

U.S. Department of Justice
National Institute of Justice
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of Justice**

Issues and Practices

Patrol Deployment

- Analyzing the Current Patrol Plan
- Addressing Single Issues
- Meeting Multiple Objectives
- Making the Change

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James K. Stewart

Director

U.S. Department of Justice
National Institute of Justice
Office of Communication and Research Utilization

Patrol Deployment

by

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Issues and Practices in Criminal Justice is a publication series of the National Institute of Justice. Designed for the criminal justice professional, each *Issues and Practices* report presents the program options and management issues in a topic area, based on a review of research and evaluation findings, operational experience, and expert opinion in the subject. The intent is to provide criminal justice managers and administrators with the information to make informed choices in planning, implementing and improving programs and practice.

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Foreword

The patrol function is of central importance to police administrators. Its contribution to the agency mission, its visibility in the public eye, and its budget share of the agency's resources make it essential that decisions on patrol planning and deployment be grounded on accurate information and careful analysis. For departments facing fiscal constraints, such analysis is particularly crucial.

Independent of its resource implications, patrol deployment presents other inherent challenges. A wide range of related functions—crime analysis, calls-for-service, shift schedules, and communications, to name but a few—must be taken into account in making any change. Deployment decisions require executives and planners to make complex judgments in prioritizing goals and attempting to meet multiple objectives. Further, realistic administrators live with the knowledge that even the best deployment strategy can be rendered obsolete by any number of events beyond their control, such as annexation, zoning changes, or new city ordinances.

Over the past decade new methods, including computer technologies, have been developed to help law

enforcement officials in determining the number of patrol officers needed to satisfy department service delivery objectives and in distributing those personnel across shifts and geographic boundaries. This report, from the Institute series *Issues and Practices in Criminal Justice*, reviews the techniques available for evaluating a current patrol deployment strategy and projecting the probable results of various changes in that deployment. While it explains the various technical solutions to deployment problems, it has been written for readers without technical training. Of particular interest are the practical examples of how police departments in different parts of the country responded to changes in city policy or new demands for service through revisions in their deployment strategies, rather than increases in their personnel ceilings.

In an era of fiscal limits, productivity and efficiency are among the most pressing issues that police managers must address. The Institute hopes that *Patrol Deployment* will assist them in meeting that challenge.

James K. Stewart
Director

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In-house support from Abt Associates staff was unbounded. Ralph Jones and Joan Peterson laid the groundwork for the study. Deborah Carrow carefully monitored the work's progress, and Judie Feins and Jan Chaiken assisted with technical and substantive reviews. Typing and secretarial support were provided by Yvonne Clark and Donna English.

During the course of the project, there were two monitors at the National Institute of Justice. Jim Gardner helped direct the focus of the study. His persistence and determination kept the project going through its lengthy and often frustrating developmental phase. John Spevacek's enthusiasm and continued interest guided the project to a smooth and successful completion.

Margaret J. Levine

Preface

The concept of patrol planning is complex and encompasses a number of interrelated processes: work scheduling, directed and preventive patrol, resource allocation, and alternative responses to calls for service. Even functions which may not be organizationally part of a Patrol Division, e.g., crime analysis, criminal investigations, and communications, can have significant impact on planning for patrol operations. Each of these components can play an integral role in the establishment of a comprehensive patrol plan and the provision of thorough, effective patrol services to the public.

The focus of this report is limited to *Patrol Resource Allocation*; that is, *calculating the number of patrol officers needed to satisfy departmental service delivery objectives and distributing those personnel across shifts and geographic boundaries*. Its purposes are to discuss resource allocation issues that affect patrol operations and demonstrate some of the mechanisms available for resolving them. It is not intended to be the definitive work on patrol planning, but rather to present alternative approaches that departments can consider in analyzing their allocation decisions. Managers can then choose the method that best fits the issues they face, the objectives they are trying to achieve, and the capabilities of their analytic staff.

The information contained here is drawn from three major sources.

- First, a literature review of research on the topic of patrol planning and reports from operations and management studies of police and sheriffs' departments. Many of these documents are referenced throughout the report, and we encourage readers to use them as a supplement to the material we have provided.
- Second, a telephone survey of 32 law enforcement agencies throughout the United States to solicit details about their patrol planning practices. The participating agencies were identified through the literature review and contacts with researchers and practitioners. Questions covered a variety of topics, including successful and unsuccessful elements of resource allocation efforts, purposes of resource allocation, performance measures used, data collection methodology, analysis techniques, costs, personnel involved, and outcomes.
- Third, site visits to police departments, based on the results of the telephone interviews and the recommendations of the government project monitor. The Albuquerque, New Mexico, Police Department; Charlotte, North Carolina, Police Department; Reading, Penn-

sylvania, Police Department; and Springfield, Missouri, Police Department were chosen because of their geographical location, size, patrol planning practices, unique features, and the availability of data specific to their experiences with patrol resource allocation.

This report is a synthesis of research and current practices. Its five chapters are organized to guide the reader through the processes involved in patrol planning, from issue development through resolving single and multiple issues to making changes in the patrol plan. Practical experiences have been used extensively to illustrate the analysis techniques and to support our conclusions and recommendations.

Chapter One introduces the concept of patrol planning. Systematic patrol planning is not commonly practiced in police departments in this country. We offer some possible reasons for its absence, but conclude that no department should overlook such an important management responsibility. The benefits of patrol planning as well as its implications for other police department functions are discussed. The chapter closes with an overview of traditional and recent practices in police operations and management that have shaped patrol planning.

Chapter Two explains some of the fundamentals of analyzing a patrol plan—issues, objectives, performance measures, planning preparations, and analysis approaches. The type of issue being addressed and its source are important determinants of staffing choices, data requirements, and analysis technique; objectives, too, direct these study components. A particularly useful discussion in this chapter describes the data that police departments should be collecting to facilitate a patrol plan analysis.

Much of the material available on patrol resource allocation methods is of a very technical nature. *Chapters Three and Four* examine these planning approaches, using examples to illustrate their application. Analytic techniques for resolving single issues such as patrol force size, officer scheduling, unequal workload, and relieving workload are presented in Chapter Three, while Chapter Four focuses on more complex procedures for addressing multiple objectives. These chapters will clarify the existing documentation for practitioners.

Chapter Five concludes the report with a description of both the key planning steps for resolving an issue and the factors that should be considered in making changes in the patrol plan.

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Chapter 1: Introduction

Patrol Planning: The Link Between Issues and Operations

One of the most pressing issues that police managers must continually address is productivity. Sometimes it is called "efficiency." Other times it is called "cost-effectiveness." Whatever the label, the bottom line is always the same: increasing public demands to fight crime and maintain order are coupled with decreasing public willingness to support public service budgets. The patrol function—the largest, most costly, and most visible component of policing—is often hardest hit. Ironically, while it is the function that may offer the greatest potential for improvement, it is also the one which most frequently is overlooked as the subject of routine planning and analysis.

Some police departments make no effort to manage their resources until a problem arises.¹ Others have ongoing or occasional patrol planning studies. The four research sites for this project give examples showing how patrol planning issues typically arise and can be resolved by analysis. In each site, an issue arose that had to be resolved, the police department carried out a study including data collection and analysis, and changes were recommended and adopted.

- In City A, the City Manager hired a consulting firm to conduct an evaluation of productivity in city departments. No fiscal crisis caused the study; rather, it was a step taken by a professional manager to assure that his citizens were getting the most for their tax dollars. The consulting firm recommended that the patrol force of the police department be cut by ten percent. Such a reduction in personnel, it was argued, would not decrease effectiveness in patrol operations. The Chief of Police, who disagreed with this recommendation, argued that a reduction in personnel of that magnitude would cause a significant decline in response times to calls for service. Even high-priority calls would have to go into a queue and wait for available cars. The City Manager was not convinced. He wanted the facts. How much of an increase in response time would be caused by this cut in personnel? One minute? Two minutes? What difference would it make? Were there alternative ways to allocate personnel that could improve efficiency?

To answer these questions, the police department implemented a computerized model that could estimate the number of patrol units required to achieve the performance objectives specified. It showed that the number of patrol

officers should not be reduced by ten percent as the management consulting firm had recommended. The Police Chief presented the results of the analysis to the City Manager and City Council, showing them numerically that the recommended reduction would result in an unacceptable increase in response times to calls for service. The City Manager and City Council agreed with the Chief, and no cuts were made in the force.

- Until 1979, the police department command in City B was dominated by a small group of officers with close ties to the incumbent city administration. Patrol resources were deployed in three equally-sized platoons over three shifts that rotated every two weeks. The younger patrol officers were dissatisfied with this deployment, particularly the frequent shift rotations, and shortly before the mayoral election in 1979, they marched on City Hall to protest their working conditions. In 1980, a new Mayor took office and a new Police Chief was appointed. The Chief announced that those interested in change could develop a plan for patrol, including changes to the shift rotation.

The officers believed that the existing allocation of resources was not responsive to the demand for police services—that those on the Night Shift had little to do, while those on the Evening Shift were usually overworked. They formed a committee to develop a new plan for allocating officers to shifts and obtained a printout of calls for service and incidents by shift and by day of the week for their study. Using these data, the committee saw that their beliefs about the staffing of shifts were correct. They decided to recommend proportional staffing of shifts: the Evening Shift would get the most officers, followed by the Day Shift, with the Night Shift receiving the fewest. Their plan was accepted by the Chief and implemented.

- The City Council in City C approved the annexation of several large tracts of land on the city's north side. Faced with the responsibility of providing law enforcement services to this newly incorporated area, the police department had to come up with a more efficient patrol plan because the city was not going to hire additional officers. Existing beats would have to be redrawn, the deployment schedule would have to be evaluated, and manpower requirements would have to be streamlined. The senior officers knew that the department had not been routinely collecting the data they needed and, thus, a database would have to be created for planning purposes.

Because the cost of abstracting essential information from several years' dispatch tickets seemed prohibitive, a random sample of calls received during the previous two years was analyzed. Results of this analysis were used in a computer model to simulate the effects of alternative beat configurations and manpower allocations. The command staff presented these alternatives to a department-wide committee for review, and ultimately a new patrol plan that was most consistent with the data on calls for service workload was adopted. The new beat structure minimized cross-beat dispatches and reduced the average travel time for responding to calls for service. Workload was equalized as a result of redistributing manpower; and the department was able to serve the newly annexed area without additional personnel.

- In City D, the police department was using a deployment plan that allocated manpower equally across shifts and divided the total number of officers evenly between the city's North and South Sectors. Because the patrol division had only three lieutenants, and schedules between watch commanders and shifts of officers varied, there was little continuity in the chain of command. Substantial annexation coupled with a fiscal crisis netted increased workload and a stabilized patrol force for the department. These problems were exacerbated by a department administration that did not actively support efforts to better plan for patrol operations.

The push for change in this police department came from a group of young officers who successfully applied for Federal monies to make improvements. A new Chief of Police was appointed two years later, and patrol planning became a recognized priority for the department. A formal call prioritization policy was developed, a system was established to handle calls for service not requiring assistance from a field unit, and data were analyzed to redraw beat boundaries and reallocate personnel among shifts to balance workload. One outcome of the review was a recommendation for a sizable increase in the number of sergeants and lieutenants in the department. The Federal grant paid for these positions initially and they have been maintained through attrition of senior officers. The end result has been the emergence of a police department that can respond to increasing service demands in an environment of tightening fiscal resources.

It is not unusual that these four departments analyzed their patrol plans under pressure of a particular issue. Most police departments do not critique or adjust their patrol plans on a regular basis, although the necessary technology and expertise have been available for the past ten years. There are several explanations for this norm. Some departments operate in a reactive rather than pro-

active mode, without a formal planning function other than what they need for budget preparations. Because problems requiring an evaluation of patrol resource allocations do not occur regularly or predictably, these departments may wait many years between patrol plan reviews.

Problems with data availability also discourage routine patrol planning. In order to conduct a thorough assessment, departments must consider a wealth of information about their operations and the public's demands for service, including number of calls for service, assists, traffic accidents, and special details. The existing records system in some departments cannot support such in-depth data requirements because the agencies either do not collect the necessary information or, if they do, it is not presented in a way that is conducive to analysis. This problem is further compounded because departments may be unwilling or unable to devote staff to collecting data from numerous sources or to upgrading the records system to facilitate future analyses.

The staff time needed for ongoing review of patrol resource allocation may be another obstacle. Yet reacting to issues by assigning a special project is a risky approach to patrol management. The staff may not have developed the background or skills to carry out a suddenly assigned study. Consultants who possess the requisite knowledge and skills for patrol planning are available, but merely developing a formal statement of the work to be accomplished by the consultant requires much careful planning and entails delays before the analysis starts.

Finally, the police bureaucracy, like any other government bureaucracy, may be resistant to change. The interrelationship of patrol operations with other departmental functions confounds the process of change for police departments because any modification of the patrol division will inherently affect many other units. Thus, departments become stuck in their traditions—the overriding philosophy being, “If it's not broken, don't fix it.” It is easy for police departments to continue with existing patrol deployments that have no apparent problems.

No matter what a department's reasons are for not institutionalizing patrol planning, they should be vigorously challenged. A person would not buy a car and presume that it would run efficiently without periodic maintenance (e.g., oil change, tune-up, tire rotation). Why then should a police department assume that it can ignore such a vital component of its operations as uniformed patrol and still remain efficient? This report discusses the benefits of patrol planning, so that you can line them up against the obstacles, and make your own comparison.

Planning For Resource Allocation Is Important

When planning patrol allocation, you are answering some of the most important questions facing the department:

- How many patrol units should be on duty during each shift?
- How should they be distributed among the various communities in the city or county?
- Should one officer or two be assigned to each car? Or, should there be a mix of one-officer and two-officer cars?
- How do patrol officers spend their time when they are not handling calls for service?
- What are the patrol beats for each car?
- Which citizen calls merit response by a patrol car, and which ones can be handled by other means, such as taking a crime report over the telephone?
- How many cars are dispatched to each call?
- What should be the starting times of patrol officers' tours of duty?
- What do patrol officers' schedules look like: days on duty, tour rotations, and so forth?

The activities involved in evaluating patrol plans are straightforward and can be a standard part of every department's on-going management effort: identify performance measures important to the department and specify objectives, collect data, analyze data, implement changes or maintain the status quo based on the analysis' results, and monitor and periodically review the plan. If crisis planning is the standard practice for resource allocation in your department, the benefits of routine planning should make you reconsider your current procedures. Among them are:

- greater control of patrol resources;
- more efficient delivery of police services; and
- enhanced information for decisionmaking.

Greater Control of Patrol Resources

Resource allocation planning establishes a management information system that permits monitoring the activities of units on patrol, e.g., calls for service; administrative, self-initiated, and personal activities; and routine and directed patrol. With information from a patrol plan analysis, managers can determine the amount of uncommitted patrol time by shift and beat. Managers can then plan structured activities for directed patrol assignments or other programs without adversely affecting the time needed to respond to calls and other duties. In Reading,

Pennsylvania, the police department found that approximately 30 percent of all patrol time could be devoted to directed patrol. One of the biggest successes enjoyed by the department as a result of better utilizing its unfilled time was the virtual elimination of purse-snatching in the downtown area, achieved through the use of stake-outs, decoys, and saturation patrol during certain hours of the day.

Since resource allocation planning provides information on the availability of patrol resources, it also becomes a mechanism by which a police department can identify problems and take corrective action. For example, without routine analysis, managers may overestimate personnel needs to accommodate authorized leave, vacation, and sick days. This results in a large relief factor—more officers than necessary have to be hired so that there will always be an adequate pool of personnel available for duty. With up-to-date information on manpower utilization, this relief factor can be controlled. During its patrol planning process, the Albuquerque, New Mexico, Police Department discovered that it was operating with a relief factor of 1.8, a finding that the department's managers concluded showed an inefficient use of resources.² Albuquerque's analysis indicated that its relief factor was due to excessive use of compensatory time and a lack of coordination in scheduling officers' vacations. As a result, commanders there decided that only the correct number of officers necessary to meet the demands of each shift would be allocated and that sergeants would have to ensure adequate staffing levels on a day-to-day basis through their control of authorized leave. The police department reduced its relief factor to 1.65.

More Efficient Delivery of Police Services

Municipal budgets are no longer increasing in real dollars with predictable regularity, and law enforcement agencies have not escaped the resulting squeeze on resources. Public pressure to justify expenditures means that departmental budgets undergo stringent review. Police executives must demonstrate that they are providing the optimum service possible for the tax dollars they receive, and they must defend with facts any proposals for additional manpower or support resources. In some communities, the push for efficiency has forced agencies to provide the *same* services for less money or *more* services for the same money. The demise of the Law Enforcement Assistance Administration has further complicated the fiscal crisis endured by police departments since they can no longer count on external funding sources for their current needs and plans for the future.

Because the patrol function accounts for such a large por-

tion of the police budget, it is imperative that departmental managers examine alternatives for controlling patrol costs. Resource allocation, when used in combination with other techniques for managing operations (such as prioritizing calls for service and using civilians to handle walk-in requests for assistance), enables managers to provide services more efficiently and possibly at a lower cost.

One of the earliest findings from patrol planning in the 1970s was that savings can be derived from matching patrol resources to workload. For example, consider the data displayed in Table 1-1, showing two ways to allocate patrol officers.

Option One is the traditional approach to deployment used by many agencies in the 1970s and earlier: equal manning on three shifts. Under Option Two (assuming 20 officers are sufficient for the Evening Shift), the department reduces the total number of officers required by matching allocations to calls for service demands. The savings are obvious. Using the efficiency model, the department deploys fewer officers yet meets the demands of the patrol force. As an added bonus, the surplus of officers can either be transferred to an understaffed section of the department or redeployed as a special operations unit for enhanced crime prevention and directed patrol activities.³

Enhanced Information for Decisionmaking

Patrol planning produces a wealth of information about existing patrol operations. This information can be used not only to evaluate the current delivery of police services

but also to develop future plans for the department. Important objectives regarding unit utilization, response time, and delayed dispatches can be analyzed and refined.

Systematic patrol resource allocation gives the police manager the tools to explain and defend the department's budget requests. As City Councils and City Managers are increasingly unwilling to accept standard rationales for hiring more police personnel, such as, "We need two officers for every two percent rise in the crime index," departments must be prepared to show the relationship between costs and services provided. The Charlotte, North Carolina, Police Department uses a computerized resource allocation program (PCAM) to simulate alternative resource requirements under particular conditions. One variable that the department tests is response time to calls for service. The department can demonstrate a five percent reduction in personnel needs by slowing down the average response time two minutes (e.g., from three minutes to five minutes). Since response time is very important to citizens in Charlotte, these data are quite useful in City Council hearings on the police budget. Not every department needs the computerized simulation capability of the Charlotte Police Department; however, it is important to have enough information on hand so that the effects of operational changes can be substantiated.

The information used for patrol planning also enhances a department's ability to respond to unanticipated pressures. For example, suppose that the Mayor decides that foot patrols would be useful in several neighborhoods

TABLE 1-1
EXAMPLE OF TWO PLANS FOR ALLOCATING RESOURCES

SHIFT	PERCENTAGE OF TOTAL CALLS FOR SERVICE BY SHIFT	DEPLOYMENT OPTIONS	
		OPTION ONE Equal Staffing	OPTION TWO Efficiency ^a
Midnight	20%	20	9
Day	35%	20	16
Evening	45%	20	20
TOTAL PERSONNEL DEPLOYED^b		60	45

SOURCE: Adapted from U.S. Department of Justice, National Institute of Law Enforcement and Criminal Justice, *Improving Patrol Productivity, Volume I: Routine Patrol* by Gay et. al. (Washington D.C.: Government Printing Office, July 1977) pp. 26-29.

^aThe efficiency option assumes that the 20 officers assigned to the Evening Shift are sufficient to respond to all calls for service and provide adequate preventive patrol during the peak demand period.

^bThis total reflects only the number of officers deployed and not the total complement actually needed, because the relief factor was not considered.

during the summer to better control teenage drinking and vandalism. With sufficient information about calls for service, fluctuations in demands, dispatch delays, unit utilization, and the work schedule, the Police Chief can determine the impact of this additional draw on his resources and the best way to accommodate it.

Patrol planning keeps managers abreast of how patrol resources are being used and enables them to make informed decisions about departmental operations. When it analyzed its patrol plan, the Greensboro, North Carolina, Police Department discovered that its patrol officers were providing an average of 100 bank deposit and funeral escorts per week. The department management was unaware that this service was consuming so much patrol time until it conducted the analysis. As a result, it was decided that business escorts (which comprised 80 percent of all escorts) would be discontinued. The department made a list of businesses that had requested bank escorts and wrote letters informing them of both the date when the service would be stopped and the rationale for the change. This change was not made without objection from the business community; however, because the department was able to show the impact of the escort service on its resources, its new policy prevailed in the end.

Influences on Patrol

Sound management of patrol operations is not an isolated responsibility. Patrol planning is complex and encompasses a number of interrelated processes: work scheduling; directed and preventive patrol; resource allocation; alternative responses to calls for service. Even functions which may not be organizationally part of a Patrol Division, e.g., crime analysis, criminal investigations, and communications, can have significant impact on planning for patrol operations. Each of these components can play an integral role in the establishment of a comprehensive patrol plan and the provision of thorough, effective patrol services to the public.

The following sections discuss some of the factors that can affect patrol planning and describe their relationship with patrol operations. Because of the many philosophies that direct each of the functions or programs discussed, there is no standard method or formula for systematically allocating patrol resources. The allocation approach will depend on the issues at hand and the priorities that departments establish. It is, therefore, incumbent upon managers to understand these influences on patrol operations before they assess their current allocation plan and prepare for changes.

Work Scheduling

At first glance, the work schedule may appear to be a simple presentation of reporting and off-duty times for officers; however, many issues such as shift rotation, interfacing with the work of other units, holidays and vacations, union agreements, and departmental policies on overtime and sick leave must all be considered when preparing the schedule. Often its significant influence on patrol operations is not fully appreciated. For example, patrol personnel may be required to work with officers from other sections on special events or unusual criminal investigations. In situations such as these, the work schedule will play a critical role in coordinating resources and assignments because it dictates which officers and how many are available to work and which ones and how many are not available.

Equipment and motor vehicle resources are another facet of operations that can be affected by the work schedule. In particular, overlay shifts or schedules such as 4-10 plans that have overlapping reporting periods may increase the need for equipment and patrol cars—a demand that may preclude certain staffing plans from being implemented. Lastly, manpower scheduling can affect productivity and officer morale. Research has shown that poorly designed schedules can lead to inefficient service, reduced officer morale, boredom or fatigue, and increased overtime; an unsupportive attitude toward the department and its command staff may be the result.⁴

In sum, the work schedule reflects not only the reporting and off-duty times for patrol officers, but is also, more subtly, a representation of managerial decisions and departmental objectives. For example, if there is a departmental objective that each officer receives at least 40 hours of in-service training a year, training time will have to be considered when the work schedule is developed. Likewise, a management decision that unity of command is a desirable operating principle will necessitate coordination of supervisors' and subordinates' schedules. The work schedule is thus linked to major facets of departmental policy, and as such becomes a tool for implementing decisions regarding the allocation and utilization of manpower resources.

Directed and Preventive Patrol

Traditionally, patrol operations are structured and directed around responding to calls for service. Time not spent on service demands is then consumed by preventive patrol or administrative and self-initiated tasks. Preventive patrol, the random touring of a beat, was originally intended to prevent and deter crime by providing a visible police presence at unpredictable intervals. Up to 40 or

50 percent of an officer's tour of duty could be spent on routine patrol, with little direction given to officers by their supervisors on how to use this time.

Research on the effectiveness of preventive patrol has produced mixed results. Perhaps the most widely known study, the Kansas City Preventive Patrol Experiment, reported no observable differences in the level of crime in areas of high, regular, and low patrol intensity.⁵ Similar conclusions were reached in patrol projects conducted in the Nashville, Tennessee, and Albuquerque, New Mexico, Police Departments.⁶ Conversely, some departments have experienced a reduction in reported crime when they increased patrols. During the Wilmington, Delaware, Split-Force Experiment, patrol officers were assigned to either a basic (call for service) or a structured (preventive patrol) platoon.⁷ The City experienced a decline in reported crime and an increase in the number of arrests made by patrol.

Though the research on the effectiveness of preventive patrol has been inconclusive, many departments have sought ways to better manage uncommitted patrol time. One approach has been the use of directed patrol assignments. That is, preplanned, crime- and location-specific activities are substituted for some portion of the time normally spent on random patrol. The directed patrol assignments address problems in the officers' beats and often can be measured against goals specified in advance.

As part of its Integrated Criminal Apprehension Program, the Kansas City, Missouri, Police Department conducted a directed patrol project in its East Patrol Division.⁸ By both matching manpower deployment to workload demands and developing dispatch alternatives and a call prioritization policy, blocks of patrol time were freed for directed patrol assignments. Manpower utilization forecasts, based on an analysis of dispatch ticket data, informed the sergeants responsible for planning and supervising their sector's directed patrol activities of the percent of time and the number of officers likely to be available. Officers at the East Patrol Division devoted 10 percent of all patrol time to directed patrol assignments, an accomplishment achieved without adding more officers to the Division.

Even though it is only one of the factors that should be considered in developing a department's patrol plan, it is important that managers clearly define the average amount of time they think officers should devote to calls for service, administrative duties, personal relief time, routine preventive patrol, and proactive directed patrol. Thorough manpower planning for patrol operations requires that managers review how officers are using their time and determine whether or not this practice is satisfactory. This assessment can be performed by analyzing information from a variety of data sources, as will be demonstrated

throughout the text.⁹ Generally, departments expect that officers will spend 35-40 percent of their tour on calls for service; however, each department will have to set its own standards. If the analysis indicates an unacceptable time distribution among the activities, changes for improvement can be made in the work schedule, in the number of officers assigned across shifts, in beat configurations, and/or in the policies and procedures that affect patrol operations. Even if the review indicates an acceptable balance among patrol activities, there may be other weaknesses (e.g., excessive response delays) that necessitate changes in the patrol plan.

