RESEARCH

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WHAT LAW ENFORCEMENT CAN GAIN FROM COMPUTER DESIGNED WORK SCHEDULES

U.S. DEPARTMENT OF JUSTICE
LAW ENFORCEMENT ASSISTANCE ADMINISTRATION
NATIONAL INSTITUTE OF LAW ENFORCEMENT AND CRIMINAL JUSTICE

WHAT LAW ENFORCEMENT CAN GAIN FROM COMPUTER DESIGNED WORK SCHEDULES

By

NELSON B. HELLER, Ph. D.

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FOREWORD

Scheduling and allocating police manpower in our nation's cities has become a complex and tedious task. New work rules, changing patterns of crime, and an increased demand for police services all contribute to the problem of ensuring rational deployment of officers and equipment.

Designing workloads and schedules, however, lends itself very well to the use of a simple computer program. Without sacrificing fairness or sensitivity to individual needs, the computer can efficiently and quickly devise schedules that meet the demands of a modern police force. Planning with the aid of the computer promises to save departments time and money.

This brochure describes the workings of the computer-based scheduling system now operating in an increasing number of police agencies. I hope it will aid jurisdictions in weighing the merits and potential economies to be derived from this innovation.

GERALD M. CAPLAN, *Director*
National Institute of Law Enforcement
and Criminal Justice

TABLE OF CONTENTS

How Important is the Scheduling and Allocation of Police Manpower?

The National Commission on Criminal Justice Standards and Goals, in its recent Task Force report on the police, has stated;*

> Every police agency should implement an allocation system for the geographical and chronological proportionate need distribution of patrol personnel. The allocation system should . . . minimize response time to calls for services, and equalize patrol personnel workload. This system should provide for the allocation of personnel to: . . . shifts . . . (and) days of the week.
>
> Every police agency should establish procedures for the implementation, operation, and periodic evaluation and revision of the agency's deployment system.

The same concern for improved scheduling and allocation of police manpower is voiced in "Improving Police Productivity, More For Your Law Enforcement Dollar," the report of the National Commission on Productivity.† In its list of "Key Questions" to be posed by law enforcement executives regarding their agencies, the Commission has included,

> In response to demands for more police protection, do you simply add more patrolmen to the force or do you try to increase police capability?
> What hours of the day are calls for service heaviest? Is that when most of your policemen are on duty?

It is pointed out in the report that to put one officer on the street 24 hours a day it is necessary to add five to the force to cover the three shifts, weekends, holidays, vacations and sick days. They estimate an expenditure of as much as $80,000 to add one manned post to the available street force.

State legislatures, city councils and police associations also are increasingly concerned with the costs and terms of scheduling and allocation procedures. Many contracts for police service go as far as to include specific restrictions relating to watch (or shift) rotations, watch change hours, and patterns of days off for the officers.

This booklet is about a computerized police work schedule design system now available to law enforcement and criminal justice agencies. The computerized system it describes is designed to take much of the work out of schedule design, and to permit schedules to be tailored to the work distributions and specific technical constraints relating to the user agency. A few schedules designed with this system are already in use in police departments in different parts of the country. If, after reading this brochure, you feel that your department might benefit from further consideration of the computerized scheduling system, you will find instructions for securing further information in the final section of the report.

Why Is It So Difficult to Design Good Police Work Schedules by Hand?

Police planners and administrators who have designed work schedules manually have often learned first hand that scheduling can be one of the most complicated, frustrating and time consuming of their planning responsibilities. Why is this so?

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*Standard 8.3, Deployment of Patrol Officers.

†See also "Opportunities for Improving Productivity in Police Services" National Commission on Productivity, 2000 M Street, N.W., Washington, D.C., 20508.

FIGURE 1. "St. Louis radio dispatch officers refer to patrol car deployment map designed to match manpower to workload."

Schedules involve much detail

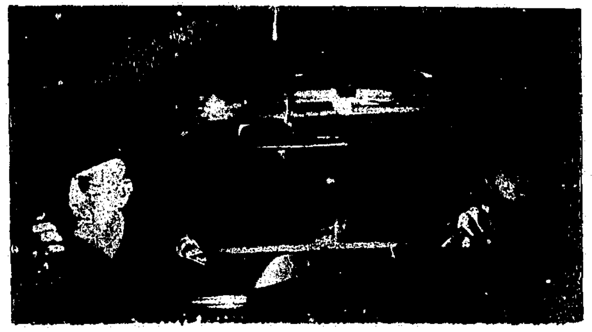
A work schedule must specify the on-duty and off-duty days and hours for every officer in the scheduled unit. Different units, performing different functions, require their own unique, individualized schedules. Even a fairly small department may have three to six units each operating on a different schedule.

Large number of features to be considered

A complicated array of considerations is used to judge the acceptability of any work schedule. These may include statutory constraints on features such as paid holidays, number of days worked per year, and hours worked per week. Management-labor negotiations may add further constraints relating to seniority, watch rotation, and off-duty periods. There are also important resource allocation considerations, relating to the achievement of a distribution of manpower over time and space which is proportional to the demand for service. And there are features which may affect morale, such as the number and spacing of weekends off, and the largest number of days in a row an officer must work without getting a day off.

No practical, comprehensive manual design procedures

No currently available manual schedule design procedure permits control of all the features of interest. Schedules have therefore been designed on the basis of a small number of important features—using, most often, repeated trial and error procedures until an acceptable compromise is discovered. This can be extremely time-consuming, and the schedule designer has no guarantee that his efforts will lead to a successful schedule.



