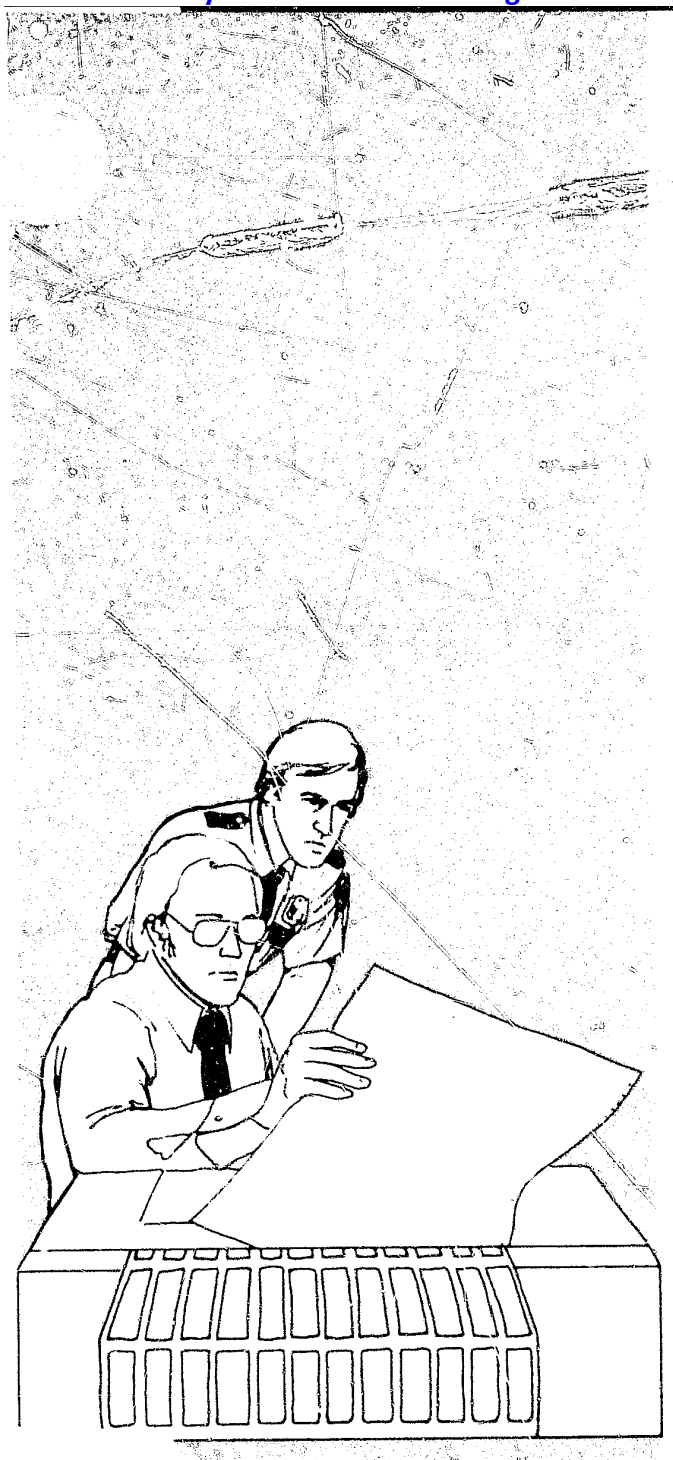

Police and Computer Technology

A Decade of Experience Since the Crime Commission

Summary

U S Department of Justice
Law Enforcement Assistance Administration
National Institute of Law Enforcement and Criminal Justice

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Kent W. Colton

September 1979

U. S. Department of Justice
Law Enforcement Assistance Administration
National Institute of Law Enforcement and Criminal Justice

Law Enforcement Assistance Administration
Henry S. Dogin, Administrator
Homer F. Broome, Jr., Deputy Administrator for Administration

National Institute of Law Enforcement
and Criminal Justice
Harry M. Bratt, Acting Director

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Abstract

In 1967 the President's Commission on Law Enforcement and the Administration of Justice (the Crime Commission) called for the creative use of science and technology in law enforcement. Since then there has been a significant growth in the use of computer technology by U.S. police departments. Survey work conducted as a part of this study shows use to be rising especially for "routine" computer applications where the technology performs 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 extended beyond "routine" uses to "nonroutine" efforts, such as with resource allocation models or police command and control operations where the machine begins to become a tool for decision-making, strategic planning and person/machine interaction, the results to date have been somewhat disappointing. The process of implementation is far more complex and unintended consequences arise.

This paper reports on the decade of experience since the Crime Commission. Drawing upon two national surveys of U.S. police departments and a series of case studies on resource allocation models and police command and control applications, the research provides useful insights concerning the evolution, implementation and impact

of computer technology. Such technology is evolving rapidly and this report will not attempt to describe all of the most recent scientific developments; for example, it does not deal directly with the use of mini-computers by the police. However, this constant change serves to remind us that successful use and implementation must rely on more than technological innovations. A new direction is called for in the use of computer technology -- one which includes greater attention to evaluation and implementation, stresses performance guidelines and transfer, and realizes that the police play a broader role in society than fighting crime.

For those interested in greater detail concerning the surveys or case studies, they should contact the Office of Evaluation, National Institute of Law Enforcement and Criminal Justice, Law Enforcement Assistance Administration, U.S. Department of Justice, Washington, D.C. 20531.

Acknowledgements

A number of people have participated in this project and deserve special acknowledgement. Scott Hebert has been extensively involved in the research and worked individually and jointly on the case studies. Richard Larson was the project director of the NSF sponsored Innovation Resources Planning Project at M.I.T., and his assistance has been invaluable in helping to conceptualize and critique 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, and Kate Hendricks contributed a number of inputs at the early stages of the project. Cora Edensword and Steven Stepak have made substantial contributions to the typing and production of the report. Finally, let me thank the many unnamed individuals in police departments throughout the country and at M.I.T. 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.

Although the contributions of others should be clear, the responsibility for the final product rests with the author.

Part I

The Expectations and the Results

A. Introduction

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 vareity 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, have they had 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 general labor-intensive

field of law enforcement. Because criminal justice agencies must process enormous quantities of data, the use of computer technology--electronic computers and new techniques such as systems analysis, operations research, and computer modeling--seemed particularly promising, and the use of computer technology by the police has expanded significantly since the mid-1960s.

A variety of factors have fueled this growth. The first was the report of the Crime Commission. The recommendations of such a distinctive group drew instant attention and outlined high expectations: "Modern technology can provide many new devices to improve the operations of criminal justice agencies, and particularly to help the police to deter crime and apprehend criminal."[1] The Commission's recommendations were fortified by the addition of large scale federal resources to the police area through the Law Enforcement Assistance Administration (LEAA). The pressure from vendors to sell their product--heightened as the Vietnamese War was ended and technology oriented industries sought to increase their domestic market--also contributed to the expansion of the computer-related innovations. 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, and this figure did not include matching money from the states.[2]

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[1]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. 246.