Communications

The substantial role of Communications is evidenced not only in the dispatcher's ability to determine and direct the number and identity of the patrol unit(s) dispatched on a call, but also in the amount of discretion that complaint takers exercise in deciding how or if a call will be handled by the police. Departments often accord calls for service a lofty status by allocating resources on the basis of the call for service workload and justifying budget increases with the rationale that quick responses cannot continue without the requested revenues. In many departments, the long-established tenet that officers should be available to respond to calls for service and the obsession with keeping response times to a minimum have prevented patrol managers from planning and initiating crime deterrent activities because Communications personnel may at any time interrupt or override such activities in favor of calls for service. Research has not, however, supported this philosophy or practice.

Only 60 of the 949 calls sampled in an LEAA-funded study of response time in Kansas City reported crimes in progress. The study hypothesized that in 18 percent of the 949 calls, citizen reporting was timely enough to facilitate an on-scene arrest. In reality, rapid response led to apprehension of a suspect in only 3.6 percent, or 35 calls. The research concluded that "although some patrol strategies affect police response time, a large proportion of Part I crimes are not susceptible to the impact of rapid police response, (and) for that proportion of crimes that can be influenced by response time, the time taken to report the incident largely predetermines the effect of police response time."^{10,11} A later study by the Police Executive Research Forum expanded on these findings. It reported that:

- Existing systems of classifying calls for service are inadequate, focusing primarily on placing calls into predetermined crime or noncrime codes, rather than basing classification on information critical to determining proper police response.

- Although information gathered during call intake is important in determining proper response, police agencies have failed to pay adequate attention to training, supervision, or guidance of call operators and dispatchers.
- Police departments operate on the premise that immediate response by a sworn officer(s) is the most desirable response to nearly all calls for service.
- Many police agencies still manage service workload on a first-come, first-serve basis or by an informal ordering system.¹²

These studies suggest that there is a critical need for police departments to not only examine both the relevancy and effectiveness of their communications procedures and subsequent patrol response, but also to evaluate alternative methods for meeting service demands and satisfying citizen expectations.

Whether influenced by the research or by the necessity to streamline in the face of decreased or stagnant budgets and increased call for service workloads, some police administrators have come to realize that responding to all calls for service is neither feasible nor practical. Rather than continue immediate mobile response as the standard procedure, departments have begun to establish priorities for disposing of their workload. Among the steps being taken are the development of call classification schemes (which match a variety of possible police responses to the specific requirements of each call) and the implementation of alternative response mechanisms to handle less serious complaints.¹³ When patrol officers are freed from the obligation of responding to every citizen request for service, they can make other important contributions to the department's mission, such as meeting with neighborhood and community groups, conducting residential and commercial security surveys, investigating crimes that have been reported, and planning and implementing directed patrol projects.

Crime Analysis

Police have collected data on many aspects of criminal activity for years. Information bulletins, MO files, suspect vehicle files, and pin maps are but a few of the crime analysis products typically found in police departments. Unfortunately, while most law enforcement agencies routinely collect and analyze crime information, there is often a breakdown in its transmission to patrol managers and department administrators who could use the information for long-range and short-term planning. In fact, the chief value of crime analysis lies in its ability to support departmental decisionmaking; thus, the failure to capitalize upon crime analysis ultimately undermines a department's efficiency and effectiveness.

The relationship between the Crime Analysis Section and the Patrol Division is one of mutual dependency. The Crime Analysis Section depends on Patrol for its data, while Patrol relies on Crime Analysis for information to support tactical and strategic planning. The Patrol Division is the principal supplier of crime analysis data such as incident reports, field interview cards, and supplementary reports. If patrol officers complete these reports thoroughly, accurately, and as quickly as possible, the department can gain the maximum benefit from crime analysis.

Crime analysis products provide the Patrol Division with information about potential crime targets, active suspects, and time-space patterns and series. Patrol commanders and supervisors, in turn, use this information to plan for the deployment of resources. With information about a crime and a profile of likely suspects, departments can develop tactics for directed patrol projects to attack the problem. In addition, crime analysis allows patrol managers to concentrate on problems at specific locations at specific times; they can assign resources both temporally and geographically.¹⁴ Crime analysis information also aids in the development of goals and objectives for the delivery of police services. By providing specific and aggregate data about crime, crime analysis not only supplies feedback about departmental effectiveness but also supports future manpower planning and program development.

Because of their interdependent nature, there should be constant interfacing between the Crime Analysis Section and the Patrol Division. Frequently, however, communication between them is poor and their relationship can be characterized as one of benign neglect. Requiring crime analysts to attend patrol roll calls on a routine basis and requiring patrol managers to provide feedback on both the utility of crime analysis reports and the types of materials that would be most useful to them can build a stronger relationship. Also, physically locating their offices near one another may foster more direct contact between them. The benefits of an active crime analysis program are too valuable to allow an unproductive situation to endure.

Criminal Investigations

Recent research on investigations has resulted in a redefining of the roles of detectives and patrol officers. Studies conducted in the mid-70's demonstrated that most case clearances result from information gathered at the crime scene by the responding officer who conducts the preliminary investigation.¹⁵ These studies also showed that successful investigations depend on the quality and quantity of facts contained in an officer's initial report. While more current research concludes that preliminary

investigations by patrol officers and follow-up work by detectives are equally important in determining whether cases will be solved with arrest, it does not diminish the role of patrol as described in the earlier work: "Patrol officers' conduct of preliminary investigations is important because most follow-up work is based on leads developed in the preliminary investigation. If few or no leads are developed, the case is likely to be screened out and never assigned for follow-up or, if assigned, the follow-up will be quickly suspended."¹⁶

Some jurisdictions have expanded the role of patrol officers to include follow-up investigations. Such a procedural change allows departments to maximize their use of resources and to increase the opportunity for successful outcomes in continuing investigations. Other benefits which may be realized include enhanced specialization and skill development for detectives and career development advantages for patrol officers who may wish to become detectives. Further, research to establish the Managing Criminal Investigations model found that changes in the roles of detectives and patrol officers produced the following results in many departments:

- Patrol officer/detective relationships and communication improved.
- The frequency of morale problems among patrol officers decreased, and the decrease was traceable to the officers' belief that their skills were being better used in the investigative process.
- An increase in detectives' productivity resulted from a lightened caseload, leaving them more time to conduct better investigations.
- Better management of the entire investigative effort by the police administrator resulted.¹⁷

Local policies and procedures governing the patrol officer's role have a direct impact on the effectiveness of investigations as well as on the ultimate outcome of the investigative process itself.¹⁸ Patrol officers, because of their role in preparing the preliminary report, are naturally involved to some degree in almost every investigation. Unless detectives are placed on street patrol and are available to respond to calls for service, the first personal contact with the victim of a crime will continue to be made by a patrol officer.

Trends in Patrol Planning

Planned resource allocation is not a new approach to managing patrol operations, but is one that is not widely used. It assumes that the temporal and geographic allocation of patrol personnel and equipment has an important influence on departmental efficiency and effectiveness. Further, it assumes that the patrol manager can reallocate

patrol resources in order to achieve specific objectives such as reduced response time, balanced workload, and fixed costs. Exhibit 1.1 highlights some of the practices that have characterized patrol planning over the years, while the text that follows presents an historical account of resource allocation techniques.

Traditionally, patrol resources have been deployed via a platoon system that utilizes equal manning of three shifts. In the mid-1970's, the University City Science Center conducted a survey of 321 police departments to assess the prevailing patterns of patrol resource allocation. The survey showed that almost half of all the police departments contacted assigned the same number of officers to the day, evening, and midnight watches.¹⁹ The equal staffing approach was particularly prevalent in departments with fewer than 100 patrol officers. In these departments, over half (53 percent) used equal staffing, compared to only 10 percent of those with 100 or more patrol officers.

This deployment method has a number of advantages that might account for its persistence. It permits a reasonably straightforward approach to work scheduling: there are three shifts and each shift has the same number of officers and supervisors. Rotation is simplified because manpower needs are consistent across shifts. Thus, whole platoons can rotate together and officers' work schedules do not have to be modified, except for changing reporting times. In addition, this allocation system assures unity of command and enhances accountability. The same officers report to the same supervisor and commander no matter which shift they work. Finally, it promotes team integrity. Since the same officers are always working together, they develop an *esprit de corps* that contributes to more effective operations.

A 1983 study conducted by the Northwestern University Traffic Institute shows some movement away from the practice of equal staffing. Of the 113 departments responding to questions about staffing plans, 85.5 percent said that they vary staffing levels to meet workload demands, and 52.2 percent said they do so by both day of the week and shift.²⁰ As the data processing capabilities of police departments have improved, more agencies are able to conduct routine analyses of patrol operations and regularly prepare monitoring reports for management. Some of these reports demonstrate the temporal pattern of patrol workload, thus giving managers a clear picture of when their resources are most needed. In the past, managers have had to allocate their resources based on their own perceptions of service demands. Often, these perceptions were guided by a sense of when crimes occur rather than when calls for service occur. This, combined with an administrative concern to always be prepared for an

EXHIBIT 1.1

TRENDS IN PATROL PLANNING

Traditional

- Equal staffing on three shifts
- Little emphasis on scheduling
- Enough patrol units available to provide an immediate mobile response to all calls for service
- Time not spent on calls for service largely devoted to unstructured, random patrol (preventive patrol)
- Minimal analysis of patrol operations

Recent

- Staffing proportional to workload
- Overlapping shifts for extra coverage during peak demand periods
- Overlapping and delayed shifts implemented
- Development of models to guide scheduling decisions
- Enough patrol units available to provide an immediate mobile response to emergency calls for service
- Diverting calls for service to telephone reporting units, queuing calls for delayed response, setting appointments for taking reports, referring calls to other agencies
- Non call-for-service time spent on both routine patrol and directed patrol
- Directed patrol assignments planned in response to problems identified through crime analysis
- Increased use of data processing for analysis
- Routine monitoring reports generated for management
- Recognition of the integrated relationship of patrol with other police functions and inclusion of representatives from such functions in decisions that affect patrol

emergency, led to inefficient staffing practices. Nowadays, police departments have the tools to determine when their workload is at its peak, and they can allocate resources accordingly.

Another reason for the trend toward proportional staffing is the recognition that crime prevention and call for service activities are both necessary components of effective policing. If a department ignores the temporal distribution of its workload and assigns an equal number of officers to each shift, there will be an imbalance between these two commitments. For example, because officers have fewer calls to answer on the Midnight Shift, the amount of time available for preventive and directed patrol is quite high. Yet contacts with citizens' groups are impossible during these hours. Conversely, on the Evening Shift, when workload is heaviest, service calls are frequently stacked and officers have only minimal time for preventive and directed patrol. The use of proportional

staffing allows a better mix of crime prevention and call for service activities to take place, since the allocation can be adjusted to accommodate both sets of scheduling considerations.

An outgrowth of the movement toward proportional staffing has been experimentation with various scheduling operations. Of the 160 departments surveyed in the Northeastern University Traffic Institute's study, 22 percent reported that they had modified their patrol force work schedule within the past year.²¹ A composite schedule based on the Traffic Institute's review would still have the following characteristics:

- three 8-hour shifts and an average work week of 40 hours;
- a daily work pattern of five days on, two days off; and
- monthly shift rotations.²²

However, the data collected revealed enormous diversity in the kinds of schedules and scheduling practices used by police agencies. Some departments reduced the number of officers on each shift in order to establish a fourth (overlap) shift to work during the busiest hours of the day. Other departments initiated staggered reporting times in an effort to provide adequate coverage for fluctuating demands.^{23,24}

The result of these staffing and scheduling changes has not simply been better management of resource utilization; they have also created a need to better manage the work environment. Consequently, innovations in the way calls for service are handled have been introduced. (See earlier section entitled Communications) Research has shown that as many as 30 to 40 percent of all calls for service are now subject to responses other than the immediate dispatch of a patrol unit.²⁵ Alternatives such as Telephone Report Units, walk-in reporting, use of civilians or police reserves, and referral to other sections of the department or outside agencies have been implemented to divert non-emergency work away from officers on the street. By reducing patrol workload, they free officers to perform other duties such as directed patrol or case follow-up, and they allow departments to give priority to those calls requiring an immediate mobile response.

Call prioritization policies have also been developed to delay and stack certain types of reports. Traditionally, departmental policies for delaying calls for service were applied informally, only when all patrol units were busy. Today, they are an integral part of police operations. Policies specify what types of calls can be delayed (e.g., larcenies), under what circumstances (e.g., 24 hours old), and for how long (e.g., not more than 45 minutes). Their implementation makes workload more manageable, results in fewer cross-beat dispatches, and means that officers do not have to be interrupted while on assignment.

Call prioritization policies that provide for delayed and non-mobile response strategies can be introduced without adversely affecting citizen satisfaction. A Police Foundation study found that citizen satisfaction is not a function of speed of response, but of certainty.²⁶ Citizens are just as likely to be satisfied by a department that promises a 45 minute response and provides one as they are by a department that delivers a more rapid response but does not state in advance what the response time will be. Further, work by the Police Executive Research Forum concluded that although affected by departmental changes in service, citizen satisfaction tends to be more a function

of individual perceptions about the quality of the environment in which they live than of the extent and level of police services.²⁷

The push to make the most productive use of existing resources has not been limited to administrative policy and procedural changes. In the field, patrol officers no longer have complete control of their unstructured time. Instead, their supervisors are assigning them preplanned directed patrol activities designed to proactively address either a specific problem (e.g., teenagers loitering in a shopping mall, auto thefts from municipal parking lots) or the department's general crime prevention and deterrence mission (e.g., reduction of drug use in high schools via speaking in assembly programs). (See earlier section entitled Directed and Preventive Patrol) Many police commanders believe these directed patrol projects to be so beneficial that they have instituted policies against interrupting them for calls for service except in extreme emergencies. They have designed forms to record details about the projects undertaken and to monitor their outcomes. Officers are held accountable for addressing problems in their beats; supervisors for ensuring that timely projects are conducted in a way that will produce results; and managers for tracking the progress made. Directed patrol has thus become a method for enhancing the use of time previously committed only to random patrolling.

Monitoring directed patrol assignments is but one aspect of police operations that has become the focus of routine data collection and analysis. Many law enforcement agencies have implemented departmentwide management information systems to monitor all facets of their operations. These systems regularly collect information and generate reports on the number and types of calls for service, units dispatched, calls delayed, calls diverted, disposition of calls, cases investigated, cases cleared by arrest, and cases closed by patrol, for example. Their departmentwide perspective recognizes that patrol and other divisions do not function in a vacuum but are part of a complex organizational structure with interrelated components. This focus enables managers to consider the global effects of operational or administrative changes and has resulted in a more coordinated approach to reviewing and evaluating departmental activities, including patrol.

Fiscal crises experienced by local governments, the need to keep up with a constantly changing environment, and increased public demands for accountability have all provided some impetus for developing monitoring systems; however, the proliferation of data processing technology has also played a significant role in fostering their development. Automation has reduced the paperwork burden im-

posed by these comprehensive systems. It has facilitated the conduct of routine analysis of on-going concerns as well as special studies of unanticipated issues.

Maintaining quality services with the resources available requires innovation and experimentation and changes in the traditional method of service delivery. The challenge for law enforcement in the 1980's is to continue finding ways to enhance efficiency and effectiveness in the

delivery of police services to the community. When increased calls for service and expanded public definitions of the problems that are appropriate for police attention are combined with static or declining local budgets, this challenge becomes even more urgent. This report, in providing examples from actual departmental experiences and factual discussions of approaches to resource allocation, will help police managers take one step toward the continued upgrading of patrol operations.

FOOTNOTES

1. Chapter Two discusses some of the external and internal sources from which issues about police patrol operations are likely to arise.
2. A relief factor of 1.8 means that in order to staff one patrol position for an eight hour shift every day, the police department had to have 1.8 officers available. The relief factor is computed by multiplying the number of hours on a shift by the number of days in a year (8×365) and dividing that total by the number of hours worked in a year ($40 \times 52 = 2080$). Using this formula, a relief factor of 1.4 is computed; however, sick leave, vacation, and holidays are not considered in the equation. In Albuquerque, officers worked an average of 31.2 hours per week, or 1622.2 hours per year, thus necessitating a relief factor of 1.8.
3. Police managers must assess carefully the patrol objectives they wish to pursue. In making one objective a priority, others will necessarily have to be compromised. A department that selects Option Two trades longer travel time to calls for service for a staffing plan that is proportional to workload.
4. The California Commission on Peace Officer Standards and Training has studied and published reports on the effects of different schedules on police officers. Also see Hand, Burgess, and Wilson, "A Four-Ten Plan for Moderate and Large Police Patrol Operations," in *Law and Order* (November 1975), pp. 8-12 for a discussion of the impact of schedule changes in the DeKalb County, Georgia, Police Department.
5. George Kelling, Tony Pate, Duane Dieckman, and Charles Brown, *The Kansas City Preventive Patrol Experiment: A Technical Report* (Washington, D.C.: The Police Foundation, 1974).
6. John F. Schnelle et. al., "Social Evaluation Research: The Evaluation of Two Police Patrolling Strategies," in the *Journal of Applied Behavior Analysis*, Vol. 8, No. 4 (1975), pp. 353-365; and William Francis Wagner, *An Evaluation of a Police Patrol Experiment* (Pullman, Washington: Washington State University, 1978).
7. James Tien, James Simon, and Richard Larson, *An Evaluation Report of an Alternative Approach in Police Patrol: The Wilmington Split-Force Experiment* (Cambridge, Massachusetts: Public Systems Evaluation, Inc., 1977).
8. Kansas City, Missouri, Police Department, *Directed Patrol Project: Final Evaluation Report, 1979* (February 1980) an unpublished document.
9. Some automated resource allocation models, in prescribing patrol plans, allow the user to specify desirable percentages of time to be spent on calls for service and other activities. These models are discussed in detail in Chapter Four.
10. Kansas City Police Department, *Response Time Analysis: Executive Summary* (Kansas City, MO: Kansas City Police Department, 1977), p. 23.
11. It is important to note that the Kansas City study has been the subject of debate and criticism among professionals. This controversy centers not only on some of the technical aspects of the work but also on some of the conclusions drawn by the researchers. For a discussion, see Richard Larson, "What Happened to Patrol Operations in Kansas City? A Review of the Kansas City Preventive Patrol Experiment," in *Journal of Criminal Justice*, Vol. 3, No. 4 (1975), pp. 267-297.
12. U.S. Department of Justice, National Institute of Law Enforcement and Criminal Justice, *Differential Police Response Strategies*, by Raymond O. Sumrall et. al., (Washington, D.C.: Police Executive Research Forum/Birmingham Police Department, 1981), p. 35.
13. The scope of this report does not permit a full discussion of call prioritization and alternative response models. They are covered briefly in Chapter Three. For further direction on these subjects, see U.S. Department of Justice, National Institute of Law Enforcement and Criminal Justice, *Improving Patrol Productivity, Volume I: Routine Patrol*, by Gay et. al. (Washington, D.C.: Government Printing Office, July 1977), Chapter Three; Sumrall, Roberts, and Farmer, *Differential Police Response Strategies* (Washington, D.C.: Police Executive Research Forum, February 1981); and U.S. Department of Justice, Law Enforcement Assistance Administration, *Integrated Criminal Apprehension Program: The Role of Communications in Managing Patrol Operations*, by Grassie, et. al. (Washington, D.C.: Government Printing Office, August 1978).
14. Gay et. al., *op. cit.*, p. 96.
15. Peter Greenwood, Jan Chaiken, and Joan Petersilia, *The Criminal Investigation Process* (Lexington, MA: D.C. Heath and Co., 1977) Department of Justice, National Institute of Law Enforcement and Criminal Justice, *Felony Investigation Decision Model: An Analysis of Investigative Elements of Information*, by Bernard Greenberg, Carol Elliot, Lois Kraft, and Steven H. Proctor (Washington, D.C.: Government Printing Office, February 1977).
16. U.S. Department of Justice, National Institute of Justice, *Solving Crimes: The Investigation of Burglary and Robbery*, by John E. Eck (Washington, D.C.: Police Executive Research Forum, 1983), p. xxi.
17. U.S. Department of Justice, National Institute of Law Enforcement and Criminal Justice, *Managing Criminal Investigations Manual*, by Donald F. Cawley et. al. (Washington, D.C.: Government Printing Office, June 1977), p. 5.
18. *Ibid.*, p. 3.
19. Gay et. al., *op. cit.*, pp. 23-24.
20. U.S. Department of Justice, National Institute of Justice, *Issues and Practices in Police Work Scheduling*, by William Stenzel and R. Michael Buren (Washington, D.C.: Government Printing Office, February 1983), pp. 13-14.
21. Stenzel and Buren, *op. cit.*, p. 2.
22. *Ibid.*, p. 1.
23. *Ibid.*, p. 2.
24. For additional information on patrol planning practices, see *Survey of Police Operational and Administrative Practices - 1981*, a review of over 120 departments conducted jointly by the Police Executive Research Forum and the Police Foundation.
25. See Eric J. Scott, *Calls for Service: Citizen Demand and Initial Police Response* (Washington, D.C.: Government Printing Office, 1981).
26. Tony Pate et. al., *Police Response Time: Its Determinants and Effects* (Washington, D.C.: Police Foundation, 1976).
27. Sumrall et. al., *op. cit.*

Chapter 2: Analyzing the Current Patrol Plan

What Can Management Learn From Analyzing the Patrol Plan?

Patrol resource allocation plans should be evaluated in terms of their contribution to the attainment of such law enforcement goals as crime suppression, recovery of stolen property, preservation of the peace, responding to non-criminal service requests, and arrest. That is, the analysis should assess how well the patrol plan helps resolve the problems with which the police are supposed to contend.

Paradoxically, while most police departments spend well over half their budget on the patrol function and devote over half their manpower to staffing a Patrol Division, they rarely take the time to look for deficiencies or needed improvements in their patrol plan. Chaiken believes this negligence occurs primarily because "patrol is conducted routinely and continuously by the lowest-level officers in the department and is unlikely to be the subject of public praise or concern, whether it operates efficiently or not."¹ Other researchers attribute it to the fact that law enforcement goals are usually stated only in general terms, and, thus, few reliable methods exist for operationalizing and measuring the impact of patrol allocation plans on these goals.² Finally, our own telephone survey of 32 departments which conduct patrol plan analyses revealed other disincentives. Departments cited the time needed to collect and collate the requisite data, the expense of the total evaluation process, pre-existing union contract conditions, and the lack of personnel with the necessary skills and background as being some of the most difficult problems facing them in deciding to implement an evaluation.

In spite of these constraints, departments can benefit from examining their patrol force allocation plans. Perhaps one of the most useful results of a patrol plan analysis is the information it provides top administrators about the operations of their agency. Today, many police managers find themselves coping with the backlash against the growth in dollars and personnel that was typical of municipal government in the 1960's and early 1970's. Because marginal personnel and budgetary increases or recommendations for cutbacks have replaced this history of expansion, proper use of resources is one of the most important tasks that must be accomplished by police administrators. The patrol planning process will inform managers as to the actual demands being placed upon their personnel and will give them a realistic picture of the op-

tions available for resource allocation based upon the best match between resources and demands. Further, a thorough patrol plan analysis will show administrators weaknesses in such areas as shift staffing and beat or sector configuration. By considering these outcomes, administrators may find ways to realize even a small percentage increase in the efficiency of personnel utilization that will not only yield significant monetary savings but will also help contain the cost of providing services.

The comprehensiveness of a department's data base will become readily apparent with the onset of the evaluation process. Shortcomings may be identified in the data collection forms themselves, the type of data being collected, or the storage and retrieval procedures. Such findings have implications not only for a department's ability to conduct a patrol force allocation assessment but also for its ability to perform other complementary analyses (e.g., strategic crime analysis). The investment of time and personnel will seem well worth the effort when managers can easily access valuable information to improve both the efficiency and effectiveness of their agency.

A patrol plan analysis may suggest the need for policy review. For example, managers may find that, in order to maintain a maximum delay of thirty minutes for calls held in queue, they will have to prescribe different responses for some calls normally handled by uniformed patrol, e.g., telephone reporting, walk-in reports or community service officers. A change from two-officer to one-officer units may be warranted if there is a need to reduce beat size to minimize response time without increasing manpower. Overlay shifts might have to be added or reporting hours adjusted if the analysis shows significant increases or changes in the pattern of calls for service. In sum, with a patrol plan analysis management can identify departmental policies that may need modification if operational goals are to be achieved.

Measuring the goals of police patrol is not always a clear process. Such goals as reducing auto thefts by ten percent or increasing Part I arrests by fifteen percent are easily calculated measures of departmental success; however, the achievement of other objectives such as satisfying citizen expectations of police service, improving officer morale, providing the community with a sense of security, or enhancing officer safety cannot be so readily ascertained. As a consequence, standards of performance that have been shown to be reliable measures of proficient patrol operations have evolved. Among the most commonly cited performance criteria are balanced workload,

response time to emergency calls, time available for officer-initiated activities, availability of back-up assistance, and frequency of cross-beat dispatches. From an analysis based on quantitative measures such as these, a manager can subjectively evaluate how adequately his resource utilization plan contributes to the satisfaction of law enforcement goals. Of course, the usefulness of the performance estimates produced by the analysis must be interpreted by persons who are familiar with departmental operations so that anomalies in the data can be pinpointed and their implications weighed (e.g., the Headquarters beat being a high crime/fast response time area because of telephone or walk-in reports).

Despite all the benefits that can be accrued from a patrol plan analysis, one caveat is in order. Patrol planning *cannot* stand alone. To be effective it must be part of a more far-reaching effort toward sound departmental management that considers the systematic interrelationship of patrol with other police functions. Patrol resources cannot be managed without a call for service management program; a call for service management plan cannot be instituted without consideration of the patrol resource allocation plan; and criminal investigations cannot be managed if calls for service are not controlled and the patrol response and role in handling those calls is not defined.

Addressing Issues in Patrol Operations

Police managers, particularly those responsible for uniformed patrol, are called upon to resolve a wide variety of issues. Typical questions that they must consider include whether the number of patrol personnel is adequate for the workload, whether response time to emergency calls is acceptable to the public, whether a better officer work schedule is possible, and whether there is sufficient patrol time available for a new patrol program, such as directed patrol, to be introduced.

Exhibit 2.1 illustrates the process of issue resolution, from issue identification through monitoring and periodic review. The origin of an issue (e.g., an external source such as an elected official or an internal source such as a new chief of police) can have a direct bearing on how it is approached for analysis, the staffing assignments made to resolve it, the analytic technique used, and the subsequent actions taken. This chapter discusses the sources of issues about patrol operations and demonstrates how an issue can affect staffing choices, data requirements, and analytic options. The remainder of the report provides an in-depth, issue-focused review of analysis techniques (Chapters Three and Four) and a summary of the steps and organizational constituents necessary for developing alternatives, making changes, and monitoring the new plan.

