible obstacle to the technology's introduction was the expense of such equipment. To counteract this, the Commission sought the creation of a federally subsidized program of research and development that would defray some of the costs.[7]

By viewing the diffusion of technology in this way, however, the Commission overlooked the fact that even the most centralized of organizations often have powerful coalitions over which the top executive has limited control and who consequently play a major role in determining the nature of changes in the department. Moreover, as in all organizations, the staff of police agencies are attempting to achieve a variety of personal and administrative goals in addition to (and often in conflict with) the organizational goal of crime control. Thus, the decision to innovate could be prompted by other factors than the desire to improve crime prevention, and the role which technology is assuming in law enforcement agencies could be quite different from what the 1967 Commission envisioned.

This chapter will consider a case of technological innovation in the Boston Police Department similar to the kind espoused by the 1967 President's Crime Commission. By examining this case, as well as the others contained in this volume, we hope to begin to develop an understanding of why police departments actually adopt such technology, what its impact is on operations, and whether the behavior and experience of the police conforms to the Crime Commission's assumptions.

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6. <u>The Challenge of Crime in a Free Society</u>, p. 269.

7. Ibid., p. 246, 269-71.

A. The Impetus for Reform

In 1962, after 77 years of state control, jurisdiction over the Boston police was returned to the municipal government. Shortly thereafter, Mayor John Collins appointed Edmund L. McNamara, a 16-year FBI veteran, as Boston's new police commissioner. Also in 1962, the International Association of Chiefs of Police (IACP) completed a survey of the Boston Police Department (BPD) and recommended a wide variety of reforms.[8]

The "Quinn Tamm Report," as the IACP survey was locally known, described the BPD as "probably the most decentralized organization in the country" and claimed that the department was characterized by divided authority, excessive spans of control, and inadequate recordkeeping.[9] The report was also highly critical of the use of patrolmen in Boston for such non-law enforcement tasks as performing clerical duties, taking the census, licensing taxis, and providing ambulance services. Among its many recommendations, the IACP suggested that the department should narrow its responsibilities, reduce its number of districts from 17 to 5, reassign the station detectives to headquarters, and organize the force according to function. The IACP's recommendations reflected the basic prescription for reform that police professionalists had been advocating for decades. As Thomas Reppetto pointed out:

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8. For a further discussion of this survey and its implications, see Chapter V of this volume.

9. International Association of Chiefs of Police, A Survey of the Police Department of Boston, Massachusetts (Washington, D.C.: IACP, 1962), p. 143; see also Thomas A. Reppetto, Public Safety Service Needs of the Future City of Boston (Unpublished manuscript, October 1971), pp. 19-25.

> the IACP sought to emphasize the law enforcement, crime control mission of the police, and to create a tightly controlled, highly centralized department with a well-trained staff operating under the classic merit personnel system.[10]

In 1964, Commissioner McNamara made a presentation to the IACP conference in which he reviewed the progress of the BPD over the previous two years in implementing the recommendations of the 1962 survey.[11] One of McNamara's first tasks as commissioner was to form a planning board, which he instructed to select those survey recommendations which it felt were within the administration's ability to put into effect.

McNamara had also created a new organizational structure for the BPD. The reorganization, which became effective in 1963, consolidated the department's divisions into four bureaus, each headed by a superintendent who reported directly to the commissioner. Under the new organization, the inspection function, which had received special attention in the IACP study, was expanded considerably to full bureau (line) status.

At the conference, McNamara also noted that he had already encountered some serious local opposition to the implementation of several of the IACP's

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10. Reppetto, <u>Public Safety Service Needs</u>, p. 22. Reppetto also notes that similar programs had been previously recommended to the Boston Police by such notable police reformers as Leonard Harrison (in the thirties) and Bruce Smith (in the forties), although few of their suggestions were ever implemented. However, because of the desire of the city administration in the early sixties to seek a more economical approach to providing municipal services and the continuing public pressure on the department to respond to a recent bookmaking scandal involving police officers, the possibilities for accomplishing such reforms seemed more favorable.

11. Edmund L. McNamara, "Discussion of Implementation of IACP Survey Recommendations," <u>The Police Yearbook</u> (Washington, D.C.: International Association of Chiefs of Police, 1964).

major recommendations. Citizens and businesses who feared that closing local stationhouses would mean a decline in the quality of police service, protested district consolidations. The IACP's suggestion to reduce the patrol force drew similar criticism from local groups as well as from members of the force.

Moreover, because the low pay scale of the policemen made them the cheapest available source of labor for performing such municipal duties as census taking and licensing, it appeared that the city administration would oppose any attempts to eliminate BPD responsibility for such functions.[12]

While some of the opposition from citizens, municipal officials, and department staff may have coincided with McNamara's personal views, it also threatened to frustrate his efforts in many of the areas where he had agreed with the IACP's recommendations (such as removing the department's responsibility for such nonpolice functions as licensing taxis). If the McNamara administration was to produce additional concrete reforms, to demonstrate to the IACP that the BPD was moving forward on the survey recommendations, it would have to look to less controversial areas.

B. The BPD Reports and Records System

One such undisputed concern was records and reports. The existing BPD records system had evolved slowly with little attention to its overall design.[13] As a result, the department had literally hundred of different

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12. Reppetto, Public Safety Service Needs, pp. 22-24.

13. Arthur D. Little, Inc., Reports, Records, and Communications in the Boston Police Department: A System Improvement Study (Washington, D.C.: Law Enforcement Assistance Association, May 1968), p. 13.

forms, many of which contained largely redundant information. Filling out all the proper forms for an incident was an arduous and time-consuming task for the patrolmen. Moreover, the data from these reports were all compiled by hand by clerks at the stationhouses and at headquarters, which increased the chance of error.[14] The BPD's system of record-keeping was so inadequate, in fact, that the FBI had refused to accept the accuracy of the department's crime statistics in 1958. In response, the department decided to switch from compiling statistics by hand to the use of unit record equipment. Several computer vendors suggested that the department purchase more sophisticated data processing equipment, but the police commissioner in office at that time had felt that such equipment was not necessary.[15]

In 1962, with the advent of the McNamara administration and the IACP report, the department was again approached by vendors. By 1964, McNamara had signed a letter of intent with IBM for the lease of a 360 Model 30 computer with 32K bytes of core memory, which the department's Data Processing Advisory Committee subsequently approved.

In October 1966, a few months before the computer was expected to be installed, BPD representatives met with the local Office of Law Enforcement Assistance to explore ways in which the OLEA could help the department in its modernization efforts. An agreement was reached that the department would request a grant to study its reporting system and to devise a design for an integrated information system utilizing the new computer. A key

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14. See Boston Finance Commission, Survey of Boston Police Department, Massachusetts Legislative Documents, House 2600 (1949), pp. 1-67; also Christian Science Monitor, May 20, 1960, p. 2.

15. Interviewed by Kent Colton with Deputy Superintendent John West, Spring 1971.

objective of this study was to determine "the most efficient method and means for acquiring, storing, retrieving, and disseminating information" of use to the department.[16] For technical assistance on the study, the department approached the Cambridge office of an internationally prominent consulting firm.

C. OLEA Grant 153

In December, 1966 representatives from the consulting firm met with the BPD. The police contingent consisted of the head of the Bureau of General Services, the head of the Bureau of Inspectional Services, two patrolmen from the Planning Division, and an operations research graduate student from MIT then working with the department.

At the December meeting, it was agreed that developing an integrated information and communications system for the department would involve at least two stages. First, the consultant would develop a plan for establishing the system. For this task, the firm suggested the department should apply for a federal grant of $30,000. For doing the actual implementation, the firm indicated that a second grant would be required, on the order of $90,000. The BPD representatives accepted this approach, but stressed that the end result "should show some benefit to other police departments in the country."[17] The department was apparently not only concerned with improving its information system, but also making it transferable and innovative

16. From BPD notes on the meeting.

17. BPD's meeting notes.

enough to increase the department's status in the police community.

The OLEA approved the Boston grant application in February 1967.[18] In September 1967, the consulting firm submitted its final report on the OLEA grant 153 project, which outlined a general plan for implementing an integrated information system.[19] In their final report, the consultants defined the value of the proposed integrated information system largely in terms of the managerial control of field units. This definition was a drastic shift from the consultants' earlier position in the grant application, in which they had argued that the principal function of the information system would be to measure differences in the quality of police service achieved by changes in operating procedures.[20] The final report claimed that the command staff had significantly less control of field units than they should, and noted "it is our judgment that the inability to control the field operations is the single greatest defect in the [Boston] police function."[21]

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18. In reviewing the request, the OLEA had had some question whether the department could do away with the regular solicitation of bids, but this problem was eventually resolved and the selection of the consultant was approved by the mayor. For its services over the course of the grant (March-August 1967) the consultant was to receive $25,915. The contribution of the department itself to the project was primarily in noncash credits (donated space and part-time of some BPD personnel). The Superintendent of Inspectional Services was named as project director for the department.

19. ADL report, op. cit., in note 18, p. 86.

20. Ibid., p. 9; and BPD "Application for Grant," January 13, 1967, pp. 2-3.

21. ADL report, Op. Cit., p. 55.

The recommendations that followed the opening sections of the Grant 153 final report also reflected the shift in the consultants' emphasis towards control of personnel. The original focus for the study had been the development of a plan for a new reporting and records system. Accordingly, the consultant's report suggested several changes in the existing records system to cut down on duplication and to free men for patrol duty.[22] (The most promising of these was the recommendation to eliminate the District Journal, a handwritten record of incidents and activities of the patrol force that required an equivalent of 75 men to maintain.) However, the most significant suggestion made in the final Grant 153 report was the recommendation to develop a real-time Command and Control System (CCS) as the foundation of the integrated information system:

> The Districts would not have to generate the synthetic reality represented by the Journals if they had the information available in the turret plus a little more. That "little" is very likely to be exactly what the turret needs to perform its function more effectively: a status board describing the recent past.
>
> At present the dispatcher (in the turret) knows which cars are on assignment, but can tell only at considerable inconvenience the relative importance of various car assignments. It is so difficult, in fact, that few attempts are made to search out cars on unimportant assignments when an emergency arises and cars are scarce. Furthermore, no attempt is made to monitor cars to see whether they are off the air so long as to suggest <u>danger or dereliction</u>. The latter information can be pieced together after the fact, <u>but is not, in spite of its utility for the supervisory sergeants at the district level</u>....
>
> It is now technically feasible to make a command and control system which will: allow the dispatcher to see

22. Ibid., p. 13.

at a glance the status of car operations in any District; allow District supervisory personnel to know what its cars are doing; provide data on daily operations in a machine-usable form for the preparation of daily operational statistics; provide the basis for a District control log to be prepared at Headquarters for transmission to the Districts; and provide the machine-usable data base for a name and location index.[23]

Although the consultant gave significant attention to how the CCS would benefit the districts, the report explicitly indicated that the real purpose of the proposed technology was not to assist individual district commanders but rather to benefit the headquarters staff.[24] However, the firm did not mention that authority for controlling the patrol force had traditionally been in the hands of the districts, not the dispatchers. Thus, the CCS threatened to modify dramatically the existing power structure in the department.

While the districts may not have been pleased with the consultant's recommendations, the response of the BPD administration to the consultant's final report was quite favorable. For one thing, in its recently released report, the prestigious President's Crime Commission had strongly endorsed similar systems. In fact, a recent graduate of MIT's operations research program, who was serving as a planner in the BPD's Planning Division, reported that "Boston is [because of the consultant's study] probably as far advanced in implementing these particular recommendations of the Crime Commission as any city."[25] This meant that the BPD could potentially ac-

23. Ibid., pp. 16-17. Italics added.

24. Ibid., p. 17.

25. Memo from S. D. Rosenberg to Supt. John T. Howland, "Comparison of the Recommendations of the Arthur D. Little Report with the Recommendations ... of the President's Commission..." (Fall 1967), p. 2.

quire a great deal of status if they developed the system recommended by the consultant. Moreover, the CCS promised to provide improved supervision of the patrol force--one of the stronger recommendations of the 1962 IACP report.

These considerations, as well as the fact that the federal government would be bearing the brunt of the costs, help to explain the BPD administration's receptiveness to the consultant's recommendations. Nevertheless, despite the firm's attempts in their final report to anticipate any criticisms that might be raised by the department, some individuals in the BPD administration had objections even at this stage. In particular, the BPD planner opposed the firm's suggestion to postpone the computer installation contemplated by the department. The consultant had argued that the planned computer would have to be designed specifically to facilitate the control of operations. The firm envisioned that this design process would be a complicated task and, in the meantime, it would be senseless for the department to install and teach its personnel to operate equipment that would probably be inadequate for the new purposes.[26]

The BPD planner, on the other hand, was apparently more sensitive to the pragmatic issues facing the department. In a memo to the project director the planner argued that the "political ramifications of cancellation at this time would probably be disastrous."[27] It seems that Kevin White, a mayoral candidate at the time, was being very outspoken about the department's inefficiency,[28] one problem which the new computer was supposed

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26. ADL report, op. cit., pp. 17-18.

27. Memo from S.D. Rosenberg to Supt. John T. Howland, "Comparisons of Recommendations...."

28. Rory Albert, A Time for Reform: A Case Study of the Interaction Between the Commissioner of the Boston Police Department and the Boston Patrolmen's Association (Cambridge, Mass.: Innovative Resource Planning Project, M.I.T., 1975) p. 7.

to help alleviate. In addition because the computer contract that the department had executed was "cancellable at the end of the term, or at ninety days notice," the planner felt that "no flexibility in planning future systems [would] be lost by proceeding as planned with the system 360."

Moreover, during 1967-68 Commissioner McNamara was chairman of the IACP Committee on Uniform Crime Records, which was strongly emphasizing computer use by police.[29] If the BPD administration was as sensitive to attitudes of the broader police community as some of its actions suggest, it would want to avoid the loss of face the department might suffer in the IACP if the computer installation was canceled.

Eventually, the planner's arguments prevailed over the consultant's recommendations and the computer installation continued as planned.

D. OLEA Grant 346

In October 1967, the BPD and the consulting firm submitted an application to the OLEA for funds to continue the effort started during Grant 153. According to the grant application, the focus of the latest work would be:

> to refine and implement a number of recommended changes in the department's reporting, records, and communications system, and subsequently to assess the impact of these changes. A major portion of the technical work performed will be to refocus a planned computer facility

29. Edmund L. McNamara, "Report of the Committee on Uniform Crime Records," The Police Yearbook (Washington, D.C.: IACP, 1968.

> from an information retrieval system to a switching system as well, for the real-time control of field operations.[30]

In other words, while several interim changes would be made in each of the areas identified in the Grant 153 final report (i.e., records, reports, communications, the computer facility, and command-and-control), the emphasis of the proposed work was the development of the command and control system. For instance, the design and implementation of a completely revised records system was to await the completion of the CCS. It was not clear from the application, however, exactly how far along implementation of the CCS would be at the end of the proposed 12-month period.

In June 1968, after the OLEA had approved the BPD's grant request for $13,450, the consulting firm evaluated the department's newly installed computer system. In an August 1968 memorandum to the BPD, the firm reported:

> Our initial examination of the computer hardware installed in the police headquarters indicated that the configuration is likely to be inadequate for all but the very short run needs of the department.... The conclusions we draw from these meetings [with the vendor and another consulting company which had advised the BPD], from consultations with computer experts... and from relevant documents are as follows:
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> a. No substantive and systematic examination of the the department's total medium- and long-range requirements preceded the specifications of computer hardware.
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> b. The new computer will do little more than duplicate the functions already satisfied by the IBM 407 accounting machine currently in use, but the cost to perform these functions will be increased substantially....

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30. BPD, "Application for Grant" (U.S. Department of Justice, Office of Law Enforcement Assistance; Form LEA-1), submitted October 23, 1967, p. 5.

c. On-line access to stolen car information cannot be furnished 24 hours per day without substantially impairing flexibility....

d. In its present configuration the machine will support only one of the police application programs which IBM reports to be available, namely a UCR package....

Upon discovering the inadequacies of the installed equipment, the firm tried to piece together how the choice was made:

> The real reason for the selection of the particular hardware now installed will probably never be known, but it is evident that no one is eager to assume responsibility.... However, the limited info that is available suggests how the decision could have been reached. IBM ... [is] convinced that the department is barely capable of working with the present computer system, and that anything more would be too complex to be understood and maintained by the present police programmers. IBM reports that if it had specified a machine with more capabilities, the department would not have agreed to lease it. IBM contends that it sold the department as much as it could support at the time the sale was made and that the department would not have been able to obtain funds to lease additional hardware. IBM expects to supply more hardware in the future, including at least another 32k of memory, and is fully aware that the present hardware is inadequate for future requirements. In the meantime, the department can learn about computers on the machine it now has, eliminate its 407 accounting machines, and enjoy the advantages (whatever they may be) of a computerized stolen car file.
>
> We question whether these benefits are worth about one hundred thousand dollars per year....[31]

In the August memo, the consultant's first formal report to the BPD on the Grant 346 work, the firm also announced that its time horizon for the project, along with its conception of the project task, had again shifted. After a brief review of the benefits that the completed CCS would yield, the firm revealed that it "may not be possible to accomplish [installation

31. Ibid., pp. 5-6.

of the CCS] within the time of the present project. Consequently, we will develop a more limited system, in parallel, for early implementation. The details of this system will be reported in a memorandum already in progress."[32] What the consultant did not make absolutely clear at this point, however, was that this limited CCS was not to be an operational system, but rather a prototype whose function would primarily be confined to use as a training tool for the dispatchers.

The consultant's draft of the functional specifications for the limited CCS prototype were submitted to the department in two parts--on December 29, 1968, and on January 4, 1969.[33] A revised schedule for the CCS project was also outlined, which included six phases. Phase One was concerned with development of the prototype CCS, with the other phases focusing on development of an operational version and expansion of the capabilities of the system (including improving the districts' access to the CCS). However, specific dates for the completion of each phase were not included.

In April 1969, the BPD's MIT-trained operations researcher/planner held a series of meetings with the consultant to discuss the functional specifications. During the sessions, the BPD planner, who was apparently

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32. Ibid., p. 8.

33. Part I of Working Memorandum EDG-3 (the functional specifications) primarily discussed the two basic "dispatching" files for the CCS: a vehicle status file and an incident status file. In addition, the CCS could potentially incorporate a number of secondary files, including missing persons, stolen vehicles, warrants, and license registration files. However, at the time of the memo, ADL noted that they were actively considering only the missing persons and stolen vehicle files. A related issue discussed in Part II of Working Memorandum EDG-3 was the Electronic Data Processing hardware ADL chose for implementing their proposal, which was different from what was then leased by the BPD.

expanding his role in the federal projects in anticipation of the forthcoming retirement of the current project director (the Superintendent of Inspectional Services), largely stuck to narrow technical comments on the proposed functional specifications.[34] The content of these discussions also distinctly reflected the administration's interest in the aspects of the CCS concerned with the control of the field force. For example, the BPD planner repeatedly indicated that the department wanted a way (via the CCS) to flag vehicles that were off the air for more than 20 minutes. In these meetings, it was evident that the administration was committed to proceed with the CCS development and was excited about whatever additional margin of control that the system would give headquarters over the performance and use of the patrol force.

E. Application for LEAA Grant NI-69-007

In May 1969, a month before the termination of Project 346, another grant application was submitted to the Law Enforcement Assistance Administration (LEAA), which had replaced the OLEA. Unlike previous proposals that suggested research and work on a number of the integrated information system components besides the CCS, this application was almost exclusively devoted to discussion of the prototype Command and Control System.

In the May 1969 grant application, the consulting firm introduced yet another project schedule. The consultant stated that the CCS development could now be viewed as three phases. Phase I was considered to be the

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34. This conclusion was made on the basis of Rosenberg's and ADL's notes on these meetings. For example, see ADL memorandum from Edward Gilbert to Steven Waldron on Case 70375, April 24, 1969.

first "brief" study of the department. According to the consultant, the department was currently engaged in Phase II, during which the recommended changes which the consultant had felt needed additional support had been "buttressed by more work." In addition, the firm claimed that during this phase it had also "created and examined a large number of systems for information management and the control of field operations." Work in this area had supposedly gone so well that the application professed, "we have finally come down to the specifications of a particular system which we believe can be installed in the very near future. Implementation is well under way...."[35]

According to the proposal, the objective of Phase III, which the department would enter on approval of this new grant request, was to create what was termed a "preliminary" command and control system for use in the command-dispatching center ("the turret") of the BPD. The development of the prototype CCS was just the first of a series of tasks that would be involved in the eventual installation of the "preliminary" system. The application also disclosed that the consulting firm had made the decision to base the full CCS on an IBM 260/40 with 128 bytes, a computer system considerably larger than the one the department then possessed.

Although by the time of this new application the consultant had developed the functional specifications for the prototype, many of the other tasks that the firm was supposed to perform under the contract for Grant 346 were incomplete, and the BPD was becoming increasingly concerned about the pace at which the CCS was being developed. Consequently, in their contract

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35. See BPD, "Application for Grant" (Washington, D.C.: U.S. Department of Justice, Law Enforcement Assistance Administration, May 8, 1969), p. 8.

with the consultant for the new LEAA grant, NI-69-007, the BPD stipulated that the prototype was to be installed and evaluated during the upcoming grant period. Moreover, the department specified that all work not completed by the firm on grant 346 was to be completed during this next grant period.[36]

F. Mayor White Evaluates the BPD

In 1969, about the time that the consultant was developing its latest grant application, the Boston Police Department again became the focus of an investigation. This time, however, the criticisms came from City Hall. Concerned with the department's high cost, citizen dissatisfaction, and renewed indications of corruption, Mayor Kevin White formed a Task Force on Police and instructed them to evaluate the department's operations and recommend improvements. The Task Force report reissued many of the same criticisms that the IACP had made seven years earlier,[37] intimating that

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36. Contract between the City of Boston and Arthur D. Little, Inc., for LEAA Grant Number NI-69-007 (September 20, 1969).

37. Two important criticisms made by the IACP were absent from the Mayor's Task Force Report, however. For one thing, the IACP had recommended reducing the size of the BPD force. However, the crime rate had risen dramatically since 1962. Moreover, Boston was the scene of numerous large demonstrations, which the department was called on to monitor while maintaining a patrol force throughout the city to respond to calls for other assistance. As a result, the Task Force and mayor felt that a reduction was not warranted.

(Footnote continued on next page.)

the department administration had been unable to significantly improve the BPD in McNamara's one and one-half terms as commissioner. According to the Task Force, the police were still poorly trained and deployed. Officers were still engaged in nonpolice tasks which (with the rise in salaries paid to the department's sworn personnel) cost the taxpayer unnecessary dollars. The department was decentralized, poorly coordinated, and exercised inadequate supervision of the patrol force. Moreover, the department was not responsive to the needs of the minority population of Boston.

The annual report from the commissioner for 1969 (issued in January 1970) demonstrated that the McNamara administration had taken the mayor's Task Force report very seriously. For almost every aspect of its operations which the Task Force had criticized, the department reported that some type of reform had taken place.[38] For example, to bring greater supervisory capability to the patrol operation, 12 additional marked cars had been purchased and assigned to patrol sergeants at the district level. Moreover, the number of patrol supervisors had been increased through promotion of

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37. (cont'd.) The second IACP recommendation missing from the Mayor's Task Force Report was concerned with the consolidation of stationhouses. White, who had established "little city halls" throughout the city, was not opposed to "local" district stations in neighborhoods. Rather he was upset that the district personnel in many areas were not responsive to the needs of the minority community, or the mayor's orders to correct this situation. Consequently, to increase the patrol force's accountability, he urged the appointment of deputy superintendents to supervise groups of districts. These command officers would "serve at the pleasure of" the police commissioner, who was appointed by the mayor.

38. Boston Police Department, 64th Annual Report of the Police Commissioner for the City of Boston for the Year Ending December 31, 1969, Document No. 1 28, p. 9.

patrolmen to sergeants. The 13 districts had also been grouped into 6 divisions, and a deputy superintendent was appointed for each one.

In the BPD's summary of its reform achievements, its technological projects figures prominently.[39] For example, the report pointed to the Command and Control System being developed as one of the ways that the BPD was trying to improve supervision, as well as to reduce response time to emergency calls. Moreover, the report mentioned that the department was continuing to seek out innovative programs that would help the BPD better exploit technology to allocate its resources.

G. The BPD Attempts to Expedite CCS Development

By February 1970, the MIT-trained planner had been appointed as an administrative assistant to McNamara and as director of the department's Planning and Research Division. He had also been selected to succeed the Superintendent of Inspectional Services as project director for the BPD's federal grants (for the CCS project, grant NI-69-007).

During Spring 1970, to get a clear sense of the CCS's status, the new planning director requested that the consulting firm report on the technical progress achieved during the latest grant period and the work that remained, with the latter to include an expected date of implementation. In the Project Plan that the firm helped to develop as part of a May 1970 application for further federal support of the CCS project, the consultant responded by providing a list of the various technical functions planned for

39. Ibid., pp. 4,9.

the upcoming grant period. However, although this list was one of the most detailed work schedules that the consultant had provided for the department to date, it was still extremely vague about the exact nature and timing of the tasks. For instance, the Project Plan claimed that "because of the inherent complexity of the work to be done and because it is not possible to arbitrarily separate each activity from the others, accurate forecasting of the work to be completed within a specific time period is not possible."[40] Moreover, the Project Plan gave little insight into the amount of technical work already completed.

Although during the NI-69-007 grant period, the firm had again been unable to complete much of the contracted work (including completion of both the prototype CCS and the new records and reporting system), the department elected to go along with the consultant in submitting this new grant request. Despite the difficulties that the department had experienced thus far, it was still firmly committed to making the system operational, if only to have something tangible to show for the grant funds already expended.

At this point, however, the planning director took several steps to minimize any delay in implementing other projects that might be caused by the slow pace of the CCS's development. For example, he phased out the consulting firm's involvement in all projects which were not inseparably tied to the CCS. He also began to seek out other consultants to perform ancillary CCS tasks (such as developing a geographic base file and

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40. Boston Police Department, "Application for Grant" (Washington, D.C.: Department of Justice, Law Enforcement Assistance Administration, May 1970); see also "Project Plan and Supporting Data," op. cit., p. 6.

monitoring the reconstruction of the communications command center), which had originally been considered part of the firm's purview. During this time, the BPD even explored the possibility of achieving some of the benefits of the CCS through the use of some less sophisticated equipment. Utilizing an idea suggested by the consulting firm in an earlier memo on patrol car communications, the planning director and the BPD's communications division developed a siren activator device that was placed in all the department's marked patrol units. This device gave the dispatcher in headquarters the ability to activate either the overhead light or siren of a patrol car to attract the patrolman's attention in an emergency if he was away from the vehicle.

The available documentation on the siren activator fails to explain why this device would be necessary if the patrolman was carrying a portable two-way radio at all times. However, according to several individuals working with the department around this time, the dispatchers were having considerable trouble contacting units. After completing a series of assignments, some patrol units would remain "off the air," feeling that they deserved a break, and would not acknowledge the dispatcher's request that they identify their status. In fact, at times the only way for the dispatcher to obtain a car to respond to incidents was to describe the nature of the call over the air which tied up valuable transmission time. At such times, if the incident was an emergency or promised excitement, many of the missing cars would suddenly "come to life." In suggesting the selective calling device, the consultant was apparently hoping that the threat of activating their siren (which is annoying loud for the occupants of a patrol car) would be an incentive for the patrolmen to stay in closer communication with the dispatcher.