[2]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

The Crime Commission report was filled with enthusiasm and raised high expectations about the possibilities of such expenditures to reduce response time, expand police capabilities and improve law enforcement services. A number of computer applications have been established by the police since the Commission's recommendations, but many of the results have been disappointing. For example, surveys conducted as a part of this study in 1971 and 1974 revealed that implementation has been slower than expected. Further, there is disagreement as to the utility of such computer use. On the one hand, the 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. Some argue that portions of this money have been wasted and that the proliferation of such systems represents a potential infringement on civil liberties. On the other hand, advocates point to the availability of better information and to past and potential improvements in police service.

However, although there has been a lot of dialogue regarding the purchase and application of such innovation in law enforcement, there has been little research or evaluation since the Crime Commission concerning the actual uses, difficulties, and diffusion of computer technology by the police. Despite prestigious recommendations, the process of introducing change requires more than

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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.

directives from the top. Important behavioral and power relationships have been involved in the actual implementation of the technology. A decade has passed since the Crime Commission selected computer technology as an area of potential significance, and the time is appropriate to evaluate what we have learned from the related events of the past ten years. The purpose of this report, then, is to address the consequences and the diffusion of innovation. Naturally, we cannot expect to describe all aspects of police computer technology in the few pages that follow -- for example, the paper will not deal with some of the more recent technological developments related to the police use of mini-computers. However, the sections which follow will outline some of the primary dimensions of the state of the art of computer use by police departments in the United States and examine the implementation and impact of such technology. What has transpired since the Crime Commission, and what difference has computer technology made?

The Summary Report includes four parts. Part I outlines the overall expectations and results of the past decade. It includes a description of the research design for the study, an analysis of the evolution of police computer use, a report on the results of "routine" and "non-routine" applications of police computer technology, and a discussion of some of the reasons for the disappointments and problems that have arisen. Part II "steps back" from the details of what has transpired to review the overall diffusion of police computer technology, and Part III outlines some broader conclusions by the author concerning police, technology and society. Finally, the Appendix provides a summary list of the recommendations found throughout the

report.[3]

B. Research Design

The research for this report has been conducted over a period of six years. The first step began in 1971, under the aegis of the International City Management Association (ICMA), with a survey of police departments in the United States and visits to 14 police departmets around the country.[4] The survey revealed that 39 percent of the 498 police departments responding to the survey were using computers. For cities with populations 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 in answering basic questions concernig the use, implementation, and impact of police computers. As a consequence, in 1974, further research was conducted as a part of the Innovative Resource Planning (IRP) project at M.I.T. sponsored by the National Science Foundation.[5] Two primary tasks were involved:

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[3]This summary report provides a synopsis of a larger document submitted to the Office of Evaluation of the National Institute of Law Enforcement and Criminal Justice, Law Enforcement Assistance Administration. For a related version of this more comprehensive set of material, see Kent W. Colton, editor, Police Computer Technology: Implementation and Impact, Lexington Books, 1978, Lexington, Massachusetts.

[4]When the study first began in 1970 and 1971, the initial focus was 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.

[5]The second phase of the research was carried out jointly by the author, Kent Colton, and Scott Hebert.

(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, including the work in this summary Report. This effort was aimed at polishing the first case studies, developing additional research cases, conducting further data analysis and a literature search, and tying together all aspects of the work.

Even with support from the various sources noted above, 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.

Three police departments were selected for case study work related to resource allocation: St. Louis, Boston and Los Angeles. Four cities were chosen for work related to command and control: Boston, San Diego and New York City as cases of computer aided dispatch (CAD) systems and St. Louis as a case of an automatic vehicle moni-

toring (AVM) system.[6]

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.

Throughout both the survey and case study research, a wide range of issues were addressed. Four question areas, though, have been especially important in evaluating computer technology in general and specific applications in particular. In many respects these four issue areas provide a general framework of evaluation for the report:

1. Does the application of computer technology work?

   Innovations often look good on paper, but the first question is does the technological change stay in operation for a period of years, and does it meet the objectives that were specified at the time of implementation? Such questions may seem simple, but many innovations have failed to overcome this first "operational" hurdle.

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[6]The study of the St. Louis AVM system was funded by a separate grant from the National Institute of Law Enforcement and Criminal Justice; LEAA Grant No. 75-NI-99-0014 to Public Systems Evaluation, Inc. It was included as a part of this research report because of its close tie to police computer technology.

2. What have been the "technical impacts" from the use of computer technology? 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, greater speed of processing, availability of new or more complete data, accuracy or consistency of outputs, lower costs of processing data, and/or wider distribution of information.

3. What have been the "service impacts" if any? Service impacts are broader and more elusive than technical impacts. Whereas technical impacts do not address how information is actually used or whether innovations achieve changes in police performance, service impacts are concerned with the degree to which the public is served and whether or not computer technology contributes to the quantity and quality of this service and to the overall tasks of the police.

4. Have there been "power shifts" through the use of computer technology? Power shifts are gains or losses in one person's decision-making effectiveness which are often made at the expense of another person. Changes in organizations, techniques, or decision-making processes often result in some shift, or redistribution,

> of the relative power of the actors involved. For example, does technology provide greater centralization or decentralization of the police; does it shift power to higher level officers, or does it alter police personnel or structure? Does it bring the loss of individual control over information, and does it impinge upon a person's privacy?

To one degree or another, many of these questions are still unanswerable. In some cases, conclusive data are not yet available, and in others a final judgment depends on value perspectives. Service and power impacts, for example, often depend on one's particular goals and 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 more limited educational opportunities. A universal evaluation of the impact of computers may have to wait until more common measures of quality have been accepted or more sophisticated techniques of social analysis are available.

More important, although many aspects of computer technology in law enforcement are well established and expanding, it would be a mistake to think such innovations will play a dominant role (at least in the short run) in revolutionizing the police or many of the issues they face. Police work, to a large extent, is determined by the conditions of our society and its people. Crime and law

enforcement have a momentum of their own.[7] Computer technology may have a role in influencing and shifting relationships, but the major law enforcement issues must be resolved in the context of society as a whole.

Nevertheless, even though definitive answers are elusive, the questions asked above need to be faced. The deepening national concern with crime and the expenditure of millions of dollars on computer technology demands a growing understanding of the use, implementation, and potential impact of computer technology on police activities.

C. The Use and Evaluation of Computer Technology by the Police

The first real-time police computer system in the U.S. 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, as noted earlier, 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 populations 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.[8]

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[7]For a discussion of this position see James Q. Wilson, Thinking About Crime, (New York: Basic Books, 1975).