How Issues Arise

Issues affecting patrol operations can arise from either external or internal sources. Examples of each are as follows:

- External Sources
 - Elected Officials
 - Annexations
 - Layoffs
 - Legal Decisions
 - Community Groups
- Internal Sources
 - New Chief of Police
 - Promotions
 - Unions

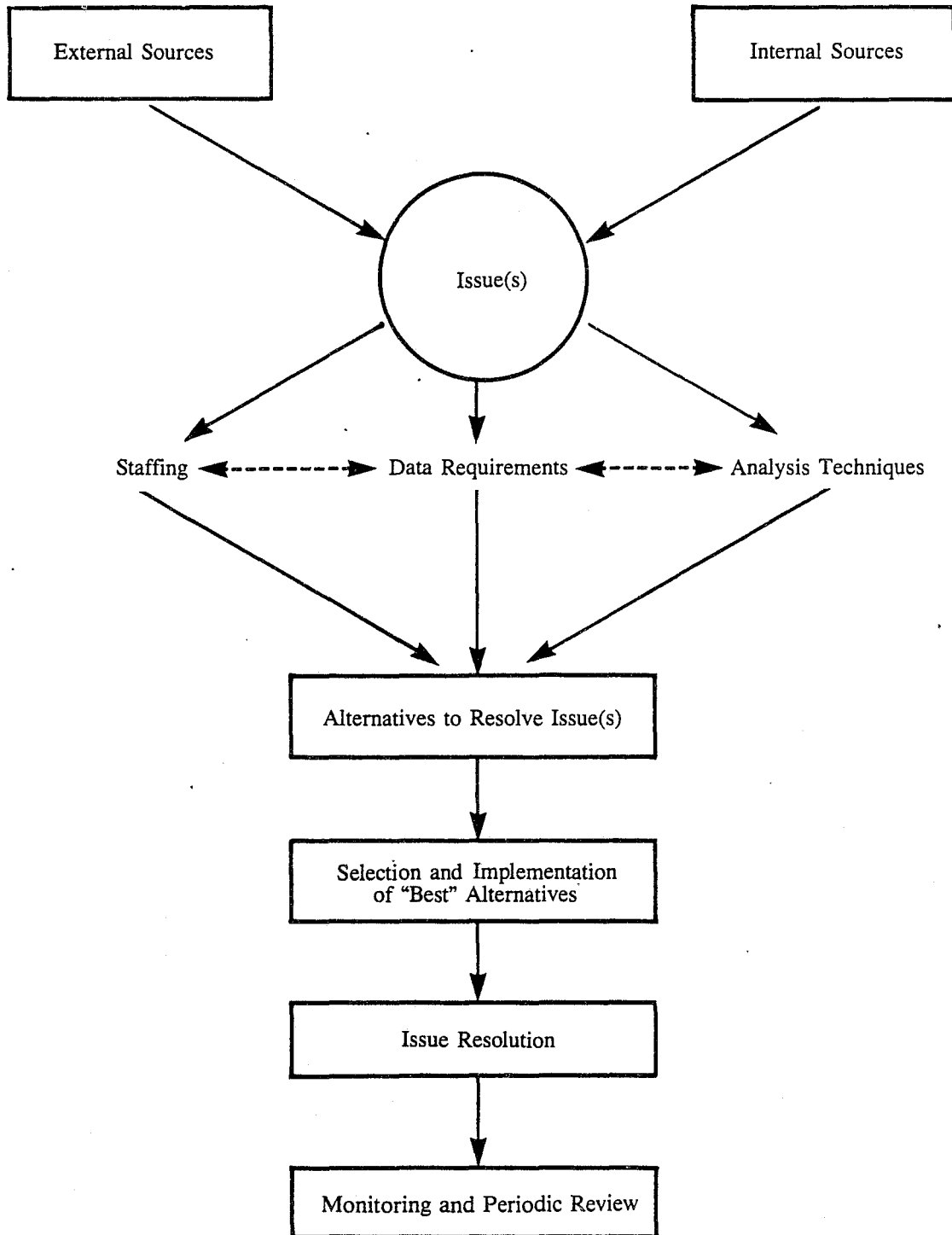
External sources are influences over which the police department has no direct control but which cause an operational change to be considered. An annexation to a city usually means a need for increased police personnel and changes to the patrol allocation plan. For example, the City of Charlotte, North Carolina, has experienced several annexations over the last ten years, resulting in additions in patrol personnel for the police department. These increases were based on the anticipated workload from the newly annexed areas as measured by calls for service, crime, and other workload indicators.

Layoffs are another externally imposed change which can necessitate reassignment of officers and reallocation of patrol personnel. In some cities, police officers have been laid off, with the result that fewer services could be provided by the department. In 1981, the City of Toledo, Ohio, due to fiscal problems, was forced to lay off over two-hundred civilian personnel, including over thirty civilians assigned to the police department. The police department had to staff the vacated positions by transferring patrol officers, with the result that fewer units could be provided for response to citizens' calls for service and crime prevention activities.

Most police departments face annual increases in citizens' calls for service. Some departments have reacted to this external influence by establishing alternative procedures for handling calls for service, as will be discussed in Chapter Three, while other departments have tried to persuade the city to increase their authorized strength so that more patrol personnel can be fielded.

Outside parties such as city officials and community groups are also sources of issues about patrol operations. It is not unusual for persons seeking public office to include the objective of reducing crime or improving police services in their platforms. In addition, many municipal

EXHIBIT 2.1
THE PROCESS OF ISSUE RESOLUTION



governments have Public Safety Committees which deal with citizen concerns about police, fire, and emergency medical services. The committee members, having a genuine interest in the patrol operations of the police department, often raise questions on how the delivery of police services to the citizens can be improved. The desire for a special crime prevention program, such as foot patrol or directed patrol, is typical of the issues posed from these committees. A somewhat related situation occurs when an individual event, such as a heinous crime or a crime wave, triggers an inquiry which results in a change in patrol operations. Finally, community groups may want a substation to service a particular area of the city and may pressure city officials and Public Safety Committees for action. Establishing a substation usually has the dual effect of increasing the authorized number of supervisory positions in the department and reallocating patrol personnel.

Internal police department influences are the second major source from which issues about patrol operations can arise. Some police departments conduct regular reviews of patrol operations. This examination may be assigned to an individual in the department, to a committee comprised of key commanders in the department, or to a section of the department such as the Planning and Research Unit. Key questions asked during such a review include the following:

- Has an increase in the relief factor created a shortage of available officers for patrol?
- How busy are the patrol units?
- Is the average travel time to emergency calls acceptable?
- Is there unequal workload among beats and units?
- How often are all units busy?
- Has there been an increase in workload?
- Is there sufficient time for crime prevention activities?

This initial review may raise other issues for further consideration, with the eventual result that changes are made to patrol operations. Indeed, it is rare for an analysis to indicate that there are no patrol allocation problems. Whether or not a further study of the problems is warranted is the decision of the department managers reviewing the analysis.

An evaluation of patrol operations can occur when there are changes in the key management personnel of a department. For example, when a new Chief of Police is appointed, particularly one from outside the department, concerns about field operations can be expected. Promotions within the department and reassignments of key per-

sonnel can also lead to a review of patrol operations. In these instances, the newly assigned personnel may bring their own ideas about operational programs which they would like to implement and, as a result, the issues are raised to determine whether these ideas are viable alternatives to the current operations.

A final way in which issues arise internally is pressure from police unions interested in improving the well being of patrol officers in the department. Typical issues from a police union center are whether officer schedules are adequate, whether the number of two-officer units should be changed, and whether more officers are needed in patrol to meet the objectives of the department and provide sufficient officer safety. These issues may evolve as part of contract negotiations when the union presents its analysis of patrol operations containing suggestions for modifications. In response, the police department management may also present an analysis.

Planning for Issue Resolution

The impetus for studying an issue is influenced by the source's span of control. For example, city officials control the budget. The issues being raised by city officials often, therefore, are budget related. Proposed police budget increases must be reviewed by city officials who, in response, may suggest alternatives for the department to consider that would not result in a budget increase. The city may favor a Telephone Response Unit for a police department, recognizing that this approach to handling calls for service reduces the need for more officers in the field. On the other hand, a budget increase for more officers may be approved if it is believed that citizens want a personal officer response rather than having their reports taken over the telephone.

In contrast, the police department management controls the allocation of patrol resources. They can consider changes in the allocation of personnel by geographic areas, by time of day, or by day of week. They can also consider changes in officer work schedules and in the mix of one-officer and two-officer units. Alternative dispatch procedures governing when nonemergency calls can be delayed and when to send back-up units are also controlled by the department management. However, the department management has constraints on these considerations as reflected by the terms of union agreements, the acceptance of changes by city officials and citizens, and the potential impact on officer morale. These constraints have a direct bearing on the issues which evolve within a police department. If the union agreement specifies the officer work schedule, then the issue of schedule changes can be addressed only through negotiations which usually occur at contract renewal time. This example illustrates both the

derivation of union influences from the contract agreement and the pressures that the union can place on department management, using the contract as a foundation.

Since changes in departmental operations have a major impact on police personnel and citizens alike, patrol issues must be given serious consideration. They always require careful analysis in order to develop alternatives and select the most appropriate course of action. The procedure for addressing a particular issue or group of issues can be divided into the following three components:

- Staffing
- Data Requirements
- Analysis Approach

Staffing

Special care must be taken by the department in selecting the staff who will be responsible for addressing a particular issue or group of issues. An individual or a section of the police department, such as the Planning and Research Unit, is usually given the responsibility for conducting the patrol analysis. Many times an advisory board is formed to assist in the development of alternatives and to approve any plan which evolves. In considering issues about the need for new beat boundaries, for example, the advisory board may be comprised of representatives from field operations, communications, data processing, and the Planning and Research Unit. If the issue is the work schedule of officers, then a union representative may be included on the advisory board.

A consultant or expert also may be hired to address an issue of particular importance to the city. When the issue has been raised by persons outside the police department, such as city officials, the use of a consultant is particularly relevant. In this case, the consultant acts as the analyst as well as the developer of alternatives for the city and police to consider. As an example, the City of Dallas, Texas, hired a consultant to determine whether the police department should have an increase in authorized officer positions. (See Chapter Four for a discussion of this study.)

If the department routinely performs a periodic review of its patrol operations, then the selection of staff may be eased. That is, there may already be persons in the department familiar with the requirements and procedures of the process since analyses have been performed in the past. Such a pool of expertise will be invaluable, not only in conducting the patrol plan review but also in recognizing inconspicuous problems before they become major issues.

Regardless of whether an individual, section of the department, or consultant has the responsibility for addressing the issue, the person(s) collecting the data, conducting the analysis, and developing alternative resolutions should have a range of skills and background relevant to the problem. Analytical skills and practical experience in field operations are general prerequisites that should be considered. Operational experience is needed because it gives the individual a 'real world' perspective both on possible solutions to an issue and on the alternatives that might be acceptable to officers in the field. For example, beat redesign should always be accomplished by someone familiar with the community's geography and, in particular, with any recent changes in streets, traffic flow, new buildings, residential developments, and other physical conditions that can affect beat design.

Analytical skills are necessary not only to ensure that comprehensive consideration is given to the types of analyses that can be performed, but also to assure that correct formulas are applied and accurate calculations made. For more difficult issues such as determining the number of officers needed to satisfy travel time or queuing delay objectives, these skills may include data processing, mathematics, and systems analysis. For simpler issues, the analyst may only need an aptitude for understanding the statistics on incoming calls, average elapsed times, and other measures which are relevant to the issue being addressed.

Data Requirements

It is difficult for the management of a police department to document the full range of activities performed by patrol officers during an eight hour shift. In general, officers are on their own much of the time. Their work is not an assembly line process but, instead, is usually determined by the volume of citizens' calls they must handle and by special duties, such as specific crime prevention activities or funeral escorts, which their supervisor assigns at the start of their tour of duty. While the supervisor generally has some idea of what his subordinates are doing, he is often in charge of six to eight geographically dispersed officers and obviously cannot know their activities at all times. In view of these circumstances, the department's management must determine patrol units' workload demands by analyzing such source documents as dispatch cards, duty rosters, officer activity logs, traffic tickets, and field interview reports.

Collecting data about officers' workload is the first step departments should take in analyzing the existing patrol resource allocation plan. However, in order to ensure that the proper data are collected and later make evaluative judgments about the adequacy of the patrol plan in han-

ding workload, the department must define what it means by workload. Typically, workload is divided into three categories: citizens' calls for service; self-initiated activities; and administrative activities. The category emphasized in an analysis will depend on the issue, but departments will usually need to collect data on all three. For example, computer models frequently used in patrol planning need information on all patrol officers' activities that make them unavailable to answer calls for service.

A common question of interest to patrol supervisors is, "How busy are the units on my shift?" This issue of unit utilization is important not only because it affects a supervisor's ability to initiate specialized activities such as directed patrol and crime prevention on his shift, but also because it influences other operational considerations such as call queuing and dispatch delays. The supervisor's question can be answered by performing a simple mathematical computation:⁴

$$\text{Unit Utilization} = \frac{\text{Workload (in hours)}}{\text{Unit Hours}}$$

Multiplying by 100 yields the percent of time a patrol car is busy on the type of work counted in "workload." Using this formula, it is apparent that changes in the definition of workload could have a major impact on a supervisor's perception of how busy the units on his shift are.

The issue to be addressed also determines data requirements. For example, if the issue concerns the average response time to calls for service, then data on the time calls are received in the Communications Center and the time the patrol units arrive at the scene are needed. Further, the department should have a priority system in Communications so that the average response time for emergency calls, as compared to non-emergency calls, can be determined. The response time issue is more difficult to address if the department does not have a priority system or if officers do not reliably notify the dispatcher upon their arrival at the scene.

At the outset, a determination must be made regarding what specific data are needed and whether the database currently exists. Typically, data about calls for service (CFS), time expended, non-CFS officer activities, backup units required, staffing schedules and actual units fielded, and response time will be required. These data may be supplemented by measures such as area of patrol districts and sectors, length of patrolled streets, manpower availability factors, and average preventive patrol and response speeds, as well as by information pertaining to policies about call delays and dispatching priorities, administrative demands on patrol officers, and manpower authorization levels.

Many police departments routinely gather these former types of data; however, for those agencies that have not routinized such data collection procedures, there are automated data processing systems that can capture and store the information, or it may be collated and tallied by hand using the source documents discussed below. For the small department that finds it difficult to commit personnel to data collection and analysis tasks, the low call-for-service workload during the early morning hours can be used by dispatchers and call takers to compile and analyze workload information.

Dispatch cards. The dispatch cards, prepared by Communications Center personnel, are a key source of information useful in measuring both the types of activities patrol units perform and the amount of time they require. A dispatch card is completed whenever an officer either responds to an incident or initiates some activity on his/her own. It usually shows such details as (1) the type of call; (2) the location of the incident; (3) the unit(s) assigned; (4) the time the call was received at the Communications Center and the time the unit was dispatched, arrived on the scene, and completed the call; and (5) the disposition of the call. Several key performance measures for patrol units can be calculated using these data from dispatch cards, for example:

- the total number of calls;
- average travel time;
- average time at the scene;
- unit utilization; and
- how frequently *all* units are busy.

Some of these measures may be further refined according to the type of call, priority, specific unit, area of the jurisdiction, day of the week, and time of day.

Dispatch tickets, while containing many valuable descriptors, should not be the sole data source for a patrol allocation analysis because they do not reflect all patrol activities. Often officers are asked to perform administrative duties such as delivering legal papers to the State's Attorney or transporting evidence to a lab. Rather than filling out a dispatch card for these assignments, dispatchers may use a system of status cards to indicate (for their own purposes) that the unit is not available to respond to calls for service. The same may be true when officers have to appear in court during their tour of duty. And sometimes, though it is against policy in most departments, officers themselves do not report to the dispatcher that they are out of service, for example when they stop to assist a citizen, issue a traffic citation, or complete a report. Likewise, they do not always report their arrival on the scene of a call to the dispatcher. Without this data

element, it is impossible to calculate travel time, response time, or on-scene time—three key indicators of a patrol plan's adequacy. Thus, if a department were to rely only on dispatch cards to assess how officers spend their time, the results of its analysis would be inaccurate because the cards do not capture the full extent of patrol activities.

Duty rosters. For the purposes of a patrol plan analysis, it is important to determine the *actual* number of officers and units fielded. An accurate accounting is necessary if a true picture of a department's ability to handle call for service demands, maintain a reasonable relief factor, and meet performance objectives (such as a three minute response time to emergencies and a maximum forty-five minute delay on non-emergency calls) is to be obtained. Some analysts mistakenly assume that the patrol plan itself indicates this number; however, what the plan shows is the number of officers and units that are *supposed* to be fielded. In reality, because of holidays, vacation, sick leave, or injury, this is often not the actual number on duty. The analyst must consult the duty roster to obtain the true number of officers reporting for work each day and the actual number of units fielded.

Duty rosters are a source of other valuable information in addition to the correct number of officers and units fielded. For example, they tell the analyst how many units are assigned to an area and how many of the units are one-officer versus two. These data are important because they are input for some of the analytic models and because they influence departmental and officer productivity measures. Some rosters also specify special non-call for service activities undertaken on a shift, including station duty, parade security, funeral escorts, court appearances, and substitute crossing guard duty, for example. Such information helps round out the full description of departmental workload. Finally, the duty roster may indicate the reasons why the actual deployment does not match the recommended deployment—vacation, holiday, regular day off, sickness, injury, etc.

Officer activity logs. One tool used by some departments to document patrol operations more completely is the Officer Activity Log. Patrol officers may be required either to account for their full eight hours of work or to record only those activities that are not dispatched via the communications center. While Officer Activity Logs collect useful information, they are called "cheat sheets" by many who use them; they do not enjoy a reputation for infallibility in police departments. It is not uncommon for officers to inflate or deflate the amount of time shown as spent on particular activities, depending on the priorities of their supervisor and commander. In addition, if officers think that they are being evaluated on the basis of their logs,

they are likely to become more proactive than they would otherwise be, and their logs would document more work being performed than is normally the case. Finally, because the logs are viewed as an unnecessary, extra paperwork burden by the rank and file, officers may not be as careful as they should be in filling them out.

To remedy these shortcomings, some departments use a sampling procedure in which officers are assigned on a rotating schedule to complete the logs. The advantage of this approach is that officers may be more conscientious if they know that they will have to use the logs only temporarily. Other departments, in an effort to ensure that officers know their logs are not intended for performance evaluation, use a planning unit instead of an operational or personnel unit to administer the data collection process. Arrangements such as not requiring a supervisor's signature and providing a drop-off box not only protect the confidentiality of the information but are meant to encourage officers to be more accurate in their reporting. Even so, this data source must be used with caution.

Traffic citations and field interview reports. Other helpful sources of information about patrol activities are traffic citations and field interview reports. Traffic citations not only can help a department pinpoint locations of traffic problems within its jurisdiction, but they can also serve as a basis for determining, to a limited degree, the frequency and utility of this officer-initiated activity and the time spent on it. Field interview reports can be used in a similar way. They may be studied not only to suggest areas of potential criminal activity, but also to further identify how much work is initiated by the officers themselves. Data gleaned from analyzing traffic citations and field interview reports may serve as a basis for directed patrol assignments. They should also be combined with the details of dispatch cards and Officer Activity Logs to give as complete a picture of total workload as possible. Thorough documentation of all patrol activities is an essential prerequisite to developing a patrol plan that both reflects the best match between resources and demands and results in an equitable and balanced distribution of the workload.

Availability of The Data: How About a Sample?

Computer-aided dispatch systems automatically capture data about officers' activities and departmental performance measures. For departments which do not have that type of system, dispatch tickets and other data sources will have to be manually tabulated or keypunched for analysis. One of the assumptions in all of the discussion so far has been that the necessary data are readily available for the analysis. In reality, this will not always be the case.

Depending on the issue being addressed, the data on which to base a decision for or against an operational change may not be available. When an issue demands data that are not available, the department management must decide whether the issue is of sufficient importance to warrant a special data collection effort. In this section, the technique of sampling will be discussed as a data collection procedure.

The advantages of sampling include the following:

- Sampling can provide reliable information.
- Sampling is a relatively quick way of obtaining information.
- Sampling is less expensive than a complete analysis of the data.

An example of the effective use of sampling is provided by the experience of the Albuquerque, New Mexico, Police Department under its Managing Patrol Operations (MPO) project. Prior to the MPO project, the police department did not keypunch any of its dispatch tickets. As a result, the department management did not have *any* information about its patrol operations. Basic information on the number of citizen calls, the average travel time to emergency calls, the average service time, and the geographic distribution of calls was not known.

As part of the MPO project, the project analyst developed a sampling procedure to obtain information from dispatch cards so that an evaluation of the patrol plan could be made. This procedure was employed throughout the duration of the project, by taking samples of dispatch tickets at six month intervals beginning with the July-December 1978 period, and ending with the January-June 1980 period. The procedure was the same with each sample. Over a six month period, there are 549 patrol shifts (183 days times 3 shifts per day). Of that total, the analyst *randomly selected* 113 shifts as a representative 20 percent sample. The sample was taken so that an equal number of each day of the week was included. The dispatch cards for the sampled shifts were then removed from storage and all were coded by graduate students from the local university. Information taken from each ticket included date, day of week, shift, unit(s) assigned, type of call, time of dispatch, time of arrival, and time completed. The types of activities reflected in the dispatches were divided into the following four major categories:

- **Citizen Calls For Service**—Those calls which originated in the 911 system as citizen requests for assistance.
- **Back-up Calls**—Dispatch tickets for all assist units required for the calls for service.

- **Self-Initiated Activities**—Dispatch tickets for self-initiated activities generated by the patrol units.
- **Administrative Activities**—Dispatch tickets for all administrative activities performed by the patrol units.

Key punching was contracted to a local firm which specialized in data entry. Together, the coding and the key punching operations for each sample required approximately five weeks to complete.

Tabulations were developed on the University of New Mexico computer to generate a complete analysis of key performance measures for patrol. For the first time in over ten years, the department management was able to have basic statistics on its patrol operations. The analysis showed a considerably greater volume of citizen calls for service than the management previously believed the department received. Based on the results of the sample, significant changes were made in the geographic distribution of officers, the percentage of officers assigned to each shift, and the work schedules of the officers.

The Sacramento, California, Police Department, also a participant in the MPO program, provides another example of sampling. There, the city Data Processing Section had responsibility for keying dispatch tickets for the department. Because of cutbacks in budget and personnel, a cost reduction procedure was implemented whereby every other day of dispatch tickets was keypunched. The procedure of keying every other day of dispatch tickets represents a *systematic sample*. Based on this sample, the police department received a series of reports which gave information on its patrol deployment on a monthly, quarterly, and annual basis. These reports served to support periodic changes in patrol operations in the department.

A final example, in which changes were implemented in the Patrol Division of the Lynchburg, Virginia, Police Department as the result of sampling dispatch tickets, is described by David Scalf.⁵ The sample size was 12.5 percent of a 288 day period, taken by selecting every eighth day of this period. Information from the dispatch card included the date, nature of the call, beat, units assigned, location, time the call was received, time dispatched, time of arrival, time cleared, and final disposition. On the basis of this analysis, a new beat design was developed and implemented by the department.

Samples are often appropriate for finding out how patrol officers spend their time. A sample of officers can be selected to complete a daily log for a one- or two-month period. In some departments, a daily log is completed every day by all officers. The criticism of this approach is that officers quickly tire of the log and begin to record unreliable information. The advantage of a sample is that

officers may be more likely to provide accurate information over a shorter period of time—particularly if they have been told of the importance of the data from the logs.

In summary, the objective of a sample is to lessen the data collection task while assuring the validity of the data base that will be used for analysis. For most agencies, a sample of 2500-3500 dispatch cards will be adequate for determining temporal and beat service demand patterns. This sample can be supplemented with aggregate daily service call totals to determine daily CFS variations. Sampling techniques have been found to be a beneficial procedure for obtaining information about a patrol plan. In the departments that have employed sampling procedures, the results have been reliable enough to serve as a basis for decisionmaking and changes in the patrol plan.⁶

Analysis Approach

The department's data processing capabilities, staffing resources, and the availability of the requisite data influence the choice of analytic technique. The analysis approach also is dependent on the complexity of the issue under consideration. At one extreme, the analysis may be completely manual while, at the other extreme, it may require computer modeling. For example, the analysis of whether there are supervision inequities is almost entirely a manual process in which data are collected on the number of officers and the number of sergeants in different geographical commands of the department; afterward the ratios are calculated by hand. A comparison then determines inequities. On the other hand, if the issue is the number of patrol units required so that the probability of a delay (that is, the probability of all units being busy) remains below a given threshold, then a computer may be required because of the complexity of the calculations. This section presents an overview of several analysis approaches whose application will be described in greater detail in Chapters Three and Four.

Dispatch ticket analysis. As discussed, one of the key data sources for analysis of patrol operations is the dispatch ticket completed on all citizen calls for service. The dispatch ticket contains a wealth of information on the call including the type of call, the unit assigned, the time of arrival, and the time the call was completed. By analyzing these data, the department management can obtain a very good picture of how patrol units are spending their time during a tour of duty. Police managers are usually interested in the following summary statistics that can be calculated from dispatch cards:

- total number of calls for service;
- number of calls for service by hour, shift, beat, and reporting area;

- average dispatch delay (in minutes);
- average travel time (in minutes);
- average on-scene time (in minutes);
- average service time (in minutes);
- average number of back-up units per call;
- unit utilization;
- probability that all units are busy; and
- average number of free units.

The *number of calls for service* is, of course, simply a count of the number of dispatch tickets completed for the basic patrol units. The only complication in obtaining this figure occurs when the department's policy is to prepare a separate dispatch ticket for back-up units rather than listing them on the original dispatch ticket. Under this circumstance, it may be difficult to link together the records of the distinct units dispatched to the same call, so it is advisable to develop separate counts for the first unit sent and the back-up units.