The siren activator effort did not fare very well, however. Within a month, almost all of the devices, which were fastened under the dashboard of the police cruisers, had been broken. Although the BPD administration officially claimed that the equipment was faulty, the head of the department's communications division privately admitted that the men hadn't liked the devices and some had "whacked them with their night sticks until they broke." In discussing the effort, some officers complained that the siren activators had impaired their ability to function effectively; others indicated that they resented the activators because of their "big brother" implications or because they kept them from taking breaks which they felt they deserved.[41]

H. Grant 70-107E: Confrontation and Concessions

LEAA approved the BPD's latest CCS grant application for an additional $100,000 in September 1970. However, the BPD planning director informed the consultant that, despite the official October 1 start-up date of Grant 70-107E, he wanted to see a much more detailed work statement from the firm before he would finalize the contract for this latest phase of the CCS development.[42]

The planning director's negative feelings at this point had undoubtedly been heightened by the fact that even in those previous instances where he had

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41. Interviews with patrolmen of District Eleven (Boston Police Department), Spring 1974.

42. See memorandum from Steve Rosenberg (Director of Planning and Research, BPD) to Maurice Silber (Contracting Officer, ADL), January 22, 1971.

directly informed the consultant's staff of his displeasure, he had apparently gotten very little satisfaction. In the revised work statement for LEAA Grant 70-107E that the firm submitted in mid-February 1971, though, the consultant seemed to have made some significant conciliatory gestures.[43] For example, despite the BPD's wishes to the contrary, since grant #346 the firm had persisted in viewing the complete redesign of the records and reporting system as work that would follow the development of the CCS. In the February 1971 version of the 70-107E work statement, however, the firm said this work would be completed during the current grant term, regardless of the status of the CCS. The February work statement also differed from the consultant's previous presentations in that it contained a detailed description of the remaining steps in the prototype CCS development, as well as a specific schedule for their accomplishment during the next six months. According to the firm's estimates, the prototype CCS would be functional by August 1971. Just what the prototype CCS would and would not do was also carefully addressed.[44]

In April 1971 the BPD planning director received a complete progress report on the CCS from the consulting firm. According to this report, the prototype system was in a "demonstration state" with one terminal on-line and with vehicle and incident files available to the programs. The memo further reported that the project team was also completing final drafts of the system's documentation and operations manual. It also disclosed that

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43. Stephen Waldron, "Work Statement: Boston Police Department Integrated Information System Project, October 1970-June 1971" (Cambridge, Mass: Arthur D. Little, Inc.), February 1971), p. 13.

44. Ibid., pp. 7-8.

much of the core storage which the BPD (upon the consultant's advice) had been leasing in anticipation of the prototype's installation would not be necessary, at least for the near future.[45]

In May 1971, after some further negotiations, the consultant finally demonstrated the prototype system for the planning director and two other BPD representatives. Though part of the prototype system was operational, several tasks associated with grant 70-107E were as yet unfinished. To ensure that such work would be completed during the present grant term the planning director sent several additional memos to the firm reviewing its obligations. For example, the memo directed that the reporting system was to be completely documented, structured and analyzed and a detailed implementation plan for installation was to be prepared, including the organization of interim filing procedures pending establishment of a new central records system. In connection with the central records system component of the contract, the consultant was to prepare a set of final functional specifications, including flow charts of the records operation and procedures, a description of the basic files that would be maintained, and estimates of file size and access requirements. For documentation of the CCS phase of the current project, the BPD demanded a series of materials, including a system description explaining all programs and flow charts, and a number of copies of the users' manuals. The planning director also mentioned the trouble that department personnel were experiencing with "bomb-outs" of the

45. Stephen Waldron, "Progress Report" (Cambridge, Mass.: Arthur D. Little, Inc., Case 70375-I, April 2, 1971).

CCS prototype. The memos implied that such problems were to be corrected before approval of the final contract payment would be given.[46]

On March 14, 1972, the BPD received a letter from the consulting firm's contracting officer. In the memo, the firm stressed that, in its own opinion, it had fulfilled its responsibility to develop the prototype. Further, the letter indicated that any further work on the CCS would be deferred until a new contract had been completed.

> Under a contract associated with Grant Number 70-107 [sic], the Prototype System has been implemented and operated for nearly a year. It was originally intended that modifications which became evident from test of the Prototype System would be embodied in the ultimate or production Command and Control System. At this time there appears to be need for an interim stage at which the modifications can be tested in the Prototype configuration before the complete hardware configuration is implemented....
>
> The objective of the proposed work is to modify the Prototype Command and Control System so that it will be simpler to operate and will better meet the needs of the department for training and further evaluation....
>
> The modified Prototype System will include a restart capability adequate for testing and training purposes. It will not include the ultimate capability to read out data to tape....
>
> The total proposed program would come to $11,000. Work would commence immediately upon receipt of a fully executed contract and would be completed within four calendar months.[47]

In response to the firm's latest proposal, on April 11, 1972, the planning director sent a letter to the consultant listing a number of CCS-

46. See, for instance, Steven Rosenberg's memos to Dr. Stephen Waldron of ADL on November 8, 1971, and February 14, 1972.

47. Memo from M.W. Silber (ADL) to Steven Rosenberg (BPD), "A Proposal for the Future Work on the Prototype Command and Control System," March 1972, pp. 1,5 (emphasis added).

related problems that had to be remedied before the BPD could begin to consider the firm's responsibility "to demonstrate an operating prototype to be completed." Among these problems was the prototype's unreliability and extreme instability. According to the planning director, the prototype system was so unstable that one could not operate it long enough to make any meaningful tests. The BPD personnel were continually plagued by the extremely frustrating problem of setting up the system by assigning a number of cars to radio calls using one of the system transactions (commands) and then having the prototype fail as soon as some other transaction was used. Moreover, whenever the system bombed out, all previously entered data were lost, making it necessary to start the time-consuming initialization procedure over again.

Another problem which was mentioned concerned the incident completion time. Although the consultant had sold the CCS on the basis of its usefulness for supervising the patrol force, the prototype did not contain a program for recording incident completion time, a critical piece of data for determining service times and for use as a performance indicator.

Finally, in his memo, the planning director reported that the department had problems in operating the system with multiple terminals on-line. The BPD staff found that intermittently the entry line was lost on one of the terminal display tubes when the other display tube was transmitting, making it impossible for each "scope" to act independently.

The planning director undoubtedly realized that the final payment for Grant 70-107E might not be enough of an incentive for the consultant to be willing to do the specified prototype modifications. Therefore, though he did not agree to the new $11,000 contract package, in his response to the firm, the director included a second list of activities that could be undertaken in "the next phase of system development."[48]

I. Change of Personnel at the Boston Police Department

The consulting firm apparently was convinced that the BPD's promise of a contract renewal was sincere, and it agreed to the planning director's counter-proposal. However, within the month, the planning director, the central actor in the department's federally subsidized programs, had resigned from the force. In May 1972, Mayor White disclosed that he was not going to ask Commissioner McNamara to serve for another five-year term. With this news, the planning director, who had been one of McNamara's key aides and had occupied a management position created by McNamara, announced his own resignation.

With McNamara's and the planning director's departures, a power struggle began in the BPD among high-ranking officers interested in preserving or improving their positions in the new administration. As a result, anything inseparably associated with the former administration became tainted, and the CCS project, like the Larson simulation (see Chapter V), was no exception. A deputy superintendent was appointed by the acting commissioner to supervise the remainder of the federally funded projects, but he apparently did not have the planning director's technical understanding nor the intellectual commitment to utilizing such sophisticated tools. Given these differences and the uncertain political environ-

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48. Memo from Steven Rosenberg (BPD) to Dr. Martin Ernst (ADL), April 11, 1972, pp. 1-3.

ment within the department, it is not surprising that the deputy superintendent carried out his obligations to the CCS project as a passive caretaker rather than actively advocating the project's implementation.

With this change of personnel, the consulting firm, whose contract had officially ended back in June 1971, terminated its work on the CCS project. The prototype was turned over to the BPD with many of the problems which the planning director had mentioned still evident.[49]

J. The April 1973 Evaluation of the BPD's Technological Projects

In the months before the planning director's resignation, the BPD's modernization projects increasingly were coming under review by external groups. In April 1972, representatives of the Governor's Committee, Massachusetts' LEAA state planning agency, had decided to evaluate the BPD's resource allocation, communications, and information system projects. The planning director apparently had been concerned with the possible repercussions of such an evaluation and sought some measure of control over who would perform the study and have access to its findings. In late April 1972, shortly before he left the department, he sent a memo to the executive director of the Safe Streets Act Committee, a mayoral advisory group, in which he asked that the Governor's Committee be reminded that the department and the city "reserve(d) the full right to approval of the successful bidder" [that is, veto any unacceptable bidder]. Moreover, he

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49. See Touche Ross & Co., A Review of Information Systems Projects and Related Operations in the Boston Police Department (Boston: Touche Ross, Inc., April 1973), pp. 3-10 to 3-13.

requested that the Governor's Committee be asked to insert a sentence to the following effect in the Request for Proposals to perform the evaluation:

> No report, oral presentation, publication, or other presentation of material concerning this contract is to be made to any person, group, agency, meeting, or assembly without the express written permission of the Boston Police Department.[50]

It is not altogether obvious why the Governor's Committee had decided to do an evaluation at this time. In the April 1973 report which resulted from the evaluation, four reasons were given.[51] First, all contracts for consulting assistance on the projects in question had been completed and the required final reports submitted. Second, the people responsible for initiation and direction of the projects--the planning director and, to a much lesser extent, McNamara--had both left the department, breaking the continuity of the development. Third, a new police commissioner, Robert J. diGrazia, had been appointed by Mayor White. Finally, the report claimed that the future development of these systems would involve the commitment of substantial additional amounts of money and department manpower.

Although these reasons seemed logical enough when the final evaluation of the federal projects was submitted to the Governor's Committee, most of the events given as rationalizations for the study had not taken place and could not be completely anticipated in April 1972 when the actual decision to do the evaluation was made. Instead, the major motivation for the evaluation appears to have been a change in the personnel on the Governor's

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50. Memo from Steven Rosenberg (BPD) to Peter Borre, Executive Director of the Safe Streets Act Committee (Boston, Mass.), April 28, 1972.

51. Touche Ross & Co., A Review of Information Systems, pp. 1-1, 1-2.

Committee staff that shifted the Committee's stance from one of funding source to one of evaluator. Essentially, the individual in charge of monitoring and assisting in the technology-oriented grants, who had been so responsive to the department's requests for funds since 1970, left the Committee staff in early 1972. His replacement found it extremely difficult to make sense out of the half-decade of BPD grants and reports and decide to enlist the aid of an outside consultant to help in this task.[52] In August 1972, a consulting firm was hired to perform the evaluation.

The evaluation consultant engaged in a two-stage study of each of the specified project areas (see Table I). First, the firm made a calculation of the results in each project area and compared them to what the firm felt were the original stated goals. To do this, the evaluation consultant reviewed written materials and project documents that were made available by the Governor's Committee and the BPD.

Second, to develop an assessment of the operational impact of the various projects, the evaluation staff observed the operations of and interviewed personnel from the Bureau of Field Operations, the Bureau of Special Operations, the Bureau of Inspectional Services, and the Bureau of Central Services. Additionally, the consultant staff met with representatives of the Governor's Committee and the Mayor's office to discuss their perceptions of the federally funded projects. However, the final evaluation report did not indicate whether the consultant had interviewed either McNamara, the former planning director, or the relevant staff of the department's previous consultants.

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52. Interview with Steven Long (Governor's Committee for Law Enforcement and the Administration of Justice), Fall 1973.

Table 10-1

The Projects which the Evaluation Consultant Examined:

Project No.	
1.	Radio Communications System Development: Redesign of the radio system and purchase of new mobile and portable transceivers.
2.	Command and Control System Development--Reconstruction: Design, purchase, and installation of ten new radio dispatch consoles, thirty-two complaint operator positions, and supporting equipment.
3.	Command and Control System Development--Computer Aided Command and Control System: Development and test of a prototype computer system to assist police vehicle dispatch.
4.	Command and Control System Development--Automatic Vehicle Monitoring System: Determine the feasibility of an electronic system to locate police cars during patrol.
5.	Bureau of Field Operations Administrative Command Center: Design and implement a communications room for the control of significant field operations.
6.	Records and Reporting System Development: Redesign and implement new paperwork procedures.
7.	Resource Allocation System Development: Develop an automated procedure to establish patrol patterns in response to changes in the pattern of crime.
8.	Statistical System Improvement (Geographic Base File): Implement an automated method to convert street address into patrol area, district, map coordinates, etc.
9.	Computer System Development: Identify and implement new computer applications.
10.	Headquarters to Station Communication System: Investigate and install new cable to provide data, audio, and video capability.
11.	Callbox System: Install free public emergency telephones at key street locations.

Table 1 (cont.)

Note: For each of these projects, the evaluation report summarized the stated goals and objectives, examples of expected operational improvements and project results, and presented the consultant's recommendations regarding further development. In this chapter we have been primarily concerned with Projects 3 and 6.

Overall, the April 1973 evaluation report was very critical of the department's attempts at technological modernization. In fact, in the Findings Summary of the report, the consultant preparing the report stated that, with the exception of the installation of the new radio dispatch consoles, mobile radios, and portable radios, the eleven projects evaluated had not achieved their stated objectives. Further, the consultant emphasized that in those areas where it felt that project goals had been modified (such as the Command and Control System), even the "less ambitious" objectives had not been fully met.[53]

The report argued that the alleged overall lack of success could be basically attributed to inadequate leadership by Commissioner McNamara and his director of planning.[54] For example, the consultant asserted that the projects undertaken by the McNamara administration had emphasized research and the use of sophisticated technology rather than concentrating on opportunities to improve the street operations (patrol and investigation) of the department. Moreover, the evaluation staff reasoned that to be successful and sustain the interest of operations personnel, some "quick payoff" projects had to be included in any overall plan of improvement. In the BPD's case, the evaluation staff concluded that projects with the potential for quich payofs had been organized in such a way as to prevent early benefits. Specifically, they pointed to the records and reporting system where the elimination of repetitive paperwork had been tied to prior implementation of the computerized command and control system. The easier project failed,

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53. Ibid., pp. 1-4.

54. Ibid., pp. 1-4, 1-5.

the staff claimed, because the complex computer-aided dispatching system had failed.[55]

The April 1973 report also claimed that the commissioner and his planning director had been unable to attach the "confidence and respect" of career department personnel even to the paperwork simplification effort, which was "well known to need improvement." The evaluation consultant suggested a number of reasons for this situation:

- Career department personnel had little or no involvement in formulating improvement projects.
- Outside consultants were prohibited from working closely with department staff and field personnel who would use the new systems.
- No line commander was made responsible for successful completion of the project.
- Few reviews of project progress were held with command personnel. Command personnel frequently did not understand the material presented to them and, feeling that the projects were not their responsibility, did not attempt to alter project direction. A general belief existed that the projects were not relevant to departmental problems.[56]

The evaluation consultant maintained that the projects had not been part of an overall program for improvement of the department, and the relative priority of projects was neither established nor reviewed by the

55. Ibid., p. 1-4.

56. Ibid., p. 1-4.

department command personnel who would be affected. Further, because the projects were oriented toward research and new technology and because line commanders were not convinced that the projects were useful, the evaluation consultant argued, no sense of urgency was attached to their completion. Consequently, "projects were not closely monitored and were not completed."[57]

After reading the full text of the April 1973 report and other relevant materials, however, a number of the statements which the consultant made in the Findings Summary appear to be inaccurate. For instance, while the Findings Summary states that only the radio equipment projects had met their objectives, information presented in other parts of the report indicates that the Automatic Vehicle Monitoring System study and the BPD Administrative Center project also had been completed according to the department's specifications (although these projects may not have had a discernible impact on operations).[58] Further research into source documents reveals that several other projects had probably met some or all of their contracted specifications as well.[59]

Even in the case of clearly unsuccessful projects, some of the evaluations's interpretations of events seem to have been mistaken. In discussing the expected operational improvements of the CCS project, for instance, the evaluation staff asserted that the goals of the project had changed from "implementation" in 1968 under OLEA Grant 346 to "demonstration and research"

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57. Ibid., p. 1-5.

58. Ibid., pp. 3-14 through 3-17.

59. For instance see Chapter 5 of this volume.

in 1970 and 1971, under LEAA Grant 70-107E.[60] In the opinion of this writer, however, the alleged change in the CCS project goals did not occur. Though the short-term objectives of the CCS project admittedly changed from grant to grant, throughout all their applications and work statements the CCS consultant had carefully and consistently specified that its long-range goal was the implementation of an integrated information system.

If aspects of the evaluation's interpretations of project accomplishments are debatable, its analysis of the critical factors in the project's histories is equally so. For example, the evaluation consultant strongly criticized the former planning director for preventing the previous consultants from working more closely with the command staff or field officers. At least in the case of the CCS project, however, it appears that it was not the department who made the decision that the consulting staff should operate independently of career officers, but the CCS consultants themselves. Similarly, although the evaluation made it look as if the police department had decided to have the records and reporting system revision follow the completion of the CCS, the department had repeatedly tried to get the CCS consultant to perform this work during the prototype phase. In fact, although in discussing future action the evaluation consultant had emphasized the importance of making a line commander responsible for project completion, it was not until the MIT-trained civilian employee of the BPD became project director (replacing a line officer) that the CCS consultant began to produce more tangible results.

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60. Touche Ross & Co., op. cit., in note 48, pp. 3-11.

While the April 1973 report contained a number of questionable points, many of its criticisms of the technological projects were quite warranted. In fact, almost all the BPD's modernization efforts exhibited significant shortcomings of some kind. For instance, as we have previously indicated, the CCS prototype package delivered to the BPD still contained the errors which caused the system to stop functioning (to "bomb out"), as well as design features that made it difficult to simulate the operation of a production system (the stated purpose of the prototype). According to the evaluation consultant, the system did not have the ability to store such data as car availability from run to run. It was not possible to simultaneously and separately simulate the complaint operator and dispatcher functions on the prototype. Moreover, the evaluation staff pointed out that the conceptual design of the system had been completed almost five years previously, and since then, developments in real-time computers and "intelligent" terminals had made the prototype's configuration technically obsolete.

K. EPILOGUE: The diGrazia Administration

In May 1973, the Commissioner's administrative staff presented diGrazia with a list of 18 projects as part of a proposal for an extended program for modernizing the department. According to department spokesmen, the new commissioner then chose "paperwork simplification" and "resource allocation" as the first to be implemented because "they had specific boundaries, were clear and readily grasped both conceptually and technically, and were programs which offered something to the men in the field."[61]

Within the month, the diGrazia administration selected the firm which had carried out the April 1973 evaluation as consultant for the resource allocation project. This effort is discussed in Chapter V of this report.

In addition to its resource allocation and paperwork simplification projects, the diGrazia administration, like its predecessor, also decided to undertake the development of a command and control system, which they termed a "computer-assisted dispatching system" (CAD). During Fall 1974, eleven firms submitted bid statements in response to the department's request for proposals. Despite the problems previously experienced, from among the eleven diGrazia selected the consulting firm which had worked with the McNamara administration on the earlier CCS prototype.

In January 1975, work began on Phase I of the new CAD system development effort. This phase was concerned with developing the basic capabilities of the CAD, which would permit complaint clerks to transmit information on calls-for-service (nature, priority, address verification) to the radio dispatcher. The dispatcher could then monitor the status of cases and their assignments via video display devices. The system would also create and maintain a record of these activities. For this work, a $410,434 LEAA grant was obtained.[62]

Phase I work was completed in mid-1976, and a follow up grant of $250,000 was sought to expand the basic system in three ways:

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61. Mary Ann Pate, "Change Processes: An Analysis of the Paperwork Simplification and the Resource Allocation Projects in the Boston Police Department," Interim Report (rough draft), July 1974, pp. 2-3.

62. Massachusetts Committee on Criminal Justice, 1976 Comprehensive Criminal Justice Plan, p. 44.

(1) develop a direct interface with the state police computer;

(2) develop a tie-in via video display and hard copy printing devices to the districts; and

(3) create additional on-line data files to alert dispatchers, and thereby field officers, of hazards associated with particular response situations.[63]

LEAA approval of the Phase II grant request was received shortly thereafter. In November 1976, however, partly as a result of pressure from the police union, the Boston City Council voted to reject the federal grant. With at least one Council member alluding to a "national racket," the action was explained in terms of the fear that if the funds were approved, the same civilian aides and consultants would be back using the funds for what the Council felt were projects of questionable benefit.[64] The Mayor and the police department tried to fight the Council's action, but to no avail.

Since the City Council vote, the BPD has been exploring ways of using existing departmental resources to complete Phase II work.

L. Findings and Conclusions

The basic question raised at the beginning of this case study was whether the President's Crime Commission was realistic in its assumptions about why and how police departments would implement the advanced technological systems the Commission advocated, and what the impact of such technology would be. While there are obvious problems to drawing conclusions to

63. Ibid., p. 45.

64. Boston Globe, November 23, 1976, pp. 1, 3.

such questions on the basis of a single case, it seems likely that many aspects of the Boston Police Department's experience may be generalizable to other large urban police forces. Indeed, many of the other cases presented in this volume exhibit similar patterns of experience, as do related studies which have been conducted.[65]

1. The Implementation Process. The data on the Boston Police Department indicates that the Crime Commission's endorsement of highly sophisticated technology (computers, simulation models, automated command-and-control systems, and the like) probably did serve as an important inducement for departments to procure such hardware. Since the BPD infrequently had the in-house technical expertise and resources to adequately evaluate technological proposals,[66] it was forced to rely to a great extent on the opinions of external reference groups (such as the IACP and the Crime Commission) for an appraisal of the technology's potential utility. Moreover, during a time when the BPD was under pressure to demonstrate significant reform (and

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65. See for example Kenneth C. London, Computers and Bureaucratic Reform: The Political Functions of Urban Information Systems (New York: John Wiley, 1974); Garry D. Brewer, Politicians, Bureaucrats, and the Consultant, (New York: Basic Books, 1973); Martin Greenberger, Matthew A. Crenson, and Brian L. Crissey, Models in the Policy Process, Public Decision Making in the Computer Era (New York: Russell Sage Foundation, 1976); and J. Chaiken, T. Crabill, L. Holliday, D. Jacquett, M. Lawless and E. Quade, Criminal Justice Models, An Overview, Rand Report R-1859-DOJ, (Santa Monica, Calif.: Rand Corporation, October, 1975).

concurrently was experiencing considerable political and intra-department opposition to many of the changes that had been recommended), the sophisticated technology--in large part as a result of the Commission's endorsement --promised to provide the administration with highly visible symbols of modernization and professionalization.

The problem in relying on the Commission's recommendations, however, is the fact that its evaluation of the technology did not necessarily represent a balanced picture. The Task Force Report on Science and Technology, from which the Commission got most of its research techniques, was prepared by the Institute for Defense Analyses. As its name implies, the Institute's activities normally were limited to performing systems analyses for the Department of Defense. However, a number of the Institute's members were interested in expanding the market for such techniques in the domestic sector. Accordingly, it is not surprising that the Institute's assessment of the technology is an exceedingly optimistic one.

In addition to the importance of endorsement by law enforcement opinion leaders, the Boston experience demonstrated that the Commission was correct in anticipating that federal subsidization would be another powerful incentive for departments to adopt the recommended technology. During the period examined, there were few individuals in the BPD who were seriously committed to applying the technology. As a result, if federal funds had not been available and the projects had to compete with other units of the organization for scarce resources, it is clear that the BPD's technological program would have been much smaller.[66]

However, while the availability of federal funding permitted experimentation which otherwise would have been impossible, it also brought its problems. The lack of a significant BPD financial stake in the technological program, for instance, seems to have contributed to the administration's tendency to be lax in demanding concrete results during the first years of the program.

In fact, although the Crime Commission correctly assessed the importance of certain factors in the decision to acquire the advanced systems, it failed to anticipate the range of problems which the BPD encountered in the course of developing and implementing the recommended technology. For example, as a result of the disorganized state of the BPD's existing records system, the complexity of the proposed technology, and the lack of previous efforts to serve as guidelines, the CCS developed required much more time and money than had been originally estimated. Consequently, four years and over $350,000 were required to produce an error-filled prototype version of the system. Moreover, because of more recent developments in the computer field, the technical work completed on the CCS was of little value to the subsequent CAD project (Phase I), which itself ended up costing at least twice as much as what the Task Force on Science and Technology had predicted

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66. The survey findings outlined in Chapter II appear to substantiate the importance of the federal grant program. According to the 1974 survey, over forty percent of those police departments who have access to a computer indicated that they had received LEAA subsidization of their electronic data processing operation, and more than 65 percent of these forces admitted that their computer facility would have been smaller or non-existant without such help.

a complete system would cost.[67] If the Boston experience is at all representative, one could hypothesize that many other departments attempting to develop advanced systems would experience similar cost and schedule overruns. The national survey of police departments which was directed by Colton in 1974 (see Chapter II) seem to further document that police departments have had problems in implementing CAD.

In addition, because the Boston Police Department did not have the technical expertise to effectively monitor and evaluate the work that was being performed, the department was in an extremely vulnerable position relative to the vendors and consultants. Moreover, some of the firms with whom the BPD dealt appeared at times to be insensitive or unresponsive to the basic needs of the organization, such as when the vendor leased the BPD an expensive computer system which the firm knew would do little more than the tasks already being performed by the department's unit record equipment. Even when the MIT-trained operations researcher became project director for the technological projects and could deal directly with the consultants, he was limited in the actions which he could take to expedite the CCS' development. For instance, a decision to fire the CCS consultant before something tangible had been produced probably would have prompted a review by the funding bodies, would have impaired the "reform" image of the department, and may have led to complete termination of the CCS effort (an outcome which the project director wished to avoid).

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67. The Task Force on Science and Technology had estimated that a command-and-control system for a city like Boston would cost $200,000; the actual figures for the CCS and CAD (Phase I) development projects were $350,000 and $410,000, respectively.

Since many police departments during the last decade may have been as technologically naive as the BPD, it seems likely that other departments required the services of outside experts, and were in a similarly vulnerable position. In 1972, for instance, the U.S. Congressional Committee on Government Operations which investigated the LEAA block grant program reported that nearly one-fifth of every state Planning Agency planning dollar had been spent on outside consultants. Moreover, the Committee suggested that there was a strong possibility that vendor "overselling" and consultant misconduct might be a common phenomenon.[68]

An interesting finding of the Boston case was the small role played by the local LEAA State Planning Agency in the day-to-day development of the technological systems. Given the limited technical expertise and manpower which the BPD could devote to the federally funded projects, the active involvement of the SPA staff might have contributed a great deal in terms of both the department's ability to monitor on-going work and the accountability of the consultants. During McNamara's administration, however, the SPA staff was surprisingly ill-informed about the technological projects' development, and apparently did little more than routinely and uncritically approve the BPD's requests for additional grants. Even after the CCS consultant had repeatedly failed to meet contract objectives, the BPD experienced little difficulty in getting additional funds.[69]

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68. Committee on Government Operations, supra note 65, pp. 17-60.