[8]The 1971 and 1974 ICMA surveys were designed by the author and administered by the International City Management Association (ICMA). Scott Hebert was also deeply involved in administering and analyzing the 1974 survey. For a more detailed description of the

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 Uses. 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 investigation and command and control. (See Figure 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. 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

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results of the survey see Kent W. Colton, "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) and "Use of Computers by Police: Patterns of Success and Failure," Urban Data Service Report, Vol. 4 (Washington, D.C.:ICMA, April, 1972).

Figure 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 and offender based files 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 and vehicle monitoring Geographic location file

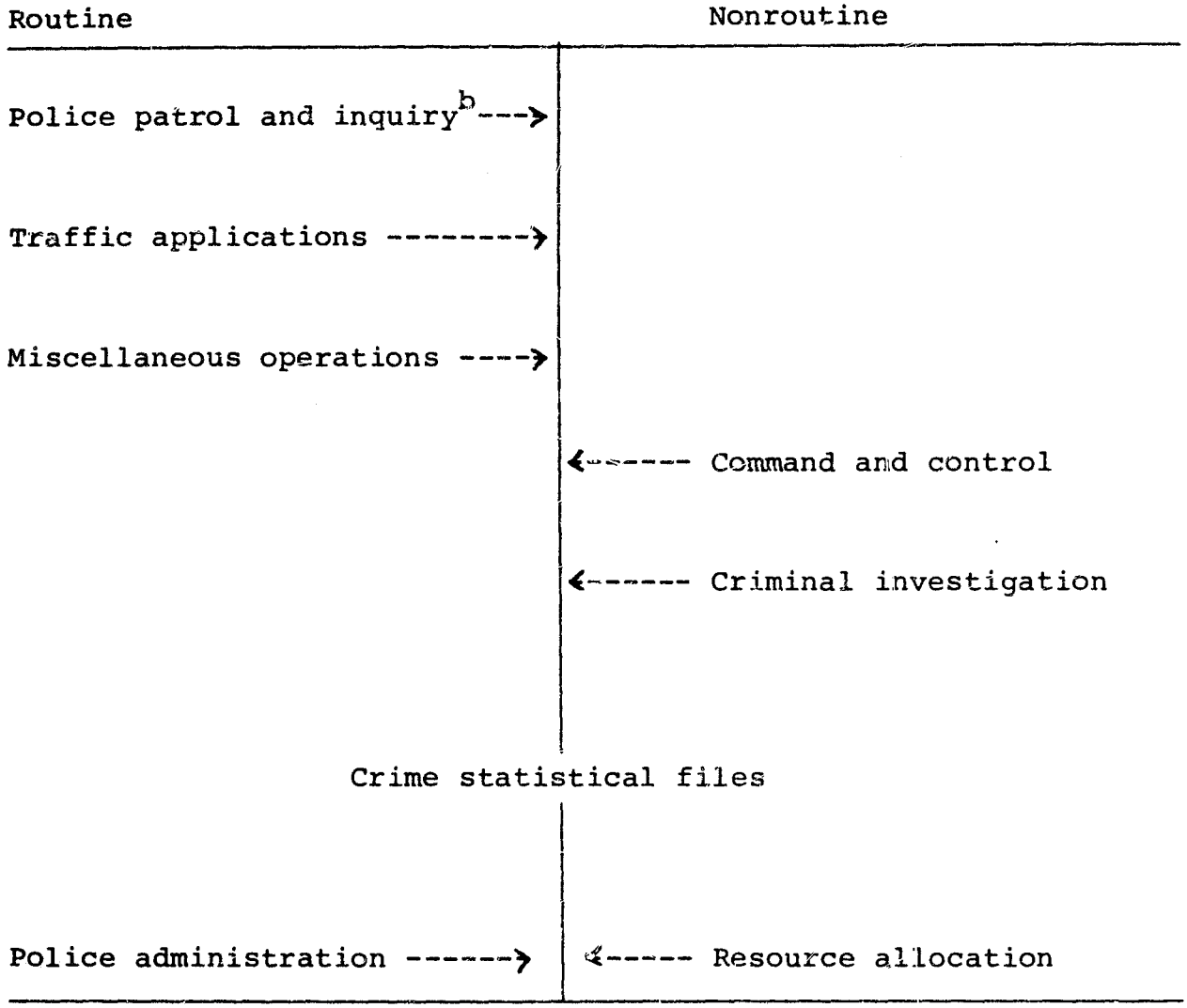
are relatively straightforward and the tasks can be labelled routine. Other routine application areas comprise traffic files, crime statistical files, police administration, and miscellaneous operations, as Figure 2 illustrates.

Nonroutine applications are more elusive to define. In this area, the machine becomes a tool for decision-making, strategic planning, and person-technology interaction. There are no absolute methods for handling problems, either because the area is complex or because they require custom-tailored treatment. The human decision-maker 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 2.)

Rather than viewing routine and nonroutine categories as sharply distinct classifications, though, they should be regarded as converging from opposite ends of a continuum. As applications move toward the nonroutine end of the continuum, systems design becomes more intricate, and behavioral, personality, and organizational considerations become more significant. 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 resource allocation. Command and control applications, especially computer aided dispatch systems, also have both routine and nonroutine dimensions.

Figure 2

Routine and Nonroutine Uses of Police Computer Technology[a]



[a]The terms "structured" and "unstructured" have also been used to draw a similar distinction. See, for example, G. Anthony Gorry and Michael S.S. Morton, "Management Decision Systems: A Framework for Management Information Systems," Working Paper No. 458-70, Alfred P. Sloan School of Management, M.I.T., April 1970. Also, Herbert A. Simon originally used the terms "programmed" and "unprogrammed" to make a related characterization. See Herbert A. Simon, The Science of Management Decisions, (New York: Harper & Row, 1970), p. 6.

[b]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 continuum.

2. The Evolution of Computer Technology. As documented from the 1971 and 1974 surveys, 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