The *average dispatch delay* is calculated using the time that elapses between a call's arrival in the Communications Center and a patrol unit's dispatch. Similarly, the *average travel time* is based on the time between the dispatch of a patrol unit and its arrival on the scene. It is obviously important for the officer in the patrol unit to notify the dispatcher upon arrival at the scene in order for these statistics to be calculated. The *average response time* is defined as the dispatch delay time plus the travel time and is another common statistic for patrol analysis. The *average on-scene time* is the elapsed period between time of arrival at the scene and final completion of the call. Finally, the *average service time* is defined as the travel time plus on-scene time. The service time represents the total time that the unit is working on the call and unavailable for other assignments. It should be noted that the service time can be calculated from the time of dispatch and time of completion; therefore, it does not depend on patrol officers informing the dispatcher of their arrival at the scene.

While these statistics are easy to calculate, a more difficult problem for the analyst is to put the statistics into a meaningful framework. For example, the average dispatch delay, average travel time, and average on-scene time are usually more beneficial if they are calculated by a call's priority class. Most departments have a three priority system, with Priority 1 calls being emergencies, Priority 2 calls being those needing immediate attention, and Priority 3 calls being everything else. A more comprehensive picture of workload demands, however, can be obtained from a seven-priority system using the following codes: 1- EMERGENCY (lights and/or siren); 2-

URGENT (exceed posted speed limits with caution, but do not use lights or siren); 3- IMMEDIATE (proceed without delay, but do not exceed posted speed limits); 4- DIVERTABLE (may be given to Telephone Reporting Unit, community service officers, etc.); 5- QUEUABLE (may be stacked and thus delayed for a period of time); 6- REFERABLE (may be handled by another agency); 7- NO RESPONSE (information only). An analysis using this expanded priority system will give departments a clearer, more exact representation of their workload and will enable managers to make more informed decisions about their personnel needs.

In addition to preparing the statistics by priority class, this information should be summarized by individual patrol unit, by geographic area, by hour of day or shift, by day of week, or by combinations of these variables. The determination of how the statistics are developed and presented will usually depend on the issue being addressed and can be expected to change from one issue to another. For example, the issue may be the average travel time to emergency calls in one area of the city. In this case, the statistics should be developed by geographic area so that the travel time in the area under question can be compared with that in other areas of the city. If, on the other hand, the issue is the distribution of workload, then the statistics should be developed for each patrol unit and beat on the shift in question.

The department management may decide to produce a set of monthly or quarterly reports from dispatch ticket information in order to monitor field activities. A good example of part of a monthly report is provided in Exhibits 2.2, 2.3, and 2.4 which show data for Zone 2 in the Jacksonville, Florida, Sheriff's Department. Exhibit 2.2, for Zone 2 on Fridays during January 1982, presents a detailed summary of all the statistics listed above plus several other measures which will be discussed in Chapter Four on multiple objectives. The exhibit provides statistics for the five different time periods which coincide with the overlapping shifts of the department. It helps illustrate how to calculate the statistics on unit utilization, the probability of all units being simultaneously busy, and the average number of free units. Unit utilization has been previously defined as:

$$\text{Unit Utilization} = \frac{\text{Workload (in hours)}}{\text{Unit Hours}}$$

As an example of this calculation, consider the information in the Shift 1 column (0700-1500) of Exhibit 2.2 which gives the average number of beat units as 14.2, the average number of calls per hour as 9.2, and the

average service time (including back-up units) as 36.5 minutes. The workload is then calculated as:

$$\begin{aligned} \text{Workload} &= 9.2 \text{ calls} \times \frac{36.5 \text{ minutes per call}}{60 \text{ minutes per hour}} \\ &= 5.6 \text{ hours.} \end{aligned}$$

And

$$\begin{aligned} \text{Unit Utilization} &= \frac{5.6 \text{ hours}}{14.2 \text{ unit hours}} \\ &= 0.394 \\ &= 39.4 \% \end{aligned}$$

In other words, on average, the patrol units were spending 39.4 percent of their tour of duty on citizen calls for service during Shift 1. Unit utilization for other shifts or an overall utilization statistic can be calculated from the data in Exhibit 2.2.

The *average number of free units* represent the average number of units that a dispatcher will find available each time a call for service must be dispatched. This average depends on the number of units fielded, the amount of call for service and non-call for service work, the average service time, and the dispatching policy of the department in regard to when back-up units are assigned. Rather than trying to determine the number of free units directly from the data, an estimate can be obtained with the information on the amount of total workload. Extending the above example, the amount of call for service workload each hour averages 9.2 calls times 36.5 minutes, which equals 5.6 hours of patrol unit work. In addition, the department has estimated that each unit spends about 10 minutes per hour on non-call for service activities, for a total of 2.4 hours (14.2 units fielded times 10 minutes) of non-call for service work per hour. Combining these figures gives a total of 8.0 hours of work for each hour of the shift. If only eight patrol units are fielded, then all eight units would always be busy; there would be no extra time. Since there are 14.2 units fielded, this means that the average number of free units is 6.2 (14.2 units - 8 units).⁷

Formally, the average number of free units is calculated as:

$$\text{Free Units} = \text{Total Units} - \frac{\text{Total Workload}}{\text{in Unit Hours}}$$

While this statistic is more complicated to understand, it provides an insight into patrol operations in terms of how many units are usually available.

From a mathematical viewpoint, the calculation of the probability of all units being busy simultaneously is even

EXHIBIT 2.2
OFFICE OF THE SHERIFF
PATROL RESOURCE ALLOCATION
PLANNING AND RESEARCH
JANUARY 1982

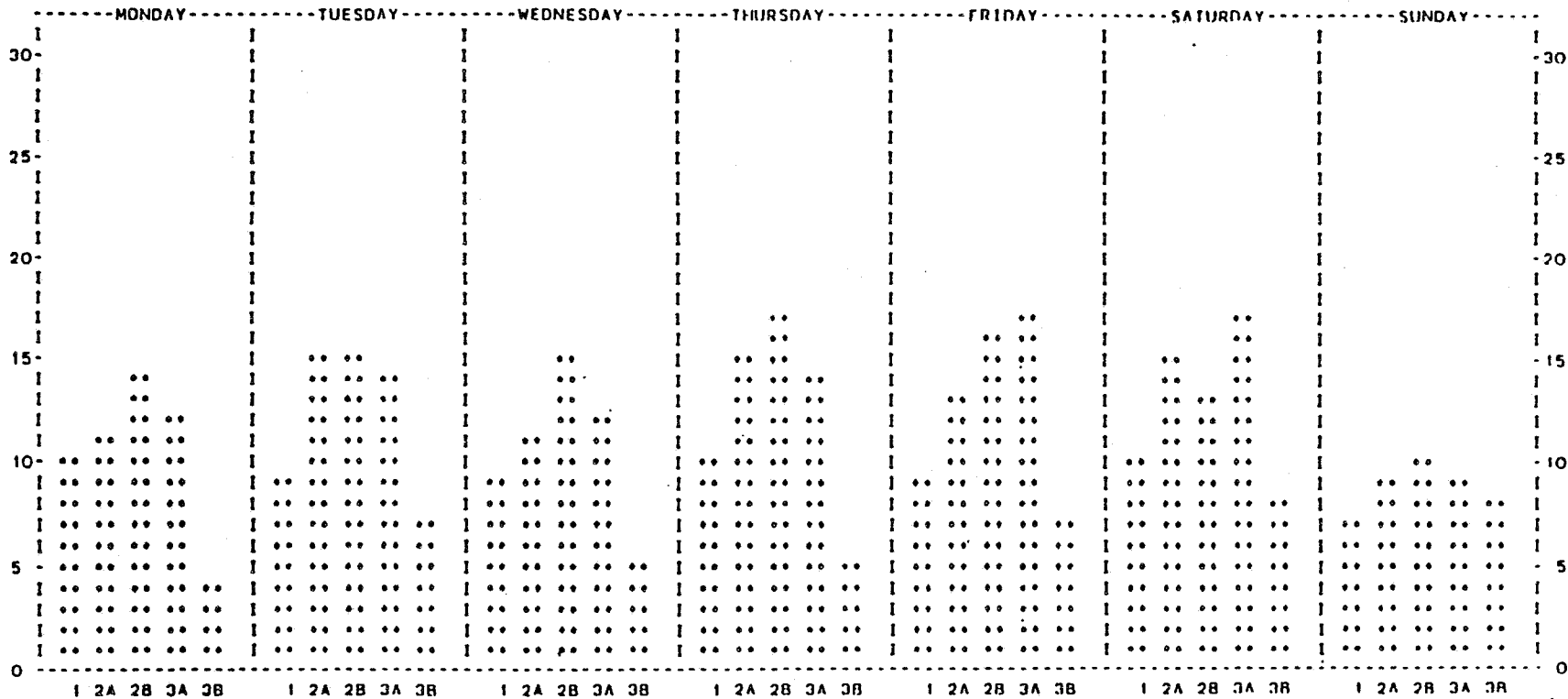
DATA SUMMARY: ZONE 2 FRIDAY	SHIFT 1 0700-1459	SHIFT 2A 1500-1629	SHIFT 2B 1630-2259	SHIFT 3A 2300-0029	SHIFT 3B 0030-0659	AVERAGE
AVERAGE NO. BEAT UNITS	14.2	15.0	21.2	20.6	14.4	16.6
AVERAGE NO. CALLS/HOUR	9.2	13.2	15.8	17.2	7.5	11.2
NON-CFS TIME (MIN/HOUR)	10.0	10.0	10.0	10.0	10.0	10.0
PERCENT OF 1 UNIT CALLS	83.4	86.9	77.7	76.0	74.0	79.1
AVERAGE SERVICE TIME - 1 UNIT	29.8	27.1	28.8	25.1	27.4	28.4
PERCENT OF 2 UNIT CALLS	16.6	13.1	22.3	24.0	26.0	20.9
AVERAGE SERVICE TIME - 2ND UNIT	40.0	69.2	38.5	30.3	26.7	37.6
PERCENT OF PRIORITY 1 CALLS	10.9	8.0	12.6	11.1	12.3	11.6
PERCENT OF PRIORITY 2 CALLS	20.0	20.0	34.9	41.7	43.5	32.5
PERCENT OF PRIORITY 3 CALLS	69.1	72.0	52.6	47.2	44.2	55.9
AVERAGE NO. UNITS DISPATCHED/CFS	1.2	1.1	1.2	1.2	1.3	1.2
AVERAGE SERVICE TIME/CFS/UNIT	31.2	32.0	30.7	26.1	27.3	29.9
AVERAGE SERVICE TIME/CFS	36.5	36.2	37.4	32.4	34.4	36.2
ACTUAL WORK/UNIT:						
CFS TIME	23.6	31.9	27.8	27.0	17.8	24.5
NON-CFS TIME	10.0	10.0	10.0	10.0	10.0	10.0
UNCOMMITTED TIME	26.4	18.2	22.2	23.0	32.2	25.5
AVERAGE NO. OF FREE CARS	6.3	4.5	7.8	7.9	7.7	7.1
PROBABILITY OF ALL UNITS SIMULTANEOUSLY BUSY	3.7	13.8	3.7	4.1	1.0	4.0
PRIORITY 1 CALLS:						
DISPATCH DELAY (MIN)	1.5	.0	1.1	1.6	1.2	1.3
TRAVEL TIME (MIN)	4.4	.0	6.5	4.2	4.8	5.3
RESPONSE TIME (MIN)	5.9	.0	7.6	5.7	6.0	6.6
PRIORITY 2 CALLS:						
DISPATCH DELAY (MIN)	2.7	2.7	2.1	3.2	5.1	3.2
TRAVEL TIME (MIN)	7.8	10.3	6.4	6.3	5.7	6.6
RESPONSE TIME (MIN)	10.5	13.1	8.5	9.5	10.8	9.8
PRIORITY 3 CALLS:						
DISPATCH DELAY (MIN)	6.0	6.4	5.6	3.8	8.5	6.1
TRAVEL TIME (MIN)	8.9	9.2	8.3	7.3	6.6	8.3
RESPONSE TIME (MIN)	15.0	15.6	14.0	11.1	15.1	14.4
AVERAGE PRIORITIES:						
DISPATCH DELAY (MIN)	5.0	5.6	3.8	3.2	6.1	4.6
TRAVEL TIME (MIN)	8.2	9.4	7.4	6.4	6.0	7.4
RESPONSE TIME (MIN)	13.2	15.0	11.1	9.6	12.0	12.1
ZONE SQUARE MILES	230.00					
AVERAGE RESPONSE SPEED	30.00					
ZONE STREET MILES	768.10					
AVERAGE PATROL SPEED	20.00					

EXHIBIT 2.3
OFFICE OF THE SHERIFF
PATROL RESOURCE ALLOCATION
PLANNING AND RESEARCH
JANUARY 1982

ALLOCATION SUMMARY: ZONE 2	SHIFT 1 0700-1459	SHIFT 2A 1500-1629	SHIFT 2B 1630-2259	SHIFT 3A 2300-0029	SHIFT 3B 0030-0659	AVERAGE
PROBABILITY OF ALL CARS SIMULTANEOUSLY BUSY:						
MONDAY	1.5	28.3	1.5	.6	.1	1.6
TUESDAY	1.2	77.3	6.1	.8	.0	2.6
WEDNESDAY	.6	52.9	8.2	.1	.1	1.3
THURSDAY	6.1	12.8	.7	.0	.0	1.2
FRIDAY	3.7	13.8	3.7	4.1	1.0	4.0
SATURDAY	9.0	91.2	3.2	34.1	3.3	9.1
SUNDAY	14.5	100.0	4.1	.0	2.9	4.8
AVERAGE	3.4	44.7	3.4	.8	.3	3.8
AVERAGE NO. OF FREE UNITS:						
MONDAY	7.3	3.5	9.1	8.9	8.8	8.0
TUESDAY	8.0	1.6	6.7	9.4	10.1	7.9
WEDNESDAY	8.0	2.2	6.3	11.5	9.1	7.7
THURSDAY	6.0	4.8	10.4	12.1	9.8	8.5
FRIDAY	6.3	4.5	7.8	7.9	7.7	7.1
SATURDAY	5.4	.7	8.0	3.7	6.4	6.0
SUNDAY	4.0	.0	6.6	11.4	6.3	5.5
AVERAGE	6.3	2.4	7.8	9.1	8.1	7.1
ACTUAL WORKLOAD/UNIT/HOUR:						
MONDAY	31.0	46.3	32.3	28.9	18.8	29.6
TUESDAY	29.2	54.1	39.9	31.0	20.3	32.0
WEDNESDAY	28.0	50.2	40.4	24.6	20.3	31.2
THURSDAY	36.6	41.9	32.3	25.4	19.7	30.8
FRIDAY	33.6	41.9	37.8	37.0	27.8	34.5
SATURDAY	37.6	57.1	34.5	47.9	33.0	37.3
SUNDAY	37.1	60.0	34.4	21.9	31.6	34.4
AVERAGE	33.3	49.8	35.9	31.5	25.1	33.0
AVERAGE CALLS FOR SERVICE:						
MONDAY	10.2	11.3	13.8	12.5	4.3	9.8
TUESDAY	9.0	14.7	14.7	14.0	7.0	10.7
WEDNESDAY	8.8	11.3	15.0	12.3	5.0	9.8
THURSDAY	9.6	15.5	16.7	13.8	4.9	10.9
FRIDAY	9.2	13.2	15.8	17.2	7.5	11.2
SATURDAY	10.2	15.3	12.9	17.5	8.3	11.2
SUNDAY	7.0	9.3	10.3	9.5	8.1	8.5
AVERAGE	9.1	12.9	14.0	13.9	6.6	10.3
AVERAGE NO. BEAT UNITS:						
MONDAY	15.0	15.3	19.8	17.3	12.8	15.8
TUESDAY	15.5	15.8	20.0	19.5	15.1	16.9
WEDNESDAY	15.0	13.5	19.3	19.5	13.8	16.0
THURSDAY	15.3	18.0	22.5	21.0	14.5	17.4
FRIDAY	14.2	15.0	21.2	20.6	14.4	16.6
SATURDAY	14.4	14.4	18.8	18.6	14.2	15.8
SUNDAY	10.4	10.6	15.4	18.0	13.2	13.0
AVERAGE	14.1	14.3	19.5	19.2	14.0	15.9

EXHIBIT 2.4
OFFICE OF THE SHERIFF
PATROL RESOURCE ALLOCATION
PLANNING AND RESEARCH
JANUARY 1982

ZONE 2 AVG CALLS FOR SERVICE



TIME BLOCKS

- SHIFT 1 : 0700-1459
- SHIFT 2A : 1500-1629
- SHIFT 2B : 1630-2259
- SHIFT 3A : 2300-0029
- SHIFT 3B : 0030-0659

more complicated than the above example. For this reason, the exact equation for its calculation will not be given in this text.⁸ As shown in Exhibit 2.2, this probability has been calculated to be 3.7 percent for Shift 1. This figure can be interpreted as meaning that approximately 3.7 percent of all incoming calls will have to be delayed for some period of time because all units are busy on other work.

Deployment by workload analysis. Depending on the issue, workload analysis, may involve a study of only calls for service or of both calls for service and the amount of time officers are engaged in routine patrol, administrative duties, and personal business.⁹ In addition to allocating resources, the information base resulting from a workload analysis can be used for planning directed patrol activities as well as preventive patrol strategies.

A standard method for analyzing the workload pattern of a department is to depict the hourly fluctuation of calls for service on 24-hour and 7-day graphs, the former showing demands by each hour of the day and the latter demands by each day of the week. The 24-hour graphs are likely to display a workload cycle whose peaks and valleys recur with an almost predictable regularity that corresponds to the public's typical daily routine. That is, when most people are sleeping during the early morning hours, patrol workload normally is low; it progressively rises through the afternoon hours until midnight when it begins tapering off.¹⁰ The 7-day graph, likewise, will illustrate a pattern: there is less variation in workload among the days of the week than there is among the hours of each individual day. Fridays and Saturdays will show a somewhat higher demand for service, as will days near holidays. On Sundays, the workload will be lighter than on Saturday. (See Exhibits 2.5 and 2.6) Some departments prepare 168-hour graphs showing all the hours of the week, instead of two separate graphs.

A temporal allocation of manpower can be attained by calculating for every day the percentage of the total workload occurring during each shift and then assigning a comparable percentage of the available officers to the shifts.¹¹ Manpower can be distributed geographically using a similar process. That is, the first step is to determine the workload in each district or sector, next calculate the portion of the shift's workload handled in each area, and finally assign manpower accordingly. (See Exhibit 2.7)

While an adequate distribution of current manpower can be attained via this simple calls for service workload analysis, there are several elements that it fails to consider. For example, time spent on calls for service, as a proportion of total patrol man-hours available, is par-

ticularly important for departments wishing to implement a directed patrol program or expand patrol's follow-up investigation activities, because they will want to ensure that officers are not committed to responding to calls for service for their entire tour of duty. Furthermore, without time information, it is difficult to determine the adequacy of existing manpower levels. According to the Police Task Force of the 1973 National Advisory Commission on Criminal Justice Standards and Goals:

Experience shows that using the number of calls for service . . . without regard for time expended is of little or no value in determining workload. For example, the same number of service calls . . . may occur on two different shifts. All the activities on one shift, however, may take twice as long as (those) on the other shift. Therefore, using only the number of incidents would indicate falsely that the workload was the same on both watches.¹²

Another shortcoming of using this level of analysis is that it does not take into account such factors as response time, dispatch delays, calls requiring back-up or multiple units, or the appropriateness of geographic boundaries.¹³ To varying degrees, these factors can affect citizens' perception of police performance and officer morale, as well as the number of officers needed to sufficiently staff the patrol function. Nonetheless, once an analysis has calculated the number of calls for service, identified the distribution of demands by time of day and day of week, and allocated the workload on a geographic basis, many agencies decide how to distribute patrol personnel. Others, however, use the calls for service model as an input to more in-depth workload analyses. (See Exhibit 2.8)

Computer models for patrol planning. Computer assisted allocation models have existed since the late 1960's, but it was not until the mid- to late 70's that programs were perfected sufficiently to make them attractive and popular among law enforcement agencies. They are particularly useful in resolving multiple issue problems, as will be demonstrated in detail in Chapter Four. Perhaps the most widely recognized and used models are the Patrol Car Allocation Model (PCAM) developed at the Rand Corporation, Hypercube Queuing Model developed at Public Systems Evaluation, Inc., and PATROL PLAN/BEAT PLAN developed at The Institute for Public Program Analysis. The advantages of these automated patrol allocation models are that:

- they are performance-oriented, thereby allowing the police planner designing staff distributions to specify acceptable standards of performance, such as maximum delays in dispatching calls for service or a desirable amount of time for directed patrol; and

EXHIBIT 2.5

SAMPLE 24-HOUR GRAPH OF WORKLOAD DISTRIBUTION

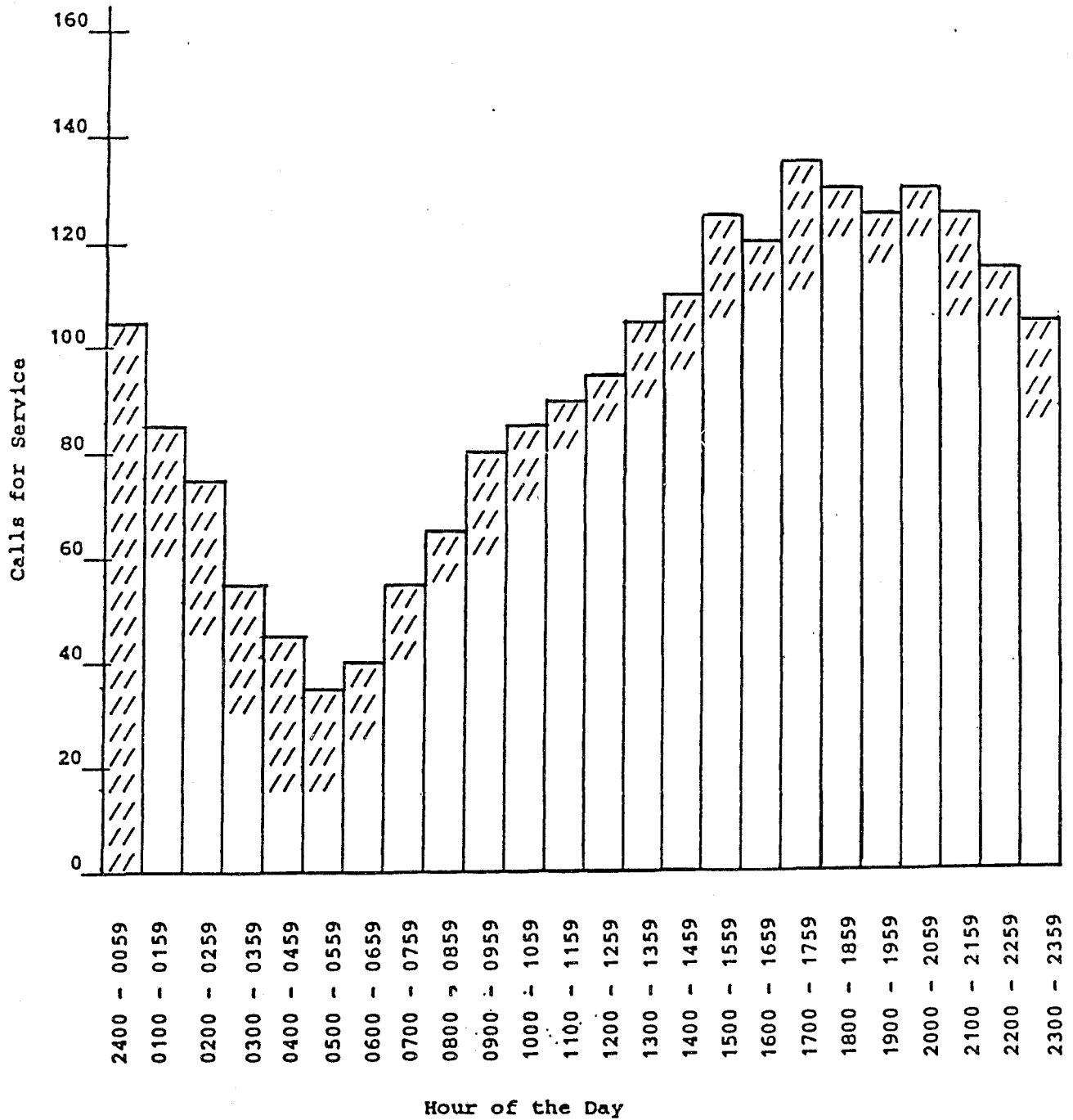
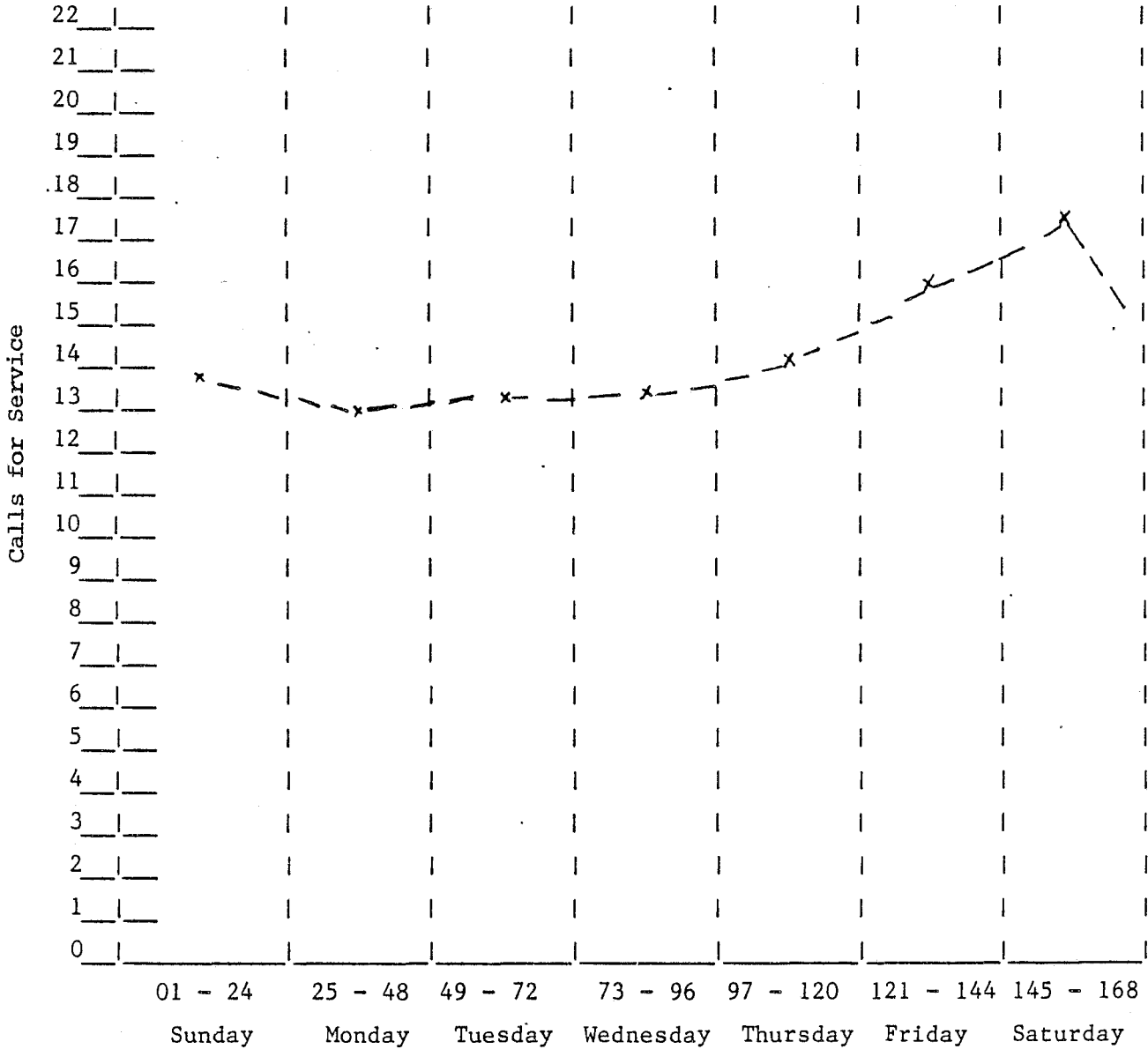


EXHIBIT 2.6

SAMPLE WORKLOAD BY DAY OF WEEK



Hours/Days of Week

Source: Reading, Pennsylvania, Bureau of Police. Analysis of Dispatch Data, 1981. Average number of calls dispatched in 1981 by day: Sunday, 115.7; Monday, 110.6; Tuesday, 111.3; Wednesday, 114.0; Thursday, 118.4; Friday, 132.7; Saturday, 144.8.