69. This particular situation may have been a consequence of the relative newness of the SPA (and LEAA programs), however. Because it had been recently established, the SPA may not have had time to institute thorough monitoring procedures. Moreover, during the first few years of its existance, the SPA apparently had more money than it had promising projects to fund. Yet, in order to guarantee that the state's share of the LEAA program funds were not reduced the following year, the SPA was under pressure to distribute all the available funds.

Moreover, when the SPA staff finally assumed a more critical attitude toward the federally-funced projects after the departure of McNamara and his director of planning, they relied almost entirely on an evaluation performed by an outside firm for their understanding of the causes of the projects' problems, and their opinion of the technology's merits. The final report from this evaluation--which contains a number of inaccuracies--provided the interregnum BPD command staff with a strong justification for abandoning the CCS system whose principle advocate they had resented (because the MIT-trained project/planning director was a civilian, yet had considerable influence on McNamara and department policy). Further, since the evaluation placed the blame for the earlier project's failure on the previous commissioner and planning director, the SPA felt no hesitation in awarding the subsequent CAD contract to the same consultant which had had responsibility for the CCS' development.[70]

The clear issue which emerges from the Boston implementation experience is the questionability of attempting to introduce a major innovation in an organization where there is little internal support for such an effort. Endorsement by the elite of the law enforcement community and federal funding may be powerful inducements to experiment with the technology. However, if the technology doesn't have a broad and influential constituency in the organization or continuity of project staff, or if it threatens powerful groups, it is very likely that the implementation effort will fail. Because the CCS project had few advocates within the department, when several key

70. In fairness to ADL, it should be noted that the CAD project apparently experienced few of the management problems which had characterized the CCS development effort.

individuals left the BPD the entire project ground to a halt. Moreover, while the subsequent administration has been able to implement part of its CAD system, opposition from both internal and external groups has created a moratorium on completion of the system.

2. The Impact of the Technology. While neither of the command-and-control systems planned by the BPD has become fully operational, the Boston case provides some indicators that technology's impact on police operations may be quite different from what the Crime Commission anticipated.

For one thing, the Boston experience demonstrates that implementation is a much more difficult process than the Commission's report would have led one to expect. And, where implementation of the technology has failed (either for technical or behavioral reasons), it seems logical to conclude that the system's impact on department performance will be negligible, outside of the negative effect of having diverted resources and attention from other reform efforts.

The Boston case also suggests that in those cases where the command-and-control systems have been more successfully introduced, its principal focus may not be crime control (as the Crime Commission had envisioned), but managerial control of personnel. From the Boston experience, it appears that police administrators may be judged by their superiors more on the basis of their general ability to placade citizens and keep their personnel "in line" than on aggregate (and often unreliable) crime statistics. Most police administrators have far less control of personnel than the Commission assumed in its reform recommendations, though, and certainly a lot less than the administrators themselves would like. For such administration, the technology represents the opportunity to get instantaneous data on the activities of each patrol car, and therefore more accountability from the patrol force.

Even in connection with the narrower objective of supervision, however, there is considerable uncertainty regarding the amount of additional control which will accrue from such systems. At best, command-and-control systems such as the BPD tried to develop will only provide data on where a patrol unit is and how long it has been at its various locations. The administrator still will not know what the officers actually have been doing. In addition, even this limited supervisory capability can be abrogated through collusion of the patrol force and dispatchers.[71] The Boston experience also showed that members of the patrol force may not be reluctant to employ more dramatic gestures of disapproval of management's attempts to increase control.[72]

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71. For a discussion of collusion between the patrol force and dispatchers, see Jonathan Rubinstein, City Police (New York: Farrar, Strauss, and Giroux, 1973).

72. Gestures of disapproval such as were exhibited by some patrolmen in response to the introduction of the screen activators and CAD are not likely to be unique to Boston. For instance, as part of a digital communications experiment, the Oakland Police Department placed manual car location transmittors in the marked patrol cars of one of its districts. A technical problem with the dispatching room's computer developed, however, and brought about a temporary shut-down of the system. When the computer facility repairs had been completed several months later, the project staff found that most of the devices in the patrol cars had been broken. It seems that the transmitters had been installed on the patrol cars' dashboards where the field officers had kept clipboards for their stolen car notices. The patrol officers had gone along with the experiment when the devices were first placed in their vehicles; however, after the system had been shut down for a number of weeks and no action taken on their requests that the devices be removed, the patrol officers started using the devices as makeshift clipboards. Unfortunately, in using the pressure-sensitive faces of the transmittor as clipboards, the officers often destroyed critical parts of the devices' circuitry. (See Scott Hebert, "Dispatching and Communications Technology in the Oakland Police Department," supra note 65.)

There are undoubtably some departments who are applying the technology as the Commission intended--that is, toward the reduction of response time in hopes of increasing arrest rates and the patrol force's deterrent effect. Unfortunately, because of the CCS' premature termination and the CAD's incomplete development, the Boston case to date provides us with little insight regarding the actual effectiveness of the advanced systems in reducing response time.

However, as we have previously argued in Chapter VII of this volume, even a sizable reduction in response time will not necessarily guarantee a corresponding increase in arrest or crime control performance. Crime and criminal justice agencies are both much more complex phenomena than the Commission's Task Force on Science and Technology represented in its report advocating command-and-control systems. And, short of requiring citizens to carry personal location devices and monitoring all buildings with cameras --actions which not only would be exceedingly expensive but also would signal the establishment of a police state--I seriously suspect that no technological development is likely to result in a significant improvement in the police's ability to curtail criminal behavior.[73] This view is shared by a number of police scholars, including James Q. Wilson, who has written:

> ..."I doubt that any department, any strategy, or any organizational principles will permit the police to make

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73. It might be useful to remember that in 1931 the Wickersham Commission had predicted that mobile patrol units, better records systems, and modern communications devices would give the police the "winning edge" in the war on crime. Yet, despite the pervasiveness of such technology in present-day police organizations, there is little evidence that the police are any better at controlling crime than they were before such equipment became commonplace.

> more than a slight or temporary reduction in the rate of most common crimes ... It would be well, therefore, not to "oversell" proposed improvements in police manpower, organization, training, equipment, or tactics."[74]

Nor are the other agencies of the criminal justice system likely to experience much greater success than the police in bringing about a reduction in the incidence of crime in the near future.[75] In fact, about the only short-term approach that we can be confident will result in a decrease in crime is decriminalization.[76]

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74. James Q. Wilson, "Dilemmas of Police Administration," in Public Administration Review, Vol. XXVIII, No. 5, Sept./Oct. 1968, p. 415.

75. See Part B of Chapter VII for a fuller discussion of this subject.

76. In his essay <u>On Liberty</u>, John Stuart Mill defined the proper sphere of the criminal law:

> "The principle is, that the sole end for which mankind are warranted, individually or collectively, in interfering with the liberty of action of any of their members is self protection. That the only purpose for which power can be rightfully exercised over any member of a civilized community against his will, is to prevent harm to others. His own good, either physical or moral, is not a sufficient warrant, he cannot rightfully be compelled to do so or forbear because it would be better for him to do so, because it will make him happier, because, in the opinion of others, to so would be wise or even right."

If we accept this definition, we must also conclude that the current sanctions in our criminal code against "victimless crimes" (such as gambling, homosexuality, prostitution, and drug abuse), like all attempts to regulate the private moral conduct of the citizen, represent an improper "overreach" of the criminal law.

(Footnote continued on next page.)

This situation raises fundamental questions not only about the purpose and value of technology in law enforcement, but also about the wisdom of the police professionalization movement's traditional prescription for reform. For example, the professionalists have consistently argued that the responsibilities of the police should be narrowed to the law enforcement function. Yet, if there is little hope of the police becoming much more effective at law enforcement than they currently are without enormous infusions of additional manpower and various forms of surveillance technology,[77] it would seem to me that making this task their sole function would be an unwise move.[78]

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76. (cont'd.) Moreover, Morris and Hawkins have pointed out that the existing criminal proscriptions against such behavior has a secondary criminogenic effect. Briefly, their argument is as follows: the imposition of criminal sanctions creates a "crime tariff" on such goods and services, which drives up prices and discourages competition; this leads to the growth of large-scale criminal groups which use the funds garnered from the provision of the illegal services/goods to diversify and expand into other criminal activity; moreover, in instances where the demand is inelastic (such as narcotics), the high prices force individuals into further criminal activity to pay for the services/goods; finally, because such crimes generally lack complainants asking for the protection of the criminal law, enforcement is particularly difficult and inefficient, and bribery and political corruption, as well as illegal means of enforcement, often result. (See Norwal Morris and Gordon Hawkins, <u>The Honest Politicians Guide to Crime Control</u> (Chicago: University of Chicago Press, 1969), pp. 4-6.)

77. As used here, "surveillance technology" not only includes electronic "bugs," location devices, and audio/visual monitoring equipment, but also law enforcement databanks.

78. Moreover, the Boston experience intimates that, in some cases, the efforts (inspired by the professionalization movement) to insulate patrolmen from political influence and the "spoils system" may have only succeeded in widening the gulf which many patrol officers perceive to exist between themselves and citizens, and reducing police responsiveness to the communities they are supposed to serve. (For more discussion on this subject, see Robert M. Igleburger et al., "Changing Urban Police: Practitioners' View" in <u>Innovation in Law Enforcement</u> (Washington, D.C.: National Institute of Law Enforcement and Criminal Justice, 1972), p. 88.)

Determining the proper role of the police in a democratic society is only one of the issues that criminal justice reformers and the public at large should be continually addressing. For instance, if we are interested in justice, and not merely the control of crime, then in addition to seeking effective enforcement strategies we must also carefully examine why certain acts are labelled criminal, and why individuals commit them. However, by defining crime and police misconduct as technical problems, the "technological approach" to criminal justice reform often obfuscates the process of addressing such questions.[79] If the emphasis on technological approaches continues to deflect attention from these more fundamental issues of reform, then instead of being the boon which the Crime Commission contemplated, the advanced technology may end up seriously impairing the quality of criminal justice in the United States.

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79. See Part B of Chapter VII.

CHAPTER XI

EVALUATION OF THE PHASE I IMPLEMENTATION OF AN AUTOMATIC VEHICLE MONITORING (AVM) SYSTEM IN ST. LOUIS

By Richard C. Larson, Kent W. Colton, and Gilbert C. Larson

The potential police uses of automatic vehicle monitoring (AVM) systems were first highlighted in 1967 by the President's Commission on Law Enforcement and Administration of Justice.[1] Studies made at that time suggested that such systems might achieve cost-effective reductions in police response time, and that they might improve apprehension rates and thus serve as a deterrent to crime. Fully eight years after the report of the President's Commission had been published, the St. Louis Metropolitan Police Department (MPD) installed a computer-assisted dead-reckoning system, FLAIR -- the first implementation of an AVM system in a major urban police department.[2] By

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Work on the evaluation project reported in this chapter was supported by Grant No. 75NI-99-0014 from the National Institute of Law Enforcement and Criminal Justice, Law Enforcement Assistance Administration, to Public Systems Evaluation, Inc., a nonprofit corporation in Cambridge, Massachusetts. This case is included because of its overall relevance to the subject of the book. Points of view or opinions stated in this chapter are those of the authors and do not necessarily represent the official positions or policies of the U.S. Department of Justice. This chapter is very similar to a report presented to the National Institute by the same authors, entitled "Evaluation of a Police Implemented AVM System: Phase I, with Recommendations for Other Cities, A Summary Report," 1976.

1. President's Commission on Law Enforcement and Administration of Justice, Task Force Report, Science and Technology, and The Challenge of Crime in a Free Society (Washington, D.C.: U.S. Government Printing Office, 1967).

2. FLAIR is a registered trademark of the Boeing Company, signifying Fleet Location And Information Reporting. The issues discussed here pertain only to the FLAIR system, and specifically to the Phase I prototype system, not an "off-the-shelf" production system.

early 1976, a Phase I prototype system, which had been implemented in the Third District of the MPD, had completed its first test year. A Phase II production system incorporating improvements arising from the Phase I experience was to be implemented in 1977. This chapter presents a summary of an 18-month evaluation of Phase I.

An AVM system should be distinguished from two other computerized systems: AVL (Automatic Vehicle Location) and CAD (Computer Aided Dispatch). AVM gives a police dispatcher real-time location estimates of each vehicle in a fleet and, through its monitoring function, provides additional vehicle status information, for example, "in pursuit," "enroute to scene," or "driver door open." An AVL system provides only location estimates, without any additional status information. A CAD system utilizes a computerized geographic base file to partially automate the call-answering, processing, and dispatching activities of a police dispatch center. A CAD system may include either an AVM or an AVL system.

With the computer-assisted dead reckoning system which is being installed in St. Louis, vehicle locations are estimated (after their starting positions have been established) by integrating raw distance and heading data transmitted at fixed intervals from the vehicle. The computer assistance occurs in a "map-matching" process which usually constrains a vehicle's estimated position to be on a street and which corrects for accumulated distance errors when the vehicle turns onto another street. This normal mode of tracking is called "closed loop." A vehicle estimated to be driving on other than a mapped street will be tracked in "open loop" mode, utilizing only the raw data. Occasionally, accumulated errors develop which eventually cause a vehicle to become "lost" -- that is, the computer can no longer match the vehicle's trajectory with possible map routes. When the tracking algorithm recognizes that a vehicle may be lost, the computer causes a "V" to be displayed with the vehicle number, notifying the dispatcher to verify the vehicle's estimated location, and if necessary, to reinitialize to the proper location.[3]

Vehicle location information is presented to the dispatcher on a computer-driven CRT display map, utilizing various colors, magnification scales, and a dispatcher-controlled cursor for indicating locations of incidents and vehicles. Using this information, the dispatcher can dispatch the car or cars closest to the scene of an incident and also perform certain command and control functions that would have been impossible without real-time vehicle location information. The monitored status of each unit, which is also displayed on the screen, is obtained from voluntarily transmitted canned messages ("officer-in-trouble," "emergency alarm," "arrived at scene") utilizing the same car-to-base station digital channel used for transmitting tracking data. In a strict sense, certain of these canned messages transcend the monitoring function and include a number of responses such as "message received" that are normally viewed as part of the radio communication process. Thus, the communicating officer is provided with nearly immediate communication to the dispatcher, regardless of possible congestion in the voice channel.[4]

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3. In addition, when a vehicle travels outside the system boundary (for example, outside the Third District, during Phase I) or is in the vicinity of a magnetic anomaly or has travelled "too" far in an unmapped "open loop" area, a "W" appears which notifies the dispatcher to reinitialize the indicated vehicle after a reasonable waiting period.

4. For further details on the system see R.W. Lewis and T.W. Leznick, "A Report on the Boeing Fleet Location and Information Reporting System," The Boeing Company, Wichita, Kansas, paper presented at the 10th Annual Carnahan Crime Countermeasures Conference, University of Kentucky, Lexington, Kentucky. This paper contains Boeing's description of FLAIR and the Phase I implementation results.

A. Design of the Evaluation

AVM systems and other high technology systems proposed for urban services need to be critically evaluated because of the cost/benefit questions surrounding them and the likelihood of their increased use during the coming decades. A proper evaluation must look beyond the purely technological features of the system to its impact on the operation of urban services and on the attitudes and behavior of personnel. Focusing on these three topics -- technology, operations, and attitudes -- this chapter summarizes the results of an intensive 18-month evaluation of the Phase I AVM System in the Third District of the St. Louis MPD. The major part of the chapter analyzes the technological, operations, and attitudinal impacts of Phase I, and the concluding section discusses more general issues, such as the benefits and costs of AVM.

In considering the results of the evaluation, it is important to remember that in 1976 when this chapter was written the AVM implementation in St. Louis was still an "experiment in progress." The city-wide Phase II of this experiment was being planned at that time, and its results were likely to be quite different from those of Phase I. The issues raised in Phase I promised, nevertheless, to be important for Phase II. Moreover, because many of the Phase I experiences in St. Louis are likely to be repeated in other cities and with other forms of AVM technology, a discussion of these experiences may assist other cities in their consideration and implementation of AVM systems.

Following the MPD's own priorities, the 18-month evaluation focused on four objectives:

- reduction in response time;

- improvement in officer safety;
- reduction in voice-band congestion;[5] and
- enhancement of command and control capabilities.

Generally speaking, each of these objectives has the potential of improving a police department's productivity. Considering that more than 90 percent of a department's budget is normally expended on salaries, fringe benefits, and pensions; that each round-the-clock one-person or two-person patrol car costs between $100,000 and $350,000 per year to operate;[6] that many cities are unable to increase the budgets for their urban services; and that demands for urban services keep rising (sometimes by more than 10 percent per year); the need for productively improving systems and procedures is apparent.

An overall outline of the evaluation plan, showing both its objectives and its three types of analysis, is presented in Figure 11-1. The most important issues raised under each of the analytical headings will be discussed. Full details of the evaluation, including the data that were collected and analyzed, are contained in the Final Report which was prepared in 1976, as part of the evaluation project.[7]

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5. As pointed out previously, this objective is not strictly AVM-related.

6. This annual cost is based on the assumption that five police officers are required to staff a one-person car for three shifts, including weekends, vacations, holidays, and sick leave. For a two-person car, ten police officers are required. Depending on salary levels, fringe benefits, and overhead rates (which vary considerably), the cost of a one-person car is generally $100,000 or more and a two-person car is $200,000 or more.

7. R. C. Larson, K. W. Colton, G. C. Larson, and M.A. McKnew, "Evaluating an Implemented AVM System - Phase I," Public Systems Evaluation, Inc., Cambridge, Mass., 1976, available from the Office of Evaluation, National Institute of Law Enforcement and Criminal Justice, Law Enforcement Assistance Administration, U.S. Department of Justice, Washington, D. C. This document is referred to elsewhere as the "Final Report."

Figure 11-1: Overall Evaluation Plan

EVALUATION PLAN
AVM System Implemented in St. Louis

ESTABLISH SYSTEM OBJECTIVES

1. Reduction in response time
2. Officer safety, emergency alarm
3. Decrease voice-band congestion by digital communication
4. Increase command and control capabilities

Analyze cost effectiveness of AVM

TECHNOLOGICAL ANALYSIS

System performance

- Accuracy
  - location
  - lost cars
  - target objectives
- Radio-channel capacity
- Computer software package

Reliability

- Headquarters equipment
- Mobile equipment

OPERATIONS ANALYSIS

Response time

- Dispatch time
- Travel time
  - empirical results
  - simulated results
- Special test
- Computer models
  - Simulation model
  - Mean-time-between lost-cars model

ATTITUDINAL ANALYSIS

Surveys

- Patrol officers
- Dispatchers
- Command staff

Findings

- Change in attitudes
- Causes for change
- Effect of special test on attitudes

Recommendations for Phase II

B. Technological Analysis

This section reviews Phase I technical performance, with emphasis on accuracy and reliability, and describes the corrective actions planned for Phase II.

1. System performance. Taking into consideration the complexity of the new technology, the system functioned well. The color display terminal showed the selected map of a part of the city with police vehicles traveling on streets and with each vehicle identified by number and by class. The display of vehicle status, digital code messages, and the four closest cars to an incident site were readily discerned. Operation of the display terminal was reasonably simple, and most of the better dispatchers integrated the AVM-supplied information into the dispatching process.

The principal hardware-operating problem during Phase I was accuracy, particularly as it related to the frequency of lost cars. A major system problem was radio-channel capacity: the assigned channel (UHF) accommodated only 97 cars compared to the 200 required by the FCC. These problems were largely responsible for the two major design changes planned for Phase II:

- an entirely new radio transmission digital format which will provide for the required number of vehicles per channel, the increased number of bits for distance and heading information, more precise synchronizing signals, satellite stations, and other improvements; and
- an entirely new software package that will increase computer capacity, include changes to improve open- and closed-loop tracking, and provide more information on street widths and off-street areas for improved accuracy.

a. System Accuracy. Phase I tests showed 95 percent of vehicle location estimates to be within 625 feet of the true location--an average location estimation error of 137 feet (upper bound) to 101 feet (lower bound), depending on the error distribution assumptions--and showed 80 percent of the estimates to be within 90 feet of the true location.[8] During both the regular Phase I operations and a special three-week test period, the system experienced an average of about 11 reinitializations per car day, or about 2.2 hours between losses of a tracked vehicle. The computer assistance in constraining vehicles to be on streets and correcting for accumulated distance errors when a corner was turned was responsible for the exceptional performance for 80 percent of the samples; however, too many of the vehicles escaped the computer hold, causing the relatively poor 90 percent confidence level and the large number of lost vehicles.

Errors that caused loss in location accuracy gave rise to lost vehicles. A modeling analysis, coupled with empirical tests, indicated that the following six factors contributed to diminished accuracy and smaller values of the mean time between losses, or equivalently, to increased values of the number of reinitializations per vehicle per day.[9]

(1) Random error. Random error resulted from tire slippage, irregular driving patterns, speed variations (if viewed as uncorrectable), and mapping errors.[10] Measurements

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8. Based on 713 dispatcher-conducted location checks in which the actual location of randomly selected cars was compared with the indicated location on the FLAIR display console.

9. See Chapter V of the Final Report for a description of modeling analysis.

10. Variations in speed cause predictable variations in tire circumference. These variations can be "corrected for" in the computer-tracking algorithm.

showed, for example, that with a calibrated "fifth wheel" the errors caused by exaggerated land switching ranged from 0.1 percent (five feet per mile) to 0.28 percent (15 feet per mile). Simple geometrical models predicted errors of up to 80 feet due to alternative methods of turning corners and traversing curves (inside versus outside lane).

(2) Quantization in distance, angle, and time. In Phase I, angular and distance resolutions were too coarse--11.25° and 24 feet, respectively. The Phase II system will include two additional bits for each of these variables, yielding resolutions of 2.8° and 6 feet, respectively. Time quantization was originally two seconds (i.e., location data were transmitted once every two seconds), but that was reduced to one second in Phase I; the Phase II system will have an update interval slightly greater than once per second.

(3) Systematic errors. Such errors were due to temperature, tire wear, and speed (if viewed as correctable). Phase I tests showed that tires increased in diameter with speed, causing errors at 60 mph (compared to 30 mph) of 2 percent (or 106 feet per mile) for a steel-belted radial tire. Phase II will incorporate "velocity" correction in the computer algorithm to correct errors from this source. Tires decreased in diameter due to wear, measuring 2 percent (106 feet per mile) for rayon-belted and 1.2 percent (63 feet per mile) for steel-belted radial. Phase II corrections will provide for odometer recalibrations. Any systematic angular errors are usually corrected in the map-matching process.

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5 OF 7

(4) Open loop tracking. As a result of crude quantization intervals in Phase I, open-loop driving was a primary cause of lost vehicles. Tests in off-street areas (parking lots, shopping centers) under open-loop conditions caused a V or a W to appear for four of the eight areas visited, and required three reinitializations. This indicated poor performance, but the results require further verification because of the small sample size. The finer distance and angular resolutions in Phase II should reduce the extent of this problem.

(5) Missed signals. In the FLAIR system, if the headquarters receiver misses two or more consecutive signals, errors can occur if a turn has taken place during that time. Three or more consecutively missed signals are more serious because the digital odometer may recycle, suggesting a travel speed much lower than actual speed. In a test throughout the city involving more than 5,000 time-slot transmissions, 2.35 percent of the signals missed (weak), 0.58 were bad data, and 0.31 percent were one of two consecutively missed signals. Overall, performance was good except in the one area of the city that is in the shadow of a hill. A satellite station may be required to provide reliable signal transfer. In Phase II, more historical data will be retained in the computer and the algorithm will be modified to use these data to reduce the probability of error from these causes.

(6) Susceptibility to subversion. The system was open to acts by patrol officers and dispatchers that were aimed at intentionally reducing system effectiveness. These included deliberately driving near magnetic anomalies and reporting incorrect locations. Subversion will be a major concern of the Phase II evaluation.

While some of the error sources just described appear to be of minor consequence, the cumulative effect of even small errors can reduce location accuracy. The inclusion of real-time speed monitoring in Phase II (and periodic recalibration of the odometer) will aid in the reduction of systematic error. Nevertheless, a certain amount of random error will remain due to changes in the center-line street mapping technique. As a part of the Phase I evaluation, a model was developed to predict the mean time between losses of a computer-tracked vehicle location system.[11] Analysis using this model suggested that reasonably tight tolerances on systematic and random error could cut the number of losses (per vehicle) due solely to these types of errors to one or two per day. Of course, additional losses may still result from missed signals, open-loop tracking, and system vulnerability.

Although it is too early to set the required accuracy performance levels, earlier simulation analyses have suggested that in a homogeneous city with no irregularities in travel paths, virtually all of the possible mean travel time reduction is achievable with one-quarter beat length resolution.[12] In the

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11. For details on this model see Chapter X and Appendix A.

12. R. C. Larson, Urban Police Patrol Analysis (Cambridge, Mass., MIT Press, 1972), chap. 7.

Third District of St. Louis, where the average beat is half a square mile, the average beat length is 1/ 2 0.707 mile. Thus, one-quarter beat length resolution correspondes to $\frac{0.707}{4}$ 0.177 mile = 933 feet. Other considerations, however, give rise to a more stringent resolution requirement. For example, accuracy of one-half block or better is needed in order to determine on which side of a barrier, such as an expressway, a car is located, or to quickly locate an officer in trouble in a high-density urban area, or to direct cars to specific streets during a command and control operation that involves a chase or the sealing off of an area. In St. Louis, this would indicate an accuracy requirement of approximately 220 feet with 95 percent confidence, based on the estimated average block length. The FLAIR System has an accuracy requirement that appears even more stringent, in that it must correctly identify each of the streets (including alleys) into which a vehicle has turned, which, in the case of the short dimension of many rectangular blocks, implies an accuracy requirement of 100-150 feet with 95 percent confidence or higher. If the tracking computer associates a turn with an incorrect street, it will attempt to relocate the vehicle to the correct street, but the risk that the vehicle will be lost is quite high.

Regarding the frequency of lost vehicles, in Phase II a level of performance should be achieved that will be substantially better than the 11 reinitializations per car per day that were experienced in Phase I. It is difficult to establish a precise target objective of tolerable reinitializations per car per day because the workloads, confidence levels, and attitudes of those using the system are involved. Yet it is important to establish such a standard as a means of measuring the performance of the system. In the case of FLAIR, the requirement for occasional reinitialization can be rationalized as a trade-off for the feature of having location estimates pinpointed to street center-lines, which facilitates command and control operations. For this benefit, a "price" of perhaps three or four reinitializations per car per day may be reasonable.

b. Reliability. In an AVM system, failures in the base station cause the entire system to be inoperative. During Phase I, the mean time between failure (MTBF) was 38.9 days and the mean time to repair (MTTR) was 1.32 days, resulting in a total downtime per year of 12 days. Most of these failures were computer-related. Although Phase II will have a standby computer, which should greatly improve performance, the transfer from one computer to the other (a manual operation) will take about half an hour, not including the time required to initialize the cars in the fleet that have moved and those that have not been self-initialized.[13]

For the AVM mobile equipment, the mean time between failure was 7.7 days per car. The mean time to repair, which did not include delays at the shop, was estimated at 1.05 hours. The most recurrent repair problem, recalibration of the magnetic heading sensor, accounted for 25 percent of all service problems.