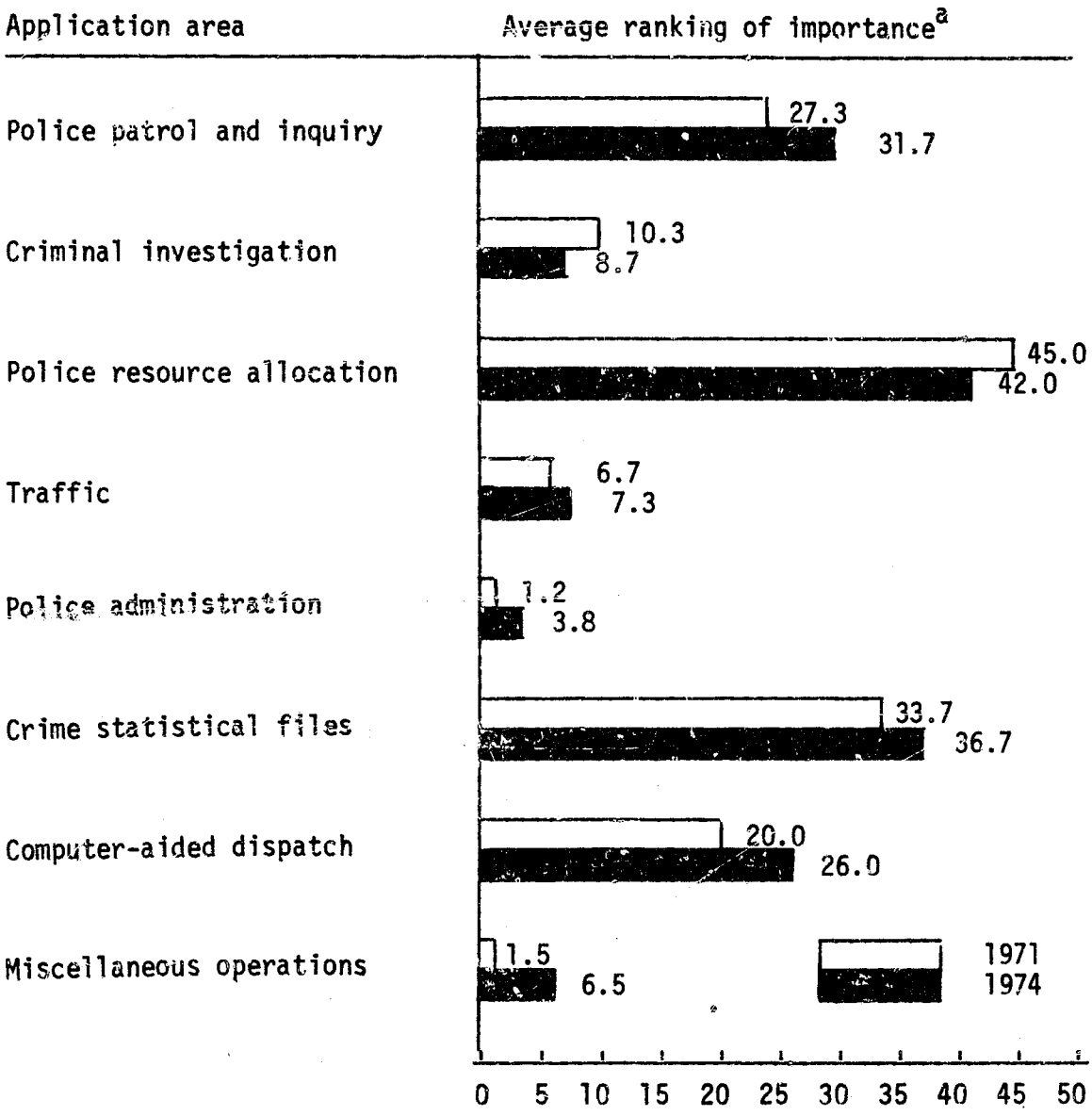
nonroutine, in which the predicted use level was actually met and surpassed. The 1971 survey results predicted that by 1974, 12 percent of all computer applications would be in the resource allocation area; the actual percentage was 16. An additional survey question in both 1971 and 1974 asked police 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 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 costs involved in implementing such nonroutine applications.

Based on estimates for 1974-1977, similar patterns seem likely in the future. As successful implementation has often been limited to routine areas in the past, traffic, police administration, crime statistical files and police patrol and inquiry systems will all remain important in the years ahead. In the nonroutine area, though, past results have been far more disappointing. Although nonroutine applications will receive increasing attention in the future, the results will probably continue to be mixed. Still, despite the fact

Figure 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.

Source: 1971 and 1974 Surveys

that the actual level of implementation has been below earlier expectations in a number of areas, use of the computer by the police is widespread and undoubtedly a permanent part of law enforcement technology. The issue now is not will computers be used, but how and with what impact?

D. The Results: Routine Applications

Based on the analysis of survey results and visits to police departments, it is possible to summarize the use of routine computer applications by the police in each of the four areas of evaluation outlined in section I.B.[9] Although the data are limited and 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. 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. Even with routine uses of computer technology, though, 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,

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[9] In the overall study one chapter is devoted to the analysis of survey results and another chapter details the results to date of routine police computer applications. See Chapters 2 and 3 respectively, Kent W. Colton, Police Computer Technology: Implementation and Impact, Lexington Books, 1978.

but there's still an awful lot of garbage coming out of police computer systems." Although 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. However, technical benefits do not specifically deal with how this information is actually used, nor do they measure changes in performance. As far as this report is concerned the more important questions relate to the third level of evaluation--service impacts.

At the service impact level, 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 have often been documented.[10] In Tulsa, Oklahoma, an additional $180,000 in

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[10] 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 or outcomes 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

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 outcomes of such routine applications, several unexpected impacts and influences become evident. For example, a former 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 man-

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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 or outcome? Because they move from simply quantity of service to quality, results measures are often difficult to establish and more costly to collect.

power 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 condition, 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 a 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 often been devoted to the crime control and law enforcement functions of the police. By improving efficiency in these areas, such aspects of police work are reinforced. Although only a portion of the police officer's time is actually spent performing "law enforcement" type tasks,

many officers still view themselves as crime fighters and their orientation is biased in that direction.[11] In most departments little time is spent training the police to settle a family disturbance; instead the focus is on enforcing the law. By overemphasing the application of technology in crime control areas, law enforcement agencies often neglect possible applications to social service functions--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.

In the fourth area of evaluation we have discussed--power impacts--the results of computer technology are the most ambiguous, but some interesting hypotheses have emerged. Since individuals could potentially lose control of personal information, continued safeguards to assure privacy and security are necessary. Further, some evidence has been documented indicating that computer technology may shift power within police departments, allowing those who are more quantitatively and technologically oriented to gain influence, and leading to a greater centralization of police power and structure. Regarding the centralization concerns, though, it seems that computers themselves do not cause centralization or de-

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[11]Only a small portion of police time is devoted to law enforcement activities such as burglary in progress, check on car, make an arrest, etc. Rather the large majority of police time is devoted to service (personal requests, animals, ambulance calls, utility problems, accidents, lost or found property, etc.) or order maintenance activities (family trouble, gang disturbance, neighborhood troubles, fights, etc.). See for example, James Q. Wilson, Varieties of Police Behavior, (New York: Atheneum 1970), p. 18, and John A. Webster, "Police Task and Study Time," Journal of Criminal Law and Police Science, March 1970, pp. 94-102.

centralization. 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 as a follow-up to the 1974 mailed survey, several indicated that decision making was becoming more decentralized with the computer. Because more information was available to field staff and district commanders, such managers were able to make wiser decisions at a more decentralized level.

E. The Results: Non-Routine 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 the 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 en-

vironment. The resource allocation applications noted in the surveys generally refer to using tabulations of crime statistics to determine deployment, not to more sophisticated models. Even where modeling work has been tried, many of the efforts 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 technique 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.[12] 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.

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[12]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.