EXHIBIT 2.7

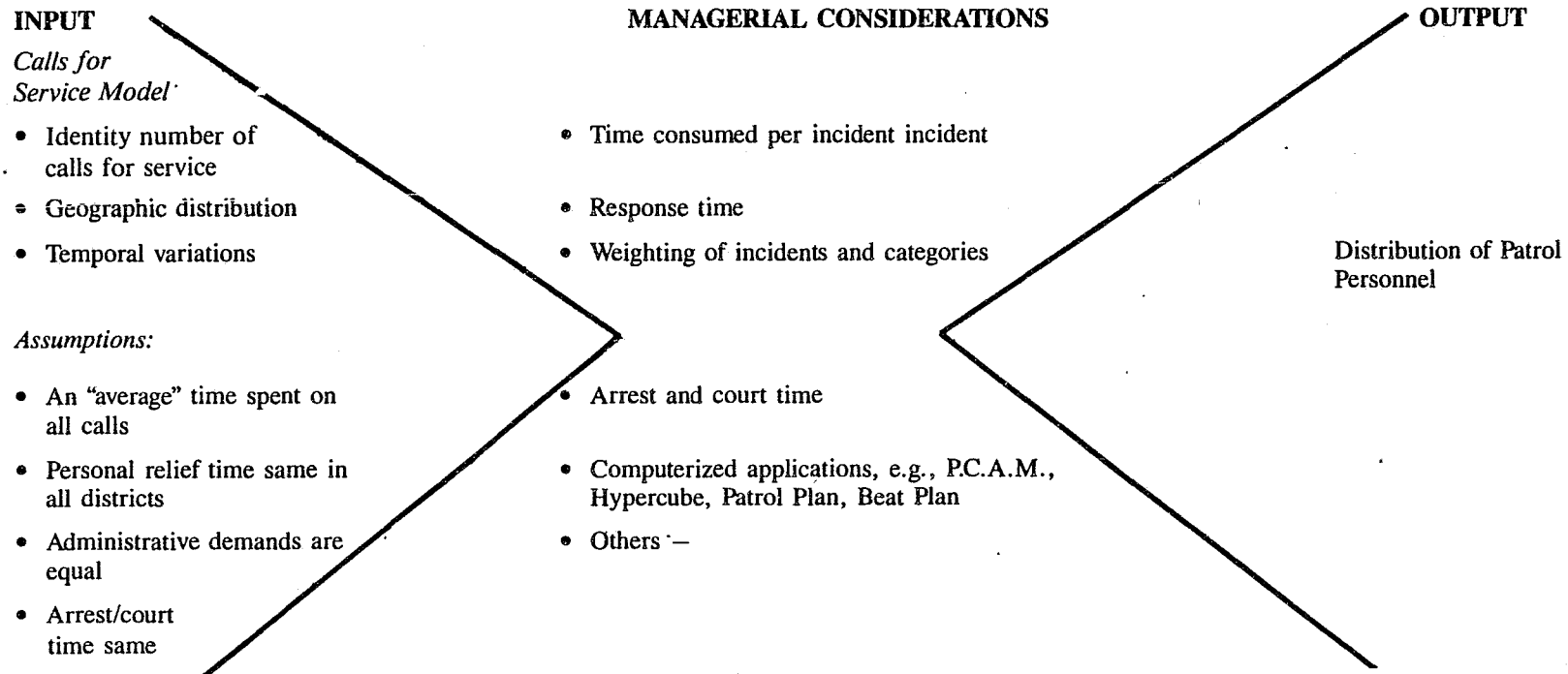
SAMPLE DISTRIBUTION OF MANPOWER BY HOURLY WORKLOAD

HOURS BY SHIFT	CALLS FOR SERVICE	PERCENT OF TOTAL HOURLY WORKLOAD	PERCENT OF MANPOWER ASSIGNED
0700 - 0759	58	2.11	DAY SHIFT 29.27
0800 - 0859	77	2.80	
0900 - 0959	90	3.28	
1000 - 1059	100	3.64	
1100 - 1159	107	3.90	
1200 - 1259	117	4.26	
1300 - 1359	123	4.48	
1400 - 1459	132	4.80	EVENING SHIFT 47.03
1500 - 1559	158	5.75	
1600 - 1659	153	5.57	
1700 - 1759	165	6.01	
1800 - 1859	172	6.26	
1900 - 1959	161	5.86	
2000 - 2059	164	5.97	
2100 - 2159	164	5.97	MIDNIGHT SHIFT 23.68
2200 - 2259	155	5.64	
2300 - 2359	159	5.79	
2400 - 0059	118	4.30	
0100 - 0159	101	3.68	
0200 - 0259	90	3.28	
0300 - 0359	60	2.18	
0400 - 0459	45	1.64	TOTAL
0500 - 0559	37	1.35	
0600 - 0659	40	1.46	
TOTAL	2,746	99.98*	99.98*

*Total does not equal 100 percent because of rounding.

EXHIBIT 2.8

USE OF THE BASIC CALLS FOR SERVICE MODEL AS INPUT TO FURTHER ANALYSIS



SOURCE: U.S. Department of Justice, National Institute of Law Enforcement and Criminal Justice, *Managing Patrol Operations: Participant's Handbook*, by Donald F. Cawley et. al. (Washington, D.C.: University Research Corporation, 1977), p. 64.

- they can perform complex probability calculations that take into consideration both the random nature of demands for police service as well as the interaction of diverse factors affecting patrol performance.

There are some drawbacks, however. Departments must have the appropriate computer hardware, or (as in Springfield, Missouri) be able to buy time from another agency that has the right equipment.¹⁴ The approaches may be costly, both in terms of gathering the requisite data and implementing an actual computer run. One department in our study, even with a computer expert on staff, reported that its software went into an infinite loop, costing several thousand dollars in rented computer time. Finally, departments may have to invest time and money in acquiring or training staff to work with the models. A basic familiarity with data processing concepts, the capability to work with an automated system, the ability to collect and organize data for calculations, and the ability to read and analyze output reports are essential staff skills.

For many types of routine tabulations, specialized programs such as PCAM, Hypercube, PATROL/PLAN, and BEAT/PLAN are not needed. SAS, the Statistical Package for the Social Sciences (SPSS), or any computer program that provides mean and standard deviation statistics and can compute crosstabulations, can be used to analyze workload and develop schedules.¹⁵ The advantages to standard statistical packages are that (1) they are already installed on many university computers and are thus readily accessible; (2) some can be run on microcomputers; and (3) they are not expensive to run. While the specialized computer models do allow convenient interactive decision testing, this capability is not entirely lost with the application of SAS or SPSS. Once the basic data are collected and tabulated, various scenarios can be tested with a hand calculator.

Issues and Objectives

One of the underlying assumptions of patrol plan analysis models is that the police department management can articulate performance objectives for its field operations. *It cannot be overemphasized that the number of patrol units needed by day of week and shift is a function of these objectives.* For example, more patrol units are required to satisfy an objective of responding to calls in less than 3 minutes on average than an objective of responding in less than 5 minutes on average.

Dividing the work of patrol units into the following three general categories will provide a framework for developing performance objectives:

- Call For Service (CFS) Work
- Non- Call For Service (Non-CFS) Work
- Uncommitted Time

By way of review, CFS work is the amount of time a patrol unit devotes to handling citizen calls for service. Non-CFS work is the amount of time during which a patrol unit is occupied with activities other than calls for service. During this time, the unit is not available to respond to calls. Non-CFS work is defined by the department but typically includes activities such as administrative duties, self-initiated work, and meals. Uncommitted time is the remaining period during which the unit is not busy on a specific activity and is available for a citizen call for service.

Based on these definitions, several performance measures including, for example, average travel time, unit utilization, queue delay by priority, and average number of units available can be described. Police department managers have the responsibility of selecting the most appropriate measures for their patrol operations (e.g., response time) and then specifying objectives for the selected measures (e.g., three minute average response time to emergencies). Only when this step is accomplished can the analysis provide information of use to the department.

FOOTNOTES

1. U.S. Department of Housing and Urban Development, *Patrol Allocation Methodology for Police Departments*, by Jan Chaiken (Santa Monica, CA: The Rand Corporation, September 1975), p. 1.
2. National Science Foundation, Division of Advanced Productivity Research and Technology, *How to Set Up Shop for the Use of the Hypercube System*, by Allen D. Gill et. al. (St. Louis, MO: The Institute for Public Program Analysis, October 1977), p. 8.
3. The terms "units" or "patrol units" refer only to those persons assigned to basic patrol duty. While the tactical squad, detectives, and traffic officers may patrol and may respond to some calls, they are not thought of as patrol units per se, and, thus, are not considered in the discussion in this text unless otherwise specified. Supervisory patrol units are likewise not included among patrol units because they do not routinely respond to calls for service. However, because supervisors are often called upon to provide back-up on domestic disputes and assaults, departments may want to consider them in calculating unit utilization.
4. In this calculation, unit hours are the total patrol vehicle hours during any specified time period. For example, if there are 5 officers working on an 8 hour shift, and each patrol vehicle has one officer, then the unit hours for that shift equal 40.
5. David R. Scaif, "Manpower Deployment: An Alternative Approach," in *The Police Chief* (Gaithersburg, MD: International Association of Chiefs of Police, December 1978).
6. For additional information on sampling, see William G. Cochran, *Sampling Techniques* (New York, NY: John Wiley and Sons, 1977).
7. The exhibit shows 6.3 units which is slightly higher than this calculation due to roundoff error.
8. For discussion of this calculation, see Jan M. Chaiken et. al., *Criminal Justice Models: An Overview* (Santa Monica, CA: The Rand Corporation, October 1975).
9. U.S. Department of Justice, National Institute of Law Enforcement and Criminal Justice, *Improving Patrol Productivity, Volume I: Routine Patrol* by William Gay, Theodore Schell, and Stephen Schack (Washington, D.C.: Government Printing Office, July 1977), p.p. 29-30.
10. Friday and Saturday nights typically are busier than other evenings, with activity extending beyond the midnight hour, while Sunday afternoons and evenings frequently have fewer calls for service.
11. If the analysis shows that certain days of the week or hours of the day have unique workload demands, departments can deploy special overlap shifts or institute delayed reporting times. Many departments offer Sundays off as an incentive to officers working irregular or unpopular duty. For an in-depth discussion on scheduling, see U.S. Department of Justice, National Institute of Justice, *Issues and Practices in Police Work Scheduling*, by William Stenzel and R. Michael Buren (Washington, D.C.: Government Printing Office, February 1983).
12. National Advisory Commission on Criminal Justice Standards and Goals, Police Task Force, *Police*, by Edward M. Davis (Chairman) et. al. (Washington, D.C.: Government Printing Office, 1973), p. 202.
13. The calls for service workload approach can be used as a basis for evaluating and redesigning beat boundaries in an effort to balance workload, though again some caution is in order because of the absence of time expended data and data on traffic flow patterns and natural boundaries that might affect access to some areas.

The first step in designing beat boundaries is to divide the jurisdiction into reporting areas, usually census tracts. Reporting areas are then numbered and a count of the incidents occurring in each reporting area is made. A data collection period of 28 days is normally sufficient but will not account for seasonal variability. Once the data are collected, individual reporting areas can be grouped into beats containing equal portions of work.

Workload is likely to fluctuate across areas by hour of the day. That is, some areas will be busier during the morning hours than they are at night, while others will be busier at night than they are in the morning. Thus, the geographic assessment should be broken down by shifts so that the end result will be beat boundaries that correspond to temporal workload demands.
14. If a department is not automated and wishes to purchase or lease equipment for a patrol plan analysis, a systems analyst should be consulted. The police department management should be able to specify in detail exactly what it wants the automated system to produce—now and for the expected life of the system. The analyst will be able to recommend appropriate hardware and software based on the department's requirements.
15. For additional information on the Statistical Package for the Social Sciences, see *SPSS User's Guide: A Complete Guide to SPSS Language and Operations*, by SPSS Inc. (New York, NY: McGraw-Hill Book Company, 1983) or SPSS/PC for the IBM PC/XT by SPSS Inc., 444 North Michigan Ave., Chicago, IL.

Chapter 3: Addressing Single Issues

Introduction

The emergence of a single issue or problem can prompt the analysis of one feature of a police department's patrol plan. In fact, most evaluations do begin with a one-issue focus but frequently expand to a complete in-depth study of the patrol plan. This chapter examines individual issues associated with determining how many officers are needed to meet predefined objectives, developing officer schedules to match workload, forming beats for equal workload, and relieving workload from patrol officers. For discussion purposes, the examples have been simplified to illustrate the techniques for resolving the issues. In actual practice, several issues may have to be considered simultaneously and the number of possible alternative solutions may be large. Chapter Four addresses these more complex situations.

Before discussing some of the typical issues in patrol allocation planning, a brief look at how an issue can turn into a "non-issue" is in order. A good example is average response time to calls for service. Suppose that an analysis of the dispatch cards shows that the average response time is nine minutes—a figure which, in most jurisdictions, would be considered too high. A more relevant analysis should center on what the average response time is by call priority. It may be found that, on emergency calls, the average response time is less than two minutes, while the average for non-emergency calls is much greater. In fact, as will be discussed later, non-emergency calls may be delayed intentionally when the unit in the area of responsibility is busy. Determining the response time to emergency calls in this case reduces the problem to a non-issue. That is, the real objective in most departments is to have a rapid response to emergency calls, while a rapid response to non-emergency calls is not as important. If rapid response to emergency calls is already being achieved, then there is no response time problem even though the overall response time is high.

The Issue of Patrol Size

One of the most important questions which police department managers must address is, "How many officers are needed in the patrol force?" The experiences of a city in the northeastern portion of the country illustrate how this issue can be resolved. The department approached the problem of patrol size in an objective manner, beginning with the establishment of a key patrol plan objective on unit utilization and progressing in a systematic manner to an estimate of patrol size needed to meet this objective.

The question of patrol size arose in this city because of concurrent decreases in department strength over a ten year period and continued increases in calls for service. The police union had complained for several years that officers were becoming so busy on citizen calls for service that patrol crime prevention activities were being neglected. After considerable discussion on how busy patrol units should be on calls for service, the following objective was established:

- There should be sufficient units on duty so that the average unit utilization on calls for service will not exceed 30 percent.

In addition to this objective, several other key features of the patrol plan analysis were established:

- The determination of patrol size would be based on the call for service activities of the previous summer.
- The patrol force would switch to straight shifts, as opposed to rotating shifts.
- A mix of 70 percent one-officer and 30 percent two-officer units would be established for each shift.
- The Traffic Unit in the department would be merged into Patrol and all officers would handle traffic accidents.

There were specific reasons for prescribing each of these features. First, the summer months were particularly busy in previous years, and it was believed that there should be sufficient patrol personnel available during these months to handle the workload. A four-week period during August was selected for analysis. City representatives believed that straight shifts were more efficient and did not waste valuable patrol resources. The straight shifts were acceptable to the police union as long as shift selection was based on seniority and there was an opportunity to switch shifts every six months. Finally, the desire for a mix of one-officer and two-officer units was based on the types of calls which were being handled by the department; about 30 percent of the calls required two officers at the scene because of potential dangers.

Using this key objective and the other desired features of the patrol plan, Exhibit 3.1 shows the basic data for the four-week period under analysis and the calculations for determining the number of officers. The first portion of the exhibit shows the *total* number of initial calls for service, assists, and traffic accidents by shift for the four weeks, along with the average times for these activities

EXHIBIT 3.1

AN EXAMPLE OF DATA FOR DETERMINING PATROL FORCE SIZE

	Midnights	Days	Evenings
1. Workload Data			
Calls For Service	1,027	1,614	2,059
Average Time (Min.)	32 min.	28 min.	33 min.
Assists	225	273	463
Average Time (Min.)	22 min	20 min.	18 min.
Traffic Accidents	109	129	150
Average Time (Min.)	63 min.	58 min.	60 min.
2. Hours of Work For Entire 4-Week Period	769 hrs.	969 hrs.	1,421 hrs.
Average Hours of Work Per Shift	27.5 hrs.	34.6 hrs	50.8 hrs.
3. Units Needed for 30 Percent Average Utilization	12 units	15 units	21 units
4. Number of 1-Officer Units	8 units	11 units	15 units
Number of 2-Officer Units	4 units	4 units	6 units
5. Number of Officers Needed Per Shift	16 officers	19 officers	27 officers
6. Total Number of Officers Needed (Relief Factor = 22)	35 officers	42 officers	59 officers

for each shift. Traffic accidents have been listed separately to measure the impact of merging the Traffic Unit into the patrol force.

With these activities and average times, the total amount of work for the patrol force amounts to about 769 hours for the midnight-8 a.m. period; 969 hours for the 8 a.m.-4 p.m. period; and 1,421 hours for the 4 p.m.-midnight shift. Since a 28-day period was being studied, the average work *per shift* amounts to 27.5 hours; 34.6 hours; and 50.8 hours, respectively.

To calculate the number of units needed to meet the desired objective, the formula on unit utilization, as presented in Chapter Two, must be reworked to solve for the number of units:

$$\frac{\text{Average Hours of Work Per Shift}}{(\text{Shift Length})(\text{Unit Utilization})} = \text{Number of Units Needed}$$

For the midnight to 8 a.m. shift, the calculation is as follows:

$$\frac{27.5 \text{ hours}}{(8 \text{ hours})(30\%)} = 11.5 \text{ units}$$

This answer must be rounded to 12 units since fractions of units are not possible. Similar calculations for the other two shifts give results of 15 units and 21 units, respectively. Exhibit 3.1 shows the number of officers needed for these shifts under the decision of a 70%-30% split between one-officer/two-officer units.

The final line in the exhibit multiplies the number of officers needed by the department's relief factor of 2.2 to give a total of 35 officers for the midnight-8 a.m. shift; 42 officers for the 8 a.m.-4 p.m. shift; and 59 officers for the 4 p.m.-midnight shift. A total of 136 officers would

therefore be required to meet the objective of an average 30 percent unit utilization.

In summary, a basic approach to solving the problem, "How many officers are needed?" can be generalized from this example as follows:

- Step 1. Set an objective for patrol performance; in this example, the performance measure of unit utilization was selected.
- Step 2. Select a time period to be analyzed.
- Step 3. Determine the call for service workload for this time period.
- Step 4. Calculate the number of units needed based on the workload and the selected objective.
- Step 5. Calculate the number of on-duty officers needed per shift based on the required mix of one-officer/two-officer units.
- Step 6. Multiply by the relief factor to obtain the total number of officers needed.

By following this step-by-step approach, the department in our example was able to show that it needed an increase in authorized officer strength to meet its desired objective. If an objective other than unit utilization had been selected, the same steps would have been followed to determine the number of units needed, but the calculations would have been different.

While this generalized approach does offer a solution to the problem at hand, it has several shortcomings that must be considered. Most importantly, the selection of a single objective, such as unit utilization, to frame patrol size does not reflect tradeoffs between objectives. For example, the analysis does not estimate the average travel time to calls for each shift. The allocation of 12 units on the midnight-8 a.m. shift may result in unacceptably high average travel time to incidents. As will be discussed in the next chapter, several objectives can be established and the number of units needed to meet all objectives can be calculated. Usually, this more comprehensive approach to determining the number of officers needed should be followed, even though it may require more detailed data collection and more sophisticated analysis.

Selection of a 30 percent unit utilization objective is also subject to criticism. While many departments have established objectives of 30 to 40 percent unit utilization, there is no universal rule to guide the choice of a percentage; in the above example, the department had no formal justification for its selection of 30 percent. Before determining specific objectives, a department should consider the "big picture" of patrol resource allocation and should have specific plans for the entire shift of units. Some time will be required for administrative duties such as roll calls,

court appearances, and meals. Time for other programs, such as increased investigative time and directed patrol, should also be considered. In sum, substantial attention should be given to defining what the police department's managers want to achieve with a complete patrol plan. These desires should then be reflected in specific objectives for the analysis.

Picking one limited time period for analysis can present problems, too. The selection of the summer season for analysis in the above example has the advantage of planning for the "worst case." Because of the experiences of this city in prior summers, the choice was a good one; however, it does raise the question of what happens during the remainder of the year when there is less call for service activity. During the slower months, other activities, such as providing in-service training or scheduling more crime prevention programs, could be pursued. The one-month approach taken in this example reinforces the need for a complete plan for using patrol resources.

Another decision in this example that is open to question is the mix of one-officer and two-officer units. Research into this question offers little assistance, since support can be found for having all one-officer units, all two-officer units, or a mixture. The mix chosen by our example city was reasonable. That distribution was based on the types of calls handled by the department, with the assumption that potentially serious calls, such as fights and disturbances, would be handled by two-officer units. In addition, the geographic distribution of these serious calls was studied and the two-officer units were assigned to areas with the more serious calls.

Finally, the impact of officer scheduling was not considered in this example. A good schedule may mean that fewer officers are needed to meet the objective than shown in Exhibit 3.1. The issue of officer scheduling is discussed in the next section of this chapter.

There are several ways to improve upon the calculations in Exhibit 3.1 and thereby lessen the shortcomings cited above. For example, the use of the prior summer's workload overlooks the possibility that more calls may occur in the next summer. If the history of the city shows, for example, a five percent increase per year, the base numbers on calls for service in the exhibit should be increased by this amount. The effect would then be a five percent increase in the number of officers needed.

Another alternative is to determine the number of units needed by four-hour periods and day of week. The midnight-4 a.m. period is almost always busier than the 4 a.m.-8 a.m. period, and weekends are usually busier than weekdays. A more complete analysis by four-hour segments during the week may have resulted in slightly different results than shown in the exhibit.

Even with these criticisms, the general step-by-step approach presented in this example holds true. Its application simply requires a department to adapt it to the local issues and patrol features under consideration.

The Issue of Officer Scheduling

The work schedule of officers is a common issue in patrol operations. The police department in Springfield, Missouri, under its Integrated Criminal Apprehension Program (ICAP) provides an example of how a department can improve its officer scheduling. In Springfield, the officers worked a fixed shift schedule which meant that they did not rotate through the shifts on a regular basis. The objective of the department was to:

- Develop a schedule that proportionately matches workload with officers.

In fact, the advantage of the fixed shift plan in Springfield was that this objective could be partially achieved by transferring officers from one shift to another.

Prior to the ICAP program, there was an imbalance between the proportion of officers assigned on the watches and the proportion of workload for the watches. As part of the ICAP program, changes were made in the schedule to match the number of officers with the workload demand. Table 3-1 summarizes the improvements which were accomplished.

This table shows that, prior to the ICAP program, the patrol officers were almost equally scheduled across the three watches. During the ICAP program, the distribution of officers was more in line with their workload. If the old plan had been retained, a difference of 19.5 percentage points between the workload and the officer schedule would have continued. With the new schedule, this difference was reduced to 10.9 percent. The table also shows that even more improvements could be made by shifting personnel from the night watch to the day watch.

After determining the number of officers that should be assigned on a given shift, the next step is to develop actual work schedules for the officers. A particularly useful microcomputer program called SCHEDULE/PLAN was developed by The Institute for Public Program Analysis (TIPPA) for the specific purpose of generating officer schedules. While SCHEDULE/PLAN is available for microcomputers, the schedules which it produces can also be developed with a manual procedure. That is, the SCHEDULE/PLAN program duplicates a manual process of scheduling.¹

One option of this program allows the user to provide the workload by day of week for a given shift and the number of officers to be scheduled. The program then determines the schedule which best matches officers to workload, given that all officers must have two days off in a row. As an example, suppose that seven officers are to be scheduled for the day watch and that the workload as measured by the number of last year's calls for service during this watch was as follows:

Day	Number of Calls	Percent
Sunday	353	10.3
Monday	546	15.9
Tuesday	513	14.9
Wednesday	500	14.5
Thursday	518	15.1
Friday	576	16.7
Saturday	433	12.6

This information serves as input to the SCHEDULE/PLAN program. The output from the SCHEDULE/PLAN program then provides the following schedule for the seven officers:

Officers	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
1	X	O	O	X	X	X	X
1	X	X	O	O	X	X	X
1	X	X	X	O	O	X	X
1	X	X	X	X	O	O	X
3	O	X	X	X	X	X	O
On-Duty	4	6	5	5	5	6	4
Percent	11.43	17.14	14.29	14.29	14.29	17.14	11.43

TABLE 3-1

SCHEDULE CHANGES IN SPRINGFIELD, MISSOURI

	Workload	Distribution of Officers	
		Prior to ICAP Program	During ICAP Program
Day Watch 7 a.m. - 3 p.m.	28.5%	35.0%	23.1%
Afternoon Watch 3 p.m. - 11 p.m.	42.2%	32.5%	43.5%
Night Watch 11 p.m. - 7 a.m.	29.2%	32.5%	33.4%
Total Percentage Deviation Between Workload and Staffing		19.5% Points	10.9% Points

SOURCE: Neal R. Berger and William G. Gay, *A Case Study Evaluation of the Implementation of the Integrated Criminal Apprehension Program in Springfield, Missouri* (Washington, D.C.: University City Science Center, March 1981), p. 77.