The number of repair incidents in Phase I, though high, was perhaps not unreasonable for a trial system. Reliability was adversely affected by temporary fixes that were applied as problems were uncovered. Also, Phase I service operations were hampered by a lack of service information, test equipment, spare parts, and spare AVM-equipped vehicles.

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13. During Phase I, a police car could drive to a location directly in front of the Third District station, transmit a code "22," and be self-initialized to that location without assistance from the dispatcher. Twenty-two such self-initialization locations are being planned.

2. Phase II concerns. By the end of 1976, many changes and improvements had been scheduled for Phase II that were expected to improve the system. However, three important areas of concern still remained that might hamper technological performance.

- The software was all new, was more sophisticated than the old, and had four times the memory and eight times as many cars to track. Some debugging was to be expected.
- The radio transmission digital format, which was entirely new, employed some state-of-the-art design techniques, and it would be operating with much greater loading of the time slots. Effects on performance and reliability had to be determined.
- Signal strengths were weak in at least one area of the city. To correct this, a satellite receiver, which had yet to be tried in the FLAIR system, might be needed. Also, other weak signal areas might be discovered during the city-wide implementation.

C. Operations Analysis

Since reduction in response time is often cited as one of the primary advantages of an AVM system, the Phase I operational evaluation focused on that area. To understand the effects of AVM on response time, it was necessary to examine the entire police response system, both those aspects which were influenced directly by the AVM system and those which were not.

1. Response time. Response time comprised four distinct components:

- time until reporting the incident to the police -- the time needed to detect the incident and make contact with the police;
- time for complaint evaluatin processing -- the time needed for

a citizen's call to be transferred from the central operator to a complaint evaluator, who either forwarded information about the incident to the dispatcher or handled the call in some other manner;

- dispatch time -- the time from dispatcher notification of an incident to dispatch of a vehicle; and
- travel time -- the time from dispatch of the police unit until its arrival at the scene of the incident.[14]

The approximate mean magnitudes of the key components of response time for the Third District are shown in Figure 11-2.[15] Of these four components, the first two were not influenced by the AVM system, but the last two were closely AVM-related. In the following discussion the first two components will be grouped together and treated briefly in subsection "a," while the last two--dispatch time and travel time--will be broken down and analyzed in detail.

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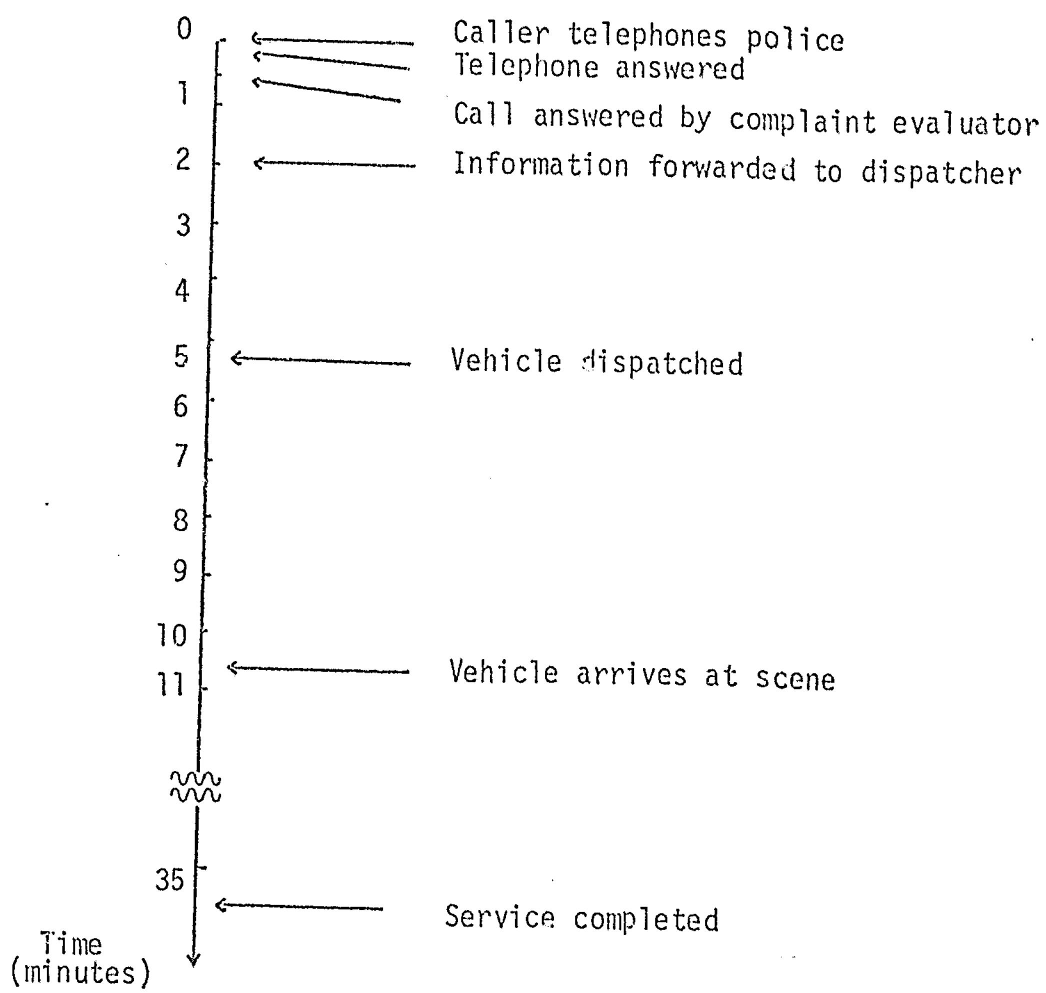
14. For more detailed discussions of the police emergency response system and the potential role of technology in improving system performance, see President's Commission on Law Enforcement and Administration of Justice, The Challenge of Crime in a Free Society, (Washington, D.C.: U.S. Government Printing Office, 1967); and Larson, Urban Police Patrol Analysis, chap. 7.

15. Due to the limitations of the incident-type data coding procedure employed by the St. Louis MPD in Phase I, it was not possible to perform a "before and after" analysis of dispatch delays and travel times by priority or urgency of calls. Limited priority-oriented response time information was obtained by an on-site observer, as reported in Chapter VI of the Final Report. The Phase II evaluation will include a more extensive analysis of priority-oriented response time.

Figure 11-2: Police emergency response system: measured mean response times (St. Louis Metropolitan Police Department, District 3)



[Same as Figure 8-1 on page 288.]

a. Telephone answering delay and complaint evaluation processing. According to studies carried out as part of the Phase I evaluation, a caller reporting an incident to the police experienced an average 30-second delay prior to reaching a complaint evaluator, and the evaluator required about 90 seconds to record the information and direct it to a dispatcher. The AVM system had essentially no influence on these components of response, but the St. Louis MPD might make certain improvements that would result in time savings. For example, an estimated 20 seconds might be eliminated by implementing two public telephone numbers in St. Louis -- one for emergencies and one for administrative calls. If the popular three-digit number 911 were to be used as the emergency number further reductions might be achieved.[16] Another possibility would be the implementation of a Computer-Aided Dispatch (CAD) system.

b. Dispatch time. The use of an AVM system need not result in a significant increase in dispatch time if the system is operated properly. Mean dispatch time during 1975 (January-November) was 3.62 minutes in the Third District, down 1.4 percent from 1974. The comparable figures city-wide (excepting the Third District) were 2.55 minutes, down 8.6 percent from 1974, as shown in Table 11-1.[17] During the first half of 1975, the Third District dispatch times were generally consistently greater than those for 1974, but starting in July they dropped noticeably below the previous year's figures. The initial rise can be attributed to the time required by the dispatchers to

16. A change to a 911 System or a Centrex System 13 was being considered by the St. Louis MPD at the end of 1976.

17. Dispatch time in the Third District has consistently been longer than in the rest of the city. Probable reasons for this include the heavy workload in that district and the resulting queuing of dispatches during peak periods.

Table 11-1

Percentage Change in Average Dispatch Times, Third District and City-Wide, 1974 and 1975

	Third District			City-Wide Less Third District		
	Average dispatch delays (minutes)			Average dispatch delays (minutes)		
	1974	1975	% Change	1974	1975	% Change
JAN	3.22	3.46	+7.4%	2.44	1.76	-27.9%
FEB	3.02	3.46	+14.6	2.20	1.81	-17.7
MAR	3.25	3.21	-1.2	2.29	1.80	-21.4
APR	2.65	2.93	+10.6	2.19	2.05	-6.4
MAY	2.54	3.66	+44.1	2.12	3.56	+67.9
JUN	3.70	4.38	+18.4	2.93	2.84	-3.1
JUL	5.22	3.62	-30.6	3.41	2.74	-19.6
AUG	4.60	4.06	-11.7	3.85	2.92	-24.2
SEP	4.74	3.81	-19.6	3.52	3.02	-14.2
OCT	3.46	3.34	-0.9	3.03	2.78	-8.2
NOV	3.97	3.77	-5.0	2.75	2.79	+1.4
AVG	3.67	3.62	-1.4	2.79	2.55	-8.6

Note: Entries in boxes correspond to the months of intensive on-scene evaluation, including stop-watch monitoring, interviewing, and special testing.

learn the use of the new system. Once they had mastered it, dispatch times for the Third District dropped significantly, at a rate faster than the overall city-wide average. Other factors which influenced the city-wide and Third District reductions in dispatch time were a drop in the call-for-service workload -- a 12 percent decrease in the Third District and a 10 percent reduction city-wide -- and, perhaps, the presence of on-scene evaluators and their influence on the dispatcher.

c. Dispatcher workload. Although mean dispatch times increased for the Third District during the first several months of AVM operation, the decrease in dispatch times during the remaining months indicates that the effect of increase in workload was at least balanced by other factors. The AVM system created an estimated 5.6 minutes of additional work per hour for the dispatcher -- due to reinitializations and cursor positioning on dispatches -- that would not have occurred without AVM. Simultaneously, however, some of the time that would have been spent in on-the-air conversations was eliminated by the car-to-dispatcher digital codes. Whether dispatcher workload increased or not, dispatchers did perceive an increase. This appeared to result from the dispatchers' constant awareness of a location check (V of W) that was queued in the status column, thereby yielding fewer anticipated periods of inactivity than would have been the case without AVM.

d. Limitations on AVM dispatch information. After the dispatcher had located the cursor at an incident site, the computer selected the four closest cars and displayed their numbers on the CRT screen in the order of distance from the incident site. The computer then determined the distance by adding the X-dimension (East-West) to the Y-dimension (North-South), which gave correct answers when the blocks were laid out in this manner. But in areas where the axis was rotated to other than North-South or East-West, or where diagonal streets existed, errors resulted from this method of computation, which (from the examples constructed) could exceed one minute in estimated travel time. Also, the computer listing of closest cars did not take into consideration either barriers, such as expressways or canals, or one-way streets. It was therefore necessary for the dispatcher to verify the closest car by observing its location on the visual display.

e. Travel time: simulated results. Through the use of a specially developed simulation model of police patrol and dispatching, mean travel time was estimated to have been reduced by up to 25 percent by switching from pre-AVM dispatching procedures to closest-car dispatching.[18] A large fraction of this anticipated reduction in travel time was attributable, however, to the relatively inefficient precinct-oriented dispatch strategy used prior to AVM -- inefficient, that is, in dispatching the closest car.[19] Other modeling analyses have indicated that the greatest reduction in travel time that can be expected from AVM is much less than 25 percent -- roughly 11 to 15 percent when compared to more conventional non-precinct-oriented dispatch policies. It is clear, of course, that the potential benefits of AVM depend critically on the dispatching policy to which it is compared.[20]

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18. See Chapter VI of the Final Report for a discussion and operating description of the simulation model.

19. In St. Louis, a precinct is a small collection of contiguous beats, and each district contains two or more precincts. Dispatch preferences are given to precinct vehicles, even if a vehicle that is in the same district but in another precinct is closer.

20. During the Phase II evaluation, the AVM patrol modeling analysis will include a new analytical model as well as the simulation model. R. C. Larson and E. A. Franck, "Dispatching the Units of Emergency Service Systems Using Automatic Vehicle Location: A Computer-Based Markov Hypercube Model," Report TR-21-76, Innovative Resource Planning Project, MIT,April 1976. This paper is to appear in the Journal of Computers and Operations Research.

f. Travel time: empirical results. Mean travel time in the Third District decreased by an average of 8.0 percent, to 4.9 minutes during 1975 (January-November) compared to the analogous pre-AVM period in 1974. As for the mean city-wide travel time, it decreased somewhat less during that period -- by 7.0 percent, to 4.7 minutes. (See Table 11-2.) Since AVM was not used to full capacity during much of 1975, it is difficult to draw strong conclusions from these data. During a specially monitored three-week test, however, mean travel time in the Third District was down 15 percent (0.89 minutes) in the test district as compared to the earlier (pre-AVM) 12-month levels, but city-wide mean travel time was down 11 percent, suggesting a new 4 percent decrease (approximately 15 seconds) due to AVM. Some of these reductions could have resulted from decreased call-for-service workloads in 1975. Therefore, the results of Phase I must be viewed as inconclusive. There was no indication that AVM increased travel time, but the empirical evidence that it decreased it was not very strong. It is possible that dispatchers' attitudes, perceptions, and motivations played a key role in measured travel-time reduction both in the Third District and throughout the city.

g. Overall response system considerations. As was shown in Figure 11-2, mean system response time in the Third District was approximately 2.0 minutes (reporting the incident and complaint evaluation) + 3.5 minutes (dispatch time) + 5.0 minutes (travel time) = 10.5 minutes. Thus a 30-second reduction in mean travel time corresponds to a reduction of about 5 percent in overall mean response time. Even if the simulated 25 percent reduction in mean AVM travel time should take place during Phase II, this would correspond to 1.25 minutes or 75 seconds, about a 12 percent reduction in overall mean response time. Since about half of the simulated 25 percent reduction was due to precinct-oriented dispatching, only about 37.5 seconds of the travel time

Table 11- 2

Percentage Change in Average Travel Times, Third District and City-Wide, 1974 and 1975

	Third District: Average travel time (minutes)			City-Wide Less Third District: Average travel time (minutes)		
	1974	1975	% Change	1974	1975	% Change
JAN	5.44	5.30	-2.57	5.55	4.83	-12.97
FEB	5.16	4.97	-3.68	4.86	4.62	-4.94
MAR	5.29	4.89	-7.56	4.82	4.60	-4.56
APR	5.18	4.79	-7.53	4.76	4.59	-3.57
MAY	5.37	4.90	-8.75	4.90	4.69	-4.29
JUN	5.32	4.83	-9.21	4.89	4.67	-4.50
JUL	5.46	4.78	-12.45	5.05	4.73	-6.34
AUG	5.59	4.48	-13.42	5.29	4.62	-12.67
SEP	5.58	4.74	-15.05	5.22	4.71	-9.77
OCT	5.31	5.18	-2.45	5.02	4.60	-8.37
NOV	5.18	4.97	-5.41	4.97	4.80	-3.42
AVG	5.35	4.92	-8.00	5.03	4.68	-7.00

Note: Entries in boxes correspond to the months of intensive on-scene evaluation, including stop-watch monitoring, interviewing, and special testing.

reduction could reasonably be attributed to AVM, corresponding to 6 percent of the response time of the total system. Overall impacts on response time of AVM are likely to be small in Phase II, which suggests that if the St. Louis MPD is interested in average response time improvements, it should concentrate on aspects of the police response system that are not directly related to AVM. In any case, during the Phase II implementation the sample size and data coding procedures will permit response time to be examined as a function of the priority or urgency of the call.

h. Cross-beat dispatches. Closest-unit dispatching, which utilizes AVM, results in a greater amount of cross-beat and cross-district dispatching than non-AVM dispatching systems. In non-AVM systems the fraction of dispatches that are cross-beat is usually about equal to the average workload of the patrol force -- that is, to the fraction of time not available for dispatch.[21] With AVM, this fraction is increased, usually markedly for low-to-moderate workload systems. This predicted behavior was found to hold true for the Third District when the simulation model of police patrol and dispatching was utilized. Such increases in cross-beat dispatches should be of particular concern to police departments that desire to maintain (so far as is feasible) the one-man, one-beat concept. At the same time, for those departments that desire wider overlapping areas of patrol responsibility, this operational consequence of AVM dispatching should cause little or no difficulty.

2. Special three-week test. A number of operational difficulties and accuracy problems appeared during the Phase I implementation of the AVM system in the Third District. In addition, on-scene evaluation suggested that

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21. See Larson, Urban Police Patrol Analysis, chap. 8.

during much of the period the dispatchers were not using the AVM system as it was intended to be used. In one sample, the cursor was used on only about 35 percent of discretionary dispatches, and information from the closest-car column influenced only 19 percent of the dispatches. The wide variability of these figures suggests that whereas certain dispatchers were well motivated and used the system as intended, others virtually ignored it. This problem resulted partly from the lack of a fully AVM-equipped fleet of vehicles.

In order to examine the operations and influence of the Phase I system under a more favorable set of circumstances, a special test was designed and conducted in the Third District from September 15 to October 5, 1975. The operation of the system was studied under two important conditions: (1) proper use of the system by a special set of dispatchers; and (2) full coverage of the entire district by AVM-equipped cars.

During the test period the operation of the system improved significantly. Dispatchers utilized the intended components to dispatch the closest car, and patrol officers seemed more satisfied with overall operations. Although no specific surveys were conducted, the on-site evaluators, (who talked to patrol officers and rode patrol in police vehicles) reported an increased confidence in the system. Although travel time was reduced during the three-week test, the reduction could not be called substantial when considered in relation to city-wide reductions. Once again, however, the special test confirmed that if the system was operated properly, dispatch time did not increase.

With effective and motivated dispatchers, an AVM system can increase the general effectiveness of the dispatching process. The ability to dispatch the closest car through the use of this sophisticated technology not only improves dispatch decisions directly, but it appears to increase the perceived level of professionalism of dispatchers. Also, the way in which the dispatchers use AVM as an aid in their activities has a major influence on the way officers in the field regard the AVM system, thereby affecting field performance through such activities as voluntary self-reinitializations.

In addition to trained dispatchers, spare vehicles and maintenance personnel are also essential to the successful operation of AVM. System performance and user attitudes are very adversely affected by the presence of non-AVM vehicles. Many of the favorable findings of the three-week test resulted from the fielding of a full contingent of AVM-equipped vehicles at all times.

In view of the substantial improvement in the operation of the system during the test period, two important conclusions were reached: trained and motivated dispatchers are essential to the successful use of the system and spare vehicle and maintenance personnel are equally essential.

D. Analysis of Attitudinal Impact

The implementation of an AVM system implies more than the routine introduction of a new technology; such an innovation also has important behavioral consequences. Generally speaking, by the end of 1976 a number of "successes" had been achieved in implementing "routine" technological innovations in police departments, including the establishment of real-time computer information systems to provide rapid retrieval of information for the officer in the street. But when implementation efforts went beyond routine systems to such nonroutine innovations as transferring,modeling, or operations research, or to implementing an AVM or CAD system, the process became far more complex and only limited success was achieved. Such efforts faltered partly because insufficient consideration was given to behavioral and human factors. A number of studies have demonstrated that often it is not technical difficulties which limit long-run implementation, but behavioral and people-oriented factors.[22] Therefore the implications of installing the AVM system in the Third District formed one of the primary components of the Phase I evaluation.

Attitudinal surveys of dispatchers and patrol officers were conducted in the Third District and the Fifth District (the control district) both before and after the implementation of the system. The results of these surveys will be summarized, and then their implications for the Phase II implementation of FLAIR will be discussed.

1. Summary of findings. General attitudes of police officers toward FLAIR shifted significantly during Phase I. Before using the system, 64.4 percent of the officers in the Third District thought that FLAIR was "a good idea." When Phase I ended, only 39.8 percent felt that way. Five factors seem to have contributed to this attitudinal change.

First, problems with the accuracy and reliability of the system seem to have been the primary cause of the change in attitudes, indicating that a crucial link exists between attitudes and the technical performance of a system. In 1974, 44 percent of the police officers in the Third District felt that there were equipment and computer problems with the FLAIR System. By the end of 1975 the number perceiving such difficulties had nearly doubled, reaching 78 percent. (See Table 11-3.)

Second, because of such operational problems, many of the initial expectations concerning the system were not met. Such unfulfilled expectations led to the disillusionment of some officers and a drop in positive feelings

22. See Chapter II of this report. Also see Robert K. Yin, Karen A. Heald, Mary E. Vogel, Patricia D. Fleischauer, and Bruce C. Vladeck, A Review of Case Studies of Technological Innovations in State and Local Government, Rand Report # R-18070-NSF (Santa Monica, Calif.: Rand Corporation, 1976).

Table 11-3

Percentage of Police Officers Perceiving Problems in FLAIR System by Problem Area, Third and Fifth Districts, 1974 and 1975.

	Third District		Fifth District	
Problem Area	1974	1975	1974	1975
Equipment, Problems	44.0%	78.2%	43.2%	48.4%
Lack of Street Support	15.1	21.0	28.4	28.1
Disciplinary Abuses	65.1	27.7	56.8	53.1
Difficulty in Operating	7.8	16.8	16.2	12.5
Communications Problems	N.A.	24.4	N.A.	12.5

Table 11-4

Percentage of Police Officers Perceiving Importance of Officer Safety and Nearest-Officer Dispatch by Degree of Importance, Third and Fifth Districts, 1974 and 1975

	Third District		Fifth District	
Type of Police Work	1974	1975	1974	1975
Officer Safety				
Very Important	78.7%	53.4%	78.4%	80.6%
Fairly Important	15.2	21.2	10.8	8.1
Not Important	6.1	25.4	10.8	11.3
Dispatching Nearest Officer				
Very Important	65.1%	30.5%	62.2%	63.5%
Fairly Important	26.5	37.3	29.7	25.4
Not Important	8.4	32.2	8.1	11.1

Table 11-5

Percentage of Police Officers Perceiving Effects of FLAIR on Disciplinary Process, Third and Fifth Districts, 1974 and 1975

	Third District		Fifth District	
Effects of FLAIR on Disciplinary Process	1974	1975	1974	1975
Fairer	10.3%	6.0%	2.7%	8.3%
No Difference	31.5	68.4	27.4	30.0
Less Fair	58.2	25.6	69.9	61.7

toward the system.

Third, the capabilities and motivations of the Phase I dispatchers were mixed, and since the effective operation of AVM relies heavily on well-motivated and well-trained dispatchers, this uneven quality contributed to the downward shift in attitudes.

Fourth, although attitudes, generally speaking, are volatile and a downward trend may be reversible, initial impressions are difficult to overcome. Any future change in officer attitudes may be expected to depend heavily upon the operational quality of the system during Phase II. It is encouraging that during the special three-week test conducted in September and October 1975, the careful selection of dispatchers, the availability of a full fleet of AVM-equipped cars, and personal two-way radios all had a positive influence on the officers in the Third District.

Fifth, the level of information about the system and the initial source of information were important in influencing attitudes toward AVM. The pre-implementation training seminar held in the Third District seemed to be instrumental in influencing positive attitudes, as compared with the experience of the Fifth District, where much of the information about FLAIR was communicated by word of mouth. Even after the attitudes of the Third District officers became more negative, a strong correlation existed between those who were favorable toward FLAIR and those who felt well-informed about the system. Among the possible initial sources of information, the opinions of other officers seemed particularly important in influencing and reenforcing feelings toward the new system.

In addition to the shift in officer attitudes toward FLAIR during Phase I, the evaluation revealed a shift in the way officers perceived FLAIR's influence on four areas of police operation: officer safety, nearest-officer dispatch, digital communication capability, and concern about disciplinary abuses.

Although officer safety remained the top area of importance to officers, its overall rating dropped significantly after implementation. Whereas eight out of every ten of the officers surveyed before implementation in both the Third and Fifth Districts felt that officer safety was a very important goal of the AVM system, after implementation only five out of ten officers in the Third District had such feelings. Operational difficulties had obviously made the officers question whether the system could locate them in emergencies. (See Table 11-4.)

The perceived importance of AVM in dispatching the nearest officer also dropped significantly in the Third District after implementation, again showing the influence of technological problems on attitudes.

Both before and after implementation, the digital communication capability of the system was perceived by police officers as well as dispatchers to be one of the most important aspects of the new system.

Concern over disciplinary abuses dropped significantly in the Third District after the Phase I implementation. In 1974, 65.1 percent of the officers had expected disciplinary abuses to be the major problem but in 1975 only 27.7 percent saw such abuses in that light. (See Table 11-3.) This drop can be attributed to operational problems, which caused a number of officers to feel that the system could not adequately track them anyway. Nevertheless, the department's general concern about disciplinary abuses was shown by the fact that even after the Phase I implementation in the Third District, such abuses remained the primary concern of the Fifth District. (See Table 11-5.)

The survey responses indicated that officers believed that FLAIR would have (or had had) little impact on police preventive patrol. Officers did feel, however, that the AVM system would improve the ability of the department to tell where they were, and that this might diminish their flexibility and force their continued movement on patrol. Such comments regarding AVM's potential impact on police operations are only speculative, however. Further work must be done during Phase II in order to evaluate the actual impact of FLAIR on police operations.

2. Implications for city-wide implementation. In previous studies, a number of factors have been identified which contribute to the successful implementation of technological innovations.[23] Five factors promise to be especially important in the Phase II city-wide implementation: the link between attitudes and technological performance; the involvement and training of police personnel; person-machine interface; the involvement of top supervisors; and the long-term commitment and continuity of personnel.

a. Link between attitudes and technological performance. Accuracy and reliability are essential if the new system is to be accepted and made to work over the long run. In order to avoid the rapid deterioration in attitudes experienced in the Third District during Phase I, the Phase II system should be tested under realistic operational field conditions before it is implemented city-wide -- preferably in the Third District because of that

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23. Factors critical to the successful implementation of new technology will be discussed in detail in Chapter XIII of this report. Also see: Kent W. Colton, "Computers and the Police: Police Departments and the New Information Technology," Urban Data Service, (Washington, D.C.: International City Manager's Association, November 1974); J. Chaiken, T. Crabill, L. Holliday, D. Jaquette, M. Lawless, E. Quade, Criminal Justice Models: An Overview, Rand Report #R-1859-DOJ, Santa Monica, Calif.: Rand Corporation, October 1975);Yin et al., Review of Case Studies of Technological Innovations in State and Local Government.

district's previous experience and familiarity with the system. Even though the system receives such a test, however, it should be realized that problems (such as map errors, magnetic anomalies, or questions resulting from inter-district dispatching) may still arise when the system is implemented city-wide. Such difficulties should be anticipated, for they are a normal part of the implementation of a new technology.

b. Involvement and training of police personnel. There is a paramount need for effective training and communication concerning FLAIR. This means more than just an initial training seminar. As pointed out earlier, the feeling of being informed about the system was one of the most important factors influencing attitudes toward AVM. An ongoing dialogue is needed in order to answer questions and candidly explain problems that may arise. In order to achieve such communication, the training program being planned for Phase II should be supplemented by periodic visits from personnel of the MPD and the AVM manufacturer to the "roll calls" at the beginning of each police patrol shift.