FIGURES 2a and 2b. "In most cities police patrols are scheduled around the clock."

Why Was a Computerized Work Scheduling System Developed?

These problems, confronted every year by virtually every law enforcement agency in the country, have motivated the development of a computerized work scheduling system which automatically:

- determines appropriate manning levels for each day and watch,
- constructs suitable sequences of watch assignments, and of days worked and days off for each officer,
- facilitates solution of common problems of schedule administration,
- substantially decreases the time required to design schedules,
- tailors schedules to fit design constraints set by the user's needs,
- produces a set of equally acceptable schedules from which the final selection may be made by the unit commander on the basis of additional, nonquantifiable considerations, and,
- designs schedules which are virtually identical for all officers in the unit, a feature which greatly reduces the likelihood of the lowered officer morale which sometimes results when schedules are not equally desirable.

The computerized scheduling system, only recently developed, has been used to design work schedules for police units in two cities in Missouri and one in Oklahoma. A questionnaire survey of officers in one unit which has employed the new type schedules for more than 3 years indicates that the great majority of the officers approve the schedules, both overall and with respect to their major attributes.

What Types of Schedules May be Designed?

Most of the major types of work schedules currently used by law enforcement agencies may be designed with the computerized scheduling system. Included are:

- schedules in which all officers are permanently assigned to specified watches (i.e., hours of the day),
- schedules in which all officers periodically rotate watches after specified periods of time,
- individualized schedules in which no two officers have identical on-duty assignments over a complete schedule rotation period,
- group schedules, in which officers work in teams of prespecified numbers, each officer having the same schedule as the others in his team,
- schedules involving overlay watches, in which some officers report for work part way through one watch and work through to the corresponding point on the next watch; some of these schedules provide for overlay watches only some days of the week; and,
- multi-component schedules based on two or more schedules of the same, or different, types (e.g., a schedule in which one group of officers rotates through the day and afternoon watches only, while a second group rotates through the afternoon and night watches only).

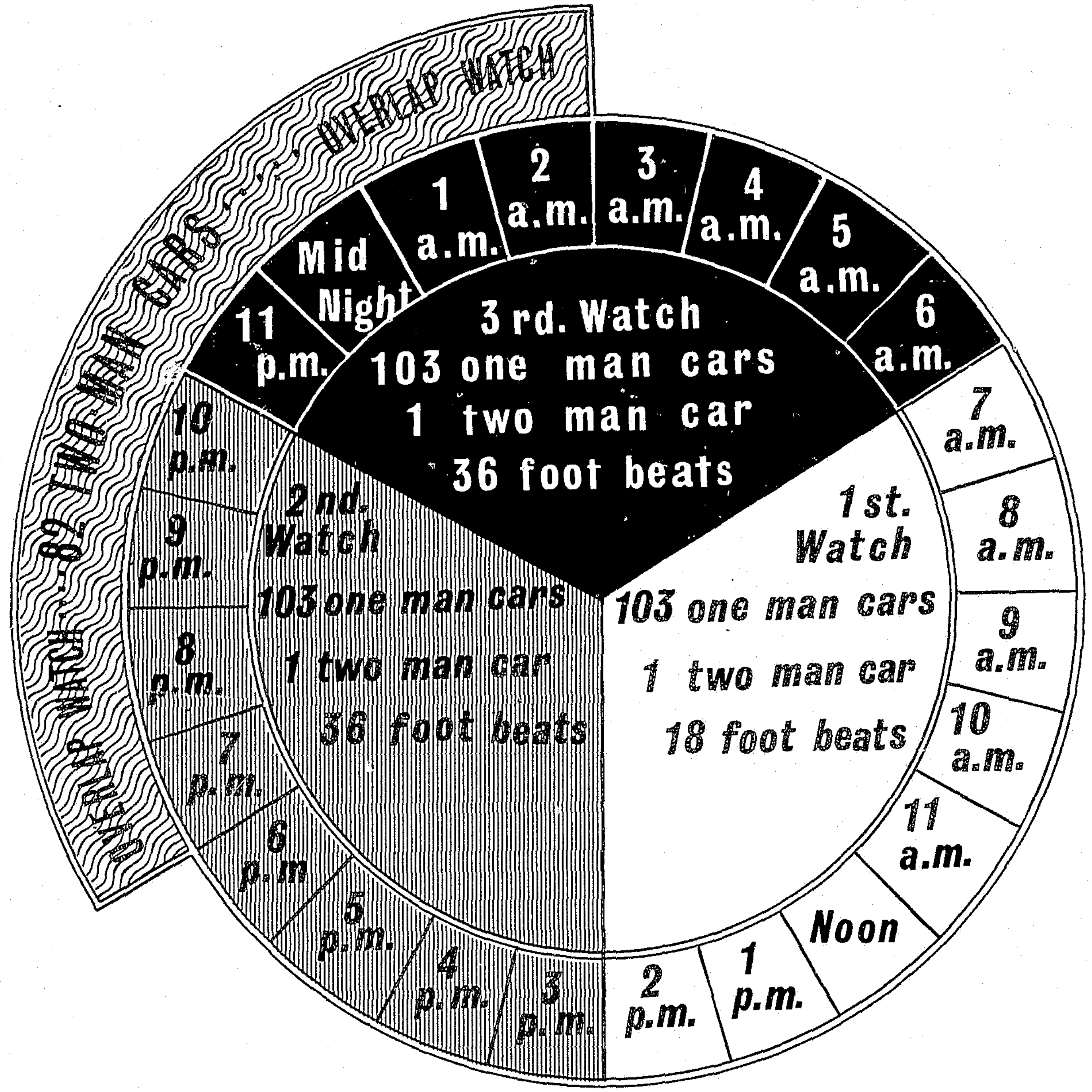


FIGURE 3. "Some schedules include overlay watches to raise manpower levels during the hours of heaviest demand."

