

TELEMASP BULLETIN

TEXAS LAW ENFORCEMENT MANAGEMENT AND ADMINISTRATIVE STATISTICS PROGRAM

December 1995

Vol. 2, No. 9

Patrol Allocation

Personnel allocation is one of the most challenging and important responsibilities of police administrators. In the past, police commanders allocated patrols using subjective methods such as guesswork, the comparison of police strength with that in other comparable jurisdictions, or the addition of officers to compensate for an increase in crime (Wilson and McLaren 1977). More recently, patrol allocation has been determined based on the workload. Gay, Schell, and Schack (1977) contend that "when officers are appropriately deployed according to workload demands, patrol costs can be dramatically reduced, or the attention of officers can be directed to pre-planned activities." To meet the increased demands placed upon police agencies, construction of a patrol allocation model that will minimize both the cost of crime to society and the cost of crime prevention strategies is necessary (Giertz 1970).

The purpose of this bulletin is to present the results from a survey of Texas law enforcement agencies concerning patrol allocation methods employed.

Prior Studies

In 1959, the Trenton, New Jersey Police Department contracted with the International Association of Chiefs of Police (IACP) to study their patrol personnel allocation so as to determine how many uniformed patrol officers were necessary by time and location. This development marked the beginning of modern patrol allocation studies. The IACP study also attempted to balance the workload of officers by location and the time required to handle calls-for-service and other duties.

A sample of calls-for-service was used to determine the geographic location, time of day, and day of week for each incident. The incidents were then weighted, taking into account the longer time necessary to process the more serious offenses. Each weighted incident was then mapped and beat boundaries were determined. The time of day and day of week was used to disperse the workload equally by shift and by number of personnel.

To determine the number of officers needed, the IACP weighted the time used for calls-for-service and allocated one-third of an officer's time for preventive patrol, which included traffic enforcement duties, commercial business inspections, and field interviews. Vacation, regular time off, sick and injury leave, training, court appearances, and other non-duty times were used to estimate the number of hours that one person was available to work during a year. These factors were all combined to determine the number of personnel needed.

Chaiken (1975) described various mathematical models for resolving patrol allocation problems. Several key issues were identified for consideration when developing a patrol allocation plan. They included the number of patrol units on duty, the design of patrol beats, the policy for dispatching patrol units, and the scheduling of personnel. Chaiken then listed key steps that should be taken when developing a patrol allocation model:

1. the collection of data, including both calls-for-service and non calls-for service;

2. processing the data in order to focus on one specific policy issue;
3. selecting an acceptable method of analysis, such as the Patrol Car Allocation Model (PCAM) or devising one's own program;
4. finding people with the relevant analytical capabilities from within or outside the department;
5. assembling a project team including the department's planners, outside analysts, and administrator(s) to steer the program;
6. acquiring and running computer programs to examine the data; and
7. developing policy recommendations based on the results.

Chaiken recognized that budgetary and political constraints must also be considered when developing a patrol allocation model.

Gay et al. (1977) studied preventive routine patrol by analyzing patrol workload and developing efficient allocation schemes. A number of concrete steps were recommended to facilitate the improvement of both the efficiency and effectiveness of uniformed patrol operations. Workload patterns were examined on both a 24-hour and day-of-week basis. Gay et al. then developed a system to deploy personnel by time and location which would match the number of patrol units to the demand for services. This was accomplished through a computerized system.

Levine and McEwen (1985) contended that workload includes any or all of the following:

- total number of calls-for-service
- officer-initiated activities
- administrative activities
- 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 patrol units per call
- probability that all units are busy
- average number of free units

A Patrol Allocation Model

After reviewing the prior patrol allocation studies, a model might be designed as depicted in Figure 1. This model is based on factors identified in previous research that should influence patrol allocation decisions. Data collection and data analysis are utilized to determine the most efficient patrol assignments.

Data Collection

The first step in designing a patrol allocation plan is to determine which data the agency will use and then acquire that needed data. This should include calls-for-service and officer-initiated incidents, as well as the time and location of police activity.