The case studies in this report demonstrated the difficulty of actually implementing more advanced resource allocation techniques in police patrol operations. In St. Louis the use of a 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 several years ago, and questions have even been raised within the police department concerning the manual resource allocation procedures that were implemented.

Of the three cases reviewed in this study, the Los Angeles Police Department (LAPD) has the only resource allocation system utilizing computer technology which is actually operating 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 original LEMRAS/ADAM deployment model was dropped in 1974 to be replaced by the ADAM historical reporting system which was implemented in June, 1975.[13]

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[13]LEMRAS stands for Law Enforcement Manpower Resource Allocation System. ADAM stands for Automated Deployment of Available Manpower. For a complete analysis of each of the three cases noted above see Colton, Police Computer Technology: Implementation and Impact, Op. cit., Chapters 4 (St. Louis), 5 (Boston), and 6 (Los Angeles).

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, conflicts arose between the deployment model and team policing--a new overall strategy for police work implemented in the LAPD (this will be discussed later). Also, questions arose in terms of responding without delay to calls-for-service. Finally, one of the original service objectives of the initial allocation system, improved crime prevention, has been virtually abandoned as one of the factors considered in the current ADAM historical reporting system.

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, a number of projects are currently underway to implement two more recent modeling efforts: the Patrol Car Allocation Model (PCAM) and the Hypercube Model.[14] These models allow the user to identify a wide range of

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[14]For a discussion of the hypercube model see Richard C. Larson, ed., Police Patrol Deployment: New Tools for Planners, (Massachusetts: Lexington Books, 1978). For a review of the PCAM model see Jan M. Chaiken and Peter Dormont, Patrol Car Allocation Model: Executive Summary (New York City: The New York Rand Institute, September 1975), R-1786/1-HUD/DOJ. For a review of implementation efforts for these

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 paper 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."[15]

What can be said, then, about the various efforts to utilize

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two models see Jan M. Chaiken, "Implementation of Emergency Service Deployment Models in Operating Agencies," RAND Paper Series, Paper Number P-5870, (Santa Monica, CA: Rand Corp., May 1977), pp. 13-17.

[15]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, CA: Rand Corp., October 1975), p. xii. For further discussions of problems in implementing models and technology in public organizations see 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).

computer technology in police resource allocations? Five conclusions have been drawn.

1. 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 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 this author's opinion that this type of "fluid patrol" is very unlikely to occur on a widespread, ongoing basis. Rather than looking for the long-term implementation of computer aided resource allocation to redesign police deployment on a daily basis, we should expect the use of the modeling techniques on a more limited, almost one-time basis, where police departments use computer technology to redesign their patrol structure at a point in time and then wait for several years or at least three to six months, to restructure patrol beats.

2. 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. Of the three cases in this study only the Los Angeles ADAM historical

reporting system is currently in operation, and even in this case it took eight years for implementation. This 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 implementation factors.

3. Despite past disappointments, police computer modeling efforts should not be abandoned. We should continue to seek improved methods for police resource allocation, but with extensive user involvement. All police departments must deploy their resources in some manner or other. If the right criteria are built into the models, technology may assist in more effectively identifying and responding to future needs.

As noted earlier, 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. 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.[16]

Use of such 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

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[16]Jan M. Chaiken, "Implementation of Emergency Service Deployment Models in Operating Agencies," RAND Paper Series, Paper Number P-5870, (Santa Monica, CA: Rand Corp, May 1977), pp. 13-17.

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 decisions 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 has day-to-day decisions is often unable or unwilling to afford the luxury of model building and analysis.

4. As computer modeling work is continued, evaluation is essential: careful consideration should be given to a 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 evaulation is carried out. The time seems appropriate to develop a systematic program of evaluation, and the Law Enforcement Assistance Administration should design a multi-disciplinary 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, it must be independent; and pretest 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. The inability to relate innovations to changes in crime statistics has already been highlighted, 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. Learning how to more appropriately measure police performance is one of the primary research challenges for the next few years.

5. 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 illustrating 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. A 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 purposes.

Any resource allocation system is obviously based on some

basic set of criteria or decision rules used to deploy resources. To obtain the best results a police department must select rules compatible with their basic objectives. A department must be especially careful in buying from a vendor a preprogrammed system relying 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, other aspects of police work such as community service and police presence may have a higher priority. Emergency responses to calls-for-service comprise only a small portion of 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.

2. Command and Control. The potential for automating aspects of police command 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.[17] 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 report will discuss the results of three cases within the command and control area--efforts to establish CAD systems in Boston, New York City, and San Diego.[18] A fourth case on implementing a Phase I AVM system in the St. Louis Police Department has also been documented and reported elsewhere in the literature.[19]

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[17]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.

[18]For the complete description of these three case studies see Colton, Police Computer Technology: Implementation and Impact, Op. cit., Chapters 9(Boston), 10(New York City), and 11(San Diego).

[19]See Richard C. Larson, Kent W. Colton and Gilbert C. Larson,

As reported earlier, the 1971 and 1974 ICMA survey results indicated that the implementation of CAD systems has been far slower than initial anticipations. As further confirmation, a 1975 study found that, of the 135 police departments in jurisdictions with a population more than 100,000, only about 10 percent had a CAD program.[20] 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. In reviewing the four areas of evaluation outlined earlier, the successes and failures of the three case studies provide six insights for the future.

1. 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. Further, both systems seem to be well accepted by the officers in the respective police departments.

2. Both San Diego and New York City have achieved technical benefits from CAD. Such benefits include increased information availability, rapidity in matching addresses with geographic loca-

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Evaluation of a Police-Implemented AVM System: Phase I, with Recommendations for Other Cities, National Institute of Law Enforcement and Criminal Justice, Law Enforcement Assistance Administration; U.S. Department of Justice, U.S. Government Printing Office, Washington, D.C., June 1977.

[20]R.L. Sohn, et al., Application of Computer-Aided Dispatch in Law Enforcement, An Introductory Planning Guide, (Pasadena, CA: Jet Propulsion Laboratory, 1975) p. 3.

tion, the effective transfer and recording of data in the dispatch process, and the retrieval of information from the dispatch process.

3. Both cities have also experienced positive service impacts in terms of "process" oriented measures. Some of these process service benefits include: 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 both communications divisions.

However, when it comes to measuring the actual service "results" attributed to CAD, the findings are inconclusive. In the New 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. In fact, to the extent that data exists, it seems to show that the impact on response time has generally been negligible or modest at best. Further, the police departments have essentially not analyzed the influence of the CAD systems 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.

4. The power impacts and the cost-benefit ratio of CAD systems are still unclear. 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 and benefit 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, only 4/10ths of 1 percent of the annual budget was devoted to the CAD system. Stated in another way, the costs of operat-

ing SPRINT are roughly equivalent to maintaining 10 police patrol units on an annual basis.

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.

5. The three CAD cases point 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 formulating the program, prohibition of outside consultants from 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.[21] 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.