What Features of the Schedule may be Controlled by the Schedule Designer?

When a schedule is to be designed with the computerized scheduling system, the schedule designer meets with the commander of the unit for which the schedule is being designed, after first consulting any appropriate personnel regulations, to determine the requirements which the schedule must satisfy. A partial list of features of the schedule which may be tailored to the needs of the unit follows.

- **Distribution of manpower in proportion to the demand for service**

The level of on-duty manpower each watch and day of the week may be made proportional to the average demand for service, providing increased manning for the busier periods and decreased manning for the less busy periods. This feature can be very beneficial for departments whose demand for service regularly peaks on certain days of the week, and during certain hours of the day. Compared to a schedule with equal manning at all times, the proportional schedule prevents an excess of manpower from being scheduled for the quieter periods of the week, and regularly supplies additional manpower

to the busy periods. In doing so, the proportional schedule equalizes the workload per man over the watches, and provides a decreased sensitivity to absences (particularly on the busy watches). In departments employing equally manned watches, these benefits can only be achieved by hiring additional manpower.

- **Periods of days off**

The designer may specify the lengths of the longest and shortest acceptable periods of consecutive days off, called "recreation periods" in some departments. For example, it may be required that a recreation period be at least 2 days and no more than 4 days in length. In addition, the designer may indicate any number of paid holidays, or days of compensatory time off for overtime earned, to be scheduled automatically as additional "recreation days."

FIGURE 4a. "Officers often work on Sundays and holidays when others are off . . ."

FIGURE 4b. and FIGURE 4c. ". . . so careful attention must be paid to scheduling their days off."

Recreation periods including a weekend (i.e., Saturday and Sunday) are considered especially desirable by most police officers, both because of the normal concentration of social events on weekends and because of the frequently heavy police workload on Saturdays. Consequently, the design programs include procedures for assuring a maximum number of weekends off, and for spacing them as uniformly as possible over the rotation period. Also, the programs favor schedules with longer weekend recreation periods over those with shorter ones.

- **Periods of on-duty days**

The schedule designer may specify the lengths of the longest and shortest acceptable periods of consecutive days on duty, called "work periods." Automatic control of the length of the longest work period in this manner is an extremely useful feature. In one department in which officers, using a manually designed schedule, occasionally worked 11 to 13 days in a row, the computerized schedule design system was able to reduce the longest work period to 8 days.

In addition, the design programs favor schedules:

- with work periods of fairly uniform lengths,
- in which the longer work periods are separated by shorter work periods, and,
- in which the longer work periods are followed by the longer recreation periods, and the shorter work periods by the shorter recreation periods.

- **Watch change conditions**

In a conventional three-watch schedule in which officers periodically rotate watch assignments, for an officer who is scheduled to work both the day preceding and the day of assignment to a new watch, the number of off-duty hours between consecutive on-duty assignments may be as few as zero or as many as 32, depending on the watch rotation sequence. Both situations are considered undesirable in many departments, since the first allows no rest between assignments, while the second amounts to a 1-day recreation period. Therefore, the computerized design procedure is automatically restricted to schedules in which officers are on recreation either the day before or the day of the watch change, or both. In short, every watch change is "covered" by a recreation period, leading to off-duty periods of acceptable length at the watch change point; the range of acceptable lengths for these periods may be separately specified by the schedule designer. Incidentally, this procedure makes possible the automatic scheduling of occasional "mini-vacations," recreation periods of exceptional length (e.g., 6 to 8 days).

- **Numbers of on-duty officers**

When the design programs are used to develop schedules whose manpower levels are proportional to the demand for service, individual upper and lower limits may be specified for the number of on-duty officers each watch each day of the week. Thus, for example, if a particular unit requires a minimum of three officers to function effectively, the program may be set to schedule at least three officers for all watches, including those for which a low demand for service might indicate a need for fewer than three officers. Similarly, if equipment limitations make the scheduling of more than six officers for any watch undesirable, the program may be set to schedule no more than this number of officers for any watch. In computing the best allocation of manpower to the watches, the computer programs indicate which watches have allocations restricted by one or the other of these limits. This information may be used to determine which watches ought to be manned, if continuous service is not required.

- **Lengths of assignment to each watch**

When designing a rotating schedule, the schedule designer may control the number of weeks of consecutive assignment to any watch. This permits him to avoid periods which are too short to allow the officers time to adjust to their new working hours, and periods which are too long to allow officers some time on each watch during each season.

How Can a Rotating Schedule Produce Manning Levels Each Watch Which are Proportional to the Workload?

It is not difficult to demonstrate that a rotating schedule can be constructed with virtually any distribution of manpower over any number of watches. The procedures for accomplishing this useful

objective are incorporated in the schedule design programs. Basically, it is achieved by dividing the work force into an appropriate number of equal sized groups, causing the time spent by each group on any watch to be proportional to the corresponding workload, and properly phasing the rotation of the groups. This will be illustrated for a simple three-watch schedule in which two-ninths of the workload occurs on the night watch (11 p.m. to 7 a.m.), three-ninths on the day watch (7 a.m. to 3 p.m.), and four-ninths on the afternoon watch (3 p.m. to 11 p.m.), a distribution of work quite close to that for police departments in many cities.