Data Analysis

Data analysis involves the calculation of time spent completing different types of calls-for-service and officer-initiated incidents. Each, which is applied to both criminal and non-criminal incidents, is weighted based upon the type of incident. According to McLaren (1967), weighting is based partially on the time required to handle a particular incident and partially on the seriousness of the incident. In the model developed by the IACP, the weights ranged from one to four, with Part I Offenses assigned a four, indicating the heaviest impact on patrol allocation (Cawley and Miron 1977).

Other factors that should be taken into consideration when developing a patrol allocation model include features of the district (residential, commercial or industrial areas); patrol style (i.e., one or two person squads); type of patrol technique used (foot, car or motorcycle); political influence; time needed to respond to incident (especially critical in rural areas); and the number of available officers.

Computer programs may be necessary to determine the best patrol allocation plan since the collection and analysis of workload information and the allocation and scheduling of patrol officers can become very complex and tedious. Computer programs allow for easy calculation of alternatives using various factors that the agency considers when developing a patrol allocation plan. Two computer programs that have been developed specifically for devising patrol allocation plans are the Police Car Allocation Model (PCAM) and the Hypercube Queuing Model.

PCAM was designed to enable police departments to determine the number of patrol units necessary during particular times of the day in each patrol area. The program matches patrol allocation in a way that is consistent with overall manpower shifts, dispatch policies, and the performance objectives for patrol units in responding to calls-for-service. This program takes into account workload variation based on the season or month, day of week, and hour of day.

The Hypercube Queuing Model, or Queuing Model, allows police managers to design individual patrol beats based on several factors, including the elapsed time between the receipt of a request for service and the assignment of a patrol unit. Elapsed times are divided between emergency and non-emergency categories, and beats are configured based