6. Finally, the time is appropriate for a more thorough evaluation and definition of performance guidelines related to 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 actively promoting their products, sometimes without standards, clear performance guidelines, 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 guidelines 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

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[21] See Raymond L. Hoobler and Kenneth N. Fortier, "A Computer Aided Dispatch System for the San Diego Police Department," Police Chief, October 1975.

nontransfer) 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 the transfer process.

F. The Crime Commission Revisited

When the Crime Commission issued their report in 1967 they were optimistic about the use of science and technology in law enforcement. They set forth a far ranging program of application and experimentation. Some of these experiments have worked, but a number of others have failed, and whether explicitly or implicitly, the Commission oversold the potential impact of such innovations on reducing crime and increasing arrests. They also seemed to assume that innovation would occur automatically from the top down, that little attention was required for the diffision process, that the only motives for implementation would be altruistic, and that vendors of technology would be neutral and pressure-free in their "unbiased advocacy." Finally, they recommended so many possible experiments that it was difficult to select and focus priorities and to follow through. What have we learned from our experience over the past decade and what recommendations can be made for the next few years?

First, it should be clear that it is extremely difficult to measure the effectiveness of technological innovations in confronting crime. In a number of cases, particularly as reported in the overall study report, allocation and command and control projects failed to demonstrate clear improvements in a department's patrol performance, particularly in the area of crime control.

Perhaps the greater failure was the original expectations which were built in the 1960s 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 or response rates 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 or technology as opposed to changes, for example, in the weather or the unemployment rate.

Second, it should be apparent that a number of the original specific objectives of the Crime Commission will not be met, and expectations for the future must be altered. The best illustration of this is related to response time. Based on the evidence to date it would be a mistake to maintain hope that response time benefits will justify command and control and resource allocation technological innovations. As noted earlier in this report, the CAD system did not achieve response time benefits. Further, in St. Louis tests of a Phase I AVM system, it was found that AVM did not bring the expected reduction in response time. In fact, although the question will be examined again closely in a Phase II experiment, current findings lack any evidence to suggest that travel time reductions due solely to AVM will significantly improve police operations or reduce costs.[22]

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[22]See Richard C. Larson, Kent W. Colton, Gilbert C. Larson, Evaluation of a Police-Implemented AVM System: Phase I, Op. cit., pp. 15-33.

The entire response time system includes a number of components, not the least of which is the time it takes the victim to call the police after a crime has occurred. In the past, excessive attention has been focused on the elements of the response system which can be influenced by technology. In fact, it seems after reviewing the evidence of this report that response time is primarily a personnel and human issue rather than a technical problem. If response time is to be improved, people who have been victimized will need to call the police more rapidly, or a department will need to reorganize both the flow of the technology and the flow of people related to their communications system. Technology alone will make little difference.

Third, the experience of police departments in using computer technology to date has forcefully demonstrated the importance for performance guidelines in the diffusion of such innovation. The relationship between the user and the vendor must be clearly defined and performance guidelines specified. San Diego had a very clear set of vendor specifications in their request for proposal for the CAD system, and this was invaluable in achieving the desired product. The Boston proposal for CAD 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. Effective implementation necessitates such standards, and the Law Enforcement Assistance Administration, or its sequel, should play a central role in developing guidelines. The more detailed cases in this study provide a preliminary base for establishing such specifica-

tions in the resource allocation, CAD and AVM areas. In addition, a wider based evaluation of such technology should be conducted to identify both the advantages and problems which have occurred to date and to outline a clear set of performance guidelines for users and vendors in analyzing and implementing new systems.

Finally, it seems that at least one of the major reasons for the disappointment of the Crime Commission was their failure to recognize many of the complexities and motivations concerning the implementation of technology and the interaction between the context and nature of police work and the technology. Police organizations have a number of characteristics that are quite different from those of other public and private institutions. In most industrial organizations and public bureaucracies, movement to higher levels of power and status is accompanied by greater discretion of freedom of choice in decision-making. 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 direction from superiors, and consequently the administrator's ability to control and influence police behavior is severely limited.[23]

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[23]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

A further complication in understanding the police is the local and fragmented nature of law enforcement and the fact that police departments have a variety of different tasks and styles of operation. The popular conception of police work, often 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,[24] and different police departments have different styles of operation depending on whether their orientation is, for example, legalistic (identified by strict interpretation and enforcement of the law and strong centralized authority), watchman (characterized by a more traditional approach, greater discretion and weaker centralized authority) or service oriented.[25]

The implications of these various characteristics of police work on the use and implementation of computer technology by the

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the public's intolerance of a policy of strict law enforcement, necessitate exercise of police judgment. For a discussion of this see James Q. Wilson, Varieties of Police Behavior (New York: Atheneum, 1970), p. 7. Also, see Gary Marx, Chapter II, Police Accountability: Performance Measures and Dimensions, Richard C. Larson, ed., Lexington Books, 1978.

[24]For a discussion of the actual allocation of police time, see John A. Webster, "Police Task and Time Study," Journal of Criminal Law and Police Science, March 1970. Also see James Q. Wilson, Varieties of Police Behavior, Op. cit., p. 18.

[25]For a characterization of these three groupings of police style see James Q. Wilson, Varieties of Police Behavior, Op. cit., especially pp. 140-226.

police are significant. To the extent that police personnel exercise discretion in their work, they will be able to influence the implementation and success of technological innovations. Several studies have shown that police often consider their job to be an unpopular one and their behavior to be disliked by the public.[26] As a consequence, they often develop a defensive posture and react by turning inward, "minding their own business," "keeping their mouths shut," and "not sticking their necks out." Secrecy becomes the rule and change is suspect, particularly changes introduced from the 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 officers and departments. The computer is an "innovation," a new approach to operation, a potential controller and revealer of valuable information.

The interaction between computer technology and the police will depend, therefore, on the nature and style of the particular police department involved. 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.

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

On the other hand, a computer might be of less use 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.

In summary, then, the eventual influence and impact of technology in policing will not come from the technology per se, but from an interaction between police work, the nature of a particular department, and any specific innovation. When the Crime Commission set forth their recommendations in 1967 it seems that they assumed, at least in part, that police administrators would have strong centralized control and that the diffusion of innovation in the form of computer (and other) technology would be primarily an act initiated from above with effective communication from higher to lower echelons of the police department providing the linkage for implementation. The Commission did not address the many possible motivations for using technology, the fragmented nature of police work, the variety of departments around the country, the influence of vendor pressures, and the discretion of local police officers. In essence, the implementation process was not perceived to be a primary problem, and the diffusion of change received little attention in the Commission's final report. Rather, the primary problem recognized by the Commission was monetary, and recommendations for federal assistance to help finance the cost of experimentation, research and development were high-

lighted.[27]

In failing to more specifically address the diffusion of technology, the Commission overlooked the primary obstacles such innovations have met over the past decade. The use of technology has the potential to influence prominence and power within organizations. Coalitions develop, and decisions to implement technology are prompted by many factors. Behavioral factors have proved essential in achieving acceptance and success, and the nature of innovation and change is a long term and deeply rooted process. With this in mind then the next section of this report will examine the diffusion of police computer technology.