FIGURE 5. "Police services needed during some hours of the day may not be needed during others."

Since the workload can be divided conveniently into ninths, the officers in the unit to be scheduled are divided into nine equal or approximately equal groups, numbered from one to nine. During the first week of operation under the new schedule, these groups can be assigned to the three watches as follows,

Group:	1	2	3	4	5	6	7	8	9
Watch:	N	N	A	A	A	A	D	D	D

where N, A, and D stand for nights, afternoons, and days. This assignment generates the desired distribution of manpower, with two-ninths of the officers on the night watch, three-ninths on the day watch, and four-ninths on the afternoon watch. During the second week the groups are reassigned by shifting the group numbers one position to the right in the list, and rotating the final number around to the beginning of the list:

Group:	9	1	2	3	4	5	6	7	8
Watch:	N	N	A	A	A	A	D	D	D

In this manner the distribution of the manpower over the watches has been maintained as desired. Notice that only groups 2, 6, and 9 actually changed watches; the other groups carried on with the previously assigned watch. The assignment for the third and successive weeks are made by successively shifting the group numbers one position to the right and rotating the final number around to the beginning of the list. For example, the assignments for the fourth week are,

Group:	7	8	9	1	2	3	4	5	6
Watch:	N	N	A	A	A	A	D	D	D

At the end of 9 weeks each group has rotated once through all the watches, having spent 2 weeks on the night watch, 3 weeks on the day watch, and 4 weeks on the afternoon watch.

The schedule constructed above is not the only one which generates the desired distribution of manpower over the watches. For example, if for some reason an assignment of four consecutive weeks to the afternoon watch is considered too long, the schedule might be rearranged into two full rotations through the watches, as follows,

Group:	1	2	3	4	5	6	7	8	9
Watch:	N	A	A	D	N	A	A	D	D

In this case officers rotate through the three watches once in 4 weeks and then a second time in another 5 weeks.

It is also possible to utilize this procedure to develop a proportional schedule in which some groups of officers are permanently assigned to some watches while others rotate. For example, suppose group 8 consists of "limited duty" officers permanently assigned to the day watch, and group 9 consists of officers who attend college in the morning and are permanently assigned to the afternoon watch. The schedule might be,

Group:	1	2	3	4	5	6	7	8	9
	Rotating Schedule							Permanent	
Watch:	N	N	A	A	A	D	D	D	A

Here groups 1 through 7 work a rotating schedule involving 2 weeks on nights, 3 weeks on afternoons, and 2 weeks on days, while groups 8 and 9 are permanently assigned as indicated.

These examples illustrate how rotating schedules may be designed to distribute manpower over the watches in proportion to the workload. The computerized design programs embody an advanced form of this procedure which allows them to design schedules whose manning levels each watch also vary by day of the week in proportion to the workload each day. An example of this type of schedule is presented in the following section.

What Does a Computer Designed Work Schedule Look Like?

To illustrate the features of a computer designed work schedule, a schedule designed for a 14-man traffic safety unit operating only on the day and afternoon watches is shown below. Information on the distribution of accidents reported to the unit, by day and watch, and on the number of men in the unit, was used by the scheduler as input to the first of the three computer design programs. The result-