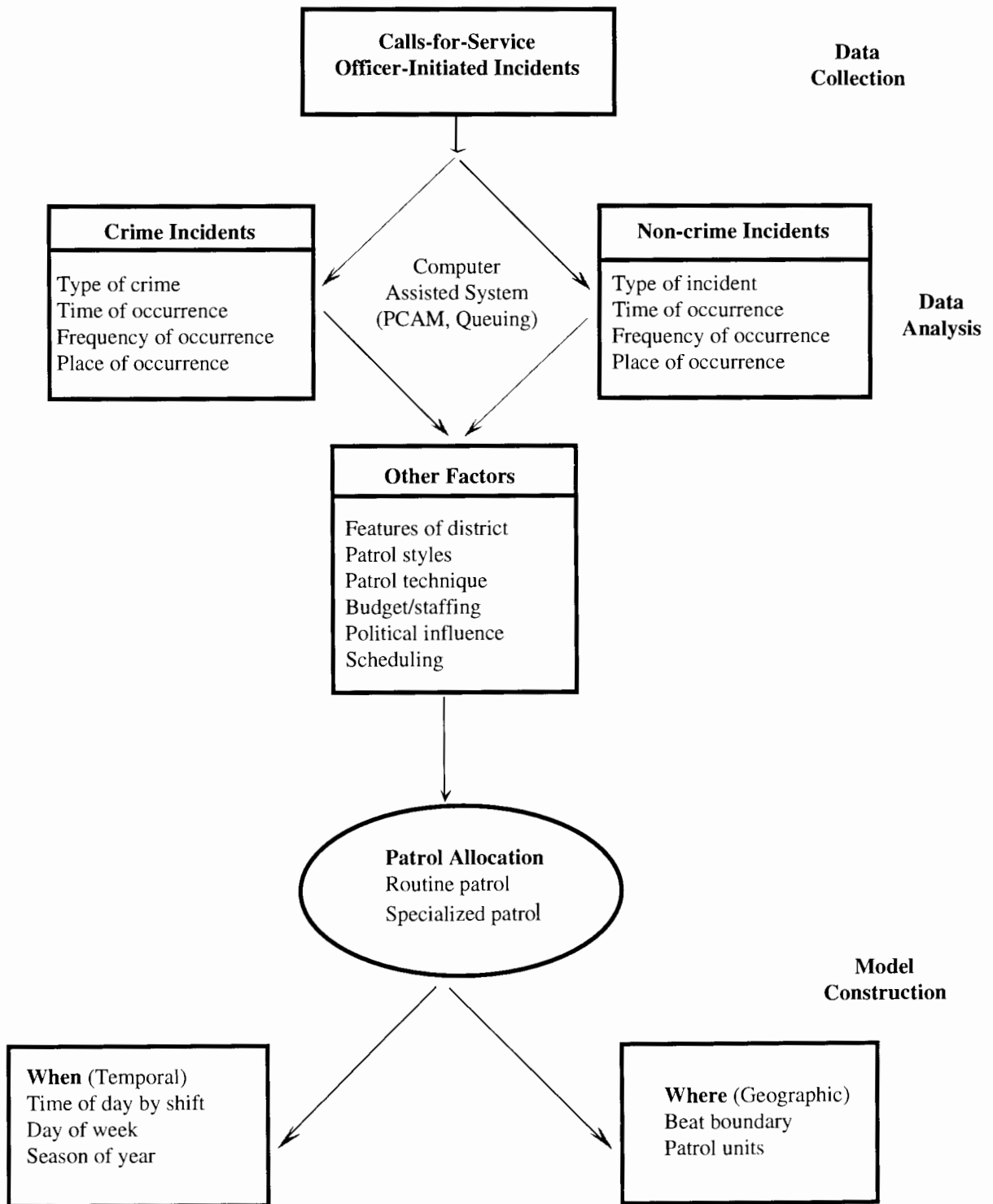


Figure 1

A Patrol Allocation Model



on these estimates as well as performance expectations for the beat. While computer programs make it simple to calculate beat boundaries and number of personnel needed for certain shifts and days of the week, the police manager must decide what is an acceptable level of performance for the agency.

Need for Temporal Deployment

The shift staffing formula in which an equal number of officers are assigned to each of the three basic duty shifts should be reconsidered. In the past, equal shift deployment was popular even though departments of all sizes could alter shift deployment patterns during each watch according to workload demands. Equal shift deployment may negatively influence police work given the incidence of call stacking. When criminal activity is the highest, departments that deploy an equal number of officers to each shift are frequently unable to carry out effective preventive and directed patrol activities. Thus, temporal deployment patterns should be developed to proportionately match the number of patrol units deployed to the demand for service by time of day and day of week.

Need for Geographic Deployment

Geographic deployment is the allocation of patrol officers to various beats. The number of calls-for-service and/or the amount of time consumed in responding to the calls are often used to designate area assignments and beat boundaries. It may be necessary to change the geographic beat areas and patrol units during each watch depending on the calls-for-service workload and the number of personnel assigned to the shift.

Patrol Allocation in Texas Law Enforcement Agencies

Forty agencies responded to the TELEMASP survey regarding patrol allocation. Twenty-three agencies reported having a patrol allocation plan, while 17 of the responding agencies did not employ such a strategy. The results of this survey are described in the following sections.

Most agencies (61%) reported implementing a patrol allocation plan after 1988. One agency, however, reported implementing such a plan in 1964. Another agency reported the adoption of a patrol allocation plan this year.

The responding agencies viewed patrol allocation as a responsibility of the operational support unit. In 12 agencies (52%), the patrol division is responsible for the allocation plan, while seven agencies (30%) designate support services

as being responsible for patrol allocation. In 13 (57%) of the responding agencies, a captain is responsible for determining the patrol allocation plan. Seven agencies reported that an assistant chief has this responsibility.

Allocation Based on Population

Interestingly, for those agencies responding to the survey, the proportion of officers to citizens is higher in those police agencies that implement an allocation plan compared to those that do not have a program. The proportion of police officers to citizens in jurisdictions that have a patrol allocation plan is one police officer to 574 citizens (1.74/1000). In agencies without an allocation plan, the ratio is one police officer to 657 citizens (1.52/1000). The use of allocation plans may enable a department to utilize personnel more efficiently; however, a simple ratio does not measure allocation effectiveness. It is possible that allocation plans do not allow reduction of police-citizen ratios. Rather they tend to be implemented in agencies where demand is higher. The ratio of officers to citizens by agency size is shown in Table 1.