On the other hand, care should be taken not to oversell the system. Evidence from Phase I indicates that initial expectations were too high in the Third District. In introducing the Phase II system it will be important to discuss the problems of Phase I in order to establish a realistic but positive set of expectations.

c. Person-machine interface. One of the most significant elements in the successful implementation of a new technology is the development of a proper person-machine interface. In the case of FLAIR the link between the dispatcher and the new system is especially vital. The role of the dispatcher must therefore receive priority attention in the Phase II implementation.

At the end of 1976, a major turnover in dispathers was being projected for 1976 and 1977 due to the discontinuance of a cadet program. In order to place capable people in the new jobs, an upgrading of the dispatcher's job description, qualifications, and salary may be required. In addition, procedures for dispatcher-car interactions should be clearly specified, and special training should be provided. During Phase I, dispatchers did not receive specific training on how to handle such "rare events" as responding to an officer-in-trouble call, handling pursuits, or dealing with civil disturbances. To avoid a repetition of this problem, special training exercises might be planned in which one dispatcher simulates these types of rare occurrences.

d. Involvement of top supervisors. Just as it is important to train police officers concerning a technological innovation and to integrate them into the new program, it is essential that police supervisors become deeply involved in the implementation. Experience in other police departments has shown that new technologies are likely to fail without sustained commitment from top management. In the case of FLAIR, the Phase I results have demonstrated that the response-time benefits of the system are below initial expectations. Other potential benefits, such as the opportunity for improved command and control or better management of resources, must therefore be examined to determine the degree to which the benefits may justify the costs. In order to test these areas, the deep involvement of the St. Louis staff is required. A new set of computer-prepared operational reports has already been designed for the Phase II FLAIR System. If these reports are to be worthwhile, they should be modified and perfected by the St. Louis command staff so as to provide the best information possible from a management perspective.

Further, to properly test the benefits of the system, it may be appropriate to set up new command and control or organizational relationships, at least on a temporary basis. For instance, a high-level command person might be assigned to the dispatch center to supervise command and control situations when they arise.

e. Long-term commitment and continuity of personnel. In a recent study it was found that efforts to implement operations research modeling projects in criminal justice agencies are often promoted by a single advocate or a small group of advocates.[24] Although such advocates play an important role in spreading innovation, their presence also leaves the innovation vulnerable if a shift in personnel occurs and a key advocate leaves the agency or is transferred. In order to assure success of the AVM system in St. Louis, a long-term commitment based on a broad base of support is required. To broaden involvement and develop support for technological innovation, many police departments have established a management-users committee of top-level command officers to help monitor and oversee change. The St. Louis MPD might consider establishing such a committee.

E. System Objectives and Cost Considerations

An important part of evaluating an AVM system is determining whether the objectives of the system have been met and also whether the benefits justify the costs.

1. System objectives. Although the question whether the four objectives of the AVM program in St. Louis (outlined at the beginning of this chapter)

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24. J. Chaiken et al., Criminal Justice Models. (Santa Monica, Calif.)

have been fulfilled cannot be finally answered on the basis of the Phase I evaluation, some initial conclusions can be drawn. (These conclusions are summarized in Figure 11-3.)

a. Response time reduction. Phase I test did not reveal the expected reduction in response time. Although this question will be examined closely in Phase II, the current findings do not suggest that savings in travel time due solely to AVM will significantly improve police operations or reduce costs.

b. Officer safety. When the emergency alarm is activated in the FLAIR System, the dispatcher is alerted visually and audibly, the location of the activating vehicle is known immediately from the display, and the computer-selected closest cars are identified for quick dispatch. During Phase I, however, the degree to which the officer safety objective was not attained could not be established, largely for three reasons:

(1) Lost cars and system location errors decreased the patrol officer's confidence in the dispatcher's ability to locate him accurately and consistently. Therefore some officers preferred to announce their situation and location over the voice radio.

(2) Improper use of emergency alarm. Some officers used the emergency alarm improperly, as for example, when they activated it to see whether or not the system was operating, and some occasionally activated it by accident, causing a "false alarm" condition that decreased the sense of urgency in responding to a real alarm.

(3) Few real alarms. The number of real alarms (and therefore the sample size) was small, it was difficult to make a proper evaluation.

Figure 11-3

Summary of Phase I Evaluation Results: Meeting System Objectives

EVALUATION RESULTS
AVM System Implemented
in St. Louis
(Phase I)

ESTABLISH SYSTEM OBJECTIVES

TECHNOLOGICAL ANALYSIS

OPERATIONS ANALYSIS

ATTITUDINAL ANALYSIS

MEETING SYSTEM OBJECTIVES

Response time - only modest reduction; results inconclusive.

Officer safety - results inconclusive because of equipment and accuracy problems and small sample size.

Digital communications - level of voice-band congestion was not materially changed. However, system experienced high usage; permitted instant mobile-to-base communication; provided flexibility in dispatcher operations.

Command and control - new possibilities identified and recommended for city-wide Phase II implementation.

OVERALL COST-EFFECTIVENESS - system cost ≈ $2,000/year/car or 2% of total cost for one-person car. Cost justification not yet established.

During Phase II, the AVM system and equipment will be improved to increase accuracy; additional training will be given to officers and the emergency knob will be enhanced to reduce apparent false alarms; and implementation will be city-wide, which will increase the number of incidents. Nevertheless, the officer safety had not been met by the end of 1976.

c. Reduction in voice-band congestion. Vehicle-to-base station digital communication in the St. Louis AVM system allows transmission of 99 "canned" messages, thereby providing status information and an alternative means of interacting with the dispatcher. One of the original objectives was to decrease voice-band congestion by using this new medium. Although tests made by the MPD during Phase I showed essentially no change in voice-band occupancy levels, four other benefits became apparent.

(1) High usage of digital communications by patrol officers. More than 2,000 messages were sent per day, or more than 100 per day per car. This represented an expansion in the capacity of the communications system over what could have been accommodated by the existing voice channels.

(2) Instant communication of change in status. The patrol officer could communicate a change in status instantly to the dispatcher, whereas with voice radio alone he would have needed to wait for clear channel status. This could either have involved a considerable delay, or he might not have bothered to communicate at all.

(3) Organization of work tasks. The dispatcher could organize work tasks better, permitting some digital inquiries to accumulate before acknowledging them if other matters had higher priority. Voice radio does not have this flexibility.

(4) Security. Digital messages were relatively secure and could not be intercepted by the commonly available "police-monitor" radio.

Although digital communication was not strictly a part of the AVM system, both police officers and dispatchers felt that it provided some of the most important benefits of the Phase I period.

d. Command and control. The term "command and control" pertains to the ability of the dispatcher to deploy or command vehicles (especially under extraordinary circumstances) and to the ability of the patrol administrators to control and modify the manner in which patrol operations are conducted.

Utilizing the display, dispatchers had several opportunities during Phase I to incorporate AVM information into their handling of extraordinary events. For instance, in October 1975 a chase starting in the Third District resulted in the dispatcher's commanding patrol cars by voice radio toward locations for possible interception; after the chase left the district, however, the dispatcher's effectiveness was greatly reduced because most of the radio time was spent asking for the locations of the various cars involved. Phase II, which will be city-wide, is expected to provide more opportunities to evaluate the dispatcher-related command and control benefits of the system. If these benefits are to be properly evaluated, however, dispatchers should receive special instructions concerning all aspects of AVM usage (not just normal dispatching), and organizational experiments should be conducted. For example, an officer experienced in the field of deployment might be assigned to help oversee the dispatching function for extraordinary incidents, particularly those which cross district boundaries.

The results of Phase I gave little information on the potential of FLAIR to affect patrol operations. It seemed, however, that fewer patrol units volunteered for unnecessary back-up assignments and that fewer units congregated for prolonged visits than before FLAIR was implemented. Conversely, the FLAIR-equipped vehicles appeared to be attentive to their assigned duties, whether on assignment or on patrol. This behavior could be observed on the display, and of course the patrol officers were aware of that. But this capability also had negative consequences. Patrol officers indicated in the attitudinal surveys that FLAIR had limited their flexibility and their ability to follow-up on hunches. Such limits may have resulted in a reduction of time wasted, but they may also have had a negative impact. AVM is potentially useful in improving the efficiency and effectiveness of the patrol force but this aspect of Phase I still must be tested. In any case, information on AVM will provide an important tool for control in patrol experiments.

2. Costs and related considerations. The total cost of implementing the AVM system is estimated at $2,700,000 (including both Phases I and II.) These expenses, however, must be placed in the context of overall police operations. By extrapolating the probable production costs of this particular AVM system, one can estimate the total system cost to be approximately $9,500 per car (capital investment), or, on the basis of ten year life, an annual depreciation of about $950 per car per year. The estimated operating and service costs exceed this amount: about $1,000 per car per year. The total of amortized investment cost and operation and maintenance costs over a ten-year period then approaches $2,000 per car per year.

As noted previously, the average cost of fielding a round-the-clock one-person patrol car is $200,000 per year. The total AVM cost at

$2,000 per year then represents no more than 2 percent of the cost for a one-person car or 1 percent for a two-person car. If it can be shown that AVM will increase the efficiency and effectiveness of the force by x percent because of better management of the forces, then AVM will provide at least x:2 return on investment. If x is equal to 10 percent, for example, this would produce an impressive 5:1 return.

Clearly, more than just monetary factors must be considered when evaluating the advantages and disadvantages of AVM. It is important, for example, to examine the implications that AVM may have for police policy and approach. To the extent that AVM stresses rapid response to calls-for-service and dispatching the closest car, it may limit or conflct with an alternative approach to policing -- the "one-person, one-beat" approach, which gives the patrol officer responsibility for a particular area, as in team policing. It is probably impossible to produce a definitive review of costs and benefits that will be applicable to all police departments. Costs and benefits, which depend on goals and priorities, will be different for each and must be reviewed individually.

CHAPTER XII

THE IMPLEMENTATION OF COMPUTER TECHNOLOGY BY THE POLICE

by Kent W. Colton

The research in this report demonstrates convincingly that the implementation of computer technology in law enforcement -- or, for that matter, in other areas -- is far from automatic. The diffusion of innovation is a complex and personal process. Chapters 2 and 3 outline a number of routine computer uses where successful implementation has been achieved, but even with routine applications, success varied considerably among police departments. Further, the case studies have shown that many of the efforts to implement nonroutine applications of computer technology have been disappointing, either because the innovators have failed to consider factors essential in the change process or because the technology itself was inferior or unable to deliver what had originally been promised.

The difficulty of implementing computer technology -- particularly nonroutine uses where the technology expands from simply transmitting information to using modeling and systems analysis techniques as tools for management, decision-making, and education -- has been demonstrated in a number of recent studies. A 1975 report by the Rand Corporation examined a number of cases to implement computer models in the criminal justice area. Summarizing the study, the report had this to say: "In general, models have failed to achieve the level of use for policy decisions that was intended by the model builders and those who funded

them."[1] In a 1976 book reviewing public decision-making in the computer era, Martin Greenberger and his colleagues reached somewhat similar conclusions: "Yet, there is one thing that policy models have in common. Most fall short of their potential as instruments for the clarification of policy issues and the enlightenment of policy makers. There is considerable evidence indicating that modeling is, indeed, effective in education policy modelers... But the use of models in the making of policy decisions is beset with problems."[2]

Why is it so difficult to implement nonroutine computer technology? What can be done to more effectively implement and transfer, where appropriate, such innovations in urban police departments and in the criminal justice area as a whole.

One of the conclusions of this report is that people involved in the implementation of computer technology often make assumptions (either implicit or explicit) about technology and the process they are following. These assumptions are often at the heart of the problem. Although sometimes partially true, and often undoubtedly expedient, they generally return to haunt the implementer and help to bring about the eventual demise of the effort. Six assumptions are particularly troublesome and will be discussed in this chapter. After the

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1. J. Chaiken, T. Crabill, L. Holliday, D. Jacquett, M. Lawless, E. Quade, Criminal Justice Models: An Overview, Rand Report R-1859-DOJ, (Santa Monica, Calif.: Rand Corp., October, 1976), p. v.

2. Martin Greenberger, Matthew A. Crenson, Brian L. Crissey, Models in the Policy Process, Decision Making in the Computer Era, (New York: Russell Sage Foundation, 1976), p. 321.

ramifications of each of these are described, a checklist or series of strategies which seem to contribute to successful implementation will be discussed (although no magic formula will be offered since none exists). The chapter will end with some overall thoughts concerning the diffusion and transfer of technology in the law enforcement field.

A. Common Assumptions Concerning the Implementation of Computer Technology

Six somewhat overlapping assumptions have been highlighted here. Others could undoubtedly be identified, but these six are more than adequate to demonstrate our failure in implementing technology to understand the operation of organizations, people, and the decision making process.

1. If the technology exists, then there must be a need and implementation should proceed. This is probably the most troublesome of the six assumptions that will be discussed. There is a tendency for those who have been involved in the design and implementation of technological innovations and models to begin to believe that just because the technology is there an automatic need or interest exists. This often is not the case, either because the innovation is questionable and does not fit a particular law enforcement agency, or because the innovation is not perceived to be worthwhile by the police department or agency involved, even if it is a good idea.

In the three resource allocation case studies in this report, many members of the police departments involved did not perceive the existing allocation process as an area in need of reform. Since they viewed the existing allocation methods as adequate, little importance was attached to the innovation effort. As such, when the efforts encountered problems and were substantially altered or fell by the wayside, there was little concern.

In the research carried out by Rand on efforts to establish models in 39 different criminal justice agencies the same problem appeared. Of the 39 modeling efforts examined, only seven were found to be working or to have produced recommendations that were partially acted upon. Seven were in some stage of installation and future use was still anticipated. The remaining 25 models were cases of nonuse. In these instances the reasons for this lack of implementation were explored. A variety of factors were involved, but one of the primary causes for non-implementation was that the model was acquired for a potential use which did not arise.[3] The Rand report goes on to indicate that one of the key factors contributing to the successful transfer of technology is the perceived importance of the issues addressed by the models, and related to that, the appropriateness of the model as perceived by the agency administrator.

Finally, for some of the law enforcement community resistance to the innovation is more than a matter of not feeling a need; their opposition results because they feel that the new theories

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3. J. Chaiken, et al., Criminal Justice Models: An Overview, pp. 117-125.

conflict with their traditional theories of policing. The conflict between the LEMRAS/ADAM system and team policing is discussed at length in Chapters 6 and 7. The same phenomenon was also found in the St. Louis police department. The idea of the St. Louis experiment was to use an operations research model to help more effectively allocate patrolmen so that a higher percentage of officers would respond to call-for-service without delay. In order to accomplish this the number of men assigned to a particular beat was varied depending upon the time of day, the day of the week, etc. However, a number of the St. Louis command staff indicated that when the new technology was implemented they had deep concerns that such variations in assignments violated the principle of fixing a patrol officer's responsibility to a certain territory. The concept of fixed responsibility was basic to their philosophy of policing and they felt that to violate it would be a mistake. Although when the new technology was implemented, these officers generally pursued the politically safe course of following the lead of their supervisors, deep down they distrusted the system, and this distrust led to the eventual demise of the innovation.

Just because the technology exists, it does not necessarily follow that it is needed or should be implemented.

2. <u>If only the technical problems can be resolved, then implementation can proceed</u>. There is sometimes a tendency to think that if only the technical difficulties in implementing an innovation can be resolved, then implementation will proceed without difficulty. Research on the use of technology by the police shows this assumption is incorrect. Indeed, the most critical problems in implementing and transferring new technology seem to be behavioral and interpersonal. In the two surveys conducted as

a part of this study, it was found that the primary problems faced by the police in using the computer were not technical, but behavioral and people-oriented. In the study of criminal justice modeling by Rand, an effort was made to see what had contributed to the failure of models to achieve the level of use for policy decisions which had originally been intended. The report indicated that the primary reason for failure rested with characteristics of user agencies and the interactions between model builders and user agencies. The characteristics of the models themselves were less important to the explanation, with the main model-related obstacle being the unavailability of data necessary for operating the model.[4]

3. Implementation must rely on a small group of supporters, either because of time constraints or because agreement could never be achieved among all the various actors. In the three resource allocation chapters in this report, it is noted that changes in the administration of the departments were particularly detrimental to implementation. In two of the cases, chief executives were replaced. The new executives not only brought a new set of actors into the planning and research area, but they had different priorities and theories of police work. In fact, the new person often exhibited distrust of the ongoing efforts in the department initiated by the previous administration. In Boston, for example, the department had already done a great deal of work in trying to perfect and implement a resource allocation computer simulation package when the new chief arrived. The original builder of the model even volunteered

4. J. Chaiken, et al., op. cit., pp. 117-124.

to develop a more sophisticated version of the allocation technique. However, because the simulation work was associated with the previous Commissioner, this offer was rejected [even though several months later a decision was made to hire a different consultant to develop a resource allocation program].

Although it would be almost impossible to achieve full agreement on innovation among all of the potential actors within a law enforcement institution, an effort should be made to try to develop a broad base of support. At a minimum, those who are involved in implementing new technology must clearly realize the risks they are taking if they fail to do so. In fact, often times it appears that little or no effort is made to involve or consider the needs of the command staff or the officer in the street in designing innovative efforts. For example, better than five years ago the Los Angeles Police Department designed and implemented an Automated Field Interview Reporting System. The program aided investigation by providing rapid computer access to information on stops and interviews made by police officers. The system was an immediate success. However, after a few years the interview form was redesigned so that it became less convenient to place in the pocket. As a result, the men quit carrying them, and it was only when the old form was reissued that the system becan to function again. Because of form design, the system had nearly been abandoned. Broad acceptance and use by the police officer is essential to success, and assuring such support is often not a technical matter alone, but involves such practical behavioral factors as convenience and comfort.

4. Law enforcement supervisors really don't need to understand how innovations work; they simply need to know how to use the technology.

The implementation of new technology implies far more than knowing "how to use" the innovation. Understanding the technology is necessary in order to evaluate the system's effectiveness. If managers fail in this understanding, they will inadvertently release much of their control either to those who are using the technology or to the system per se. In fact, the innovation may end up "controlling" them. As discussed previously, a conflict between the objectives of the model and various theories of policing can only be detected if supervisors understand how the system that is being installed actually works.

Understanding is also necessary if police supervisors are to take full advantage of new technology and to adjust to changing situations. The evaluation of the Phase I AVM System in St. Louis outlined in Chapter 11 has shown that the system has achieved only modest response time improvements. Although this finding may be modified when the system is implemented citywide, at this point it seems that if AVM is to be cost effective, other potential benefits of the system (such as the potential for better command and control and improved management of police resources) will need to be exploited. In order to achieve these benefits, though, police supervisors will need to help design meaningful reports from the system, experiment with organizational modifications, and supervise effective education and communication. Carrying out such activities requires far more than simply knowing how to use the system.

5. <u>The quicker the innovation can be installed, the better</u>. The temptation in implementing new technology is to try to rush the process without waiting to develop a broad base of support or to clarify the basic objectives, purposes and technical capabilities of the system.

If a project is ready, it makes sense to begin while the momentum for change is still strong. However, successful installation requires a long-term perspective. In the resource allocation cases, all three operated on a trial basis for a year or two; only one worked over the long run and then only after eight years and considerable modification. Quick installation is not always better, particularly if the innovation lasts for only a year or two.

Almost without exception innovation will take longer than expected, and those involved must be prepared to adapt to the problems that arise.

6. <u>If new technology is installed, positive results will automatically occur</u>. The case studies of both resource allocation and CAD have demonstrated that the results of technological innovations in law enforcement often differ from expectations, and positive benefits are not automatic. Further, there are numerous methodological problems in evaluating the impact of new technology. Data in the form of crime statistics only measure changes in the number of crimes reported and do not necessarily reveal the actual incidence of criminal acts. More importantly, in most cases it is essentially impossible to establish a valid relationship between the changes that do occur as measured in crime statistics and the introduction of a new technology. To the extent that an innovation promises to improve police performance, and then fails to deliver, though, it will undoubtedly undermine confidence.

B. Elements Contributing to the Successful Implementation of Computer Technology

It should be clear by now that the process of integrating new technology is a fragile one. If implementation is to occur, one of the keys is to bridge the gap between the new innovation and the existing institutional and organizational setting. Although technical and hardware problems cannot be ignored, it is critical to give careful attention to the behavioral and interpersonal aspects of implementation and a careful interface between the use and those who understand the technology. What factors contribute to successful implementation? Based on the case studies and survey work, twelve factors that seem essential in implementing computer technology have been identified. In essence, they are the antithesis of the assumptions discussed above and can be grouped into two broad categories: those related to the nature and the environment of the innovation, and those related to the project management of the innovation. Each of the twelve is a necessary but not sufficient aspect of successful implementation. Obviously, it is impossible to expect that each of the conditions can be met whenever computer technology is implemented, and it would be a a mistake to wait for implementation until all factors are resolved. Obstacles will obviously arise, but innovation can still occur. However, this list does provide a checklist for the implementation process. Enthusiasm to try a new idea should not overshadow a realistic review of the need and requirements for innovation and an analysis of the eventual probability for success in light of the factors described below.

1. Conditions related to the nature and environment of the innovation. Four factors are especially important in this regard.

a. A perceived need for change among those influenced by the innovation--both police administrators and officers on the street. The case studies have demonstrated the essential nature of this factor a number of times. In the St. Louis resource allocation case and in the Boston resource allocation and CAD cases, one of the primary reasons the systems encountered such difficulty was that the new techniques were not established as "ideas in good currency" in the organization "which filtered their way up through the rank and file." Rather, it was an idea brought in from the outside and sold to a few high-level department executives. Although some command staff could be convinced that such techniques should be tried, there was no internal feeling of need or broad base of support.

One of the best indicators of this perceived need is a willingness to pay for change. Both San Diego and New York City "used their own money," so to speak, when they installed CAD systems. Many of the recent Hypercube and PCAM police resource allocation modeling efforts have been funded directly by the departments involved. Although projects funded from the outside may still succeed, often there is less commitment and support than in self-funded efforts.

b. A clear and realistic understanding at the outset of the policy issues involved. When the LAPD first began the LEMRAS resource allocation project, they failed to realize the policy conflict between the modeling and team policing. If such policy issues had been identified initially, the process of implementation would have been far different.

c. Effective timing and system design so as to meet user needs. Although the first attempt at CAD failed miserably because of failure to identify user needs, the second attempt was well timed to coincide with rising communications' demands. Timely implementation to meet these demands was a significant aspect of the second San Diego installation.

d. The proper selection of priorities in implementing computer technology. The proper selection of priorities plays an important role in implementing new technology. The most effective formula seems to be to start with innovations achieving a definable product useful to the "police officer in the street." After that, more nonroutine innovations can be developed. Also, computer technology has often been confined to a narrow range of officer needs. The focus has been on crime and law enforcement activities. One way to gain wider acceptance might be to emphasize service and order maintenance objectives.

2. Factors relating to the project management of innovation. Eight elements are included in this part of the checklist for innovation.

a. A long-term time framework and perspective. One cardinal rule should be learned concerning the implementation of new techniques: it almost always takes longer than initially planned. For example, eight years were spent in the implementation of the ADAM historical reporting system in Los Angeles. Institutions and organizations have existed for years. As such, they have established a great deal of momentum which must be overcome when change occurs. Also, unexpected technical difficulties often arise. Immediate results should not be expected, and in turn a final evaluation cannot be made until the system has operated over a long period. A long-term timeframe on the part of all actors involved is an important criterion for success.

b. Involvement and quality of top-level leadership. Police departments tend to be fairly rigid organizations with well established chains of command. Understanding, involvement, and support by the top leadership is essential if technological innovations are to be implemented and used. More than support solely from the Chief is required, though. In addition, support from a core of agency leaders is necessary if commitment is to endure.

c. Involvement of other police personnel. Besides the top commanders, police at the operating level must be involved in the design and development of computer technology. One of the reasons the resource allocation system faltered in St. Louis was that the field officers strongly resisted a shift of only one hour in their daily schedule because it would have required them to commute to work during the normal rush hour traffic. On the other hand, when the ALERT system was instituted in Kansas City, eight policemen were selected through a series of special tests to become programmers and systems experts. In order to cultivate and maintain their interest, a special technical pay scale was introduced. Throughout the department sworn personnel referred to the involvement of these eight policemen as one of the keys to success.

This is not to say that the only way to succeed is for police officers to become programmers. Clearly the actual technical task of programming can be performed by a civilian or someone who is unfamiliar with police work. However, the full potential of the computer in police operations may not be realized until sworn personnel are involved intimately in the design and development of computer applications. For example, in Los Angeles the police department has evolved a very successful working relationship with the City Data Service Bureau. A number of police officers work in the department's Advanced Systems Development Section (ASDS) doing the major systems analysis and designing computer applications. In turn, the Data Service Bureau appoints technical programmers to work with ASDS personnel, and these technicians are responsible for the programming and technical aspects of each application.

d. Caliber of computer systems and technical staff. Individuals are required who have both technical skills as well as broad perspectives which will allow them to see beyond computer technology to law enforcement needs and to communicate successfully with the police department. In order to attract such individuals, cities must be willing to pay competitive wages.

e. Continuity of personnel. Earlier in the chapter it was pointed out that a critical obstacle to implementation was having only a small number of "advocates," thus making the implementation vulnerable to a transfer or change in personnel. New systems require a long-term perspective; they also require continuity over time to implement these changes. Change in personnel is inevitable, but at the same time a certain degree of continuity is desirable.

f. Effective training, education, and information dissemination. The process of communication is often at the heart of effective innovation. Carefully designed training programs provide an important link in such communication. However, innovators must be prepared for feedback and the dialogue process must be two way.

g. Emphasis placed on human-computer interaction. There is sometimes a tendency to consider computer technology as a replacement for people. This is both unrealistic and inefficient. One of the most critical variables for the efficient and effective operation of any computer system is the development of the proper balance in the interaction between man and machine. For example, in a visit to a midwest police department the author watched the installation of a real-time computer system. The purpose of the system was rapid response to the officers in the field. However, the method for retrieving information from the computer was inefficient because of the interaction between the computer and communications personnel. An officer would call the dispatcher to request information on a stolen car. The dispatcher would write the request down and hand it to a terminal operator who would query the computer. The time taken for the operator to get a reply from the computer was usually less than 30 seconds. The terminal operator was servicing several dispatchers, though, so a queue would often form and a delay would result. Once the terminal operator received a response he would contact the patrol officer. The result was a ten-minute (sometimes longer) delay for the officer in the street. For the officer, the system was slower than the pre-computer, manual operation. In direct contrast was the example of another department where a video terminal was placed directly in front of the dispatcher. A request for information was typed directly into the computer. The result was a ten-second response and extremely satisfied users.

The machine will not replace the human element in police operations. Because something can be automated does not mean that it should be. If we are to fully utilize the computer as an aid in police work, more time must be spent on finding the best relationship between man and technology in order to obtain the optimum performance from both.

h. Unbiased evaluation. There is often insufficient information to make a determination regarding the actual benefits of many technological innovations. Funding agencies often exercise little initiative in monitoring the introduction of new deployment techniques, and often require little in terms of research design and evaluation. Recently, the Law Enforcement Assistance Administration has become more conscious of the need for evaluation. If systems have technical or behavioral problems these should be identified early and rectified. The evaluation component should be integral to the design of a project, and not considered as an afterthought.