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[27] The Challenge of Crime in a Free Society, Op. cit., pp. 269-271.

Part II

The Diffusion of Police Computer Technology

There is a human tendency to seek direct solutions and to try to classify actions as either failures or successes. When it comes to the diffusion of technological innovation there seems to be no single prescription that will guarantee success. It is possible to identify what not to do, particularly with the benefit of hindsight; and one of the conclusions here 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. Five such assumptions are listed below:

- If only the technical problems can be resolved, the implementation can move forward.
- Time constraints often mean that implementation must rely on a small group of supporters.
- Law enforcement supervisors really don't need to understand the basic assumptions and philosophies which underlie particular innovations, 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.

This list is not intended to be exhaustive, but the cases in this study have shown how such assumptions can work against implementation. Although sometimes true, or at least partially true, and often undoubtedly expedient, they generally return to haunt the implementor and to bring the eventual demise of the effort.

For example, as noted above, the hope of the Crime Commission for the anticipated benefits of the technology led them to overlook the importance of implementation and to underestimate the institutional and motivational constraints that would arise.

A. Factors Influencing Implementation

Based on a realization of the pitfalls of such assumptions it is possible to identify a series of "necessary but not sufficient" conditions in the implementation process. The factors are divided into two categories: those related to the nature of the environment of the innovation, and those related to the project management of the innovation. In essence, they are built upon and serve to summarize many of the common themes which have emerged from the case studies: the need for understanding the environment and motivations for change, the long term nature of innovation, vendor pressures and the temptation to oversell or overestimate a project's potential, the necessity of setting priorities and outlining clear performance guidelines in advance, and the importance of human and behavioral considerations such as the continuity of personnel and the involvement of police officers at all levels to the extent possible. Listed below, they serve as a "check list" for future consideration--not as a magic formula for success.

1. Conditions related to the nature and environment of the innovation:

A clear and realistic understanding at the outset of the project of the policy issues involved. Multiple, even conflicting objectives are often involved. For example, when Los Angeles 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. Effective change must usually build from within an organization. If innovation becomes an "idea in good currency," its chances for success will rise significantly. One of the indicators of this perceived support is a willingness to pay for change. Both San Diego and New York City "used their own money," when installing CAD systems. 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 and resist the temptation to oversell and therefore build impossible expectations. 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 sees to be to start with routine innovations that assist the officer in the street; more nonroutine innovations can be developed later to serve a more narrow range of officer needs. Also, 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:

Establishment of a clear set of performance guidelines at the beginning of a project. Such guidelines serve as a framework for clear understanding between the vendor and user. They were invaluable, for example, in San Diego, and their absence in other cities has been at the root of many difficulties.

A long-term time framework and perspective. Eight years were spent in the implementation of the ADAM historical reporting system in Los Angeles, and the New York City SPRINT CAD system has evolved significantly within a seven year period. Such projects inevitably take longer than initially planned, and if an adequate time-frame is not allowed, frustration and rejection will ensue.

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 people and machines.

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 careful not to oversell and be prepared to listen to feedback. The dialogue process must be two way.

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.

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.

Unbiased evaluation. A careful (and, if possible, independent) evaluation should be an integral part of any implementation effort.

Obviously it is impossible to expect that all of the factors relating to the nature, environment and project management of change can be achieved whenever computer technology is implemented. There is no simple answer to assure success. It is clear, though,

that in the past we have failed to devote adequate attention to the implementation and diffusion of innovation not only in law enforcement but in almost all areas of urban service delivery. 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. Innovation requires more, however, than adherence to the checklist outlined above.

B. "Policy Management" and the Process of Innovation

Conflict of some type or other is fundamental in the public sector--conflict between interest groups in the formulation of public policy, regional conflict, economic conflict, and conflict between technical experts and the bureaucracy. 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 of "policy management" where those with power decide to trade off competing goals and values.

The fact that the diffusion of technology takes place in this conflict/policy management 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--involves value choices and becomes a further factor in the decision-making process. Instead of speaking of the diffusion of innovation as if it were some truth to be embraced by all, one must realize that tension is inherent in the process of innovation. The most pressing question is not how to eliminate or even bridge the conflict between

technology builders and technology users. Such conflict is normal and to be expected. Rather, the most important question is to understand the differing perspectives of technology builders and 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,[28] 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 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."[29] The introduction of new actors in the process, though, will in and of itself make little difference. If these engineers or researcher/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 in and of itself 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 appli-

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[28] Jan Chaiken, et al., Criminal Justice Models: An Overview, Op. cit., pp. 123-127.

[29] Martin Greenberg, et al., Models in the Policy Process, Public decision Making in the Computer Era, p. 339.

cations 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.

C. The Diffusion of Technology: Some Directions for the Future

With this perspective, a few additional comments concerning the diffusion and transfer of computer technology in law enforcement are in order. Diffusion of innovation basically involves four steps: [30]

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.

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, and for that matter diffusion related to all urban services, all four deserve consideration.

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[30] See, for example, Granville W. Hough, Technology Diffusion, Federal Programs and Procedures (Mot. Airy, Maryland: Lomond Books, 1975).

1. Inventing--the need for better technology. Although this report has neither the space nor the capacity to be too specific, "better technology" improvements can and should be made in the quality of law enforcement computer applications. For example, in the modeling area we must build better models. Over the last decade, progress has been made. The Hypercube and PCAM Models offer better options to police users than those available six or seven years ago. Further, it may be possible, within the professional 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 guidelines 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 and to develop specific standards of performance in each of these areas. Resource allocation, CAD and AVM

are three primary areas identified in this report requiring such a set of performance guidelines. 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 guidelines 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.[31] Based on other experimentation which is going on around the country, these guidelines could be refined so as to provide general recommendations 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 product oriented research.

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. This report has already expressed skepticism about the possibility of introducing a new breed of "engineers" or "researcher/pragmatists" to aid in bridging the gap between the

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[31]For a discussion of such performance guidelines in AVM 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," Op. cit., pp. 61-63.

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, 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 impelmenting 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.

4. Integrating--the need for the internal motivation and integrity of change. One of the most critical elements for implementation success is that the desire for change must come from within, not without. Better evaluation and guidelines for 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.[32]

D. Changing Expectations

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 1960s. Perfection should not be expected instantly in an area so young and rapidly changing. Still, a certain mystique, as well as commercial force, surrounding the application of computers has led to high expectations, and, in

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[32] Space and the focus of 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 Chris Argyris and Donald A. Schon, Theory in Practice, Increasing Professional Effectiveness, (San Francisco: Jossey-Bass, Publishers, 1974) especially Chapters 4 and 5.