Table 1

Ratio of Officers to Citizens by Agency Size

Proportion of officers to citizens in the five largest responding agencies: 2.03/1000	Proportion of officers to citizens in the ten largest responding agencies: 1.76/1000
Average ratio of remaining departments: 1.66/1000	Average ratio of remaining departments: 1.72/1000

Computerization

As mentioned earlier, since the collection and analysis of workload information and the allocation and scheduling of patrol officers can be complex and tedious, computer programs may be necessary to aid in the design of a patrol allocation model. Fifteen of the 23 responding agencies that use patrol allocation plans have computer programs to assist in the determination of patrol personnel allocation. Computer programs used by responding agencies specifying a program are listed in Table 2.

Table 2

Computer Programs Used in Texas Police Agencies

Agency	Computer Program
Arlington Plano	Lotus 1-2-3
Beaumont	Roark System/AS400
Carrollton	Map Info and Harvard Graphics
Fort Worth	In-House System
Houston	Patrol Plan II
Mesquite	OCS Software and In-House System
Waco	Statistics on Computer Aided Dispatch
Austin	Pros by Central Analysis of Tibron
Dallas	Police Patrol Scheduling System (PPSS)

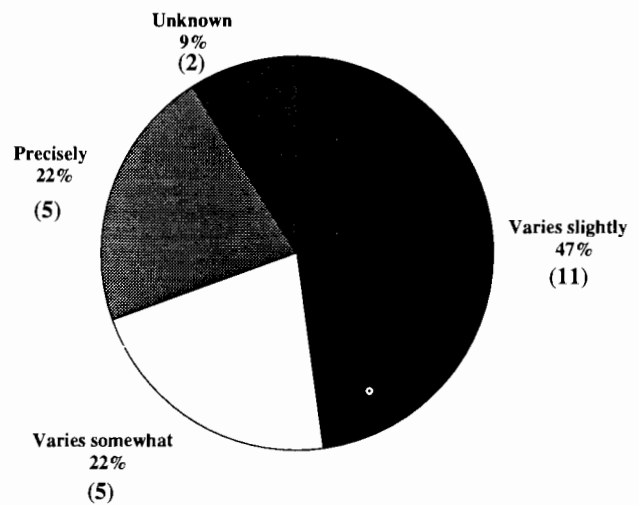


Figure 2

Degree to Which Scheduling Conforms to the Allocation Plan (Number of Agencies)

Changing Shifts and Beats

A patrol allocation model can be constructed to meet the specific needs of a police agency by calculating the temporal deployment (when) and geographic deployment (where) of officers. Proportional shift distribution and changeable beat boundaries can allow for the most efficient use of personnel. Seven (30%) of the responding agencies reported that beat boundaries change during different times of the day, while 16 (70%) agencies do not change their beat boundaries. The 23 agencies that utilize patrol allocation plans were asked to identify how closely patrol scheduling conforms to the allocation plan. Five (22%) agencies indicated that their patrol scheduling conforms to the patrol allocation plan precisely, while 11 (47%) agencies vary slightly from the agency's plan (see Figure 2).

Seventeen of the responding agencies that use a patrol allocation plan use calls-for-service as a factor in determining their plan. Officer-initiated incidents were used by 13 of the responding agencies. The factors used to determine the patrol allocation plan are shown in Figure 3.

Friday evenings are busiest. According to the survey results, a summary of patrol officers distributed by weekday and shift shows the highest number of police officers are scheduled to work on the Friday evening shift. The average percentage of patrol officers and supervisors assigned by shift and by day of week is shown in Table 3. It is apparent that Friday holds the peak proportion of manpower and the evening—especially Friday evening—is the most active of the three shifts. The distribution of the average number of officers assigned by day and shift is shown in Figure 4. The data are based on 16 police departments responding to the survey. As shown, there are approximately 64 officers dispatched to patrol the Friday evening shift. In contrast, there are an average 38 officers who patrol the Sunday morning shift.

Of the responding agencies that reported the usage of patrol allocation plans, 18 indicated that they review their plans every six months to one year. Upon review, many of those agencies rearrange their allocation plans if needed.