C. Thoughts Concerning the Diffusion and Transfer of Police Computer Technology

There is a human tendency to seek direct solutions and to try to classify actions as either failures or successes. In the area of diffusion of technological innovation, though, there seems to be no one absolute, single answer. It is possible to identify what not to do (particularly with the benefit of hindsight); and, indeed, insights from the past should help us prepare for a more sensitive future. The right prescription, though, must come from a combination of factors. In the public sector conflict is fundamental -- conflict between interest groups in the formulation of public policy, regional conflict, economic conflict, and conflict between technical experts who want to influence policy and the laymen within the bureaucracy who do not want to yield power. Public decision-making is often less a process of rational choice (the problem is always: "Whose objectives are you going to rationalize?") than it is an effort, at best, of "policy management" wherein those with the power to decide must tradeoff competing goals and values.

The use and diffusion of technology taking place in this conflict environment has ramifications for the implementation process. Neither is technology value-free. The introduction of innovation -- such as a new computer modeling technique to allocate police resources -- of necessity involves value choices and when brought into an organization becomes a further factor in the decision-making process. Instead of speaking of the diffusion of innovation as if it were some neutral truth to be embraced by all, it is advisable to realize at the outset that tension is inherent in the process of innovation. The most pressing question is not how to eliminate or even bridge the conflict between model builders and model users. Such conflict is normal and to be expected. Rather, the most important question is how to understand the differing perspectives of the model builders and model users and to best mediate conflicts which arise. A failure to understand the basic policy decision-making process leads to unworkable recommendations for diffusion. For example, some have argued for the need for more "engineers" in the technology process[5] while others advocate development of a new breed of researchers/pragmatists -- model analyzers -- as highly skilled professionals and astute practitioners able to review both the needs of modeling and for controlling

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5. Jan Chaiken, et al., Criminal Justice Models: An Overview, pp. 123-127.

and directing the model builder. "The model analyzer would be neither model builder nor model user, but in a middle position between the two, empathetic with both."[6] The introduction of new actors in the process, though, will in and of itself make little difference. If these engineers or researchers/pragmatists are supermen or superwomen, they may be able to enter the arena and play an important role in conflict definition and resolution. However, their presence will do little to change the basic setting and context for decision-making and it is this basic environment that will provide the ground rules and influence the use, implementation, and impact of computer technology. Routine computer applications, by comparison, are relatively straightforward to implement since they generally involve automating an activity which was already being performed manually. However, nonroutine uses of technology have the potential of changing power and decision-making relationships, and, as such, the process of implementation is far more complex and value laden.

With this perspective, it is possible to make a few additional comments concerning the diffusion and transfer of computer technology in law enforcement. Diffusion of innovation basically involves four steps:[7]

- Inventing -- the creating of ideas, technologies, models, etc.
- Informing -- publicizing the technology and educating the law enforcement community concerning the technology and its possible advantages and disadvantages.

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6. Martin Greenberger, et al., Models in the Policy Process, Public Decision Making in the Computer Era, p. 339.

7. See, for example, Granville W. Hough, Technology Diffusion, Federal Programs and Procedures (Mt. Airy, Md.: Lomond Books, 1975).

° Implementing -- introducing the technology into a law enforcement agency.

° Integrating -- the overall social and economic acceptance and adjustment to the innovation by the agency.

In developing a more realistic and productive outlook and direction for the diffusion of law enforcement technology, all four deserve consideration.

1. Inventing -- the need for better technology. Although this report has neither the space nor the capacity to be too specific, improvements can and should be made in the quality of law enforcement computer technology. For example, in the modeling area we must build better models. Over the last decade, significant progress has been made. The Hypercube and PCAM Models offer far better options to police users than those available six or seven years ago. Further, it may be possible, within the processional community of computer technology, engineering and operations research, to establish higher standards and criteria by which inappropriate innovations can be weeded out.

2. Informing -- the need for "truth in technology." One of the greatest failings related to computer technology in the past decade is the tendency to overpromise. Expectations have been raised only to be dashed due to a whole range of technical and behavioral factors. The primary change agents in law enforcement technology are vendors. They obviously have a vested interest in selling their product and this interest has tended to focus sales propaganda on the advantages of technology as compared to the drawbacks. The time is ripe to develop realistic performance standards and to try to assure that in the informing and educating process that the costs of technology, as well as the

benefits receive ample publicity.

We now know enough about police computer technology to identify application areas (such as those outlined in Chapter 2) and to develop specific standards of performance in each of these areas. For example, regarding CAD, San Diego and New York City both developed specifications of accountability for hardware vendors. Based on the experience in San Diego, New York, Boston, and other cities, general criteria and standards for cities with different sizes and communication needs could be developed. Regarding AVM, the evaluation work in St. Louis has already led to illustrative recommendations of accountability regarding accuracy, maintenance and repair, system capacity and system adaptability.[8] Based on the experimentation which is going on around the country, these standards could be refined so as to provide general guidelines for those who are interested in the application of AVM technology. The Law Enforcement Assistance Administration is obviously one of the primary actors to stimulate the development of such guidelines.

3. Implementing -- the need for "policy management." It has been pointed out that the implementation process is not simply a matter of policy choice, but a process of conflict resolution requiring the understanding and management of different values and perspectives. I have already indicated that I am skeptical about the possibility of introducing a new breed of "engineers" or "researcher/pragmatists" to

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8. See Richard C. Larson, Kent W. Colton, and Gilbert C. Larson, "Evaluation of a Police Implemented AVM System: Phase I, with Recommendations to Other Cities," report to the National Institute of Law Enforcement and Criminal Justice, LEAA, funded by Grant Number 75-NI-99-0014 to Public Systems Evaluation, Inc., 1976, pp. 61-63.

aid in bridging the gap between the builders of technology and the users.

However, it has become apparent in analyzing the implementation of law enforcement technology, that a new breed of police officers is emerging. These are officers who have "come up through the ranks" and have, therefore, "paid their dues" and are respected within the police community. At the same time, though, they have had some experience with both the advantages and limitations of new technology. Rather than trying to teach outside engineers about police work, it may be more profitable to cultivate this inside set of "police technology experts." For example, there may be ten or twenty members of police departments around the country who have developed real expertise in implementing CAD systems and a sense of the standards should should be applied. Perhaps they could serve as consultants to other departments in implementing CAD technology. In essence, they could become a "pool of resources" in special areas of concentration to aid in the diffusion process. However, they must maintain their independence from vendors or others who have a vested interest in the technology transfer process.

4. Integrating -- the need for the internal motivation and integrity of change. It is essential to remember that one of the most critical elements of success is that the desire for change must come from within, not without. Better evaluation and standards of performance can help educate police departments as to the advantages and limitations of technology, and "pools of resources" from within and without the law enforcement community might establish a two-way communication to facilitate diffusion. Still, the final desire for change

and the specific design and implementation of alternatives must come from within the police department involved. Openness and meaningful communication are required, and although it is difficult to maintain such behavior constantly, it is essential in helping to bring about effective innovation.[9]

The implementation and diffusion of computer technology in law enforcement involves many dimensions. We have suffered disappointments and mistakes. Although there is no absolute prescription for the future, hopefully our experiences of the last decade have taught us something about what not to do and how we might realistically proceed in the future. Evaluation is necessary to weed out unjustified innovations but it should be remembered that the field of computer technology is still in its infancy. The first commercially sold stored program computer, the Universal Automatic Computer, or Univac 1, was built only 26 years ago in 1951. The third generation of computers has been commercially available only since the late 1960's. Perfection should not be expected instantly in an area so young and rapidly changing. On the other hand, a certain mystique, as well as commercial force, surrounding the application of computers has led to high

9. Time and space in this report preclude a full discussion of the importance and process of communication and integrating in professional practice. For a thought-provoking and worthwhile treatment of this subject see Christ Argyris and Donald A. Schön, Theory in Practice, Increasing Professional Effectiveness, (San Francisco: Jossey-Bass, Publishers, 1974), especially Chapters 4 and 5.

expectations, and, in many respects, to oversell. The reality of the state of the art is often far less than the general impression portrayed in the literature. As time goes forward, hopefully expectations will become more realistic and our ability to perform will improve.

CHAPTER XIII

EXECUTIVE SUMMARY AND CONCLUSIONS

by Kent W. Colton

The use of computer technology by the police has expanded rapidly since the mid-1960s. A number of factors have fueled this growth. Given the labor-intensive nature of police work and the tradition of devoting only a very small percentage of departmental resources to research and development, interest focused in the 1960s on improving police services by allocating dollars for equipment and technology. Recommendations from the President's Commission on Law Enforcement and the Administration of Justice (The Crime Commission) suggested that technology might be an important tool for police work, and federal funding from the Law Enforcement Assistance Administration (LEAA) provided added resources to purchase such equipment. The pressure from vendors to sell their product--heightened as the Vietnamese war ended and technology oriented industries sought to increase their domestic market--contributed to the expansion of computer-related innovations.

A number of unanswered questions about the use of this technology remain. Critics claim that much of the money has been wasted and that such innovations do not significantly increase the efficiency or effectiveness of crime control. Advocates are more optimistic that the costs are justified. However, although considerable attention has been devoted in the police literature to promoting technology, surprisingly little has been written about its implementation. Despite prestigious recommendations from the Crime Commission, the process of introducing change requires more than directives from the top. Important behavioral and power relations are involved and the law enforcement community must address such questions as: How are decisions to implement technology made; how do various groups within the police react; and what impacts result? Such questions address the consequences and the diffusion of innovation.

With these issues in mind, this report has examined the use of computer technology by the police in the United States. Our three objectives were:

(1) To document the current use and evolution of computer technology;

(2) To analyze the implementation of such innovations in law enforcement; and

(3) To assess the impact of computer-related technology.

In addressing such concerns, researchers probe for understanding and explanations. Answers and relationships sometimes appear, but often results uncover new questions and the process of inquiry continues. Some of the issues raised in this report have clear answers--for example, those pertaining to the use and change of computer innovation. Answers to other questions--particularly those on the implementation and impact of technology --are less straightforward. In some cases the data are inadequate to reach a conclusion; in others, even if better data were available, a final opinion would depend on perspectives and value judgments.

More important, although computer technology is here to stay and expanding, it would be a mistake to think such innovations will play a major role (at least in the short run) in revolutionizing the police or many of the major issues they face. Law enforcement, to a large extent, is determined by the conditions of our society and its people.[1] Crime and law enforcement have a momentum of their own. Computer technology may have a marginal rôle in influencing and shifting relationships, but the major law enforcement issues must be resolved in the context of society as a whole.

With these caveats in mind it is possible to begin to determine where computer technology is now and where it might be headed. It is not enough for advocates to refer to particular success stories or for critics to claim that hardware innovations have failed to reduce the crime rate. First, we must identify and classify how police use computer technology and how this use has evolved over time. Based on this classification, we can begin to assess implementation and impact. To analyze impact, though, a framework for evaluation is necessary. There is a wide range of issues to be addressed, and at least four levels of questions have been examined in this study:

1. Does the application work? That is, does it stay in operation for a period of years, and does it meet the objectives that were specified at the time of implementation?
2. What have been the technical impacts of technology through changes in the input, processing, or output of information? For example, does it provide lower costs of processing data, availability of new or better information, greater speed of processing, or wider collection or distribution of information?

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1. For a discussion of this position see James Q. Wilson, Thinking About Crime, (New York: Basic Books, 1975).

3. What have been the service impacts, if any? How has the application affected the tasks and services of the police? Since technical impacts provide no measure of changes in performance, the evaluation of service impacts must seek to examine the process and results of technological innovations.[2]

4. Have there been any power shifts through changes in the structure of decision making? Does technology affect internal balances of power? For example, does it provide greater centralization or decentralization, shifts of power to higher-level officers, loss of electoral power to the bureaucracy, or loss of individual control over information that impinges on privacy?

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2. In evaluation research a range of evaluation measures have been identified to review impact. In this study at least two levels of service impacts have been useful: process measures and results measures. "Process measures" refer to changes in the process of delivering public services such as changes in the time it takes to answer the telephone because of a new communications system or changes in the time required to provide the police officer with information about a stolen car or wanted person. The emphasis with process measures is on efficiently delivering services with an improving ratio between inputs and outputs. "Results measures," on the other hand are more interested in the actual effectiveness and quality of innovations in terms of their impact on police service. Telephone calls may be answered more rapidly, but what difference does it make. If information is delivered to the officer in the field in seven seconds, what is the result. Because they move from simply quantity of service to quality, results measures are often difficult to establish and more costly to collect. For one discussion of measuring performance of public programs see Robert N. Anthony and Regina E. Herzberger, Management Control in Nonprofit Organizations, (Homewood, Ill.: Richard D. Irwin, Inc., 1975), especially Chapters VI and XII.

This report has not been able to answer all of these questions concerning each application of compu.er technology. Still, such a framework provides a useful beginning for review. The questions are more than monetary factc-s as to whether the benefits justify the costs. Because of the fragmentary nature of police work and the variety of styles of police behavior the circumstances in each police department differ. Some have put up more resistance than others, and some achieve greater success than others. Although this report will try to draw general conclusions, ultimately costs and benefits depend on individual goals, priorities and structures.

Using this four-part framework for evaluation the conclusions chapter is divided into five sections covering the us- and implementation of computer technology. The first section will review the use and evolution of information technology; the second will assess routine computer applications; and the third will analyze computer technology in selected nonroutine uses. The fourth section will discuss the implementation of technology in the law enforcement environment; and the fifth will include some final thoughts about impact and implementation. Appendix B outlines a series of recommendations to the LEAA regarding the use and implementation of computer technology.

A. The Use and Evolution of Computer Technology by the Police

The first real-time police computer system in the United States was installed in the St. Louis Police Department in the mid-1960s. Since then the growth of computer technology by the police has been widespread. However, surveys conducted as part of this study in 1971 and 1974 revealed that implementation has been slower than expected. The 1974 survey was mailed to all U.S. police departments in cities with a population over 50,000. Of the 326 (80 percent) that responded, 193 (56 percent) were using computers. Although this was an increase of 12 percent over 1971 responses, it was only about half the growth predicted by the earlier survey.[3]

Some of the difference may be explained by a slight variation in response rate between the two studies and by varying interpretations of survey questions. But, more important, estimates of future growth tend to be overly optimistic. The slower rate may also indicate that some police departments are taking a more careful and sophisticated approach to computer use. A healthy pragmatism--and sometimes even skepticism--exists in many departments.

1. The range of computer use. As part of the survey, police departments with computers were asked to identify which of 24 applications they were using. The 24 applications were grouped into eight areas: police patrol and inquiry, traffic, police administration, crime statistical files, miscellaneous operations, resource allocation, criminal invesitgation and command and control (See Figure 13-1).

In evaluating use and impact, a useful distinction can be made between routine and nonroutine applications of computer technology. Routine applications involve the relatively straightforward, repetitive manipulation and inquiry of prescribed data, often by means of a definite procedure. The same manipulation was usually done by hand before the advent of the computer.

3. The 1971 and 1974 surveys were designed by the author and administered by the International City Management Association (ICMA). See Figure 2-1 in Chapter II, p. 42.

Technology simply makes the process quicker and easier. For example, although police patrol and inquiry applications are technically advanced and provide rapid retrieval of information to the field officer such inquiry systems are relatively straightforward and the tasks can be labelled routine. Other routine application areas comprise traffic files, crime statistical files, police administration, and miscellaneous operations, as Figure 13-2 illustrates.

Nonroutine applications are more elusive to define. In this area the machine becomes a tool for decision-making, strategic planning, and man-machine interaction. There are no absolute methods for handling problems, either because the area is complex or because they require custom-tailored treatment. The human decisionmaker plays a vital role in judgment, evaluation, and insight. Nonroutine application areas in law enforcement include resource allocation, investigation of crime, and command and control, including among others computer-aided dispatch and automatic vehicle monitoring. (See Figure 13-2)

Rather than viewing routine and nonroutine categories as sharply distinct classifications, though, they should be regarded as converging from opposite ends of a spectrum. As applications move toward the nonroutine end of the spectrum, systems design becomes more intricate, and behavioral, personality, and organizational considerations become more significant. Several applications fall between two extremes. The best example is crime statistical files, which, though generally routine in collection and processing, provide the basic data for a number of nonroutine activities, such as resource allocation. Command and control applications also have both routine and nonroutine dimensions.

Figure 13-1

Computer Application Uses

Application areas	Computer applications
Police patrol and inquiry	Warrant file Stolen property file Vehicle registration file
Traffic	Traffic accident file Traffic citation file Parking violation file
Police Administration	Personnel records Budget analysis and forecasting Inventory control file Vehicle fleet maintenance Payroll preparation
Crime statistical files	Crime offense file Criminal arrest file Juvenile criminal activity file
Miscellaneous operations	Intelligence compilation file Jail arrests
Resource allocation	Police patrol allocation and distribution Police service analysis Traffic patrol allocation and distribution
Criminal investigation	Automated field interrogation reports Modus operandi file Automated fingerprint file
Command and control	Computer-aided dispatching Geographic location file

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[Same as Figure 2-3, p. 45]

Figure 13-2

Routine and Nonroutine Uses of Police Computer Technology

Routine	Nonroutine
Police patrol and inquiry[a]	
Traffic applications	
Miscellaneous operations	
	Command and control (including among others, computer-aided dispatch and automatic vehicle monitoring)
	Criminal investigation
Crime statistical files	
Police administration	
	Resource allocation

[a]The dotted arrows reflect the fact that routine and nonroutine categories are not sharply defined classifications. Rather they should be regarded as converging from opposite ends of a spectrum.

[Same as Figure 2-4, p. 49]

2. The evolution of computer technology. The growth of computer use by the police may be divided into four periods: 1960-1966, 1967-1971, 1971-1974, and 1974-1977. The primary uses of the computer between 1960 and 1966 were in the routine areas of traffic, police administration, and crime statistical files. In fact, by the end of 1966, traffic and police administration applications represented 54 percent of the total computer use.

However, between 1967 and 1971 shifts in emphasis occurred in the use of computers. Though traffic, administration, and criminal statistics applications experienced strong development, even more striking was the tremendous growth in police patrol and inquiry applications. Such inquiry uses increased sevenfold between 1967 and 1971. By 1971, almost one-fifth of all reported police computer use was devoted to the rapid retrieval of information on outstanding warrants, stolen property, or vehicle registration. In the late sixties, one nonroutine area of computer technology -- resource allocation -- received increasing attention. In absolute numbers, resource allocation still represented only a small fraction of total police computer operations at the end of 1971, but its greater than sixfold increase between 1966 and 1971 suggested that it would soon become a major application area.

Between 1971 and 1974, significant variations appeared between the computer use anticipated by police and actual implementation. By 1974 four of the five most common application areas were routine. In each case, though, actual implementation was significantly less than predicted. Resource allocation was the only area, routine or nonroutine, in which the predicted use level was actually met and surpassed. The 1971 survey results predicted that by 1974 12 percent of all computer applications would be in the resource allocation area; the actual percentage was 16. An additional survey question in both 1971 and 1974 asked police departments to rank the relative importance of different computer applications. There was little shift between the two years, and in both 1971 and 1974 resource allocation applications were ranked first (Figure 13-3).

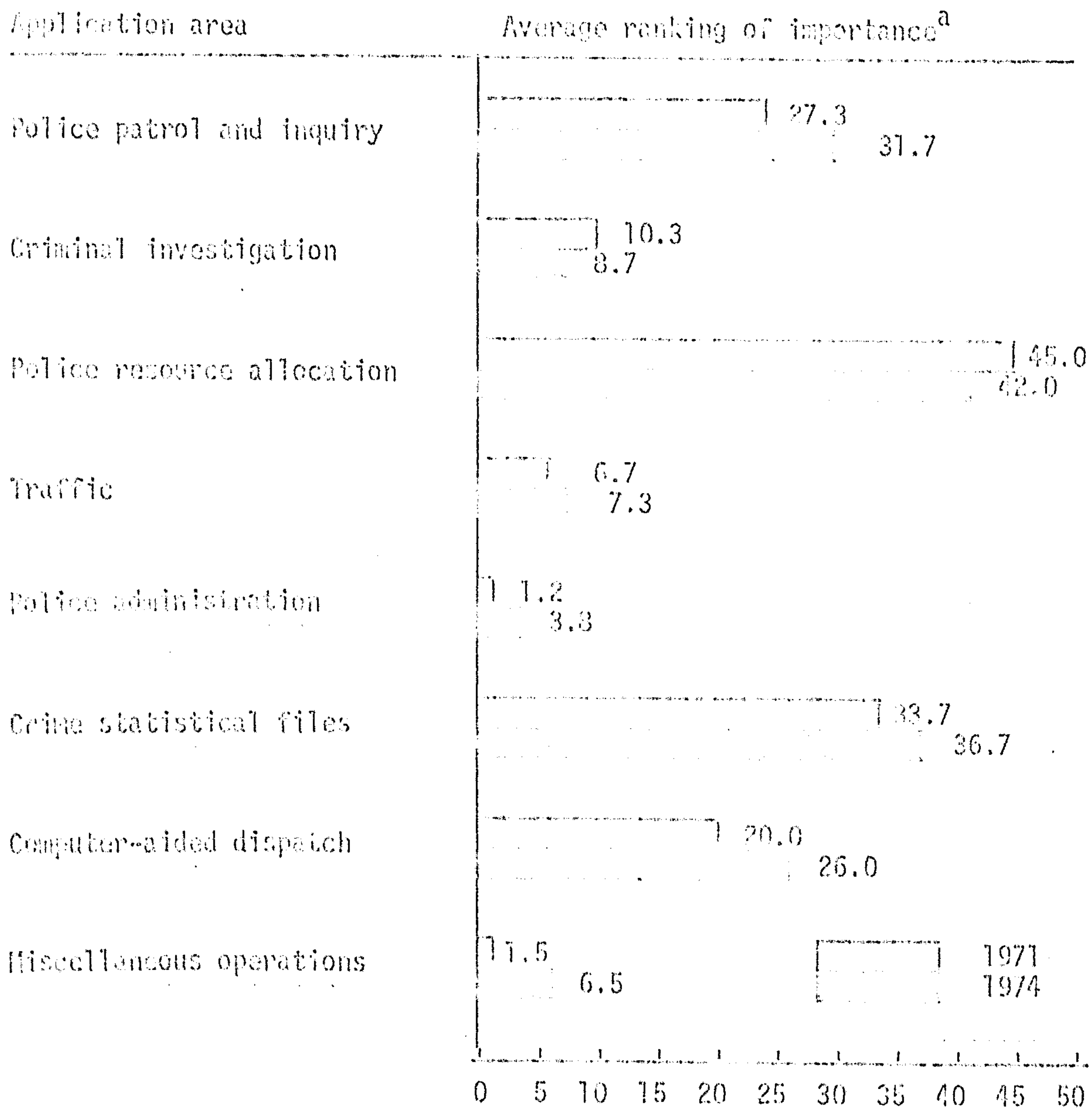
In two other nonroutine applications -- criminal investigation and computer-aided dispatch -- 1971-1974 use fell far below initial expectations. In 1971, survey responses predicted that 9.5 percent of all computer applications would be in criminal investigation by 1974, but the actual percentage was only 4.7. Similarly, 61 departments predicted that they would implement a computer-aided dispatch system by 1974. However, only 15 such systems had been installed by 1974 -- less than 1 percent of the total computer applications. The general failure of departments to acquire such systems despite earlier ambitions reflects the difficulty, time, and cost involved in implementing such applications.

Based on estimates for 1974-1977, similar patterns seem likely in the future. Many routine uses, which are still far more widespread than nonroutine applications, have evolved since the early 1960s. Nonroutine applications are also receiving increasing attention, although implementation has been slower than predicted, and a number of such uses are still in the planning and testing stages. Resource allocation continues to be the primary nonroutine computer use that has been consistently implemented across the country.

After a decade and a half of use the computer, with all its

Figure 13-3

Importance of Computer Applications in 1971 and 1974, As Ranked by Police Departments



[a]Ranking is based on the average number of times applications were selected by police departments as one of their three most important applications.

[Same as Figure 2-8, p. 62]

interesting implications and problems, has unquestionably become a permanent part of law enforcement technology. The issue now is how computer technology will be used and with what impact.

B. Routine Applications

In analyzing police computer use routine applications (including applications for police patrol and inquiry, traffic activities, police administration and miscellaneous operations) will be examined against the four-part framework for evaluation outlined earlier in the chapter, even though the data are limited.

Although results vary greatly, routine applications have often succeeded at the first level of evaluation--successful operation and meeting objectives. Numerous police patrol and inquiry applications and crime statistical files are working around the country today, as shown in Chapter III. For example, seven-second retrieval of information to the officer in the street has been a reality in Kansas City, Los Angeles, and other police departments for a number of years. On the other hand, as the 1974 survey results indicate, the rate of implementation has been slower than expected; and even with routine uses of computer technology, the success varies significantly among police departments, often because of human rather than technical considerations. Furthermore, large resources from the LEAA have in some cases served as a "seductive stimulant" for police departments to get involved with computer technology in the absence of an intrinsic desire for understanding. As one police data processing manager put it, "Millions of dollars have been spent, but there's still an awful lot of garbage coming out of police computer systems." A ..iough no one knows how much waste and misuse exists, police computer hardware has undoubtedly been sold to police departments who don't know how to use it or for nonessential applications.

At the second level of evaluation--technical impacts--computer technology has provided a number of positive benefits. In at least some departments extensive amounts of new or better information are available more rapidly for broader distribution, although, again, results vary among police agencies. Real-time information is not only available to the officer in the field, but also traffic, police administration, and crime statistical records are more accessible. However, technical benefits do not address how information is actually used, nor do they measure changes in police performance. As far as this report is concerned, the more important questions relate to service impacts.

At the service impact level, though, the information available is less clear. In reviewing more narrow process oriented measures of efficiency, a number of routine applications have improved service to the public and shown to be cost-effective. Although full-scale analyses of costs and benefits were not covered in this project, illustrations of the process service benefits were discussed in Chapter III. In Tulsa, Oklahoma, an additional $180,000 in estimated revenue was returned after the first year's operation of a new automated traffic citation system. In Long Beach, California, membership in an automated want/warrant system in the Los Angeles area increased the number of 1970 warrant arrests 31.5 percent over 1969 figures. In Kansas City, Missouri, the ALERT (Automated Law Enforcement Response Team) system was installed in 1969, and the number of monthly inquiries per police officer concerning stolen cars or wanted persons rose from 36 in January 1970 to 90 by May 1971, and in 1975 police officers were averaging 250 inquiries per officer per month. In Oakland, California, after digital computer terminals were installed in half the patrol cars in 1971 and 1972, units with terminals in their cars made more than seven times as many information requests, received more than three times as many "possible hits," and were three times as productive in warrant arrests and vehicle recoveries as nonequipped units.