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 our expectations will become more realistic and our ability to perform will improve.

Part III

A Broader Perspective

We can learn a great deal from our experiences since the Crime Commission. 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 benefits stemming from the routine use of computer technology, and even 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. At the outset of the report it was 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 modifications.

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.[33]

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[33] For an interesting presentation of this argument see Abbe Mowshowitz, The Conquest of Will: Information Processing in Human Affairs, (Reading, Massachusetts: Addison-Wesley, 1976).

At the other extreme are the technologists, the champions of the rational, scientific approach, and the vendors who sell their products. 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 innovations have failed. Promises have been overextended, expectations have not been met, and resources have been wasted. The answers to the basic law enforcement issues do not lie in hardware; they lie in 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 hardware 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."[34]

In summary, most arguments against the computer are made on the grounds that too much money is currently being spent on law

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[34] Interview between Kent W. Colton and a police sergeant in Oakland, California.

forcement technology, particularly when it is not clear that the benefits of such technology justify the costs. This report has found such arguments to be valid in some cases; but in others, it appears that as long as benefits are defined in more narrow, process-oriented terms, they can often justify the costs, particularly with routine applications. Further, this efficiency may continue to develop with time as computer technology becomes more spohisticated, 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 computer technology that are even more important than those of costs and benefits. The use of such technology by the police must be placed in perspective. Among the most pressing law enforcement questions at this time are concerns 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 sub-

stantiate our present approach, and perhaps to indirectly work against major innovation, if required. This can cause anxiety about the negative effects of computer technology on the grounds of the changes that it will not 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 given its known limitations, its use should always be considered in the overall law enforcement context.

The greatest strengths of computer technology seem closely related to its greatest weaknesses. Computers have the potential to aid in criminal justice activities through rapid communication, more accurate and complete 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 overestimate its potential. However, these very benefits, if not properly controlled 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 which will guide our actions over the next decade and beyond, one slanting toward attention to evaluation and implementation, stressing guidelines 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 SUMMARY OF ISSUE AREAS AND RECOMMENDATIONS CONCERNING THE USE OF COMPUTER TECHNOLOGY BY THE POLICE

I. Issue Area: A number of advanced deployment models have been developed to assist in the allocation of police resources. Any claim about the impact on performance of such models will remain largely speculative, though, until more careful research and evaluation is carried out.

Recommendation: The LEAA* should develop a systematic, multi-disciplinary experiment to test and evaluate alternative resource allocation strategies. (pp. 30-31)

II. Issue Area: The benefits and costs of police command and control computer applications have also received only partial evaluation despite the fact that vendor pressure to market such technology is increasing.

Recommendations:

- The LEAA* should develop a systematic evaluation of the computer-aided-dispatch systems which have been established throughout the country. The focus of the evaluation should be on measuring benefits and costs to date and setting performance guidelines for the future. (pp. 35-37, 38-39)

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*Or some other research funding agency such as the National Science Foundation.

- Building on current research in St. Louis, the LEAA* should also fund a nationwide effort to evaluate automatic vehicle monitoring systems. (pp. 41-42, 55)

III. Issue Area: It is extremely difficult to measure the effectiveness of technological innovations in aiding police service. Crime statistics have generally failed as a measure of performance because of the difficulty of establishing a linkage between technological change and variations in crime rates.

Recommendation: Research should be focused on new measures of police performance (e.g. impact of innovations on workload distribution, response-to-calls-for-service, officer and citizen ~~satisfaction, etc.)~~ ~~Learning how~~ to more appropriately measure police performance is one of the primary research challenges for the next few years. (pp. 30-31, 39-42, 54-55)

IV. Issue Area: Past computer efforts have often resulted in oversell, false expectations, failure to specify relationships between uses and vendors, and lack of clearly defined performance guidelines.

Recommendations:

- Based on the evaluation efforts noted above, specific performance guidelines should be outlined in at least three areas: computer-aided-dispatch, automatic vehicle monitoring

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*Or some other research funding agency such as the National Science Foundation.

and resource allocation systems. (Other computer application areas not discussed in detail in this report such as criminal investigation and offender based files may also be appropriate for such a set of performance guidelines. (pp. 41-42, 54-55)

- Such guidelines should take into consideration the needs of different police departments based on size of city, geography, current technology, etc., while at the same time outlining a clear set of vendor specifications to be used in preparing RFP's (requests for proposals). They should include detailed performance measures in such areas as system accuracy, maintenance and repair standards, system capacity and adaptability, etc. (pp. 28-29, 41-42, 54-55)

V. Issue Area: In the past LEAA funding has often overemphasized and favored projects which were considered to be "new" or "innovative." The consequence has sometimes led to misuse of funds on new ideas and less resources devoted to following through on ideas that have proven successful. Recommendation: The LEAA should identify those areas where computer technology has achieved the greatest success so far and assist other departments in achieving similar benefits, if possible. (pp. 55-56)

VI. Issue Area: LEAA funding has sometimes limited the ability of police departments in dealing with vendors because funding contracts generally establish specific time constraints

for the use of money, and the process of extending grants is bureaucratically complex and psychologically discouraging.

Recommendation: Police departments should be given greater financial flexibility in working with vendors so they can require a certain level of performance before payment is made. (One of the reasons for the success of the San Diego CAD system was their ability to withhold funds until the promised product was delivered.)

VII. Issue Area: Computer uses in law enforcement have tended to overemphasize the crime control and law enforcement functions of the police, therefore neglecting possible applications related to social service areas.

Recommendation: Police departments and federal funding agencies should reexamine and reemphasize the potential for computer use related to social service activities--e.g. computer files to assist with referal information, medical assistance, or listings of agencies and names of people who might provide social service assistance. (pp. 21-22, 42-45)

VIII. Issue Area: With expanding uses of police computer technology, abuse might lead to the unwarranted use of information in police files, and individuals may lose control and access to personal data.

Recommendation: Continued and constant efforts are required to evaluate the privacy implications of law enforcement computer systems and to assure appropriate privacy and security. (pp. 22-23, 61-62)

IX. Issue Area: Many of the disappointments with police computer technology have arisen through the failure to recognize the complexities and motivations concerning the implementation of technology and the interaction between the context and nature of police work and the technology.

Recommendations:

- Concentrate greater LEAA resources on educating police departments concerning the behavioral and institutional dimensions of technological innovation and the transfer of computer technology. (pp. 42-45, 54-58)

- The desire for change must essentially come from within the police departments, and law enforcement officials must be sensitive to the essential factors in implementing technology related to both the nature and environment of the innovation and the project management of the innovation. (pp. 48-51)

- An alternative approach to providing technical assistance and technology transfer should be developed by taking advantage of the new breed of police officers who are technology experts and establishing "pools of resources" to aid in the transfer process. (pp. 55-56)

END