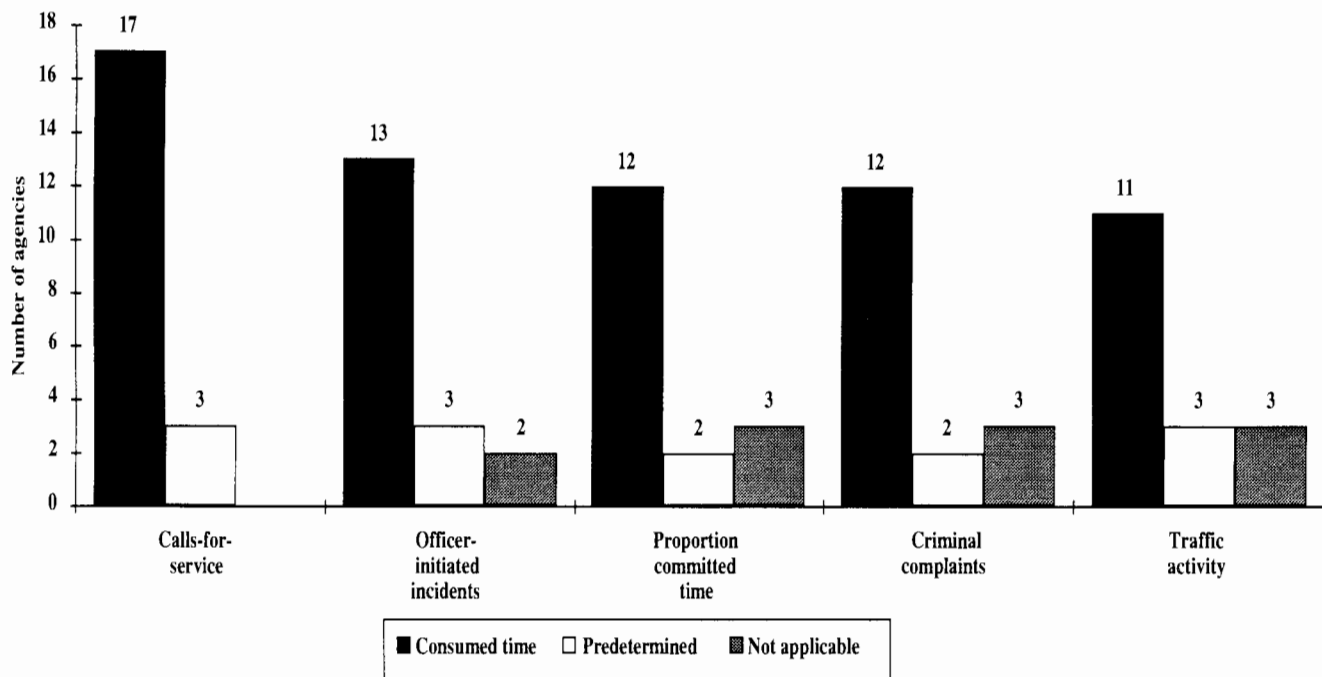


Figure 3

Factors Used to Determine the Patrol Allocation Plan

Table 3

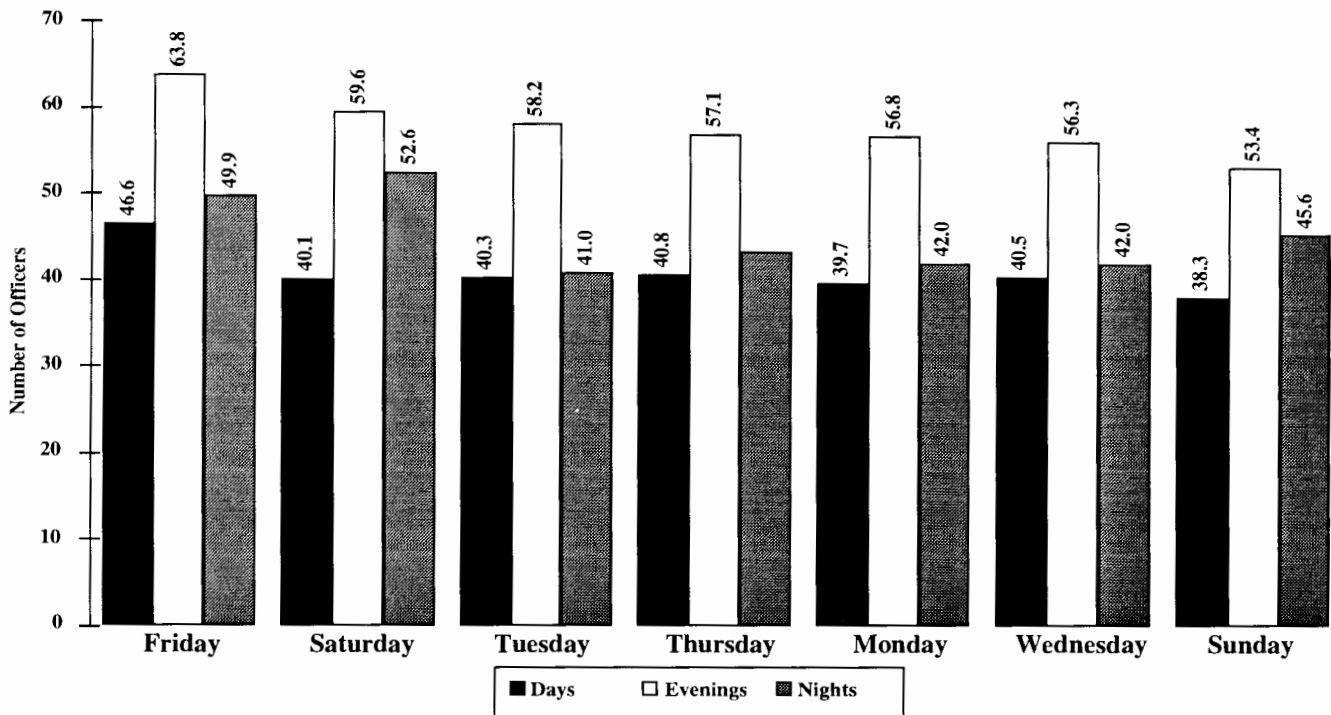
Percentage of Officers Allocated by Shift and by Day of Week

Day of Week	Shifts			Total Wkdys.
	Days	Evns.	Nghts.	
Monday	4.0%	5.3%	4.3%*	13.6%
Tuesday	4.1%	5.5%	4.2%	13.8%
Wednesday	4.1%	5.4%	4.2%	13.7%
Thursday	4.5%	5.8%	4.6%	14.9%
Friday	4.6%	6.1%	4.9%	15.6%
Saturday	4.1%	5.9%	5.1%	15.1%
Sunday	3.8%	5.1%	4.4%	13.3%
Total Shifts	29.2%	39.1%	31.7%	100.0%

* The Monday Night Shift shows a score of 4.3. This means that of all patrol manpower allocated during a seven-day week, 4.3% is used during the Monday night shift.

Conclusion

Patrol is one of the most important aspects of police work and requires the most personnel. Although an optimal patrol allocation model may be somewhat difficult to design, it should not be neglected since it is the foundation of efficient and effective police management. To determine the best model, the use of a computer in the analysis of patrol workload is recommended. Finally, it is important to consider temporal and geographical deployment patterns, as well as special needs of the jurisdiction when developing a police patrol allocation model. This will help to insure appropriate, efficient, and effective patrol deployment and allocation.



Average Number of Patrol Officers Distributed by Weekday and Shift

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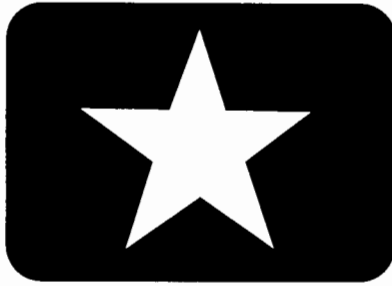
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Thank you to the following law enforcement agencies for contributing to this TELEMASP Bulletin:

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ISSN 1075-3702, are produced
under an agreement with the

Police Research Center
Sam Houston State University
Larry T. Hoover, Ph.D., Director
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