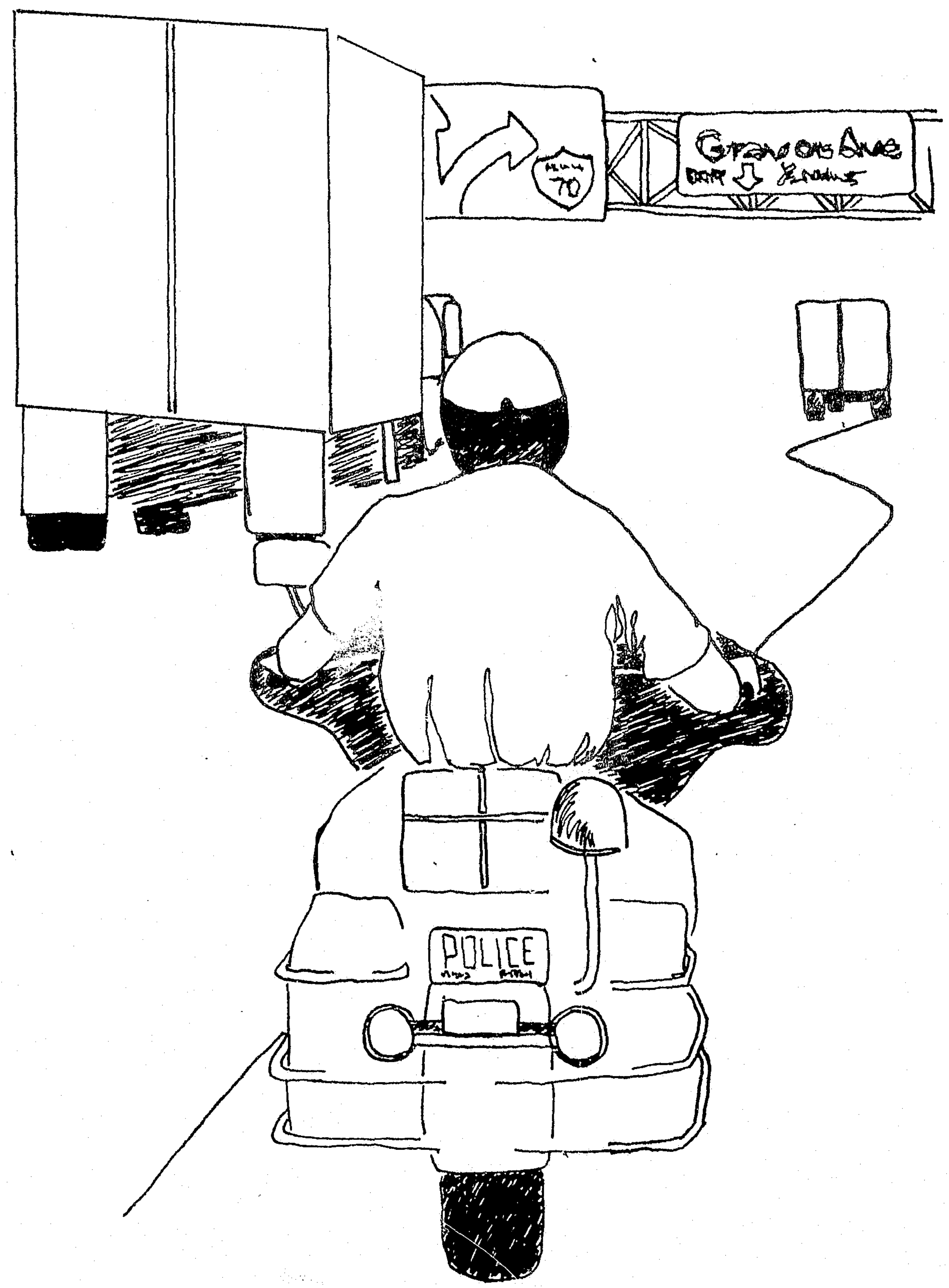


FIGURE 6. "Motorcycle patrols operate mainly during daylight hours—usually no more than two watches per day."

ing output indicated the following distribution of on- and off-duty manpower by day of the week and watch:

Watch	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Day (7 a.m.–3 p.m.):							
On-duty	5	5	5	5	6	5	4
Off-duty	2	2	2	2	1	2	3
Afternoon (3 p.m.–11 p.m.):							
On-duty	5	5	5	5	6	5	4
Off-duty	2	2	2	2	1	2	3

Seven men were to be assigned to each watch, with five of them on duty 5 days of the week. Friday's heavier workload required six men, while Sunday's lighter workload required only four men. The scheduler was then asked to design a rotating schedule, fitting the manpower distribution, and in which officers were to spend 3 to 4 consecutive weeks on each watch before rotating to the next watch. Using the two remaining design programs, the scheduler produced the basic rotation and recreation schedule shown in the illustration.

```
RANK NO =   2            SOLUTION NO =   9
               MON TUE WED THU FRI SAT SUN
            1   R   R   *   *   *   *   *
            2   *   *   R   R   *   *   *
            3   *   *   *   *   *   R   R
                    AFT A / DAY B
            4   *   *   *   *   *   *   R
            5   R   *   *   *   *   *   *
            6   *   R   R   *   *   *   *
            7   *   *   *   R   R   R   R
                    DAY B / AFT B
            8   R   R   R   *   *   *   *
            9   *   *   *   R   R   *   *
           10   *   *   *   *   *   R   R
           11   *   *   *   *   *   *   R
                    AFT B / DAY A
           12   R   R   *   *   *   *   *
           13   *   *   R   R   *   *   *
           14   *   *   *   *   *   R   R
                    DAY A / AFT A

     RANK MEASURE =  4030802   01002C00101 21503 +  0.91
```

FIGURE 7a. "The computer designed schedules indicate days off, shown as "R" (recreation day) and the assigned watch for each officer."

```
NUMBER OF WEEKEND RECREATION PERIODS                    =  4
MAXIMUM NUMBER OF CONSECUTIVE WORKING WEEKENDS          =  3
MAXIMUM LENGTH WORK PERIOD                              =  8
NUMBER OF MAXIMUM LENGTH WORK PERIODS                   =  2
          RECREATION PERIOD COMPOSITION
          RANK   LENGTH/START   NUMBER
            1       4 / FRI       0
            2       4 / THU       0
            3       4 / SAT       1
            4       3 / FRI       0
            5       3 / SAT       0
            6       2 / SAT       2
            7       4 / WED       0
            8       3 / THU       0
            9       4 / SUN       0
           10       3 / SUN       1
           11       2 / FRI       0
           12       2 / SUN       1
WORK PERIOD RANGE                                       =  2
MAXIMUM - TWO CONSECUTIVE WORK PERIODS                  = 15
NUMBER OF MAXIMUM - TWO CONSECUTIVE WORK PERIODS        =  3
STANDARD DEVIATION - WORK/REC RATIOS                    = 0.91
WORK PERIOD LENGTHS   7   8   6   7   7   7   7   6   7   8
 REC PERIOD LENGTHS   2   2   2   2   7   2   2   3   2   4
```

FIGURE 7b. "Attributes of the schedule are displayed in a table printed along with the schedule."

The rotation period for this schedule is 14 weeks. Each of the officers in the unit is assigned a number from one to 14. During the first week of operation of the schedule each officer works the assignment for the week bearing his number (shown at the left of the chart). For example, man six is assigned to the day watch and is on-duty on Monday, on recreation on Tuesday and Wednesday, and then on-duty from Thursday through Sunday. For the second week of operation each officer is advanced to the next numbered week in the schedule, with man 14 rotating back to week one. Continuing the example for man six: he advances to week seven, where his assignment is to work the day watch Monday through Wednesday and to be on recreation Thursday through Sunday.