In this figure, an "X" represents a day worked and an "O" represents a day off. Three officers have Saturday-Sunday off; one officer has Monday-Tuesday; one officer has Tuesday-Wednesday; one officer has Wednesday-Thursday; and one officer has Thursday-Friday. The department management has the responsibility of determining which officers are assigned to these individual slots.

With 7 officers, there are 35 officer-days available each week; the percentages across the bottom of the table show the distribution of the officer days. The greatest percentage of officers are scheduled on the two days (Monday and Friday) with the greatest percentage of workload. Comparing these percentages with the workload data shows that the total deviation is only 6.74 percentage points, a good match between personnel and workload.

In summary, one scheduling approach for police departments with fixed shifts is to (1) allocate officers across the three shifts based on workload percentages and (2) develop officer schedules which match the percentage of officers on each shift with the day of week workload. There are, however, many other alternatives to developing officer schedules besides the fixed bracket approach just described. The report, *Issues and Practices in Police Work Scheduling* by Stenzel and Buren, is an excellent source which summarizes the advantages and disadvantages of different types of schedules currently in use around the country.²

As with the previous example, the approach in this example has the disadvantage of not showing the effects of these changes on other patrol performance measures such

as travel time and unit utilization. In a complete analysis, the changes in these measures should be determined. In addition, it is advisable to conduct an evaluation of whether officer productivity has increased. Some of the elements in this type of evaluation might be:

- average number of hours of sick leave;
- average response time to emergency calls;
- number of Part I and Part II arrests;
- number of Part I clearances;
- number of traffic citations;
- number of officer separations from the department;
- number of neighborhood group meetings attended by field patrol personnel.

Such a study should compare these elements prior to and after implementation of the new schedule.

The Issue of Unequal Workload

Another issue frequently raised in police departments concerns whether the patrol beats can be changed to provide a more equitable distribution of workload among the patrol units. As discussed in Chapter Two, the term "workload" can include a variety of activities. A common approach is to define workload as the amount of time that patrol units spend on citizen calls for service. Another approach is to expand this definition to include crime prevention

activities and other self-initiated activities related to patrol. Before studying the issue of unequal workload, the appropriate definition of workload must be identified. Assuming that this has been accomplished, the following discussion shows the steps involved in redesigning patrol beats.

The main data collection effort for a beat redesign is to develop workload statistics by *reporting areas*, defined as small geographic areas which can be combined to form beats. The reporting areas may be census tracts, square grids, or some other geographic subdivision developed by the city or the police department. The advantage of using census tracts is that subsequent analysis may be performed on the relationship of beat activity with demographic statistics from the most recent census.

The tabulation of workload by reporting areas is a straightforward process in which a period of time, such as the previous year or the previous summer, is selected and workload statistics are generated for each reporting area based on the address of the incidents. The percentage of workload for each reporting area is then calculated to determine the distribution of the work. As stated in Chapter Two, the workload included in this analysis should be only that of the basic patrol units and should not include calls for supervisors, traffic units, or other specialized units.

Once the tabulations are made, the reporting areas can be combined to form new beats, usually with the aim of equalizing workload. In practice, there is an underlying objective to alter the existing beats as little as possible and still provide a more equitable workload distribution. For managers, the revised beat design is more likely to gain approval if the amount of change is small, and for patrol officers, a shorter learning period is needed if the new beats have few changes.

New beats can also be developed with the assistance of computer models, such as the Hypercube or BEAT/PLAN programs which are discussed more fully in the next chapter. These models were designed for the specific purpose of assisting in the development of beats. To work with these models, the user must already have a beat configuration in mind. The program is given a description of the design, along with the workload data, and it then estimates measures of patrol performances. The advantages of this approach are that the program can calculate a variety of performance measures, in addition to measures of equalized workload, and can show the effects of revisions on the beat design.

With either approach to the redesign of the beats, the question arises as to what is meant by "equal workload." There are two common measures:

- Deviations from the average.
- Difference between the busiest and least busy beats.

To show the use of these measures, consider the following hypothetical example which gives the percentages of workload for two proposed five-beat designs of the same geographical command:

Design No. 1		Design No. 2	
Beat Designation	Percentage Workload	Beat Designation	Percentage Workload
Beat A	22%	Beat A'	25%
Beat B	18%	Beat B'	21%
Beat C	15%	Beat C'	20%
Beat D	22%	Beat D'	19%
Beat E	23%	Beat E'	15%
100%		100%	

With 5 beats, the perfect design under an objective of equalized workload would have each beat with exactly 20 percent of the workload. Deviations from the average of 20 percent are a measure of how equal the workloads are. Under Design 1, Beat A is two percentage points *above* the average; Beat B is two percentage points *below* average; Beat C is five percent *below* average; Beat D is two percentage points *above* average; and Beat E is three percentage points *above* average. Over all 5 beats, the total amount of deviation is 14 percentage points or an "average deviation" of 2.8 percentage points. With Design 2, the average deviation is 2.4 percentage points. With this measure, the decision would be to implement Design 2, since it has the lower average deviation.

The other measure of equal workload is the difference between the busiest and least busy beats. In Design 1, the busiest beat is Beat E with 23 percent of the workload and the least busy beat is Beat C with 15 percent, for a difference of 8 percentage points. With Design 2, the difference is 10 percentage points. Therefore, with this measure, Design 1 should be selected.

These examples illustrate that the definition of "equal workload" can affect the eventual decision of which beat plan is best. If management is concerned with the overall picture, then the measure of average deviation should be selected since it reflects this concern. If, on the other hand, management is concerned that no beat deviate greatly from the average, then the second measure should be used.

In this discussion, it has been assumed that there were no other issues to be considered. That is, no changes in the number of personnel, officer scheduling, or other aspects of the patrol plan were contemplated. This assumption is realistic, since it is frequently the case that the number of personnel cannot be changed and that the officers' schedule is also fixed. A disadvantage of addressing only one issue is that undesirable consequences may occur. For example, with either of the above proposed designs, some beats may cover large geographical areas because of low activity. The result may be that the travel time in these areas will be much greater than the overall average. In the analysis for this issue, it may be advisable to address the impact on the average travel time as a part of the study. That is, the initial issue of equal workload may lead to a consideration of other factors in the patrol plan.

The Issue of Relieving Officer Workload

While several factors have affected the operations of police departments and other government agencies in the past few years, fiscal constraints have had the greatest impact on police services. Cutbacks in funding have been the primary reason most police departments have placed increasing demands on officers. As a result of these financial problems, police departments have faced layoffs and hiring freezes at the same time as they have had to deal with attrition, increasing numbers of calls for service, and increasing accountability requirements.

The need to provide services in a time of diminished resources has forced law enforcement agencies to ask some critical questions such as:

- How can the agency maintain a desirable level and quality of service when financial support is limited or being reduced?
- Must service be reduced, and, if so, where?
- How will citizens react to changes in services?

To effectively cope under these circumstances, which Charles Levine has called "cutback management,"³ police administrators need to reevaluate traditional methods of service delivery. Levine stresses the need to question time-honored approaches in operations and administration and to formulate flexible solutions to problems of productivity and effectiveness.

In addition to fiscal difficulties, there are other important reasons why police departments have become interested in relieving officer workload. First, studies have shown improvements both in productivity and officer morale when inequities in workload are minimized and when fluctuations are evened out.⁴ Second, in order to

introduce new programs, such as directed patrol and Managing Criminal Investigations, police departments must recapture blocks of officer patrol time. Both of these programs require the commitment of more time on the part of patrol officers and cannot be implemented successfully without reducing or restructuring officers' workload. Furthermore, many of these innovative programs are popular with officers because they increase the proportion of time spent on serious police work and direct "nuisance calls" to be handled in other ways.

Each of the alternatives that will be discussed challenges traditional methods of handling calls for services. When properly implemented, however, all have been found to relieve officer workload and improve productivity without adversely affecting citizen satisfaction. Most of them require expansion and formalization of processes that many departments are already using on an informal or sporadic basis and, as such, they do not represent wide departures from current operating procedures.

Alternatives to Traditional Mobile Response

There are a number of alternatives available to reduce officer workload and increase productivity. Nearly all of these alternatives to traditional mobile response contain some mechanism to produce more time for officers to perform other activities. They have been developed and tested by the National Institute of Justice under programs such as Differential Police Response (DPR), Managing Patrol Operations (MPO), Integrated Criminal Apprehension Program (ICAP), and Managing Criminal Investigations (MCI), and they include:

- Telephone Report Units (known variously as TeleServe Units, Expeditor Units, Telecom);
- delayed mobile response (stacking calls, setting appointments);
- referral to other sections (inside or outside the department);
- walk-in reports;
- use of non-sworn personnel in lieu of patrol officers (e.g., civilian evidence technicians, animal control officers, community service specialists).

One of the major purposes of developing alternative response strategies is that those calls requiring rapid mobile response can receive priority, while other calls are handled by methods which both satisfy the citizen and accomplish the needs of the department. Each is intended to be used in addition to providing immediate mobile response for handling the emergencies which account for only 5 to 10 percent of all calls.

A prioritization scheme for choosing the appropriate response to all calls is integral to the development of call alternatives. The system of prioritization at police departments that have developed Telephone Report Units, delayed mobile responses, and other alternatives is generally based on a number of factors, including: the time of the incident (in-progress, just occurred, or cold); the presence or absence of injuries (actual, probable, or potential); and the appropriate response mode for that particular event category (e.g., immediate mobile, delayed, telephone, walk-in). Many of the departments that have implemented call alternatives have found that successful implementation required the support and understanding of all staff, especially in Communications. Also, steering or advisory committees, made up of staff from all levels, guided the implementation effort.

Telephone report units. One of the most effective call alternative strategies for relieving officer workload is the Telephone Report Unit (TRU), in which reports are handled over the telephone rather than by a patrol officer dispatched to the scene. A TRU typically consists of several call takers, often light duty officers or civilian employees, who record reports over the phone, generally during the day and evening. A police department must consider what the most appropriate staffing pattern is for a TRU. This decision usually requires a special study by the department to resolve how busy the Unit will be, what the availability of limited duty personnel is expected to be, whether the city would authorize additional civilian personnel, and other related questions.

In order for a Telephone Report Unit to operate effectively, several procedures must first be established, including:

- (1) A call classification system and prioritization scheme so that call takers can properly classify incoming calls and choose the appropriate response.
- (2) A method by which calls will be diverted from Communications to the TRU.
- (3) A training program on the new procedures and call classification scheme for call takers and dispatchers.
- (4) A training program for patrol officers and personnel from other departments who must be familiar with the new procedures.

Depending on the types of calls that are handled by TRU, they have been found to record from 35 to 45 percent of all reports taken by a department.⁵ Citizens' satisfaction with police service as a result of having their reports taken over the phone has not suffered, and the workload relieved from officers has allowed large blocks of time to be recaptured for other activities.

The most thorough implementation of Telephone Report Units and accompanying changes in communications took place as part of the National Institute of Justice's Differential Police Response project in Greensboro, North Carolina; Garden Grove, California; and Toledo, Ohio. All three sites first established call classification schemes which provided information on the nature of the incident, time of its occurrence, presence of injuries, amount of property damage or loss, and type of assistance requested. Flip charts for each code were then developed to assist call takers in asking proper questions for that type of incident. After asking a series of structured questions and using the flip charts, the call taker could decide the most appropriate classification and response, ranging from an immediate dispatch of a patrol unit to non-mobile responses such as TRU or walk-in reports. Each site determined which types of calls could be handled adequately over the phone. Garden Grove, for example, selected the following types of reports: missing persons; runaways (over the age of 14); petty thefts; vehicle burglaries; grand thefts; simple assaults (suspect not at the scene); indecent exposures (victim left the scene); traffic accidents (victim came to the department); vandalism; and incident-information reports.

The increase in productivity attributed to the TRU has varied as a result of the types of calls the TRU takes. Under LEAA's Integrated Criminal Apprehension Program, at least 20 departments set up Telephone Report Units. Results from the evaluations of some of these TRUs show that they handled from 10.5 percent of a department's workload in Fairfax County, Virginia, to 19 percent on the first watch and 13 percent overall in Springfield, Missouri; 15 percent of all calls in Nashville, Tennessee; and 23.1 percent of all reports in Virginia Beach, Virginia.⁶ Higher productivity was found for TRUs established in Albuquerque, New Mexico, Charlotte, North Carolina, and Sacramento, California.⁷ The TRUs in these three departments handled between 30 and 40 percent of their total crime reports. In Garden Grove, California, Toledo, Ohio, and Greensboro, North Carolina, TRUs were found to handle 30 percent of all reports shortly after implementation, growing to 35 percent within a few months.⁸

In addition to the volume of work that Telephone Report Units can handle, they afford major savings in the amount of time taken to complete a report. Nashville's TeleServ Unit handled calls, on the average, in 16 minutes, compared to 34 minutes average time for a patrol car.⁹ In the Hartford, Connecticut, Police Department, which implemented a Managing Calls for Service Program modeled on the ICAP program, it was found that a TeleServ Unit, staffed exclusively with light duty officers, provided the department with a savings of 7.57 work years in just a

year's time. Furthermore, administrators in Hartford figured that, given the savings on vehicle maintenance costs and supervisory requirements with the TeleServe Unit, the annual savings afforded by the Unit is \$200,000 per year.¹⁰

As a result of this savings in time and cost, many departments have shown large increases in patrol officer self-initiated activity and arrests. When the development of TRUs and other call alternatives is accompanied by a directed patrol activity program, the increases have been most striking. For example, after increasing directed patrol efforts through time made available by its TRU, Hartford experienced a 55 percent increase in stops of suspicious persons, resulting in a 129 percent increase in arrests. The police department also enjoyed a 34.5 percent increase in officer initiated stops of vehicles for traffic violations, with an accompanying increase in arrests of 246 percent.¹¹

Delayed response. A delayed mobile response means that the presence of a police officer is required at the scene, but the incident is of a sufficiently minor nature that a rapid dispatch is not necessary. Types of calls that may fall into this category are larcenies and burglaries that occurred several days previous to the request for service, unoccupied suspicious vehicle calls, and vandalism calls. Virtually all Communications Centers in police departments have policies for delaying calls for service. In the past, these policies were applied only if all patrol units were busy. Now, the current trend is to develop formal delayed response strategies which specify what types of calls can be delayed, under what circumstances, and for how long. Delayed response is generally based on a number of factors, such as the seriousness of the call; time of the incident (whether in-progress, just occurred, or cold); presence or absence of injuries (actual, probable, or potential); and amount of damages. Under appropriate circumstances, a dispatch may be delayed until the patrol unit in the area of responsibility is available to take the call. Most departments' policies state a maximum delay time, such as 30 or 45 minutes, after which the closest available unit is assigned to the call.

While the delayed mobile response does not directly reduce officer workload, it does help make the existing workload more manageable. It increases the likelihood that officers will receive calls in their area of assignment, resulting in fewer cross-beat dispatches and making officers more aware of activities in their assigned areas. Further, an officer does not have to be interrupted while on another assignment, such as another call or a directed patrol activity. Instead, the officer can complete the assignment and then handle the delayed call.

In Greensboro, North Carolina, calls falling into the Priority 2 category are held up to 30 minutes or until the appropriate patrol unit returns to service, whichever comes first. If, after 30 minutes, the unit is still unavailable, the call can be assigned to a unit from an adjoining beat. In Greensboro, a patrol unit should always arrive within 45 minutes of the time a call is taken. Incidents in this category include those which involve minor injuries; those in which an injured victim has been removed from the scene and is already receiving medical attention; property damage incidents; and any other situations where the immediate presence of a sworn officer is not required but an officer at the scene is desirable. Greensboro found that over 30 percent of all of its dispatched calls were eligible for a delayed mobile response.¹²

In every delayed response call, it is imperative that the call taker inform the citizen that an officer will not arrive immediately but within some stated timeframe (e.g., one hour or 30 minutes). Call takers may be reluctant to inform citizens that it may be an hour before a patrol car arrives. However, if citizens expect an officer will arrive sooner than he does, this will lead to citizen dissatisfaction. In those Differential Police Response sites where this was noted to be a problem, once the call takers correctly informed the citizen as to the expected police arrival time, citizen satisfaction was no longer adversely affected.

Use of non-sworn personnel/referrals/elimination of response. Referral of calls to more appropriate departments or agencies can also offer a significant reduction in officer workload. Similarly, services that have been traditionally offered by the police department, but that are not necessarily law enforcement work, can be eliminated and thereby provide substantial recovery of patrol time.

As part of the Differential Police Response (DPR) project, civilian members of the Greensboro Police Department were trained to take reports that had been routinely handled by sworn officers. These civilians included evidence technicians, community service specialists, animal control officers, and parking enforcement officers. (Some departments have police reserves that can be used for these assignments.) The citizen was always informed by the Communications Center call taker that a civilian specialist would be dispatched to take the report. If the call could be more appropriately handled by a specialized police unit, such as the Juvenile Bureau, the citizen was informed that someone from that unit would call them back. Call takers were also trained in making referrals to appropriate community service agencies in the city.

Elimination of an on-scene response to certain types of calls can offer a substantial savings in patrol time. For

example, in Greensboro, prior to the DPR project, the patrol officers were handling an average of 100 escort calls per month, where businesses requested escorts to make bank deposits. Under the DPR project, these calls were virtually eliminated, with a resultant savings of about 50 hours of patrol time per month.¹³ The police department contacted all the businesses prior to the discontinuation of the service to explain the need for this policy change. While there were some complaints, most merchants understood the problems of the police department and readily agreed to the elimination of the escort service.

Similarly, Hartford found that a great deal of time went into responding to open fire hydrants, electrical inspections, and various other activities that could be more appropriately handled by other city departments. As part of its Managing Calls for Service Program, these non-police functions were transferred to the Housing and Fire

Departments. In addition, the police department trained its Communications staff in crisis intervention techniques, general rules on landlord/tenant relations, diagnoses of emergency medical problems, and other areas, so that they could more accurately make referrals and choose alternative call responses.

Walk-In reports. Requesting a citizen to come to the police department in person to fill out a report offers yet another method to reduce officer workload. Frequently, the types of calls handled by walk-in reports could be handled by the Telephone Report Unit, but in order to reduce the workload in TRUs, the call taker can inform citizens that for certain problems, such as lost property, their report can be taken in person by coming to the department.

FOOTNOTES

1. For a discussion of this process, see U.S. Department of Housing and Urban Development, Office of Policy Development and Research, *Work Schedule Design Handbook: Methods for Assigning Employees' Work Shifts and Days Off* (Washington, D.C.: Government Printing Office, August 1978).
2. U.S. Department of Justice, National Institute of Justice, *Issues and Practices in Police Work Scheduling*, by William Stenzel and R. Michael Buren (Washington, D.C.: Government Printing Office, February 1983).
3. Charles H. Levine, *Cutback Management in the Criminal Justice System: A Manual of Readings* (Washington, D.C.: University Research Corporation, 1982).
4. See Berger and Gay, *op. cit.*; J. Thomas McEwen, *An Evaluation Report on the Managing Patrol Operations Field Test* (Alexandria, VA: Research Management Associates, Inc., 1982); and J. Thomas McEwen, *An Evaluation Report on Differential Police Response* (Alexandria, VA: Research Management Associates, Inc., 1984).
5. See J. Thomas McEwen, *op. cit.*, 1984.
6. Major Carroll D. Buracker, "Tele-Serv," in the *FBI Law Enforcement Bulletin*, Vol. 47, No. 1 (January 1978), p.p. 6-10; Berger and Gay, *op. cit.*; John F. Schnelle et. al., *A Comprehensive Evaluation of a Personnel Time-Efficiency Program in a Metropolitan Police Department: An Organizational Behavior Perspective* (Nashville, TN: Nashville, Tennessee, Police Department and Middle Tennessee State University, 1981); and Virginia Beach, Virginia, Police Department, *Telephone Reporting Unit: Analysis of Its Structure and Operation* (1979), an unpublished report.
7. J. Thomas McEwen, *An Evaluation Report on the Managing Patrol Operations Field Test* (Alexandria, VA: Research Management Associates, Inc., 1982).
8. J. Thomas McEwen, *An Evaluation Report on Differential Police Response* (Alexandria, VA: Research Management Associates, Inc., 1984).
9. John F. Schnelle et. al., *op. cit.*
10. Hartford, Connecticut, Police Department, *Managing Calls for Police Services* (June 1981), an unpublished report.
11. *Ibid.*
12. J. Thomas McEwen, *op. cit.*, 1984. 14. *Ibid.*
13. *Ibid.*

Chapter 4: Meeting Multiple Objectives

Introduction

The previous chapter discussed how a police department can address single issues regarding patrol operations. This single-issue approach is easy to understand, and frequently, in police departments, a single issue dominates to the exclusion of other related issues. In contrast, this chapter discusses how a police department can address several issues.

Because the resolution of multiple issues can be a much more complicated procedure, many departments have turned to the use of computer models, such as those introduced in Chapter Two, to assist in the analysis. In this chapter, the models will be described in detail as a primary approach for addressing several issues. While they are not always required with multiple issues, departments have found them advantageous.

There are two basic approaches used by police departments to resolve multiple issues:

- Address the Issues Independently
- Address the Issues Sequentially

Addressing the issues independently means that each issue can be approached as a single issue using the procedures described in Chapter Three. A sequential approach is necessary when some issues must be resolved before others can be addressed. For example, the number of units to be fielded should be determined before designing beats.

Addressing Issues Independently

Suppose, in a particular police department, it has been determined that the objectives of the patrol plan will be (1) to reduce the average unit utilization to 35 percent on citizen calls for service and (2) to have an average of at least six patrol units free during a shift. Suppose further that the data for the shift under consideration show that there are an average of 9.2 calls per hour, that each call requires 36.5 minutes, and that the average amount of non-call for service work is 10 minutes per patrol unit per hour.¹

In this case, the two issues can be addressed independently. Using the procedures described in Chapter Three for calculating unit utilization and number of free units, it can be determined that 16 units are needed to achieve the first objective and that 14 units are needed to achieve the second objective. In other words, with 16 units fielded, the unit utilization would be exactly 35 percent; fielding 14 units would result in an average of 6 free units. The ap-

propriate solution is to allocate 16 units since this number of units achieves both objectives, while fielding 14 units would achieve only the second objective. With 16 units, the unit utilization will be 35 percent and the average number of free units will be 7.7 units, which means that both objectives will be met.

This example requires relatively few calculations since only one shift is being considered. However, the number of calculations would increase considerably if the results were needed by day of week and time period, and if there were several geographic areas. The computer models described later in this chapter were developed to accommodate this type of problem and have the advantage of performing the calculations in a rapid fashion.

More difficult calculations are required if the objectives under consideration involve travel time or the probability of delay. While these calculations can be performed manually, they are very time-consuming. Use of the computer models reduces this time considerably and, in addition, allows several objectives to be evaluated simultaneously. Output from the models shows the number of patrol units needed to satisfy all objectives, as well as a designation of the "dominating" objective—the one that requires the most units in order to be satisfied. Examples of this output are provided later in the chapter.

Addressing Issues Sequentially

It may not be possible to consider issues independently. For example, suppose in addition to the two objectives on unit utilization and number of free units, the department also wants to have equalized workload for all units. In this case, the first step is to determine the number of units which are needed to meet the first two objectives, as described above. Once this determination has been made, beats can be designed so that there is roughly equal workload for the units. In other words, the beats cannot be designed without first resolving how many units are needed.

In actual practice, most patrol issues are resolved in a sequential manner, since they involve determining (1) how many units should be fielded, (2) what the beat configurations should be, and (3) what the most appropriate schedule should be. This does not necessarily mean, however, that the analysis must proceed in this order. Indeed, if it is known that the number of authorized personnel will not be increased, then the approach may be first to determine the best schedule for the available personnel and then to develop new beats.

A more complicated example along these lines is provided by the experience of the San Jose, California, Police Department during its Patrol Emphasis Program (PEP) in 1978. An excellent description of that experience was prepared by Mr. Jim Gibson and Ms. Elba R. Lu in a report submitted during the grant period.²

The San Jose Experience

As part of the Patrol Emphasis Program, the Assistant Chief of Police requested that the PEP staff study existing patrol allocation procedures, with the aim of developing an alternative plan which would alleviate many of its weaknesses. At that time, the department operated under a seven district configuration, with the officers working a 4/10 schedule (4 days per week; 10 hours per day). Each district had five to eight beats which were further divided into census tracts that served as "beat building blocks." The three shifts under the 4/10 schedule were Day Shift (7:30 a.m. to 5:30 p.m.), Swing Shift (5:00 p.m. to 3:00 a.m.), and Midnight Shift (10:00 p.m. to 8:00 a.m.). Five of the six overlapping hours were from 10:00 p.m. to 3:00 a.m., with the remaining overlap hour split at the changing of the shifts (7:30 a.m. to 8:00 a.m. and 5:00 p.m. to 5:30 p.m.).

The results of the study of the existing patrol plan showed several deficiencies:

- The workloads of the seven districts differed significantly.
- The central core of the city was divided into three districts on three different radio channels which inhibited the ability of the patrol units to meet the service needs of this area.
- Two of the busiest districts were on the same communications channel which created a channel overload during peak hours.
- With the 4/10 Plan, it was not possible to staff the shifts in proportion to workload without reducing the number of officers on the Midnight Shift below levels considered acceptable for officer safety.
- The Day and Swing Shifts were being deployed during the traffic rush hours which occasionally resulted in a backlog of calls for service.
- The backlog of calls was further aggravated because patrol operations were centralized. In a city covering approximately 150 square miles, this deployment practice created shift change problems for outlying patrol units.