However, when one examines the actual service results or effectiveness of such routine applications, several unexpected impacts and influences become evident. For example, the Kansas City Chief of Police reported that after installing their ALERT system, one of the most advanced police patrol and inquiry systems in the country, the police department experienced an overload of police officers making stolen car checks, thereby creating a potential manpower drain and shifting concentration from other vital police tasks such as preventive crime patrol. In addition, it is extremely difficult to measure the effectiveness of technological innovations in combatting crime. Crime statistics are a product of a wide range of influences such as time of day, season, weather, unemployment and economic conditions, neighborhood development

patterns, political activity, community unrest, and reporting requirements. Relating the use of routine technological innovations to changes in crime statistics requires an enormous and unwarranted "leap of faith." A number of evaluations of technology have attempted to relate the impact of such innovations to crime pattern changes. It is the conclusion of this report that such efforts are wasted, and we are far better off to simply admit the difficulty of trying to correlate technological, or for that matter many other law enforcement changes, with broad social indicators of crime. Further, even if we discard crime as a yardstick and try to evaluate performance based on other measures of police activity, there is always the risk that undue emphasis will be given to those indicators which can be most easily measured--such as the number of car checks or arrests for stolen property.

Finally, as far as service impacts are concerned, it seems that routine computer uses by the police have almost entirely been devoted to the crime control and law enforcement functions of the police. In Chapter I it was pointed out, though, that only a small portion of police time was devoted to law enforcement activities (burglary in progress, check on car, make an arrest, etc.) and that the large majority was devoted to service (personal requests, animals, ambulance calls, utility problems, accidents, lost or found property, etc.) or order maintenance activities (family trouble, gang disturbances, neighborhood trouble, fights, etc.). By over-emphasizing the application of technology on crime control, law enforcement agencies neglect possible applications to social service activities, for example computer files to assist with referral information, medical assistance, or listings of agencies and names of people who might provide social service assistance. Some police agencies have already devoted attention to such applications, but if departments were to compare the dollars allocated for computer technology in each of the three areas of police activity--service, order maintenance, and law enforcement--to the actual time spent by officers in the street in these three areas, a shifting and reordering of priorities might result.

In the fourth area of evaluation--power impacts--the results of computer technology are the fuzziest. Individuals could potentially lose control of personal information, so safeguards to assure privacy and security are necessary. Further, computer technology may shift power within police departments, allowing those who are more quantitatively and technologically oriented to gain influence. (The implications of such shifts will be discussed in the final section of the chapter.)

C. Nonroutine Applications

Although the service and power shifts of routine computer applications raise certain questions and concerns, in general, in terms of operational performance and technical impact, a number of routine applications have been successful. However, nonroutine uses of computer technology bring greater complexity both in terms of implementation and evaluation. In this report case studies have been conducted in two areas of nonroutine use--resource allocation and command and control. Each will be discussed below.

1. Resource allocation. In surveys in both 1971 and 1974, police departments considered resource allocation to be their most important area of computer use. Resource allocation was also the only area in which the number of applications reported in the 1974 survey actually exceeded 1971 predictions. All police departments must make deployment decisions and the interest in the use of technology to aid in this allocation process is growing. However, the interest in automated police deployment should be placed in the context of a realistic understanding of the law enforcement environment. First, the resource allocation applications noted in the surveys generaly refer to using tabulations of crime statistics to determine deployment, not to more sophisticated models; and even where modeling efforts have been tried, many of the cases have met with only limited success.

In the 1974 survey, 147 police departments characterized their resource allocation process. Seventy (48 percent) indicated that they use no mathematical techniques in deciding how best to deploy their patrol force. Fifty (34 percent) indicated that they rely on some version of a hazard or quantitative formula for distributing resources.[4] Only 27 (18 percent) indicated that they used an advanced mathematical method, such as a computer simulation or another computer-aided resource allocation approach. In those departments which reported they were not using a mathematical method, though, more than half (60 percent) said they were using a computer to collect and store information for police service analysis. In other words, police use computers to keep track of law enforcement statistics and in a number of cases these data are undoubtedly used to assist in resource allocation decisions. However, the number of modeling projects is limited.

The case studies in this report have demonstrated the difficulty of actually implementing more advanced resource allocation techniques in police patrol operations. In St. Louis the use of the computer model that was implemented in the late 1960s is now purely optional, and no district captains currently request computer-generated reports. The command staff and the Board of Police Commissioners are essentially doing nothing to encourage use of the system by other commanders. In Boston, the proposed deployment techniques utilizing computer modeling were dropped

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4. A hazard formula identifies a series of factors that are felt to be significant in determining the demand for police patrol service. Generally, an attempt is then made to deploy units so that each sector has about the same hazard values. Most departments simply determine the anticipated work load, but some have more sophisticated approaches that entail the computation of total service times or consider a number of additional factors. Some of the most commonly used factors in calculating the hazard value of an area include the number of crimes against persons, total of all crimes, calls for service, population, juvenile delinquency, accidents and aided cases, school crossings, and licensed premises.

several years ago, and questions have been raised within the police department concerning the manual resource allocation procedures that were implemented.

Of the three cases reviewed in this report, the Los Angeles Police Department (LAPD) has the only resource allocation system utilizing computer technology which is actually operating and established as a part of its deployment process. The first level of evaluation--having an operating system--has been met. However, even there, the objectives of the resource allocation project were substantially modified. The LEMRAS/ADAM deployment model was dropped in 1974 to be replaced by the ADAM historical reporting system which was implemented in June, 1975. The current ADAM package no longer includes forecasts of future needs, and deployment recommendations are based on manual calculations using computer generated reports of historical data. The LAPD has achieved technical benefits in terms of reducing the manpower required to analyze workloads and to calculate deployment plans, but many of the service impacts are still unclear, for example, in terms of responding without delay to calls-for-service. Finally, one of the original service objectives of the LEMRAS/ADAM system, improved crime prevention, has been virtually abandoned.

Efforts in police departments to utilize computer technology in resource allocation go far beyond the St. Louis, Boston and Los Angeles case studies examined in this report. The modeling techniques used in these three cases are now outdated, and improved models have been developed. For example, as discussed in Chapter VII, a number of projects are currently underway to implement the Patrol Car Allocation Model (PCAM) and the Hypercube Model. These models allow the user to identify a wide range of performance measures--for example, mean travel times to various locations, workload balances, response to calls-for-service and other dispatching strategies--and based on the relative importance of these various measures, alternative deployment strategies are provided. As a consequence, some of the objections in St. Louis and Los Angeles--that those modeling efforts did not consider enough of the relevant factors--have been overcome. The actual results of most of these efforts still must be evaluated, though. Further, the implementation problems encountered in the three cases in this report do not seem to be isolated instances. Rather, there is strong evidence that such difficulties are commonplace. For example, according to a 1975 report by the RAND Corporation that examined a number of attempts to implement computer models in the criminal justice area: "Through a series of interviews with model builders and personnel in agencies that attempted to implement models, a picture of the implementation process was obtained. In general, criminal justice models have failed to achieve any notable level of use for policy decisions."[5]

What can be said, then, about the various efforts to utilize computer technology in police resource allocations? Five conclusions have been drawn.

a. Many of the early predictions and promises concerning computer-aided resource allocation systems have not come true, and our expectations for the future should be altered accordingly. At one time some advocates argued that the use of computers and technology might result in the almost daily reallocation of police units. An officer reporting for duty would

5. J. Chaiken, T. Crabill, L. Holliday, D. Jaquett, M. Lawless, and E. Quade, Criminal Justice Models: An Overview, RAND Report R-1859-DOJ, (Santa Monica, Calif.: Rand Corporation, October, 1975), pp. xii.

call in and be assigned to patrol or to answer calls in an area designated through the analysis of available data and the aid of modeling technology. It is apparent that this type of "fluid patrol" is not going to occur. This is illustrated by the St. Louis experience. At one point in the St. Louis resource allocation, patrol beats were changed every four hours, a practice long since abandoned for two reasons: behavioral factors worked strongly against such shifts (which were confusing and unsettling to the officer on patrol), and the benefits were questionable, especially since workload needs did not seem to warrant such dramatic action).

Past experience, then, should appropriately temper our future expectations. Rather than looking for the long-term implementation of computer aided resource allocation to redesign police deployment on a quarterly basis, we should expect the use of modeling techniques on a more limited, almost one-time basis, where police departments use computer technology to redesign their patrol structure once and then wait for several years before using the model again.

b. Many of the problems in implementing computer models are the result of behavioral and organizational difficulties. Past experience has shown both a misunderstanding of the nature and environment of technological change, and a failure to properly manage innovation. The case studies in this report demonstrate the difficulty of getting police users involved in modeling efforts. Although the ADAM/LEMRAS system in Los Angeles has been altered substantially since its inception in 1967, the ADAM historical reporting system is currently in operation, partially because of the sensitivity and approach of LAPD personnel. Chapter VII outlines how the eventual approach in Los Angeles contrasted with the project management efforts in St. Louis and Boston. Still, it took eight years for changes to be made in Los Angeles which highlights vividly the need for a long-term timeframe, the involvement of command leadership, the continuity of personnel over time, and a number of other factors that will be dealth with in more detail later in this chapter.

c. Despite past disappointments, police computer modeling efforts should not be abandoned. We should continue to seek improved methods for police resource allocation, but with a more realistic perspective. All police departments must deploy their resources in some manner or other. The two surveys in 1971 and 1974 demonstrated that there was an increased use of quantitative data in making manpower decisions. According to one chief of police: "I used to feel that the only criteria in police work was to get more officers on the street. Now I have come to realize that other standards of performance should also be considered. There is more to resource allocation that seat-of-the-pants observations." If the right criteria are built into the models, technology may assist in more effectively identifying and responding to future needs.

Further, in order to develop police models, detailed review and analysis of the criminal justice system is required. Use of the technology may aid the operations of the police, not because the model per se will improve the system, but because law enforcement personnel may become more educated and involved in the decision-making process. However, if this education process is to be meaningful, it must be two-way, not only involving the model builders, but extensively involving the model users as well. It is difficult to involve law enforcement decision makers in such a process, not only because of differences in style and approach, but because the complex world of policy management faces immediate demands. The police commander who faces day-to-day decisions is often unable or unwilling to afford the luxury of model building and analysis.

The last few years have seen the development of several new and more flexible approaches to computer-aided police deployment such as the Hypercube or PCAM models, and in fact, according to recent estimates, since September, 1975, 12 police departments have used, or are using PCAM (with an additional seven departments as possible future users), and approximately 24 police departments have used or are using the Hypercube Model, at least on an experimental basis.[6] However, in designing and implementing such models hopefully we can learn from the past so that our expectations will be realistic and we will remember that the quality of the outputs of the model are highly dependent upon inputs, design, and assumptions.

d. As computer modeling work is continued, evaluation is essential, and careful consideration should be given to a more systematic program to evaluate such technology. Any claim about the impact on performance of advanced deployment models will remain largely speculative until more careful research and evaluation is carried out. The time may be appropriate to develop a more systematic program of evaluation, and the Law Enforcement Assistance Administration should consider designing such an experiment to test alternative resource allocation strategies. It is only through such an experiment that it can be determined whether, or to what degree, development and implementation of such police technology is warranted. If such evaluation is forthcoming, though, it must be independent; and pretest conditions must be analyzed, implementation monitored, and the effects of

6. Jan M. Chaiken, "Implementation of Emergency Service Deployment Models in Operating Agencies," RAND Paper Series, Paper Number P-5870, (Santa Monica, Calif.: Rand Corporation, May, 1977), pp. 13-17

the technology reviewed. The evaluation must be multi-disciplinary with attention paid to the local citizenry's perception of changes in the overall quality of service in all three dimensions of police performance--law enforcement, service and order maintenance. However, the case studies have highlighted the inability to relate innovations to changes in crime statistics, and success or failure will need to be measured in other terms, such as evaluating the impact on workload distribution, the response to calls-for-service, and officer and citizen satisfaction.

e. Finally, and perhaps most important, there is no one best way to allocate law enforcement resources. Rather, there is a range of alternative strategies, and each implies a different, sometimes subtle, set of consequences. The computer cannot prescribe the ideal method. When embarking on the implementation of innovation, it is important to review and understand the consequences of alternative policing strategies and to realize that the use of technology is not value-free. The experience in the LAPD is especially informative in demonstrating this point. Team policing and the resource allocation model, ADAM, represented two separate philosophies of police work. ADAM placed priority on responding to calls-for-service, generally irrespective of patrol beat assignments. Team policing focused on assigning patrol officers to one area of the city to prevent crime. The conflict appeared when ADAM was implemented in the team policing environment. The problem was not the ADAM system, per se; rather, there were two different strategies involved, both with very different objectives.

Any resource allocation system is obviously based on some basic set of criteria or decision rules used to deploy police forces. To obtain the best results a department must select rules compatible with their basic objectives. A department must be especially careful in buying a preprogrammed package from a vendor that relies on a set of decision rules which are essentially unknown to the department. The result may be unexpected or yield the wrong consequences. Certain criteria--for example, responding to calls-for-service--may be given emphasis when, indeed, they do not have the highest priority. Emergency response to calls-for-service comprise only a small portion of the actual police work, yet it is possible that such measures can become primary criteria for allocating resources if departments fail to take the time to think carefully about their deployment strategy.

Earlier it was stated that if the right criteria were used, technology might assist in meeting future needs. However, in deploying manpower, no single criterion will bring magic results. Goals and objectives vary, depending on the focus or emphasis which is desired. There is more to police work than crime-related activities; service and order maintenance functions are also of primary importance. Unless the use of computer technology can reflect this insight, oversights may develop and subtle and undesired impacts may arise.

2. Command and control. The potential for automating aspects of police camnand and control operations were first pointed out by the Crime Commission in 1967. Computer-aided dispatch (CAD) systems provide the framework for bringing together many of these new tools through the partial automation of the call answering and dispatch process. Other command and control technological changes that have been considered or tried include mobile and portable digital terminals to allow officers in the street to communicate digitally with headquarters, automatic vehicle location (AVL) and automatic vehicle monitoring (AVM) systems to keep track of the

location and monitor the status of police units, and 911 emergency telephone services.[7] A CAD system may include AVM or AVL systems, 911 telephone service or mobil digital terminals.

Some of these innovations in command and control are routine; the technology basically replaces a previously manual activity such as with digital terminals or the automated transfer of information from the telephone operator to the dispatcher. However, CAD also provides the framework for a number of nonroutine activities, such as tracking and monitoring vehicle location, automatically timing the length of calls and raising a "flag" if a call takes over a specified time (say 30 minutes), or providing new information to be used for management. Command and control as discussed in this report, then, relates not only to dispatch deployment, but to the ability of police administrators to control and modify the manner in which police operations are conducted.

This study documents four cases within the command and control area--three CAD systems in New York City, San Diego, and Boston, and one AVM system in St. Louis. As such this report has only begun to examine the many dimensions of such innovations. First, the implementation of CAD will be reviewed, then AVM.

a. Computer-Aided Dispatch. As reported earlier, the 1971 and 1974 ICAM survey results indicated that the implementation of CAD systems has been far slower than initial anticipations. As further confirmation, a 1975

7. A distinction has been drawn in this report between AVL and AVM systems. An AVM system provides a police dispatcher with real-time location estimates of each vehicle in a fleet and, through its monitoring function, provides additional vehicle status information (for example, "in pursuit," "enroute to scene," etc.). An AVL system provides only location estimates without additional status information.

study found that of the 135 police departments in jurisdictions with a population of more than 100,000, only about 10 percent had a CAD program.[8] The use of CAD systems is just beginning, and a number of obstacles have been encountered in the installation process. However, in San Diego and New York City working systems have been developed, although in Boston the problems of introducing the new technology have been more significant. The successes and failures of the three case studies provide seven insights for the future.

First, it is possible to establish ongoing, operational CAD systems. The SPRINT system in New York City has been working since 1970 and the CAD system in San Diego has been operating since 1975. Second, both cities experienced technical benefits such as increased information availability, rapidity in matching addresses with geographic location, the effective transfer and recording of data in the dispatch process, and the retrieval of information from the dispatch system.

Third, in terms of process measures, both cities have experienced certain positive service impacts: telephone calls are answered and serviced more rapidly (telephone talk time in San Diego has dropped from 3 minutes to 77 seconds, and the average time required to answer the telephone is 2.5 seconds); standards can be set for communications and field backlogs (New York City has met its standard of answering 98 percent of telephone calls within 30 seconds, and air-time delay and field backlogs are monitored and recorded); and the workload has been more evenly distributed within communications divisions. However when it comes to measuring the actual service results attributed to CAD, the conclusions are inconclusive. In the New

8. R. L. Sohn, et al., Application of Computer-Aided Dispatch in Law Enforcement, An Introductory Planning Guide, (Pasadena, California: Jet Propulsion Laboratory, 1975), p. 3.

York City and San Diego police departments there is a general feeling that dispatch time has been reduced, but the data are inadequate to prove or disprove such a hypothesis. Further, the police departments have essentially not analyzed the CAD system's influence in such areas as improving police productivity by enabling patrol officers to respond to more calls per shift or providing a better match between police service needs and available resources. Also, the impact of the new technology on crime has not been evaluated (although, as pointed out earlier, such a review of the influence on crime would have major limitations).

Fourth, the power impacts of the CAD systems are also clouded. CAD systems highlight the importance of the dispatcher in the delivery of police services. As greater information increases the ability of the dispatcher to carry out his or her job, it also increases influence and power of communications personnel. In Boston some of the resistance to CAD technology resulted because of a fear of increasing the power of the dispatcher. Another potential power shift relates to the ability of police administrators to control and modify the manner in which police operations are carried out. Both the New York City and San Diego CAD systems provide a wide range of new information to managers. A number of reports are regularly produced and distributed in New York City, and in San Diego lists of available reports are circulated to police personnel with further documents provided upon request. Such data offer a rich potential for the better management of police field resources and dispatch personnel and for bringing greater authority and control to police managers. However, the ultimate impact will depend on the ability of law enforcement administrators to analyze and use this information effectively as a resource.

The question remains, then, as to whether the benefits of CAD justify the costs. Although the expenses of much of this technology seem high, when placed in the overall context of the costs of police operations, the comparative magnitude of the dollars seems to diminish. In New York City, for example, the annualized costs for developing and operating the SPRINT system are about $2.7 million. Because the 1975 police budget in New York City was approximately $625 million, this means that 4/10ths of 1 percent of the annual budget was devoted to the CAD system.[9]

In both New York City and San Diego technical and service benefits have been achieved to help offset such costs, and it seems highly likely that the use of CAD systems will continue to expand. Whether their full potential is achieved, though, will depend on the skills of the management personnel. Police chiefs have seldom considered themselves as managers in the past; rather, their responsibility has been to balance pressures within and without the city and to promote the need for law enforcement and police resources. Consequently, it is still unclear as to whether they or their assistants will be able to channel the potential technological talents of the computer to do more than simply perform routine operations.

The <u>fifth</u> conclusion from the three CAD cases points to the complexity and importance of implementation. In Boston a number of factors were identified which contributed to the problems of installing a CAD system in the police department: lack of involvement by career department personnel in in formulating the program; prohibition of outside consultants from

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9. Stated in another way, the costs of operating SPRINT are roughly equivalent to maintaining 10 police patrol units on an annual basis. (Cost estimates are discussed in more detail in Chapter IX.)

working closely with department staff and field personnel who would use the new system, and lack of progress reviews with field personnel. Police officers are often suspicious of change, and CAD has the potential for huge modifications in police operations. Where possible police must be involved in identifying the need and designing the operation of technological innovations. It is possible that the CAD system in Boston will someday become fully operational, but first, behavioral, technical, and political obstacles must be overcome. In San Diego great care was made to train personnel and to involve dispatchers and operational officers in the design of the new system, and this approach certainly contributed to their apparent success. Even in San Diego, though, the primary problems to date relate to behavioral difficulties (such as boredom, monotony, and the isolation of the personnel in the communications center from the rest of the police department). A special 90-hour training program was developed for telephone and dispatch operators but in 1976 personnel shortages forced the department to rely on on-the-job training instead, at least in the short run.

Sixth, the relationship between the user and the vendor must be clearly defined and performance standards for CAD technology must be specified. Although San Diego had a very clear set of vendor specifications in the request for proposal for the CAD system, the Boston proposal lacked the same clarity and misunderstandings inevitably developed. In the long run, both the police and the vendors of technology will benefit from a clear framework and set of standards and specifications. In fact, it is the conclusion of this report that effective implementation necessitates such standards.

Seventh, and finally, the time is appropriate for a more thorough evaluation of CAD technology in the law enforcement community. Although some systems are still in operation, others have met with only limited success and the reality is far below initial expectations. Still the interest in CAD among law enforcement agencies appears to be high, and a number of vendors are out actively promoting their products, sometimes without standards, checks and balances. The LEAA should consider funding a thorough evaluation of such technology to identify both the advantages and problems that have occurred to date and to outline a clear set of performance standards for users and vendors in considering the implementation of a new CAD system. Such an evaluation could play an important role in the process of technology transfer (or non transfer) both in terms of realistically educating interested departments in the benefits and the costs of such innovations and in terms of identifying possible "pools of resources" to aid in the transfer process.

b. Automatic Vehicle Monitoring. The application of AVM highlights a number of additional dimensions in the evaluation of computer technology related to police command and control. In analyzing the St. Louis experiment, four objectives were reviewed: (1) reduction in voice-band congestion through digital communications, (2) response time reduction, (3) improved officer safety, and (4) increased command and control capabilities. The evaluation in Chapter XI of this report reviews only the Phase I AVM experiment in one police district in St. Louis, District 3. (The Phase II city-wide implementation of the system was underway as of 1977.) Based on the Phase I experience, though, only one of the initial four objectives--digital communication--has achieved positive results. Although the level of voice-band congestion was not materially changed through the use of the digital communication components of the AVM system (called FLAIR), the system experienced high usage, allowed a far greater number of communications between the field and the dispatch center, provided both field officers and dispatchers with greater communications flexibility, and was generally accepted positively by officers in the field.

Regarding response time, the Phase I AVM tests did not support the expected reduction in response time. Although further careful review is needed during Phase II, current evidence does not suggest that savings in travel time due solely to AVM will significantly improve police operations or reduce costs. This is particularly true when one realizes that little is known about the relationship between response time and apprehension probability,[10] and that in an urban environment, travel time as a component of total system response time rarely exceeds about 50 percent of total system response time. Thus, a 10 percent reduction in travel time is not likely to decrease total system response time by more than 5 percent. Since a significant amount of time often passes before a crime is even reported to the police, this further dilutes the impact of a travel time reduction due to AVM.[11]

Regarding improved officer safety, the St. Louis AVM system includes a special feature to alert the dispatcher visually and audibly that an officer has pushed a button indicating that he or she is in trouble. However, during Phase I the rate of cars that were "lost" or mislocated by the system was so high that the confidence of patrol officers in the emergency aspects

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10. Two studies on this subject include Herbert H. Isaacs, "A Study on Crimes and Arrests in a Metropolitan Police Department," Appendix B, Task Force Report, Science and Technology, President's Commission on Law Enforcement and Administration of Justice, Washington, D.C., 1967, pp. 88-106; and by Clawson and Chang in Seattle to appear in a special issue of Management Science on Criminal Justice, A. Blumstein and R. Larson, co-guest editors.

11. See for example Deborah H. Bertram and Alexander Vargo, "Response Time Analysis Study: Preliminary Findings on Robbery in Kansas City," The Police Chief, May, 1976, pp. 74-77.

of AVM decreased significantly. Also, the number of actual emergency alarms during Phase I was small, making a proper evaluation difficult due to small size.

Although it is premature to state a final conclusion regarding the officer safety aspects of AVM, the St. Louis case does provide an excellent opportunity to review the human aspects of adding location information to police command and control. Behavioral and organizational factors are important in implementing CAD applications, but they are essential for installing AVM systems. A crucial link exists between attitudes and system technical performance. Before using the Phase I system, 64 percent of the officers in the experimental area --District 3--thought AVM was a "good idea." Because of operational problems discussed above, after the Phase I implementation, only 39 percent still felt positively. If new systems are to receive the support of police personnel, hardware vendors must be accountable for system accuracy, maintenance and repair standards, system capacity and system adaptability. Also, the operation of AVM relies heavily on well-motivated and trained dispatchers. Because the capabilities and motivations of dispatchers were mixed, this uneven quality contributed to the shift in attitudes. One of the most important aspects in implementint new technology is developing the proper human/technology interface. The point at which this is especially vital with command and control is the link between the dispatcher and the new system. If the Phase II system being implemented city wide in St. Louis is to succeed, several behavioral and managerial factors must be considered. These include: priority attention to the role of the dispatcher, an effort by vendors and top management to keep from "overpromising," the development of detailed standards for evaluation, ongoing dialogue and feedback concerning the system, careful involvement of top police supervisors, and a long-term commitment and continuity of personnel. Further, sensitivity is required concerning the potential for disciplinary abuse. The patrol officers' association in St. Louis has referred to AVM as a "fancy cow bell for cops." To the extent that AVM is used primarily as a means to justify discipline it will face strong officer resistance. On the other hand, if used as a means of encouraging better management and deployment of police personnel, officers may be more receptive to change.

In fact, since the response time improvements of AVM seem dubious the final evaluation will generally depend on shifts in command and control capabilities pertaining to the ability of the dispatcher to deploy (command) vehicles, especially under extraordinary circumstances, and the ability of patrol administrators to control and modify the manner in which patrol operations are conducted. Few results were available during Phase I regarding the potential of AVM for affecting patrol operations. The average cost of fielding a round-the-clock one-person patrol car usually exceeds $100,000 per year or, for a two-person patrol car, $200,000 per year. The total AVM cost at $2,000 per year, then, represents no more than 2 percent of the cost for a one-person car (or 1 percent for a two-person car). Compared to the one-person car, if it could be shown in Phase II that AVM will increase the efficiency and effectiveness of the force by x percent (because of better management of the forces), then AVM will provide at least x:2 return on the investment. If x is equal to 10 percent, for example, this would produce a 5:1 return on investment.

Such analysis indicates that there is potential for management improvement, but again, the results will depend upon the ability of police administrators to utilize the new resource. An evaluation is being conducted of the Phase II implementation, and an attempt will be made to measure changes, if any, on patrol operations. More conclusive findings must await this evaluation.

Finally, more than just monetary factors must be considered when evaluating the advantages and disadvantages of AVM. The implications that such innovations might have for police policy and approach must also be considered. To the extent that AVM stresses rapid response to calls-for-service and dispatching the closest car, it may conflict with an alternative approach to policing--the "one-person, one beat" approach that gives a patrol officer or team responsibility for a particular area. Therefore, a definitive review of costs and benefits that will be applicable to all police departments is probably impossible. Rather, the costs and benefits for each city will vary and must be reviewed depending on individual goals and priorities.

D. The Implementation of Computer Technology

Throughout the report we have noted that how computer technology is implemented is crucial to success. Even with routine computer applications the success has varied widely among police departments because of styles of implementation and the fragmented nature of law enforcement activities. With nonroutine applications, where the success has been far more limited, the process of implementation has been particularly important. The main problems have generally not been technical, per se; rather they have often been behavioral, organizational, and dependent upon the relationship between vendors and users. The LEAA has spent large sums of money to support computer technology, and comparatively speaking, they have neglected the process of implementing these innovations.