A careful examination of the schedule will reveal that its work periods vary in length from 6 to 8 days, and its recreation periods from 2 to 4 days, with the exception of one longer 7-day recreation period which begins on Thursday of week seven and runs through Wednesday of week eight. This "mini-vacation," occurring once every 14 weeks, was designed into the schedule at the request of the unit commander.

After 14 weeks each officer has rotated once completely through every week of the schedule and returned to his initial week. Since all officers share the same basic rotation and recreation schedule, their individual schedules are identical, with the exception that they lag or lead each other by some number of weeks.

Many other useful features have been designed into the schedule by the computer design programs:

- the proper distribution of on-duty and off-duty manpower by day and watch has been achieved,
- officers have been scheduled for 3 or 4 weeks on each watch before rotation,
- four weekend recreation periods, the maximum number possible, are included in the schedule, with no more than three working weekends separating any pair of weekends off,
- every watch change has been covered with a recreation period, completely eliminating off-duty periods of unacceptable length between watches, and,
- the maximum length work period, constrained to no more than 9 days by the schedule designer, was found to be 8 days long; this was, incidentally, 2 days shorter than that for the manually designed schedule which had been proposed for the unit.

What are the Prerequisites for Computerized Scheduling?

If your police department is considering use of the computerized scheduling system, you probably have many questions about the types of information needed as input, the equipment and training required to run the programs, and the related costs. Some likely questions, and their answers, follow.

● What type of workload information is required?

Ideally, information regarding the average workload for each watch each day of the week should be available. The workload may be measured by the number of calls for police service, the number of crimes reported, or the number of hours spent servicing calls. If no such figures are available:

- they may be estimated by sampling crime or called-for-service records, or,
- a "judgment" estimate may be made, based on knowledge of which watches in the week are usually busy and which are usually quiet.

● What other input information is required?

The following additional information will be needed:

- the watches during the week when officers will be on duty, and their hours,
- the number of paid holidays per year received by each officer,
- the number of officers in the unit being scheduled,
- any special limitations on the number of officers who may be on duty on any watch during the week,
- restrictions relating to the lengths of acceptable work and recreation periods,
- the number of weeks officers are to be assigned to each watch before rotation (if a rotating schedule is being designed),
- the number of weekends in a row an officer may work between weekends off, and,
- information on the officers' preferences for different types of recreation periods of varying lengths and including different days of the week.

● What type of computer equipment is needed?

The computerized scheduling system consists of three computer programs written in FORTRAN IV. They were developed and tested on an IBM 360/65 computer using a FORTRAN G compiler.