Based on this analysis, two main issues were identified: (1) the need to develop new district boundaries; and (2) the need for a better scheduling plan. The resolution of these two issues was assigned jointly to the department's Research and Development Unit and the PEP staff. The combined staffs formed a task force comprised of the PEP Project Manager, the Director of Research and Development, the Supervisor for Systems in Research and Development, the Coordinator of the Computer Aided Dispatch System, two statistical analysts (one from each section), the staff analyst from PEP, and the staff psychologist from PEP. At the request of the Assistant Chief of Operations, plans developed from this group were reviewed by the command staff of the Bureau of Field Operations and other designated members of the department.

The first task undertaken by the group was the redistricting of the city. After extensive staff work, five plans were developed, with each plan having eight districts. The plans were then ranked along seven variables to determine which ones most nearly equalized the workload among the districts. The seven variables considered were:

- number of non-traffic assignments;
- consumed hours on non-traffic assignments;
- number of traffic assignments;
- consumed hours on traffic assignments;
- population;
- square miles;
- patrol preventable crimes (Robbery, Burglary, Auto Theft, Bicycle Theft, Larceny from a Motor Vehicle, Malicious Mischief).

On the basis of this ranking, two plans were selected for further analysis.

The next step in the process was the development of better officer schedules. The objective of the staff was to develop a schedule of starting times which, when staffed at levels in proportion to workload, would (1) equalize the workload of officers assigned to different shifts as much as possible and (2) result in staffing levels in each district that were as nearly equal as practical. A large number of possible shift starting times and schedules were studied by the staff. At one point, 27 options were considered in detail to determine the schedule that would best meet the above objectives. From this analysis, two candidate schedules emerged as having the most potential.

Since the development of the schedules had occurred independently of the redistricting, it was at this point that

the staff had to combine the results of the two efforts. Their concern was whether, for a particular schedule, some districts would experience an unusually high demand for service on one of the shifts. To address this question, the two redistricting plans were paired with the two potential schedules. From an analysis of the combinations, one of the plans and schedules was selected as the best alternative because it had no extreme cases of demand (either high or low), while the other three displayed undesirable peaks and valleys of demand for some districts.

The final plan divided the city into eight districts, using five radio channels. The three watches were changed so that the Day Shift was from 6:30 a.m. to 4:30 p.m., the Swing Shift from 3:30 p.m. to 1:30 a.m., and the Mid-night Shift from 9:00 p.m. to 7:00 a.m. In addition, as the Bureau of Field Operations' command staff recommended, the plan also included a Late Swing Shift on Thursday, Friday, and Saturday evenings, reporting from 6:00 p.m. to 4:00 a.m. on those days.

The experience of the San Jose Police Department under its PEP grant provides an excellent example of a systematic approach to the development of a revised beat plan. The steps followed in the San Jose approach were:

- Analysis of the current patrol plan to identify deficiencies.
- Acceptance of results showing that the two main issues were the need to redistrict and the need to develop improved work schedules.
- Establishment of a research team and task force to conduct further analyses.
- Development and evaluation of several revised district plans and new work schedules.
- Acceptance of the new patrol plan, with some modifications, by the key management personnel in the department.

As a final note, it should be mentioned that the PEP staff developed a mathematical model for the development of schedules with overlapping hours. The existence of overlapping hours, as occurs in a 4/10 plan, complicates the objective of assigning officers in a proportionate manner. The San Jose formula is described in detail in the final Patrol Emphasis Project report cited earlier.

Use of Computer Models

As previously indicated in this report, computer models have gained increasing popularity among police departments as aids in addressing patrol issues. The purpose of this section is to describe these models, their input re-

quirements, and the output reports that can be produced. Several examples are given from police departments that have successfully applied the models.

Overview of The Models

The following models will be discussed:

- Patrol Car Allocation Model (PCAM)
- Hypercube Model
- PATROL/PLAN Model
- BEAT/PLAN Model

These models were selected because they have been applied most frequently in patrol resource allocation reviews over the last five years. Exhibit 4.1 summarizes the purposes of the models, their primary input requirements, and their outputs.

The Patrol Car Allocation Model (PCAM) was developed by Dr. Jan Chaiken at the Rand Corporation to aid in analyzing a department's patrol plan and assist in determining the number of patrol units needed by day of week and time period.³ The PCAM model can be applied to develop an overlap shift so that more units are provided during busy hours. It can also consider a priority system for calls in calculating the number of units needed.

The purpose of the Hypercube model is to assist in the design of patrol beats. The Hypercube model was developed by Dr. Richard Larson at Public Systems Evaluation, Inc. To operate the Hypercube model, the user must provide a description of the patrol beats under consideration. The model then produces estimates of several performance measures such as average unit utilization and interbeat dispatches under the proposed beat design. If the results are not satisfactory, the user can adjust the beats and run the Hypercube model again to estimate performance measures.

While these two models have been developed on large computer systems, the PATROL/PLAN and BEAT/PLAN models were developed under the direction of Dr. Nelson Heller at The Institute for Public Program Analysis (TIPPA) to be run on microcomputers. These microcomputer models are smaller, less powerful versions of PCAM and Hypercube. Like PCAM, the PATROL/PLAN model can be used to analyze the current patrol plan and to determine the number of patrol units needed under given objectives on performance measures defined by the department. Similarly, the BEAT/PLAN model, a microcomputer version of the Hypercube model, can be employed in the actual design of patrol beats.

EXHIBIT 4.1

OVERVIEW OF AUTOMATED RESOURCE ALLOCATION MODELS

Patrol Car Allocation Model (PCAM) and PATROL/PLAN

Purpose: These models can be used to estimate the number of patrol units needed by geographic command, day of week, and shift to meet predetermined objectives. They can also be applied to estimate patrol performance measures if a given number of patrol units are fielded. Further, the models can allocate a given number of patrol units over several days and shifts to minimize certain performance measures. The PATROL/PLAN model is available on several microcomputers; the PCAM model is normally operated on a larger computer.

Primary Output From The Models Includes (for each area, day, and shift):

- Number of patrol units fielded
- Average number of calls for service per hour
- Average unit utilization
- Average travel time to calls
- Probability that a call will be delayed
- Average number of free units
- Minimum patrol interval

Primary Input For The Models Includes:

- Size of area and number of street miles patrolled
- Average number of calls for service per hour
- Percent of calls requiring 1 unit, 2 units, 3 units, etc.
- Average service times for 1st unit, 2nd unit, 3rd unit, etc.
- Average response speed by priority class (if known)
- Patrol speed

Hypercube and BEAT/PLAN Models

Purpose: These models assist in the design of patrol beats by estimating performance measures for a given beat design provided by the user. The BEAT/PLAN Model was developed on microcomputers while the Hypercube Model was developed on larger computers.

Primary Output From The Models Includes:

- For the geographic area:
 - Average time to calls
 - Difference in workload between the busiest and the least busy unit
 - Percent of out-of-area responses
- For each patrol unit:
 - Average travel time to calls it handles
 - Number of calls handled
 - Percent of calls handled outside its area
- For each patrol area and (for Hypercube model) reporting area:
 - Average travel time to calls in the area
 - Percent of calls handled by a patrol unit assigned to the area

Primary Input For The Models Includes:

- Reporting area identifiers and X-Y coordinates of the area
- Number of calls for service and average service time
- Distribution of calls across reporting areas
- Size of area and number of street miles
- Average response speed and average patrol speed
- Reporting areas assigned for each patrol unit (overlapping assignments are permitted)

Because the PATROL/PLAN and BEAT/PLAN models are for microcomputers, they are not as extensive and versatile as their larger counterparts. For example, the Hypercube model can give performance measures for each reporting area, but the BEAT/PLAN model does not provide this information. If the user needs reporting area performance measures, then the Hypercube model would have to be selected for the analysis. Similarly, the Hypercube model takes out-of-beat dispatches into account, while BEAT/PLAN does not. If the user is interested only in approximate workload information at the beat level, then either model can be selected.

The PCAM and PATROL/PLAN models operate in two "modes" called *descriptive* and *prescriptive*. Used as *descriptive* tools, the models provide estimates of performance measures for a specific allocation plan. The user can, for example, describe the current allocation plan to the model and the model will then provide estimates of average queue delay, probability of delay, average number of patrol units available, and other performance measures. This descriptive mode is beneficial since these measures are not easily calculated from the raw data and may not be immediately available to the department. In this sense, the models fill a void in department managers' knowledge about the operations of the patrol force. More important, the user can describe an allocation that may be under consideration but has never actually been implemented. The model will also give performance statistics for the proposed allocation.

Because the models work on assumptions which may not exactly reflect the "real world," however, the results of their application may not be exactly the same as those given by an analysis of actual performance data. However, the results can be expected to be accurate enough for virtually all operational decisions that have to be made.

Used as *prescriptive* tool, PATROL/PLAN and PCAM allow the user to estimate the number of units needed to achieve specific performance objectives established by the department. The following are several examples of objectives that may be specified by the user:

- an average of less than 5 minutes response time to Priority 2 calls;
- an average of no more than 30 minutes per hour devoted to handling citizen calls for service;
- an average of no more than 5 percent of all calls delayed in the Communications Center; and
- an average queue delay of no more than 2 minutes.

One of these objectives will "dominate" because more patrol units will be required to satisfy it than any of the

other objectives. The number of units associated with this objective is, then, the necessary total for meeting *all* the objectives.

The selection of a model must be based on the compatibility of the model's features with the intended scope of the patrol plan analysis, as well as the computer equipment available to the police department. The PCAM model is written in FORTRAN and the Hypercube model in the PL/I programming language. Thus, the user must have access to a computer system that employs these languages in order to run either of these models. PATROL/PLAN and BEAT/PLAN were written initially in Basic for the Apple II microcomputer. The PATROL/PLAN model is now also available on the Radio Shack TRS-80, IBM Personal Computer, Kaypro, and VAX 11-750. Exhibit 4.2 identifies some recent users of the models.

Other versions of these models have been produced and marketed. For example, the Hypercube program was rewritten into COBOL by the Texas A & M University and renamed the Police Officer Development Systems. Further, Public Systems Evaluation, Inc., has made several proprietary enhancements to the Hypercube model. PCAM, Hypercube, PATROL/PLAN, and BEAT/PLAN were developed in the public domain and are, therefore, available at minimal costs to all police departments interested in applying them to their local needs.

Data Requirements for The Models

As implied by the previous discussion, analytic models require an accurate and complete description of a department's patrol operations. Seldom is all the information required by the models readily available in the department; neither are those reports that are available likely to be in the exact format for direct entry to the models. For example, a management report may provide the volume of calls for service for each geographic command, but not by day of week and hour of day. Before the first application of these models, it is usually necessary for department personnel to perform special analyses to obtain all the requisite data. After the models have been used successfully on several occasions, then routine reports that will provide the necessary data for later use of the models may be generated.

The data collection exercise required for these models is clearly not a waste of time. Indeed, it provides an opportunity to review the current patrol plan in detail and to discuss the plan with department managers, which further aids in clarifying issues and perhaps resolving minor problems. The analysis may also indicate some of the changes that will improve the patrol allocation plan.

EXHIBIT 4.2

SELECTED USERS OF AUTOMATED PATROL ALLOCATION MODELS

PCAM	Hypercube	PATROL/PLAN BEAT/PLAN
Albuquerque, NM	Arlington, MA	Hawthorne, CA
Atlanta, GA	Burbank, CA	Honolulu, HI
Charlotte, NC	Charlotte, NC	Lawrence, KS
District of Columbia	New Haven, CT	Maricopa County, AZ
Fort Wayne, IN	Quincy, MA	Norfolk, VA
Los Angeles, CA	Wilmington, DE	Palo Alto, CA
Los Angeles County, CA		Stockton, CA
Minneapolis, MO		University City, MO
Newark, NJ		
Northglenn, CO		
Portland, OR		
Sacramento, CA		
San Diego, CA		
San Diego County, CA		
Seattle, WA		
Virginia Beach, VA		
Wilmington, DE		

While the input requirements for these models are different in their own details, there are enough common elements to allow for a general description as provided below. For discussion purposes, the input requirements can be conveniently split into two categories:

- Geographic Data
- Workload Data

Geographic data. For the PCAM and PATROL/PLAN models, data must be gathered for each geographic command to be studied. "Geographic command" is a general term for what police departments may refer to as a precinct, sector, or district containing several beats staffed by patrol officers. For each command, the models need the area in square miles and the number of street miles to be patrolled. Calculating the number of street miles to be patrolled must be approached carefully, since some

streets, such as those in a university or industrial complex having its own security force, should not be included. Further, areas which are seldom entered, such as sparsely populated sections of the city, need not be included in the number of patrollable miles.

For the Hypercube and BEAT/PLAN models, more detailed geographic data are needed, since these models are for beat design and their basis of analysis is the reporting area. For each of the proposed beats, the reporting areas must be identified so that the models can calculate beat performance measures. For each reporting area, the models must be told the relative workload expressed as either the percent of workload in the area or the expected volume of workload in raw count. Finally, the coordinates for the center of each area must also be given and the size of each reporting area must be provided if calculations of intra-reporting area travel times are desired.

Workload data. With the PCAM and PATROL/PLAN models, data must be supplied describing each shift of each day. The starting times for each shift, including overlap shifts, must be given. Information must then be provided on each "time period." If the department operates strictly on a three eight-hour shift basis, then there are only three time periods; overlap shifts or other schedules, such as 4/10 plans, create four, five, or sometimes more time periods.

For each time period and day, the following items of data must be supplied:

- Average number of calls per hour;
- Percent of calls requiring 1 unit, 2 units, or 3 units;
- Average service times for 1st unit, 2nd unit, and 3rd unit;
- Percent of calls by priority class;
- Average travel time by priority class;
- Average response speed by priority class (if known);
- Patrol speed.

Calls for service can be divided into three priority classes, with Priority 1 being the most important calls and Priority 3 being the least important calls. The number of units assigned to calls is an important item of information needed by the models to recognize that back-up units are required on many calls for service. Thus, for example, the data may show that 70 percent of the calls were handled by one unit, 15 percent by two units, and 15 percent by three or more units.

Estimating the response speed to calls may be hard for police departments to do. However, the models include a procedure in their descriptive mode for estimating response speed based on the size of the geographic command, the number of units usually fielded, and the average travel time supplied by the user. Average *response* speeds of 15-20 miles per hour are typical in most police departments. The *patrol* speed is the average speed of the units during uncommitted time and generally ranges between 10 and 15 miles per hour. These speeds may appear to be low, but they include stops for traffic lights and other situations which decrease average speeds.

If the models are being used for each day of the week and each of three shifts, then it will be necessary for twenty-one sets of data to be developed for each geographic command. The data must obviously be as accurate as possible in order for the models to provide good output for operational decisions. Exhibit 4.3 summarizes the data requirements for one shift. This particular form

was used in the development of input for the PATROL/PLAN model used in the study of the Dallas, Texas, Police Department, referenced in Chapter Two and discussed in the next section. It is a convenient form for summarizing the required input information.

The Dallas Patrol Allocation Study

In 1983, the City of Dallas hired a consulting firm to conduct a study aimed at determining the number of personnel needed for the police department.⁴ The study covered all facets of the department, including patrol, investigations, traffic, and other specialized sections; however, the following discussion deals only with the patrol services component of the study. Because the city was interested in objectives for patrol operations, the initial step in the analysis required the department management to establish a set of specific objectives for patrol operations. After considerable discussion with key command personnel, the following objectives were developed:

- Patrol units will spend no more than 30 percent of their shift time on citizen calls for service.
- Patrol units will spend no more than 27 percent of their time on non-CFS work.
- The probability that all units are busy should not exceed 3 percent.
- The average response time for Priority 1 calls should not be greater than 5.5 minutes.
- The average response time for Priority 2 calls should not be greater than 12.0 minutes.

It should be obvious that these objectives were developed with the models in mind. Interestingly, this approach to defining objectives is not unusual because management is frequently willing to restrict its operational objectives in order to use the models.

The city was divided into five police divisions and the analysis was conducted on each division independently. Because of differences in officer scheduling practices, three of the districts had six time blocks to be considered and two districts had four time blocks. The form shown in Exhibit 4.3 had to be completed to reflect information by division, time block, and day of the week—a total of 182 forms. The data collection effort was extensive but was aided by the fact that the department had an excellent data processing capability and operations research analysts on staff who had the necessary training to understand the needs of the model.

Exhibit 4.4 gives the results of the analysis for Saturdays. As an example of how to interpret this output, the first

EXHIBIT 4.3

DATA REQUIREMENTS FOR PATROL/PLAN

District: _____

1. Day of Week: _____
2. Time Period: _____
3. District Area: _____ square miles
4. Patrolled Streets: _____ miles
5. Number of Units Currently Allocated: _____ unit
6. Average Number of Calls Per Hour: _____ calls for service
7. Percent of Calls Requiring 1 Unit Only: _____ %
Percent of Calls Requiring 2 Units Only: _____ %
Percent of Calls Requiring 3 Units Only: _____ %
8. Average Service Time for 1st Unit: _____ min.
Average Service Time for 2nd Unit: _____ min.
Average Service Time for 3rd Unit: _____ min.
9. Non-call-for-service-time Per Unit Per Hour: _____ min.
10. Dispatch Policy (1,2,3): _____
11. Percent of Priority 1 Calls: _____ %
Percent of Priority 2 Calls: _____ %
Percent of Priority 3 Calls: _____ %
12. Travel Time for Priority 1 Calls: _____ min.
Travel Time for Priority 2 Calls: _____ min.
Travel Time for Priority 3 Calls: _____ min.
13. Response Speed* for Priority 1 Calls: _____ mph.
Response Speed* for Priority 2 Calls: _____ mph.
Response Speed* for Priority 3 Calls: _____ mph.
14. Patrol Speed: _____ mph.

*If the response speeds are unknown, the PATROL/PLAN program will estimate them from the travel times, number of units, call rate, region area, and miles of streets.

EXHIBIT 4.4

RESULTS of PATROL/PLAN ANALYSIS

Central Division

Time Period	Units Needed	Unit Util.	Probability of Delay	Pri. 1 Response Time	Pri.2 Response Time
00-04	37	29.8*	.1	3.1	3.4
04-08	17	22.3	.4	5.4*	6.0
08-12	18	25.3	.6	5.3*	5.9
12-16	21	29.2*	.6	4.8	5.3
16-20	28	29.0*	.2	4.5	4.9
20-24	35	29.3	.1	3.6*	4.0

Southeast Division

00-04	38	29.8*	.1	3.4	4.7
04-08	16	29.0	1.5	5.4	6.7
08-12	20	28.8*	.7	4.8	5.9
12-16	27	29.0*	.2	3.1	3.8
16-20	37	29.7*	.1	3.4	4.2
20-24	48	29.5*	.1	2.8	3.5

Southwest Division

00-04	33	27.5	.1	5.4*	6.4
04-08	22	15.3	.1	5.3*	6.3
08-12	20	22.2	.2	5.5*	6.4
12-16	21	28.8*	.6	5.2	6.1
16-20	33	25.0	.1	5.4*	6.4
20-24	37	29.2*	.1	4.8	5.7

Northeast Division

00-03	45	29.7*	.1	5.0	5.4
03-08	40	12.2	.1	5.4*	5.9
08-15	36	20.5	.1	5.5*	5.9
15-24	48	23.5	.1	5.4*	5.9

Northwest Division

00-03	38	29.3*	.1	4.2	4.3
03-08	24	22.3	.1	5.4*	5.6
08-15	31	19.3	.1	5.4*	5.6
15-24	36	26.2	.1	5.5*	5.7

*Denotes dominating objective.

line under Central Division, for the midnight to 4:00 a.m. time block, shows that 37 units will be needed in order to satisfy the objectives. With 37 units, the percent of time on calls for service can be expected to be 29.8 percent; the probability of a delay will be .1 percent; the average response time to Priority 1 calls will be 3.1 minutes; and the average travel time to Priority 2 calls will be 3.4 minutes.

The asterisk beside the 29.8 percent under unit utilization for the midnight to 4:00 a.m. time period means that the percent of time on calls for service was the dominating objective in this particular analysis. More units were needed to satisfy this objective than the other objectives regarding delay probability and average travel times. In the Central and Southeast Divisions, the percent of time on calls for service was usually the dominating objective, while in the other three divisions, the travel time to Priority 1 calls was usually the dominating objective.

As an additional part of the study, estimates were made on unit requirements in some of the divisions, using the assumptions of a 20 percent increase in calls for service and longer average response times of 4.5 minutes, 5.5 minutes, and 6.5 minutes to Priority 1 calls. This "sensitivity" analysis was relatively easy to perform since the model was already established and could perform the necessary calculations quickly. As a manual process, however, it would have been very time-consuming.

The development of the staffing requirements did not stop here because it was still necessary for the consultant to consider several other factors. It was necessary, for example, to determine the mix of one-officer and two-officer units and the relief factor for the Patrol Division. In addition, recommendations were desired for the establishment of several alternative procedures for handling calls for service, including the use of special civilian personnel and the expansion of the department's Telephone Report Unit. It was only after these issues were resolved that a final plan for total staffing levels could be proposed.

The consultant concluded that over 200 additional officers would have to be hired if the department was to meet the objectives established by its management. In the Patrol Division, officers were needed because field operations fell far short of the performance objectives that had been prescribed. Only with the additional officers could the department staff the patrol units needed to meet these objectives.

Application of The Hypercube Model

The following example of the application of the Hypercube model is a summary from the publication entitled

"Field Evaluation of the Hypercube System for the Analysis of Police Patrol Operations," which was published in October 1977, by The Institute for Public Program Analysis (TIPPA). This report gave the major results of a program funded by the National Sciences Foundation for the specific purpose of assessing the utility of the Hypercube model in police departments. Participating police departments in the study included St. Louis County, Missouri, and the California cities of Burbank, Fresno, Garden Grove, Huntington Beach, Pasadena, San Diego, San Jose, Santa Ana, and Santa Clara. The application of the Hypercube model in the City of Burbank, California, is the subject of this section.

Interest in using the Hypercube model in Burbank arose from an awareness by the police department management that changes in the beat structures were needed. The patrol plan at that time divided the city into 14 beats; however, the manpower strength was usually insufficient to staff all beats on all shifts. An earlier study by the department had shown that on the Day and Swing Shifts (8 a.m. to 4 p.m. and 4 p.m. to midnight) an average of 10 patrol units were being fielded, and that even fewer units were being fielded for the Night Shift (midnight to 8 a.m.). Because it was known that additional personnel for the police department would not be approved by the city, an administrative decision was made by the department to develop a new beat plan with 10 beats, using the Hypercube model.

As an initial step in the project, the TIPPA team and members of the police department had to develop the input data needed for the Hypercube model. This step proved difficult since the department had no computerized data and no established system of geographical reporting areas. Thus, as part of the project, the department designed a reporting area system by dividing the city into 102 reporting areas and developed a database by sampling dispatch tickets and officers' daily activity logs. The sample of dispatch tickets was obtained by taking every twentieth card from the files over a one year period.

The information from the dispatch tickets was keypunched and analyzed in preparation for application of the Hypercube model. This dispatch ticket analysis provided a considerable amount of information for the department management which was not previously known. For example, under the existing plan, the city was divided into two sectors with seven beats in each sector; it was found that there was a 10 percent difference in workload between the two sectors. Prior to the redesign of the beats, a new sector boundary was established which reduced the workload imbalance to only two percent.

For each of the two sectors, members of the department developed two alternative five-beat plans. The objectives in this redesign were to encompass distinct neighborhoods within the beat boundaries, balance the workload across the beats, and minimize cross-beat dispatching. The information from these plans required for application of the Hypercube model was then developed.

On the basis of Hypercube output, the department management was able to select one of the five-beat plans for implementation in each sector. Exhibit 4.5 shows the original 14-beat structure in the city and Exhibit 4.6 shows the 10-beat structure developed with the assistance of the Hypercube model. A comparison of the figures shows that a major redesign of the beats was accomplished as a result of this study. The department management accepted the results of the Hypercube model and was able to demonstrate that the resulting 10-beat plan achieved the objectives that had been developed.

Computer Models and Their Role in Patrol Allocation

From the previous discussion, it should be clear that there are many calculations involved in even a simple patrol resource allocation problem. With more complicated problems, for example, when there are several field commands and many alternatives under consideration, the calculations can be time-consuming and tedious. One way to speed the analysis process is to use computer models; they have the advantage of being much faster than manual calculations. The computer models discussed in this chapter—PCAM, Hypercube, PATROL/PLAN, and BEAT/PLAN—were specifically designed to assist in resolving patrol resource allocation issues.

Another advantage of these models is that they can handle multiple objectives easily. Thus, for example, if there are objectives on travel time, unit utilization, and delayed calls, the models can determine the minimum number of patrol units needed to satisfy all objectives simultaneously. Some of these performance measures—particularly the queuing measures—are difficult to calculate and the necessary formulas require mathematical training to understand. By employing models, the analyst is able to concentrate on the development of performance objectives and is relieved of the calculation requirement.

Using these models also helps the analyst and the police department management focus on the issues in terms of objectives and supporting data. They require managers to be specific on what is to be achieved in the patrol allocation plan. In this regard, the models are beneficial in getting managers to focus on exactly what is desired by the department.

One word of caution is in order: *these models are not management information systems*. In fact, they require data and statistics from other systems for their input. For example, the models do not calculate the average number of citizen calls for service and average service time. Instead, someone must supply these statistics and other information to the models. The models can then provide estimates of the number of units needed to meet predetermined performance objectives.

Models Are Not for Everyone

Careful forethought is required by a police department before it decides to use a computer model. A key consideration is whether the department has the technically qualified staff, or can acquire the staff, to run the model. In addition to a solid understanding of police operations, the staff needs to have a good background in computers and mathematics. These requirements are eased if the department is able to use the microcomputer versions of the models since they tend to be more "user friendly." Fortunately, a considerable amount of documentation and reports that provide information on how to use the models is available.