The time is now ripe to change this orientation. The conclusions of this report regarding the importance of implementation have been verified by numerous studies conducted both in law enforcement and in the more general applications of technology in the public sector.[12] The question is: "What should be done?"

First, it is worth noting that people involved in promoting computer technology often make certain implicit or explicit assumptions. Some of these have been identified in this report:

- If the technology exists, there must be a need and implementation should proceed.
- If only the technical problems can be resolved, the implementation can move forward.
- Time constraints mean that implementation must rely on a small group of supporters.
- Law enforcement supervisers really don't need to understand how innovations work, they simply need to know how to use them.
- The quicker the innovation can be installed, the better.
- If new technology is installed, positive results will automatically occur.

Such assumptions often cause implementation to fail. Although sometimes partially true and often undoubtedly expedient, they generally return to

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12. See, for example, Garry D. Brewer, Politicians, Bureaucrats, and the Consultant (New York: Basic Books, 1973); and Martin Greenberger, Matthew A. Crenson, and Brian L. Crissey, Models in the Policy Process, Public Decision Making in the Computer Era (New York: Russel Sage Foundation, 1976).

haunt the implementer and to bring the eventual demise of the effort.

Based on the case studies and survey work in this report it is possible to develop a set of recommendations concerning the important factors to consider when implementing computer technology. The factors are divided into two categories: those related to the nature and the environment of the innovation, and those related to the project management of the innovation. Each of these factors is a necessary but not sufficient aspect of successful implementation.

1. Conditions related to the nature and environment of the innovation. Four factors seem especially important in this regard.

- A clear and realistic understanding at the outset of the project of the policy issues involved. For example, when the LAPD first began the LEMRAS project, they failed to appreciate the policy conflict between the model and team policing.
- A perceived need for change among those influenced by the innovation--both police administrators and officers in the street. One of the best indicators of this perceived need is a willingness to pay for change. Both San Diego and New York City "used their own money," so to speak, when installing CAD systems. Many of the recent Hypercube and PCAM police resource allocation modeling efforts have been funded directly by the departments involved. Although projects funded from the outside may still succeed, often there is less commitment and support than in self-funded efforts.
- Effective timing and system design so as to meet user needs. The first attempt at CAD in San Diego failed miserably because those involved in the design failed to identify the needs of users. The second effort focused special attention on user

concerns and was implemented at a time when change seemed essential. The outcome was far more successful.

- The proper selection of priorities in implementing computer technology. The most important formula seems to be to start with innovations that assist the officer in the street. After that more nonroutine innovations can be developed. As we discussed earlier, computer technology has often been devoted to a narrow range of officer needs. The focus has been on crime and law enforcement activities. Perhaps if greater attention were devoted to service or order maintenance objectives, acceptance would increase.

2. Factors related to the project management of innovation. Eight elements are included in this checklist for innovation.

- A long term time framework and perspective. Eight years were spent in the implementation of the ADAM historical reporting system in Los Angeles. Such projects inevitably take longer than initially planned, and if an adequate timeframe is not allowed, frustration and rejection will ensue.
- Involvement and quality of top-level leadership. Police departments tend to be fairly rigid organizations with well established chains of command. Understanding, involvement and support from the top is essential if technological innovations are to be implemented and used. More than support from the Chief is required, though. In addition, a core of agency leaders is necessary if commitment is to be maintained over time.

- Involvement of other police personnel. Besides the top commanders, police at the operating level must be involved in the design and development of computer technology. One reason the resource allocation system faltered in St. Louis was because the field officers strongly resisted a shift of only one hour in their daily schedules because it would have required them to commute to work during the normal rush hour traffic.
- Caliber of computer systems and technical staff. Individuals are required who have both technical skills as well as a broad perspective which will allow them to see beyond computer technology to law enforcement needs and to communicate successfully with the police department. In order to attract such individuals, cities must be willing to pay competitive wages.
- Continuity of personnel. Experience has shown that, as advocates for technological innovation move, the innovation often dies. Change in personnel is inevitable, but at the same time, a certain degree of continuity must be maintained.
- Effective training, education, and information dissemination. The process of communication is often at the heart of effective innovation. Carefully designed training programs provide an important link in such communication. However, innovators must also be prepared to listen to feedback and the dialogue process must be two way.
- Emphasis placed on human-computer interaction. There is sometimes a tendency to consider computer technology as a

replacement for people. This is both unrealistic and inefficient. One of the most critical variables for the efficient and effective operation of any computer system is the development of the proper balance in the interaction between man and machine.

- Unbiased evaluation. A careful (and, if possible, independent) evaluation should be an integral part of any implementation effort.

Twelve conditions for effective implementation have been outlined above. Obviously it is impossible to expect that they can all be met whenever computer technology is implemented. However, they are a checklist to keep in mind when considering the implementation process. There is no one simple answer to assure success. On the other hand, it is clear that in the past we have failed to devote adequate attention to the implementation and diffusion of innovation in law enforcement. While trying not to raise our expectations beyond reach, it should be possible to concentrate our efforts at more effective evaluation and transfer, where appropriate.

One of the first steps is to facilitate a better quality control over transactions between vendors and users. By far, the primary promoters and agents for technological change in law enforcement are those who are marketing and selling their products to the police. Although I do not advocate strict legislation or government regulation, it may be the time to begin to establish informal "truth in technology" standards. In the CAD area, for example, San Diego and New York City both developed standards to evaluate vendor performance. A broader evaluation of CAD could help to identify the utility of such systems for different police departments and to outline detailed specifications that could be applied in various circumstances. With AVM, the experience in St. Louis has already assisted in spelling out possible performance measures that could be applied concerning accuracy, maintenance and repair, system capacity and system adaptability.[13] Such standards will not only help to establish a basic level of performance, they will help to encourage the development of better technology and better models.

In addition, a good deal of attention in the literature is given to trying to "bridge the gap" between the builders of technology and the users. For example, some have argued for the need for more "engineers" in the technology process[14] and others have called for the development of a new breed of researchers/pragmatists--model analyzers--as highly skilled professionals and astute practitioners able to review both the needs for modeling and for controlling and directing the model builder: "The model analyzer would be neither model builder nor model user, but in a middle position between the two, empathetic with both."[15] I am somewhat skeptical about the possibility of institutionalizing either of these on a large scale in the law enforcement community. Police are often suspicious of change, particularly change promoted from the outside.

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13. See Richard C. Larson, Kent W. Colton and Gilbert C. Larson, "Evaluation of a Police Implemented AVM System: Phase I, with Recommendations for Other Cities," pp. 61-63, summary report of work performed by Public Systems Evaluation, Inc., Cambridge, Mass., funded by Grant No. 75NI-99-0014, National Institute of Law Enforcement and Criminal Justice, LEAA, U.S. Department of Justice.

14. Jan Chaiken, et al.; Criminal Justice Models: An Overview.

15. Martin Greenberger, et al., Models in the Police Process, Public Decision Making in the Computer Era, p. 339.

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However, it has become apparent in analyzing the implementation of law enforcement technology, that a new breed of police officers is beginning to emerge. These officers have "come up through the ranks" and have, therefore, "paid their dues" and are respected within the police community. At the same time, they have experienced both the advantages and the limitations of new technology. Rather than trying to teach outside engineers about police practices and policies, it may be more profitable to cultivate this inside set of "police technology experts." For example, there may be ten or twenty members of police departments around the country who have developed real expertise in implementing CAD systems and a sense of the standards that should be applied. Perhaps they could serve as consultants to other departments in implementing CAD technology. In essence they could become a "pool of resources" in special areas of concentration to aid in the diffusion process. However, they must maintain their independence from vendors or others who have a vested interest in the technology transfer process.

Finally, it is essential to remember that one of the most critical elements of success is that the desire for change must come from within, not without. Better evaluation and standards of performance can help educate police departments as to the advantages and limitations of technology, and "pools of resources" from within and without the law enforcement community might establish a two-way communication to facilitate diffusion. Still, the final desire for change and the specific design and implementation of alternatives must come from the police department involved.

There is a human tendency to seek direct solutions and to try to classify actions as either failures or successes. In the area of implementation, though, there seems to be no one absolute, single answer. Rather, the correct prescription must come from a confluence of factors. Even then, some implementation efforts will succeed, some will fail, and others will fall somewhere in between. Hopefully, we can learn from all three situations. Evaluation is necessary to weed out unjustified innovations, but it should be remembered that the field of computer technology is still in its infancy. The first commercially sold stored program computer, the Universal Automatic Computer, or Univac 1, was built only 26 years ago in 1951. The third generation of computers has been commercially available only since the late 1960s. Perfection should not be expected instantly in an area so young and rapidly changing. On the other hand, a certain mystique as well as commercial force surrounding the application of computers has led to high hopes and to major oversell. In reality, the state of the art is often far less than the general impression one gets from the literature. As time goes forward, expectations should become more realistic and our ability to perform will improve.

E. Conclusion

Even if computer technology can be implemented successfully, important questions remain about the final impact of this technology and the benefits and costs. The Crime Commission's report in 1967 stressed the use of technology in law enforcement, it was optimistic about the potential for such innovation. Since then we have learned a great deal. Quick solutions should not be expected, and costs accompany any benefits that are achieved. In a narrow sense, this report has found that there are technical and service impacts stemming from the routine use of computer technology, and in the area of nonroutine use, indications of technical and service improvements have been documented. However, we have also learned to expect little impact from computer technology on crime and the basic law enforcement issues. Crime is rooted in an infinite mix of factors; technology can do little to alter these conditions. Earlier, we stated that no one should expect the computer to change the direction of law enforcement dramatically. The findings of the report confirm this conclusion. The best that can be expected are marginal improvements. Still, it is relevant to ask: "What power impacts will technology have and what changes, if any, can be expected in the personnel, tasks and structure of the police?"

Determining such power impacts poses a more difficult research problem than probing technical or process oriented service impacts. No major shifts have been identified, but subtle changes may be forthcoming. The emphasis in Kansas City on conducting computer searches versus other types of law enforcement activities is one indication and the conflict between team policing and the LEMRAS/ADAM system in Los Angeles is another. To the extent that computer technology places greater emphasis on quantitative approaches to the law enforcement problem, shifts may occur.

Clearly, personnel in the law enforcement community have had more impact on technology than the reverse, but again, subtle shifts may occur in the future. Our survey results have shown that people with more quantitative backgrounds seem to be gaining in terms of their importance in police departments and those who have a greater ability to utilize computer technology may increase in importance in police departments.

Finally, there is some evidence that computer technology may lead to a greater centralization of police structure and power. However, based on closer examination it seems that computers themselves do not cause centralization or decentralization. Rather, they are tools that can be used to move in either direction. Centralization may be the most common result, but not necessarily. In fact, in telephone interviews with police chiefs, several indicated that, with the computer, decision making was becoming more decentralized. Because more information is available to field staff and district commanders, they should be able to make wiser decisions.

Students of technology and society have largely abandoned the view that computers and other technologies will impinge directly on institutions and organizations, causing dramatic collisions and changes of direction. Computer technology does not create social forces or trends; rather, the application and the use of new technologies are strongly influenced by political forces and social values. This is especially true in the law enforcement area. During the last decade, for example, a number of scholars have debated the nature and causes of the crime problem, only to realize how difficult it is to trace the relationships between alternative "solutions" and the crime rate. Nevertheless, technology may well support or enhance established trends or directions of change. They may make powerful people more powerful, and established practices more set.

There is a range of views about the use of computers and technology in our society. At one extreme are those who see the increasing movement towards a technological society as dangerous, a movement that will take us away from the "good life." Scientific rationality and technological progress may have questionable results and set up a chain reaction that we may not be able to reverse.[16] At the other extreme are the technologists, the champions of the rational, scientific approach, and the vendors who sell their products

16. For an interesting presentation of this argument see Abbe Mowshowitz The Conquest of Will: Information Processing in Human Affairs, (Reading, Massachusetts: Addison-Wesley, 1976).

They argue that the benefits of technology outweigh its costs and tend to oversell their products and to promise more than they can deliver. This report concludes that the truth lies somewhere between. On the one hand, computer technology has become a part of law enforcement activity. Rather than trying to unrealistically halt this reality, the most useful orientation is to evaluate current needs and progress and to promote change where it is appropriate. On the other hand, we must admit that many of our efforts at technological innovation have failed. Promises have been overextended, expectations have not been met, and resources have been wasted. The answer to our problems does not lie in hardware; it lies in basic value judgments and in people. In talking about a computer application in his police department, one police sergeant astutely remarked:

> "The computer terminal in the car is an effort by the police department to professionalize from a hardware approach. This is O.K., but the more we concentrate on hardware, the farther we move from the basic people issues. The real police problems don't have technical solutions. Instead, it's the people who are screwed up, and we need more people-to-people-type efforts in police departments, such as improvements in communication, increased motivation, productivity modifications, better interpersonal relations, etc. In short, instead of hardward solutions, we need policy resolutions of the basic issues of the police force. The result of the computer may be to take our minds off what are the more important issues."[17]

In summary, most arguments against the computer are made on the grounds that too much money is currently being spent on law enforcement technology, particularly when it is not clear that the benefits of such technology justify the costs. This study has found such arguments to be valid in a number of cases, but in others, it appears that as long as benefits are defined in narrow, process-oriented terms, they sometimes do justify

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17. Interview between Kent W. Colton and a police sergeant in Oakland, California, 1974.

the costs, particularly with routine applications. (Naturally, success regarding use varies from department to department.) Further, this efficiency may continue to develop with time as computer technology becomes more sophisticated, and particularly as police departments get better at handling the organizational and behavioral problems which often accompany the introduction of technology and the implementation of change. Certainly at this stage oversell and unmet expectations exist in many departments. Still, computer technology is in its comparative infancy, and time may bring some alterations in the operations of law enforcement work as a consequence of the computer.

However, there are other issues surrounding the use of the computer that are even more important than those of costs and benefits. The use of computer technology by the police must be placed in perspective. The most pressing law enforcement questions at this time are to define the basic task of the police, to identify how the patrolman's time is really being spent, to determine the correct allocation of resources and to determine if current recruiting and training practices complement the basic needs and priorities of the police. The computer (along with proper analysis) may help in a small way to resolve these issues, but until this is done, the implementation of the computer may also serve to reinforce the status quo, to lock in and substantiate our present approach, and to indirectly countermand major innovation, if required. This can cause anxiety about the negative effects of computer technology on the grounds of the changes that it won't bring instead of those that it will. The computer would be a fantastic tool if it could help solve socio-economic problems of our society such as racism, inequality and poverty; or even at a less comprehensive level if it could answer some of the basic issues which the law enforcement community faces today such as defining the basic task of the police, structuring police departments and selecting candidates for police service. The computer has a role to play in police departments, but it is only a machine and as such, its use should always be considered in the overall law enforcement context.

The greatest strengths of computer techology seem closely related to its greatest weaknesses. Computers have the potential to aid in criminal justice activities through rapid communication, better information and perhaps a more rational approach to decision-making. We must realize that there are limits to the benefits of this technology, though, and not over-estimate its potential. However, these very benefits, if not properly con-trolled or planned, may result in misuse, unintended consequences, wasted resources, and frustrations. Expanded computer use by the police is at a crucial point and now is the time to point to a new direction, one slanting toward attention to evaluation and implementation, stressing performance standards and transfer, and realizing that police play a broader role in society than simply fighting crime. Such a new direction requires careful consideration so that the strengths of technology can be judiciously marshalled and the weaknesses and potential risks prudently forestalled.

APPENDIX A

RESEARCH METHODS

Three research tools have been utilized to document the growth, extent and influence of computer technology by police departments: 1) two questionnaires sent to police departments throughout the country, 2) site visits to fourteen selected police departments, and 3) selected case studies.

The first two of these methods will be described in this Appendix. The case studies are discussed in the Preface, as well as in Parts Two and Three.

A. The National Surveys of Police Departments

In the summer of 1971, a questionnaire designed by Kent Colton was sent to a total of 498 police departments throughout the country under the sponsorship of the International City Management Association (ICMA). (The questionnaire is presented as Figure 2-1.) This sample included all police departments in cities with populations over 50,000 and 25 percent of police departments in cities with populations between 25,000 and 50,000. Three hundred seventy-six, or 75.5 percent, responded. (Tables 2-1 and 2-2 in Chapter II provide a detailed description of survey responses.)

The survey consisted of two parts. The first part (identified as Part A) was brief and primarily for evaluative purposes. It consisted of twelve questions, eight to be filled out if the department was using a computer and four if it was not. Part A was to be filled out by the chief of police. The second part (identified as Part B) was to be filled out by all police departments that were either using a computer or punch card equipment. This portion of the survey was longer and more technical, and the directions indicated that it should be filled out by the data processing manager or by a comparably qualified individual. Only Part A was sent to the 25 percent sample of cities with populations between 25,000 and 50,000. Both parts were mailed to all other cities. A second mailing was sent to cities that did not respond initially. Survey results from both mailings are included in the analysis.

In 1974 a second questionnaire was designed by Kent Colton and Scott Hebert. It was also administered by the ICMA and was sent to 410 police departments in cities with populations of 50,000 and over. No surveys were sent to cities with populations between 25,000 and 50,000. The second questionnaire (presented as Figure 2-2), was specifically designed for comparison with the 1971 questionnaire, as well as to collect information on issues which grew out of the analysis of the earlier survey. As with the first survey, a second mailing was sent to cities that did not respond initially. Of the 410 police departments surveyed, 326 (80 percent) responded. (Table 2-3 in Chapter II outlines the response to the second survey.)

As a follow-up to the 1974 mailed surveys, telephone interviews were conducted by Scott Hebert, Mark McKnew and Kent Colton of a sample of those cities who responded to the mailed survey. The telephone interviews, conducted with the police chief or on occasion a member of the chief's staff, were carried out in order to probe the results of the mailed survey more deeply. The telephone surveys were held with a sampling of 28 of the responding cities. The criteria for selection were based on a departmental jurisdiction of 100,000 or more and current use of EDP equipment for police functions. Eighty-two jurisdictions met these two specifications. They were stratified according to geographic location; and 28, or approximately one-third, were selected randomly for the telephone interviews. Because of the small sample size, no definite conclusions were drawn from the telephone interviews but they were helpful as a tool in analyzing the mailed survey results.

B. Site Visits to Selected Police Departments

Site visits were conducted in fourteen selected police departments in 1970 and 1971 in order to supplement information gathered from the 1971 survey. The site visits were conducted by Kent Colton and several students at the Massachusetts Institute of Technology. The related costs were supported in part by the MIT Undergraduate Research Commission, in part by the International City Management Association, and in part by the Joint Center for Urban Studies of MIT and Harvard. The students who participated in the study were Jim Ebright, Dan Greenbaum, Richard Praether, Roger Weldon, and Roger Jeanly.

Interviews were held with 143 law enforcement officials, 127 sworn police officers, and 16 civilian police employees. No formal questionnaire was administered, but a fairly common set of questions was posed to each person regarding how his department used the computer; whether he felt various applications had been successful; how automation had been introduced and implemented; and what he saw as the major effects on the personnel, the structure of organization, decision-making, and the police task.

The fourteen police departments were selected to obtain variety in terms of city size and geographic location. They include Boston, Massachusetts; St. Louis, Missouri; Wichita Falls, Texas; Tulsa, Oklahoma; Springfield, Massachusetts; Hartford, Connecticut; Atlanta, Georgia; Dayton, Ohio; Kansas City, Missouri; four cities in California: Los Angeles, Long Beach, San Francisco and Oakland; and Denver, Colorado.

Based on the distribution of geographic regions utilized by the International City Management Association, three of the police departments were in the northeast, three in the north central region, three in the south, and five in the west. One police department was in a city with a population

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1. The breakdown of cities by region is as follows: northeast: Boston, Springfield, Hartford; north central: Kansas City, St. Louis, Dayton; south: Atlanta, Wichita Falls, Tulsa; west: Los Angeles, San Francisco, Denver, Long Beach.

over one million, six were in cities in the 500,000-1,000,000 population category, four were in cities with populations of 250,000-500,000, and three were in cities from 100,000-250,000.[2]

Three to four days were spent in each of nine police departments (Boston, St. Louis, Wichita Falls, Tulsa, Dayton, Kansas City, Los Angeles, Long Beach, and Denver). In each of these cities interviews were held with a broad sample of people from the chief of police to patrolmen in the field. Interviewees were not selected according to any precise random sampling process, but opinions of a broad range of people were solicited. In the other five departments where briefer contacts were made (Springfield, Hartford, Atlanta, San Francisco, Oakland), interviews focused on questions related specifically to these departments.

These preliminary site visits were especially instrumental in selecting cities for more detailed case study analysis. On the basis of these visits, three cities were initially selected for four case studies: Boston, St. Louis and Los Angeles for case work related to resource allocation; and Boston for casework related to command and control. When the scope of the project was expanded with additional funding from the LEAA, three additional case studies were added. Specifically, it was decided to do further case study research related to command and control in San Diego, St. Louis, and New York City.

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2. The breakdown on cities by population size is as follows: Over 1,000,000: Los Angeles. 500,000-1,000,000: Atlanta, Boston, Denver, Kansas City, St. Louis, San Francisco. 250,000-500,000: Dayton, Long Beach, Oakland, Tulsa. 100,000-250,000: Hartford, Springfield, Wichita Falls.

APPENDIX B

RECOMMENDATIONS TO THE LAW ENFORCEMENT ASSISTANCE ADMINISTRATION

By now it should be apparent that there is no one common solution concerning the application of computer technology by the police. Two extremes have been identified. At one extreme are the technologists, those who argue for the increasing use of the computer. Their vested interest is greatest in the sale and success of increasing computer use. At the other extreme are those who argue that neither the technology nor the expense has yielded much benefit to law enforcement. They feel the use of technology by the police should be discontinued.

Our conclusion is that the truth is somewhere between. On the one hand, there are no quick or easy solutions. Computer technology will have little impact on crime. It is a major mistake to oversell the potential. On the other hand, a number of technical and service benefits have been achieved through the effective use of computer technology. The key is to develop a series of policies that will pursue a modified course through the middle ground with emphasis on implementation and evaluation. With this in mind, five overlapping recommendations can be made to the Law Enforcement Assistance Administration.

First, standards of performance for technological innovations should be established. One reason for many of the past technological failures was police departments' uncertainty about what to expect and require from vendors who oversold their product. We now have enough experience with a number of applications of computer technology to establish performance standards that could be used by police departments throughout the country. CAD is an appropriate illustration. Based on the San Diego, New York City, and other experiences, a standard set of specifications for CAD which would probably vary, according to city size and communication workload, could be developed as a guideline for interested departments (and vendors). By beginning to set "truth in technology" standards the LEAA could make an important contribution to computer technology.

Further evaluation is a pre-requisite to establishing such standards. This report only scratches the surface. Many of the early technology efforts that were implemented and funded by the LEAA failed to include evaluation steps and little good data are available to ascertain their success or failure. In recent years LEAA has placed greater emphasis on evaluation, and the National Institute for Law Enforcement and Criminal Justice has spent millions of dollars for evaluation. Still, evaluation efforts should be linked more closely with decisions for future funding. When projects are implemented, an evaluation program should be part of the design so that comparative data can be collected on the technical, operational, and attitudinal impacts.

When failure occurs it must be recognized. For example, within the next several years important conclusions may be reached concerning the impact of various technological innovations on response time and the utility of response-time improvements. If the Phase II AVM experiment in St. Louis indicates that the goals and objectives have not been met, it will be important to widely publicize these results. Finally, as evaluation proceeds, we should not expect significant impacts on crime. Rather, we must carefully define our objectives and look to other measures of police performance related not only to crime fighting but to service and order maintenance activities. Continued attention by the LEAA to devise measures of success and failure is essential in any evaluation effort.

Second, federal resources tend to be devoted to funding "new" and "innovative" ideas; although innovation is important and experimentation essential, the results of this study indicate that greater attention should be devoted to following through on ideas that have proved successful. To the extent that federal resources are only appropriated for new ideas, innovations can only occur in selected departments. It may be more appropriate for the police and the LEAA to identify areas where computer technology has achieved success so far and to assist other departments to experience similar benefits.

Third, based on evaluation and performance standards, clearer priorities should be outlined dealing with computer technology. In talking to police departments around the country, a number of people characterized the LEAA system of funding as haphazard and undirected. The block grant system, which tries to avoid excessive federal direction, naturally contributes to this perception. Although I am skeptical about the possibility of developing a grand master plan for the application of technology, greater efforts could be made by the LEAA to assemble and channel the information that has been gained to date when setting funding priorities. Future funding should be based on a better understanding of what has worked and what has failed in the past

Fourth, police departments need greater flexibility in working with vendors. Funding is often the key. In providing money, the LEAA must set up constraints and time dimensions. However, one of the reasons for the success of the CAD system in San Diego was their ability to withhold funds until the promised product was delivered. In several cases included in this report involving LEAA funds, payments had to be made to vendors by a particular time. The process of extending the grant was complex, and the flexibility in working with vendors was therefore limited.

Fifth and finally, greater attention should be paid to the implementation and transfer of computer technology. It has become fashionable in recent years to talk about technology transfer. Let us be the first to admit that there is no master scheme for the effective implementation of technology or for the magic transfer of an innovative system from one department to another. However, the LEAA can help to promote sensitivity to the behavioral and institutional dimensions of innovation. Although we may not know exactly what to do in every case, we do have a good idea as to what not to do. For example, failure to devote ample attention to the education and training of dispatchers when implementing a CAD or AVM system is a guarantor of trouble.

Recent LEAA legislation has emphasized technical assistance. The problem now, though, is that there is often little tie between technical assistance and an ongoing long-term committment to implementation. In fact, those providing technical assistance are usually available on a short-term basis only, are unfamiliar with the background and environment in the police department, and may even have special interests or informal contacts among vendors. Further, systems specialists have been assigned to all ten LEAA regions. However, they have little link with technical assistance, are overburdened with responsibilities within the bureaucracy, and often have expertise in only limited technical (let alone behavioral and organizational) areas.

An alternative system for technical assistance is worth considering, although this report will not attempt to outline such a program in detail.

First, if priority areas for implementation and transfer of routine and nonroutine computer applications are selected based on evaluation, "pools of resources" in each of these priority areas can be identified. Such "pools" would rely on people from government, from law enforcement and from the academic community. They could provide a resource of talent to aid in the transfer process. Second, performance standards could be developed in each of these areas and educational material could be made available outlining both the advantages and disadvantages of new technology. Third, if a police department is interested in innovation (and it is essential that the identification of need be from within) then people from these "pools of resources" could be made available to such departments to assist in the transfer process. The Office of Technology Transfer in the National Institute of Law Enforcement and Criminal Justice already provides funding for police departments to travel to other cities to investigate innovation. The communication must be two-way, though. Not only should interested parties visit other areas, those who have achieved success might be given the opportunity to travel to an area interested in implementing change and to provide them with ongoing advice on what steps to follow. When Salt Lake City began to consider CAD, they sought help from the police captain in San Diego who had been instrumental in the implementation effort in that city. Such assistance now only occurs on a limited basis, though.

Naturally, those who have achieved success will have only limited time to offer, and instant transfer will not occur. However, a small portion of the millions spent on providing police departments with computer technology could appropriately be set aside to provide impartial advice concerning its implementation, and to relate transfer and technical assistance to a more realistic perspective of how local change really occurs in the law enforcement community.

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