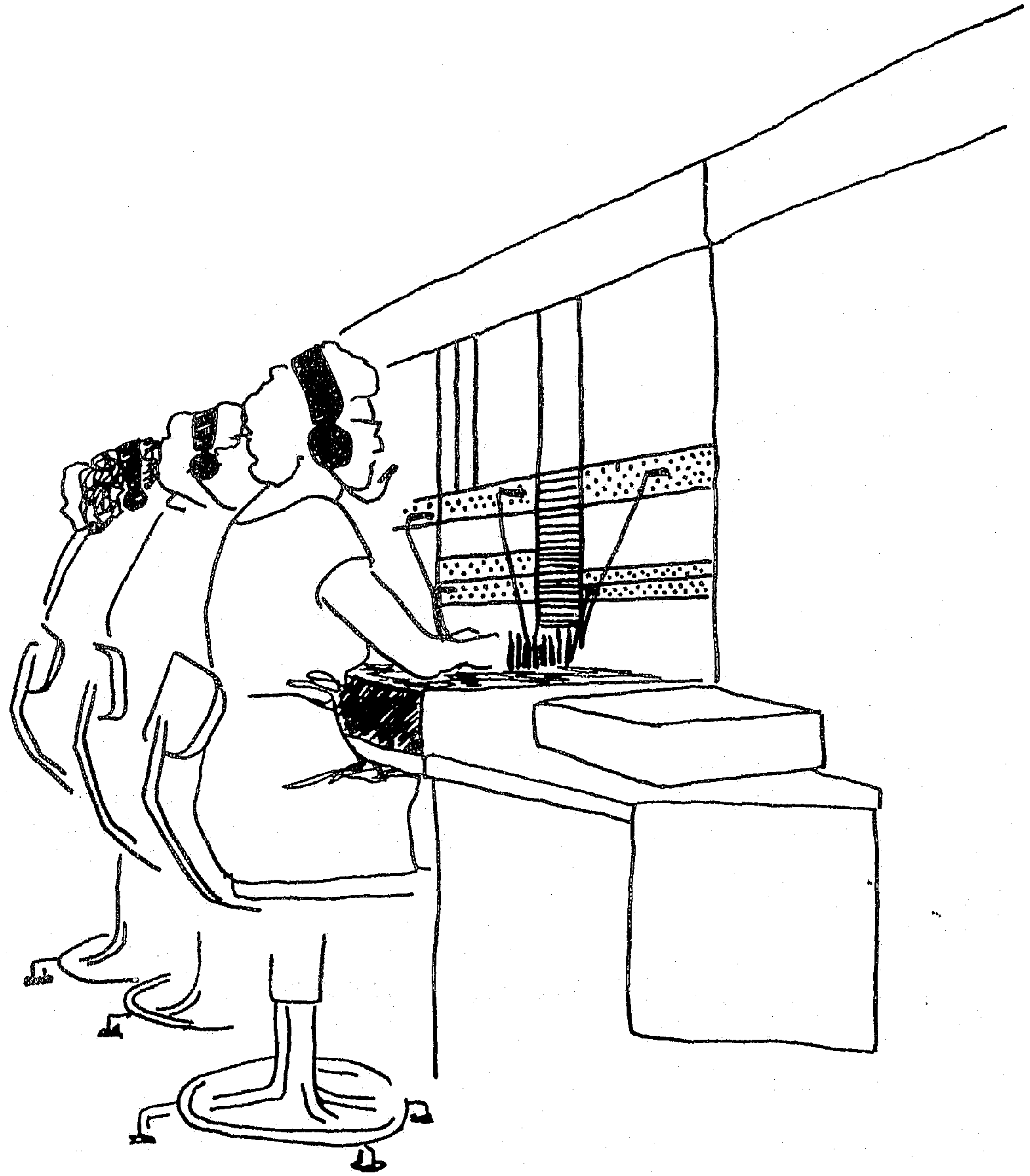


FIGURE 8. "The emergency service workload can often be estimated using information on the number of calls for service."

The load module for the largest of the three programs requires less than 75k of core storage. A run of all three programs requires from 6 to 12 minutes of CPU time, depending on the complexity of the scheduling problem.

If a police department does not own a computer of this type, considering the infrequent use which would be made of the computerized scheduling programs,

- the programs might be run at a local university, or by renting computer time from a commercial source, or,
- the design of schedules might be centralized, for a state or metropolitan area, at a criminal justice facility which owns the appropriate equipment.

FIGURE 9. "The design of schedules might be centralized for a state or region, at a criminal justice facility which owns the appropriate equipment."

• What training and skills are required to run the schedule design programs?

Most departments will find it convenient to designate one individual, either commissioned or civilian, as coordinator for the design and use of computer designed schedules. In a small department this will be a part-time job, but larger departments may require one or more full-time positions for this work.

The scheduler will have to familiarize himself with the operation of the computerized scheduling system, including preparation of the input data cards, and interpretation of the computer printouts. All of this material is covered in detail in a two volume document entitled, "Computerized Scheduling of Police Manpower." Included is a User's Manual covering procedures for use of each of the three schedule design programs, and containing both input and output for sample schedule design problems. Ideally, the scheduler would attend a brief schedule design workshop to learn and practice the use of the design programs. If this is not possible, self-study and practice with the sample problems will probably suffice. In either case, some familiarity with the use of computer program packages and with work scheduling will be most beneficial.

The scheduler should also be prepared to assist his user units in the solution of problems related to, but not encompassed by, the design of watch rotation and recreation schedules. Such problems include,

- design of vacation schedules,
- design of schedules for supervisory staff when these cannot be identical to those for supervised personnel,
- geographic deployment,
- design of schedules for in-service training,
- determination of the number of officers to assign to a given function or unit, and,
- development of an information dissemination program to inform and involve command personnel, and later to communicate the benefits of computer designed schedules to units slated to begin using them.