The police department must be able to generate the necessary input for the models. Like virtually all models, these models are "data hungry." They require the users to understand their current patrol operations in detail *before* applying them. This is a positive feature because it forces police managers to analyze their current patrol plan as part of the input development process. Analyzing the current plan can be very beneficial in identifying problem areas and in clarifying the issues under consideration. In fact, working through the analysis of current operations gives good insight into how these models operate and alleviates some of the mystery frequently associated with them. Experienced users can often predict what the outcomes from the models will be because they have acquired a thorough understanding of patrol operations.

FOOTNOTES

1. Note that this example is an extension of the example in Chapter Two using data from the Jacksonville, Florida, Sheriff's Department.
2. *Patrol Allocation Plan: Patrol Emphasis Project*, by Jim Gibson and Elba R. Lu, San Jose Police Department (April 1978), an unpublished report.
3. A major revision of the PCAM program has recently been completed. Changes include provisions for multiple dispatches of patrol units, better handling of heavy workloads, and new output by priority levels. The descriptions on PCAM in this chapter are based on the new version of the model. Further information can be obtained from Jan Chaiken at Abt Associates or from Warren Walker at Rand Corporation.
4. E. Fennessy Associates, *Staffing Requirements Study for the Dallas Police Department: 1983-1993* (November 1983), an unpublished report.

Chapter 5: Making the Change

Introduction

The previous chapters have shown how to obtain solutions for the types of issues which usually arise about patrol operations. In this chapter, the focus changes to consider the overall planning and implementation process which must accompany any change in patrol operations. The chapter is intended to be helpful if you have been assigned to evaluation of patrol allocation without much management experience. If, by contrast, you have previously implemented some kind of large scale change in a police agency, this chapter is not for you. Instead, you should develop your own implementation and monitoring plans based on the material and references in previous chapters.

Because of differences in police departments' organization, management styles, political environments, and other considerations, no single approach to the resolution of patrol issues is applicable everywhere. However, a review of the experiences of the police departments discussed in the previous chapters clearly indicates that there are several common themes in their approaches to the issues, in the manner in which their analyses were conducted, and in the process of implementing patrol changes.

If the process of change begins with the emergence of an issue, either from internal or external sources, our examination suggests the following steps may be critical for resolving it:

- The issue should be given high priority by the Chief of Police and other key management personnel.
- An analyst should be assigned the responsibility of gathering more information about the issue, conducting a study, and, perhaps, suggesting specific alternatives for issue resolution.
- An advisory board, comprised of members of the department affected by the issue, should be formed with the responsibility of determining the most feasible solutions.
- Alternative solutions should be reviewed by the advisory board and one or two selected as the most appropriate to be submitted to the Chief of Police.
- Once an alternative is approved by the Chief (and, if appropriate, officials outside the police department), an implementation plan should be developed with specific milestone dates.

- A training program should be developed to provide a means of announcing and explaining the change and instructing personnel in any new procedures.
- The operational, procedural, and/or policy changes are then implemented.
- A monitoring procedure should be developed so that the results of the changes can be determined and tracked and analyzed.
- A formal review of the patrol plan should be conducted on a routine basis, normally at 12-month intervals.

These steps are necessary to ensure not only the thoroughness of the assessment, but also the reasonableness, acceptability, and adequacy of the solution.

The degree to which each of these steps is emphasized depends on the scale and complexity of the issue being addressed. For example, the "analyst" could be an officer assigned part-time responsibility for studying the issue, the entire Planning Section of the department, or an outside consulting firm. The training may involve only a few persons or it may involve all patrol personnel. If a community group raises an issue about police protection in its area, they may be involved in the advisory board or in public comment on the plan before it is implemented. If the City Council wants to reduce spending for overtime for patrol operations, the department may have to undertake a structured, in-depth review and report to the Council. The important point here is that many police departments will have to make adjustments in the systematic planning steps described in the remainder of this chapter.

Management Support

Police department administrators must actively endorse the patrol planning process if a worthwhile assessment is to be made and changes are to be instituted. Managers should attend roll calls and training sessions to verbally advocate the resource allocation review, and they should demonstrate their confidence in the analyst's ability by allowing an independent study to take place. At the very least, a memo or special order should be issued from the Chief, explaining the review, giving his approval of the process, and ensuring that he will make the final determination of the changes to be implemented.

The experience of City D (See earlier section entitled Patrol Planning) whose Police Chief did not visibly sup-

port the concept of patrol planning illustrates the detrimental impact that such a posture can have on both the ability of a department to analyze an issue and to implement responsive changes. When recommendations were not endorsed by the Chief, the patrol planning project director had to lobby for their implementation. Because he was only a Sergeant, he had little power in the police department and could neither influence managers of the necessity of adopting his proposals nor require their acceptance. Without the official endorsement from the department's leadership, resistance to change pervaded and significantly slowed the momentum of the planning process. Patrol planning continued to have little effect until a new administration assumed responsibility for the department.

Support from the top was clearly the catalyst for evaluating the resource allocation plan in City B (See earlier section entitled Patrol Planning). Police officers there believed the distribution of manpower across shifts was inefficient, but they were unable to confirm a problem or propose changes until a Police Chief who made patrol planning a priority was appointed. With the backing of the Chief, the officers were able to analyze the existing resource allocation plan and develop modifications to remedy its shortcomings.

The Role of the Analyst

The analyst is responsible for clarifying the issue and performing the analysis in order to determine the most appropriate solution to the problem. Before starting any data collection or the actual analysis, the analyst must "structure" the issue. This may mean that objectives have to be developed or that more definition of the problem is needed. For example, a department may think that it is facing increased officer workload and decide to consider either changing officer schedules or establishing a Telephone Report Unit. As part of the process of structuring the problem, the analyst may find the real issue is an increase in officer resignations and retirements. The analyst must be alert to identify the real problem early in the study process, and then determine possible solutions.

Most issues in patrol operations are "messy"; their formulation is difficult, and there is no rule to tell the analyst when a final solution has been found. If the issue is how many personnel should be assigned to a recently annexed area, then the analyst would probably like to know the population of the area, the amount of crime there, and the number of calls for service that can be expected. If there are no data, or only poor data, then the resolution of this problem will be very difficult. While beats can be developed, officers hired, and schedules made to service the area at all times, there is no assurance that the "best"

solution has been found. In fact, it is likely that adjustments will need to be made after some experience with the new area (and some information) has accumulated.

Management often expects too much from an analyst, and consequently the analyst can sometimes fall into a trap of making claims so clearly excessive that the results cannot be taken seriously. In particular, analysts should avoid promising crime reduction if a proposed change is made. It is usually more beneficial for the analyst to advise the department management, to answer questions relevant to the issue, and to broaden the basis for management's final judgment. In this regard, the analyst should devote considerable effort at the study's outset to determining all possible actions or alternatives that could conceivably resolve an issue.

The potential application of computer models, such as the Patrol Car Allocation Model (PCAM) or the Hypercube model for beat design, for more complex or multiple issues was discussed in Chapter Four. With these models, the analyst has perhaps a more difficult task of not only structuring the problem into very specific terms, but also interpreting the model's output and explaining the approach and the results to the department's management. If the model's output reflects the beliefs of management, then the analysis can become almost gospel, and management will not be concerned with model assumptions, parameter approximations, estimates to compensate for missing data, and related problems faced by the analyst. However, if the results go against the intuition of management, then the study is likely not to have a warm reception, and the analyst will be attacked for not being "realistic." One of the primary keys to success with computer models is for the analyst to spend as much time as possible with department managers, explaining the purposes of the models, their limitations, and how the output should be used.

In the Managing Patrol Operations field test, the analysts and managers of the three participating departments (Albuquerque, New Mexico; Charlotte, North Carolina; and Sacramento, California) attended special training courses on the use of the PCAM and Hypercube models. The training was followed by on-site technical assistance. This approach proved invaluable in helping the analysts understand how to collect data for the model, establish data bases, run the models, and interpret output. At the same time, the departments' managers learned how to establish objectives, how to apply the models, and what the models could and could not do. Learning about these models from analysts in other police departments or directly from the developers of the models is an excellent approach for first-time users.

Whether the analytic process is manual or involves a computer model, the analyst will need to work with an advisory board and the key managers in the department. These working relationships often place analysts in political situations they find difficult to handle. Many analysts tend to approach problems in an objective manner and are surprised if the solution that seems "best" to them is not politically acceptable. Their proposed plan may shift power relationships in the organization, or change lines of authority and responsibility. In addition, managers and advisory groups almost always have information and insights not obvious to the analyst. If potential political problems can be identified early, then they can be overcome by a combination of further analysis, persuasion, and education.

Whether or not persuasion works may depend on how well the managers understand the nature of the issue. Some department managers not well versed in the issue may be easily persuaded, especially if they regard the analyst as an expert problem-solver. Others may not be so receptive, however. Analysts must be prepared to respond to endless questions and attempts to discredit their solutions.

Analysts must educate department managers throughout the study of an issue—a difficult task since managers will be involved in numerous other activities, while the analyst's attention is devoted to only one issue. However, if the study proceeds without discussion, then the results may be rejected because the managers simply have not had enough opportunity to absorb all the facts and alternative solutions. The use of advisory boards is a particularly useful avenue for educating department personnel on the details of an issue.

One educational technique is to present several alternatives for the resolution of a particular issue. For example, in the San Diego Police Department, several officer work schedules were presented, along with their advantages and disadvantages, for consideration by the advisory board. With this process, the department managers understood the difficulties of developing officer schedules and how to assess schedules. Another educational approach is to have frequent progress meetings with key decisionmakers during the study and to present working papers on the issue.

The most effective analyst is someone who is able to use persuasions and education to the greatest advantage in the resolution of an issue. How the analyst is selected, the abilities of the analyst, and the approach the analyst will use are important considerations which must be addressed by the management of a police department.

The Role of an Advisory Board

In virtually all of the departments examined for this report, an advisory board was formed as part of the planning process to resolve the issue being considered. Generally, the responsibilities of these boards have been to discuss different aspects of the issue(s) at hand, to review the analyst's findings, to determine the most appropriate response among several alternatives, and to agree on specific recommendations to make to the Chief of Police.

One compelling reason for establishing an advisory board is the importance of the changes which may have to be made. Because the largest number of officers is assigned to patrol operations, any changes which affect them must be carefully considered. Further, changes in patrol operations usually are accompanied by changes in other sections of the department. For example, the establishment of a Telephone Report Unit obviously brings changes in the Communications Center since the call takers must determine which complaints will be diverted to the Unit. If changes are made to the patrol beats, then the Data Processing Section will have to change the computer-aided dispatch system so that the patrol unit in the area of responsibility can be correctly determined. These changes themselves will require time to plan and implement prior to the actual change in the field.

Because of the complexity of patrol problems, the advisory boards assembled for resolution of these issues are usually comprised of the commanders of Field Operations, the Communications Center, the Planning Section, and the Data Processing Section. A union representative may also be included if it is believed that that group's viewpoints or agreement are needed or if union resistance to a change is expected. Rescheduling of officers' hours will almost always involve labor representatives at some point in the process.

In a recently completed Differential Police Response (DPR) project, the Police Chief of the Greensboro, North Carolina Police Department established an advisory board of 12 key commanders in the department, including commanders of the major divisions in the department and commanders of other sections which would be affected by the project. Project staff were also members of the board. The aim of the DPR project was to decrease the workload of patrol officers by handling calls with alternatives such as referral to the Telephone Report Unit, assignment directly to other units (e.g., burglary calls to evidence technicians), provision of a mail-in report, or a request that citizens come to the department to make their report. The members of the board reviewed the new call classification system, with the aim of determining which calls could be diverted to these alternative methods. While

it was a time-consuming procedure, there was eventual agreement on both the extent to which alternatives could be applied and the steps that would have to be taken to implement them.

The experiences of the Greensboro Police Department highlight both the advantages and the disadvantages of advisory boards. Participation of the commanders generated insights into which alternatives were most appropriate under specific circumstances, with the result that there was a good match between call types and potential alternatives. The board members concluded that overall service to the community could actually be increased if the department provided the most appropriate response to citizen calls and thereby freed time for patrol officers to perform other activities such as directed patrol. Indeed, a subsequent evaluation of citizens' satisfaction with the alternative of having reports taken over the telephone showed excellent support for this alternative.

Another critical advantage to advisory boards, and one that was realized in Greensboro, is that involving key personnel in the total change process gives the resultant modifications a greater likelihood of being institutionalized by the department. Building a sense of ownership among departmental staff and eliciting their agreement on the worthiness of the changes helps guarantee that their support will continue after the changes are instituted.

The Greensboro experience also points out two problems with the use of advisory boards. One is that board deliberations take time and can stretch out the planning and implementation of changes. Because of the multifaceted nature of patrol changes, several alternatives must usually be considered and the board members may request more detailed analysis before making any decisions. The two-month duration of Greensboro's board is typical for major changes to patrol operations.

A second problem is that advisory boards tend to be conservative in their recommendations. This attitude may be attributable to the scope of the potential changes combined with the dynamics of group decisionmaking. There is a substantial probability that compromises will have to be made among members in order to reach final decisions. In Greensboro, it was generally agreed that even more types of calls could have been assigned to alternative responses, but the initial decision was to proceed cautiously with the alternatives until experience showed what level of citizen acceptance could be achieved.

In spite of these problems, advisory boards proved very beneficial in the departments that were studied for this report. By having these boards, managers were involved in all aspects of issue resolution and provided their own insights on the "best" direction for the department. The

greatest benefit of the boards, however, was probably that management committed itself to the change process so that the success of the eventual solution was greatly enhanced.

The Need for Training

Some type of training program is almost always needed with changes in patrol operations. The extent of the training will depend on the extent of the changes being made. Changes in patrol beats, for example, are usually handled readily, simply by reviewing the new beats at roll call meetings. Similar training is appropriate for such changes as a new work schedule, implementation of an overlap shift, or changes in the mix of one-officer and two-officer units. Some departments such as the Hawthorne, California, Police Department, have provided computer training for patrol supervisors so that they can calculate performance measures for any increase or decrease in patrol strength.

For more extensive changes, the training program will take longer both to plan and to deliver. For example, the implementation of increased on-scene investigations by patrol requires that officers learn new procedures, probably with new reporting requirements. In Managing Criminal Investigations (MCI) projects, a new incident reporting form may be introduced so that patrol officers can record solvability factors and other relevant information for a later decision on whether to proceed with the investigation. The new forms and new procedures associated with patrol's investigative responsibilities must be explained in detail.

Other sections of the department besides patrol may need training for some kinds of changes. For example, Communications Center personnel will have to be instructed on the operations and purpose of a Telephone Report Unit so that they can screen calls more efficiently and select the calls which should be handled by the Unit. Training of Communications Center personnel will also be required with the introduction of new patrol beats and with many other changes made to patrol operations, such as the establishment of an overlap shift or the initiation of directed patrol.

Monitoring Patrol Changes

A frequently overlooked part of any change in patrol operations is the need for follow-up monitoring. Monitoring can take several forms, depending on the changes that are made and the interests of the department management. At the very least, the analyst may be requested to track the operational changes for a short period of time after implementation in order to determine whether they have had the desired effect on patrol operations. Thus, for ex-

ample, with the implementation of a Telephone Report Unit, the analyst will want to collect information on the number of reports taken over the phone and the change in unit utilization in the field as a result of the TRU.

Another monitoring technique used by many departments is to have the Data Processing Section develop special reports focusing on the results of the changes. For its Managing Patrol Operations project, the Charlotte, North Carolina, Police Department developed a series of reports that showed the extent to which the new beats and scheduling procedure achieved the objectives set by the department. In addition, these reports provided information in a convenient format for future use of the PCAM and Hypercube models to make adjustments to the plan. A problem with this particular monitoring approach is that managers may lose their enthusiasm for reviewing the reports if the initial few months show that the changes were successful. The ultimate result is that considerable effort has been expended to collect and analyze information for a report without much long range utility. As discussed in Chapter Two, the use of samples on a periodic basis may be a better approach in these instances.

In summary, the importance of monitoring should not be overlooked by a department. Monitoring not only shows how well the changes are succeeding, but frequently can be a source of information to resolve future issues that arise for the department.

Periodic Review

While monitoring can point out the effect(s) of operational changes as well as weak links in the patrol plan, a thorough study of the plan should be conducted on a routine basis. The steps included in such a routine evaluation are: (1) select important performance measures and specify objectives; (2) collect data; (3) analyze data; and (4) implement changes or maintain the current plan based on the results of the analysis. Each of these components has been discussed in this report.

The police departments visited for this research evaluated their patrol plans annually. A complete review is beneficial not only in identifying adjustments that need to be made in patrol operations, but also in helping a department evaluate the degree to which patrol objectives, such as maintaining the number of delayed dispatches at three percent of all calls for service, have been attained. Further, as discussed in Chapter One, the review will provide valuable data for both administrative decisionmaking and budget justifications.

It is not always the case that substantial modifications have to be instituted after each periodic review; however, it is likely that some minor refinements will have to be made

because of shifts in departmental workload or the demographics of a community. For example, a beat's boundaries might have to be moved over one street, or another type of call might have to be designated for referral to telephone reporting. The advantage of the periodic review is that if major problems do exist, they can be remedied before they become insurmountable.

The Inevitable Monkey Wrench

A police department does not always have the time and resources necessary to carefully study a patrol issue. For example, the City Council may unexpectedly pass a local ordinance that has a direct impact upon the police department. Or the police union may decide to oppose a departmental program that is either being contemplated or has already been implemented.

The experiences of the Toledo, Ohio Police Department during its Differential Police Response project illustrate the unanticipated demands that can be placed on a department and the ways in which a department must react to such circumstances. During the project, the City suffered fiscal problems to such an extent that, at one point, it laid off 200 City employees, including over 30 civilians from the police department. These layoffs occurred over a two-week period, which was hardly time for the police department or other City agencies to plan changes in a careful or systematic manner. The problem for the police department was especially difficult since most of the civilian positions were critical and consequently had to be filled without delay by sworn officers.

At the time of the layoffs, Toledo's Telephone Report Unit was staffed by civilians; their positions were terminated in the cutbacks. The subsequent decision of the police department was to transfer four officers into the Unit and immediately expand the types of calls which could be handled over the phone. While the department had some experience with taking reports over the phone, it was difficult to determine what other types of calls should be transferred to the Unit. In addition, there was no assurance that four officers would be sufficient to handle the increased workload.

The obvious problem in situations such as Toledo's is that the police department is placed in the defensive position of having to react quickly to an issue. Given this pressure, the usual approach is to depend on the experience of commanders to determine the course of action that should be taken. What is important, however, in reacting to crises is that the department have a mechanism for evaluating whether quick changes are effective or whether further change is needed. It is important that someone in the department be assigned the responsibility of analyzing a

change once an appropriate period of time has elapsed. In this way, the department recaptures the necessary time to determine whether the change was adequate and whether other changes should be considered as well.

Resistance to Change

The experiences of police departments offer one final lesson: resistance to change is normal and should always be expected. One overriding reason is that change disrupts what is regarded as the usual way of conducting business. For example, if the same officer schedules have been in existence for many years, then any appreciable schedule change will be opposed by some members of the department. Another problem is that many changes, such as the introduction of a directed patrol program or the redesign of beats to redistribute workload more equally among patrol units, result in increased workload for at least some patrol officers.

Any concept, program, or change "not invented here" is also likely to encounter resistance by officers. If it is believed, for example, that the department is introducing a new program only because some other nearby agency has the program, then a negative reaction can be predicted. One of the problems with introducing either the PCAM or Hypercube model in some police departments has been a belief that their operations are somehow "different" and do not fit the assumptions of the models. Even though it has generally been found that the models can be adapted to the unique operations of a department, and can still provide valuable information on which to base decisions and make changes, an effort at persuasion and education will be required. With other programs, such as directed patrol, police managers will routinely make visits to other departments with similar programs and then make appropriate changes to adapt the program to their own operations. Still, some elements of the department will probably resist.

The point to remember about resistance to change is that it is a normal part of any issue resolution process. The department management must take steps to deal with any opposition that can be identified or anticipated. One way is to meet with those whose resistance can be expected, such as union representatives, prior to implementation. Those interested in making the change can then provide information about why it is necessary and beneficial. In addition, persons can be selected for participation on advisory boards specifically because they are known to be opposed to certain changes.

Training programs are another mechanism for dealing with resistance to change, particularly when the resistance is coming from patrol supervisors and patrol officers. In these cases, it may be advisable for the management of the department to deliver some of the training in order to demonstrate their strong support for the operational change.

* * * * *

This report has demonstrated the processes of patrol planning. Several important themes that emerged in the discussion bear repeating here as a conclusion.

- (1) Routine patrol planning is essential to responsible resource utilization and should be incorporated into every department's on-going management effort. Though issues often drive a patrol study; departments should not wait until a problem arises to evaluate their patrol operations.
- (2) The comfort of tradition should not be an acceptable rationale for avoiding patrol planning. Though resistance to change and fear of new ideas are normal and should be anticipated, they can be overcome. Clear management support for the patrol planning process, open communication between management and line officers, and involvement of representatives from functions affected by patrol planning will help reduce opposition. Then, payoffs such as increased productivity, more efficient delivery of police services, more effective management of departmental resources, and enhanced information for decisionmaking can be realized.
- (3) Patrol resource allocation is not a solitary process. Because of the interrelationship of patrol with other police functions such as Communications and Criminal Investigations, changes in the patrol plan will necessarily affect these operational units, and vice versa.
- (4) There are many approaches to conducting a patrol plan analysis; no one way is correct for every department all the time. A department's choice of analysis technique will depend on its objectives, the complexity of the issue at hand, the capability of its staff, the completeness of its data base, and the availability of technical resources.

Appendix: Some Sources of Further Information

1. Rand Corporation

Documents listed in the footnotes of this report as published by The Rand Corporation can be obtained from:

Publications Department
The Rand Corporation
1700 Main Street
P.O. Box 2138
Santa Monica CA 90406-2138
(213) 393-0411.

The price of Rand reports varies according to the length of the document being ordered. Contact the address or telephone number above for further information, citing the report number.

The 1985 version of the Patrol Car Allocation Model documentation (not cited in the footnotes of the present report) comprises three volumes, as follows:

Patrol Car Allocation Model: Executive Summary,
Rand report R-3087/1 - NIJ
Patrol Car Allocation Model: User's Manual,
R-3087/2 - NIJ
Patrol Car Allocation Model: Program Description,
R-3087/3 - NIJ.

Copies of the Patrol Car Allocation Model (PCAM) computer program are available from the Rand Corporation. The computer program is written in the FORTRAN language. In addition, an early version (1975) of the Hypercube Queuing Model, written in either the PL/I language or the COBOL language, is available from the Rand Corporation with its documentation R 1688-HUD (three volumes). (See also Enforth, Inc., below.)

The computer programs and sample databases are provided on magnetic tape at a cost of \$40 plus postage, or \$25 plus postage if you provide the magnetic tape. (The cost is the same for one program or for both programs together.) There is an added charge of \$50 for all copies mailed outside the United States. When ordering a magnetic tape, specify the number of tracks (7 or 9), density (800, 1600, or 6250 bpi), IBM labelled or not, and either ASCII or EBCDIC character set.

These two programs are also available from Rand on diskettes formatted for IBM DOS (Disk Operating System).

The programs are in the public domain, and you may modify them in any way desired after receiving them. For further information, or to order the programs, contact:

Dr. Warren E. Walker
The Rand Corporation
1700 Main Street
P.O. Box 2138
Santa Monica CA 90406-2138
(213) 393-0411.

(See also Enforth, Inc., and Abt Associates, Inc., below.)

2. National Technical Information Service

The 1975 versions of PCAM and the Hypercube Queuing Model (PL/I version), together with other deployment programs for use by fire departments and emergency medical agencies, are available with documentation for \$250 by ordering Accession Number PB 259 881 from:

National Technical Information Service
U.S. Department of Commerce
Springfield VA 22161.

3. Enforth, Inc.

The designer of the Hypercube Queuing Model, Richard Larson, has developed substantially improved versions of the model, which are available as proprietary software by contacting him as follows:

Dr. Richard Larson
Enforth, Inc.
929 Massachusetts Avenue
Cambridge MA 02139
(617) 547-8859.

4. Abt Associates Inc.

One of the designers of the Patrol Car Allocation Model (PCAM), Jan Chaiken, can answer questions about the program, provide copies of the program on diskette, or assist you in obtaining copies of the programs on magnetic tape from the Rand Corporation. Contact him as follows:

Dr. Jan Chaiken
Abt Associates, Inc.
55 Wheeler Street
Cambridge MA 02138
(617) 492-7100.

Dr. Chaiken also has a copy of the BEAT/PLAN and PATROL/PLAN computer programs and documentation and can provide xerographic copies at cost. He does not have experience using these models. (See also Research Management Associates or Computing Power Applied, below.)

5. Research Management Associates

One of the authors of the present report is familiar with using the computer models described here. His company, Research Management Associates, has assisted police departments in applications of PCAM, PATROL/PLAN, and SCHEDULE/PLAN. Contact him as follows:

Dr. J. Thomas McEwen
Research Management Associates
1018 Duke Street
Alexandria VA 22314
(703) 836-6777.

6. Computing Power Applied

One of the designers of the BEAT/PLAN, PATROL/PLAN, and SCHEDULE/PLAN computer programs, Richard Kolde, provides copies of these programs and their documentation, plus assistance in using the programs. Contact him as follows:

Dr. Richard Kolde
Computing Power Applied
206 Straightoak Court
Ballwin MO 63011
(314) 227-5488.

7. SPSS, Inc.

The computer program SPSS (Statistical Package for the Social Sciences) is available in several versions on mainframe computers (SPSS 9, SCSS, and SPSS^X) and as software for the IBM PC/XT and compatibles (SPSS-PC). For further information, contact:

SPSS, Inc.
Suite 3000
444 North Michigan Avenue
Chicago IL 60611
(312) 329-2400.

8. SAS Institute, Inc.

The SAS Statistical Analysis System is available on many IBM mainframe computers. For further information, contact:

SAS Institute, Inc.
Box 8000
Cary NC 27511

9. National Criminal Justice Reference Service

Information about sources of many research reports, especially those published by LEAA, the National Institute of Justice (or its predecessor the National Institute of Law Enforcement and Criminal Justice), or the Bureau of Justice Statistics, can be obtained from:

National Institute of Justice/NCJRS
Box 6000
Rockville MD 20850
(800) 851-3420.
(301-251-5500 in the Washington, DC, metropolitan area, Maryland, and outside the United States).