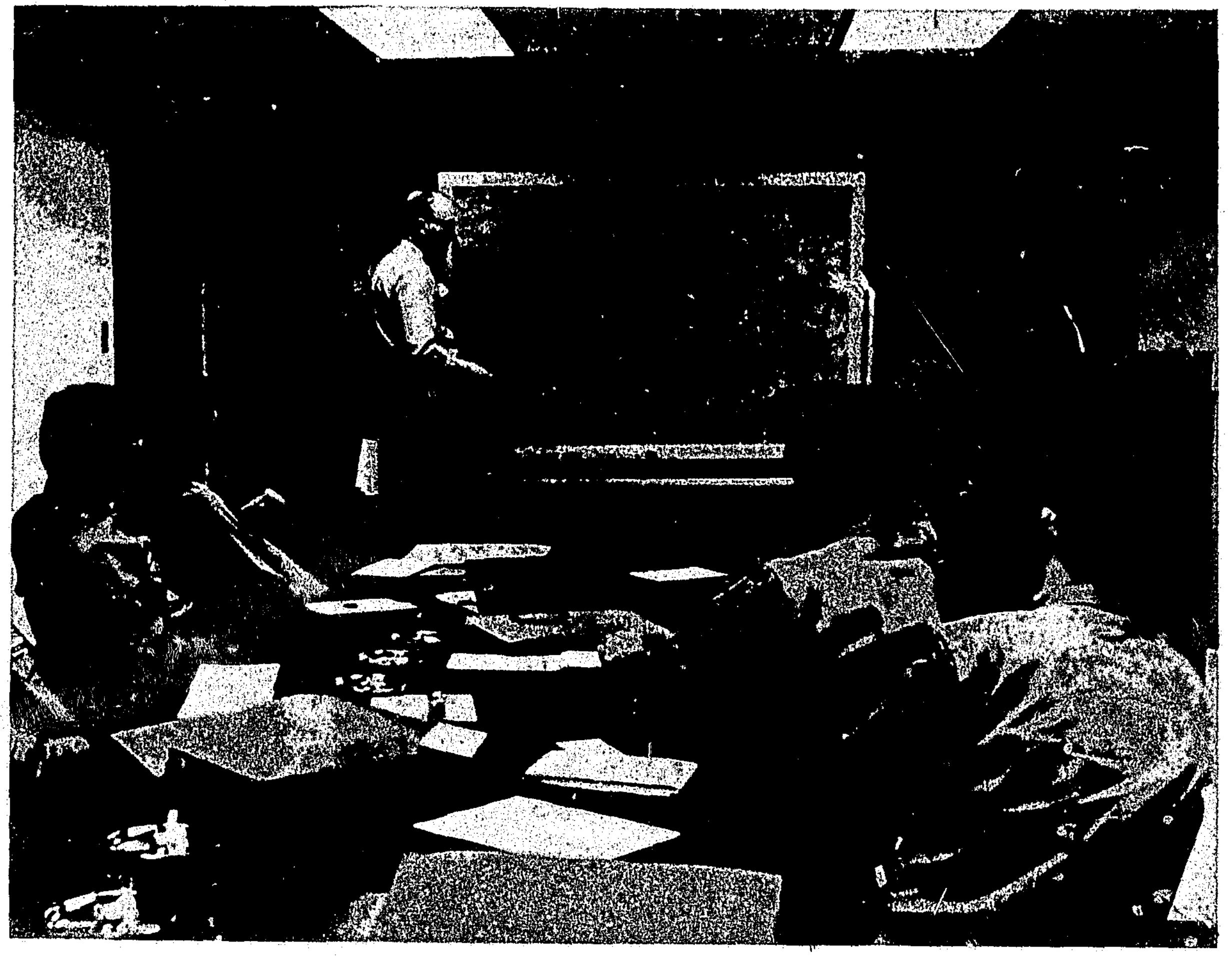


FIGURE 10. "The scheduler may also be asked to develop schedules for in-service training."

The scheduler will continue to serve as a resource to unit commanders once their units have adopted computer designed schedules. In this regard he will provide technical assistance relating to,

- scheduling compensatory days off for overtime earned by individual officers,
- modification of on-going schedules to accommodate changes in the number of officers in a unit, or in department regulations (e.g., relating to the number of paid holidays per year), and,
- determination of appropriate intervals for the regular redesign of schedules.

How Much Will It Cost to Switch to Computer Designed Schedules?

The cost of implementing the computerized scheduling system in a police department currently using manually designed schedules is minimal. The major cost items are:

- **Computer programs and reports**

The computer programs are available to qualified criminal justice agencies free of charge from the Law Enforcement Assistance Administration. There is a small charge for copying them onto a magnetic tape supplied by the user, and for purchase of a tape if none is submitted by the user. The related reports are also available free of charge. A small charge is made for postage and handling.

- **Scheduler**

The position of scheduler should be created, if none already exists. The scheduler may be an individual who was formerly responsible for manual schedule design. With the assistance of the computer programs, the number of manhours required to design a schedule should decrease considerably.

This may be offset slightly if the department chooses to employ a more sophisticated type of schedule than previously used, relying on the expanded schedule design capability offered by the programs. In addition, the department may incur some one-time costs in connection with training the scheduler to use the computerized system.

- **Computer costs**

The computer costs for schedule design, which are quite low, will vary with the number of schedules designed annually, and their complexity. Experience with the schedule design programs indicates that about 6 to 12 minutes of computer time are required for each schedule. This time depends on the type of computer used, and the feasibility of the design constraints imposed on the schedule. If the constraints are too severe they may preclude the design of an acceptable schedule (i.e., none may exist). In such cases, this fact is indicated by the programs, and they may be rerun with a more relaxed set of constraints.

How Can More Information on Computerized Scheduling be Obtained?

Computerized schedule design should be of interest for many types of law enforcement operations. The characteristics of activities for which it can be particularly beneficial include any of the following:

- a nonuniform demand for service over the periods of the week when service is offered,
- services being offered more than 5 days per week,
- services being performed more than one watch per day, or,
- situations in which work schedules are renegotiated periodically in connection with labor contracts.

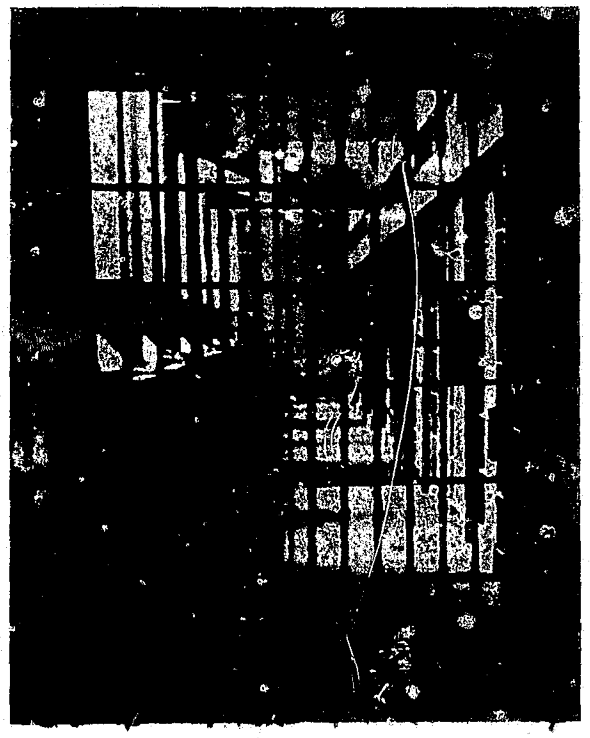


FIGURE 11a. "Computer designed schedules can also be useful for non-police operations such as those of prison security . . ."

FIGURE 11b. ". . . or of a criminal justice information system."

These characteristics are also found in many criminal justice operations outside the realm of law enforcement. Some examples are guard services at custodial institutions, warrant office operations involving extended hours or more than 5 days per week, and support services for automated or manual records and information systems.

Additional information on the computerized schedule design system described in this booklet is available to criminal justice agencies by writing to the Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Police Division, 633 Indiana Avenue, N.W., Washington, D.C. 20531.

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