Simulation of a Criminal Justice System Model

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ABSTRACT

This paper presents a simulation model of a criminal justice system. The model is written in GPSS and is a general model that can be adapted to a specific criminal justice system by modifying the model parameters. A flow chart of the system and a block diagram of the model are included.

Statement of Problem

One problem faced by society and government is the growing burden being placed on the criminal justice system. Criminal investigators, jurists, courtroom facilities, and penal institutions are being utilized to their fullest extent. Simulation has proved to be a useful tool in the analysis of complex systems. The criminal justice system possesses the characteristics of a system that lends itself to analysis by computer simulation. Questions concerning the behavior of a criminal justice system can be formulated and answered using simulation and the effects of innovative changes can be observed without disrupting the actual criminal justice system.

The objective of this paper is to present a simulation model of a criminal justice system. The structure of the model is general and can be adapted to fit specific systems. The model is written in GPSS (General Purpose Simulation System) with the events that occur in the simulation model closely paralleling the events that occur in the actual system. Figure 1 depicts the criminal system from which the model is developed.

Bateman and Doescher and Navarro and Taylor have developed simulation models for segments of the criminal justice system. This paper presents a model that attempts to encompass most of the segments of the justice system from commission of a crime to incarceration.

Approach Taken in Building the Model

The GPSS model consists of transactions and blocks. The transactions represent an individual who is part of the criminal justice system. The individual may occupy any or all of the following states in the system:

(1) Criminally investigated
(2) Not tried due to lack of evidence
(3) Tried and found guilty
(4) Tried and acquitted
(5) Placed in confinement
(6) Paroled

In the simulation model the transaction occupies blocks to indicate the state of the system model. Statistics are maintained on transactions that indicate system performance. There are two principal types of events in the model: time related events and decision events. The model logic is shown by Figure 2. After a crime has been detected and categorized the following time related events occur:

(1) time between crimes
(2) time for criminal investigation
(3) time for case preparation
(4) time for completion of a trial
(5) time of incarceration before parole
(6) time of probation

The time for each of these events is a random variable; therefore, distribution times must be provided for each crime classification.

The following primary events occur in the model:

(1) The crime is investigated
(2) The case is dismissed or a case is prepared for trial
(3) A trial is conducted
(4) The accused is found guilty or acquitted
(5) The convicted individual is sentenced and placed in an institution
(6) After a period of incarceration the individual is paroled or continues to complete the sentence
(7) Each individual in the system may be a first offender or a repeat offender.

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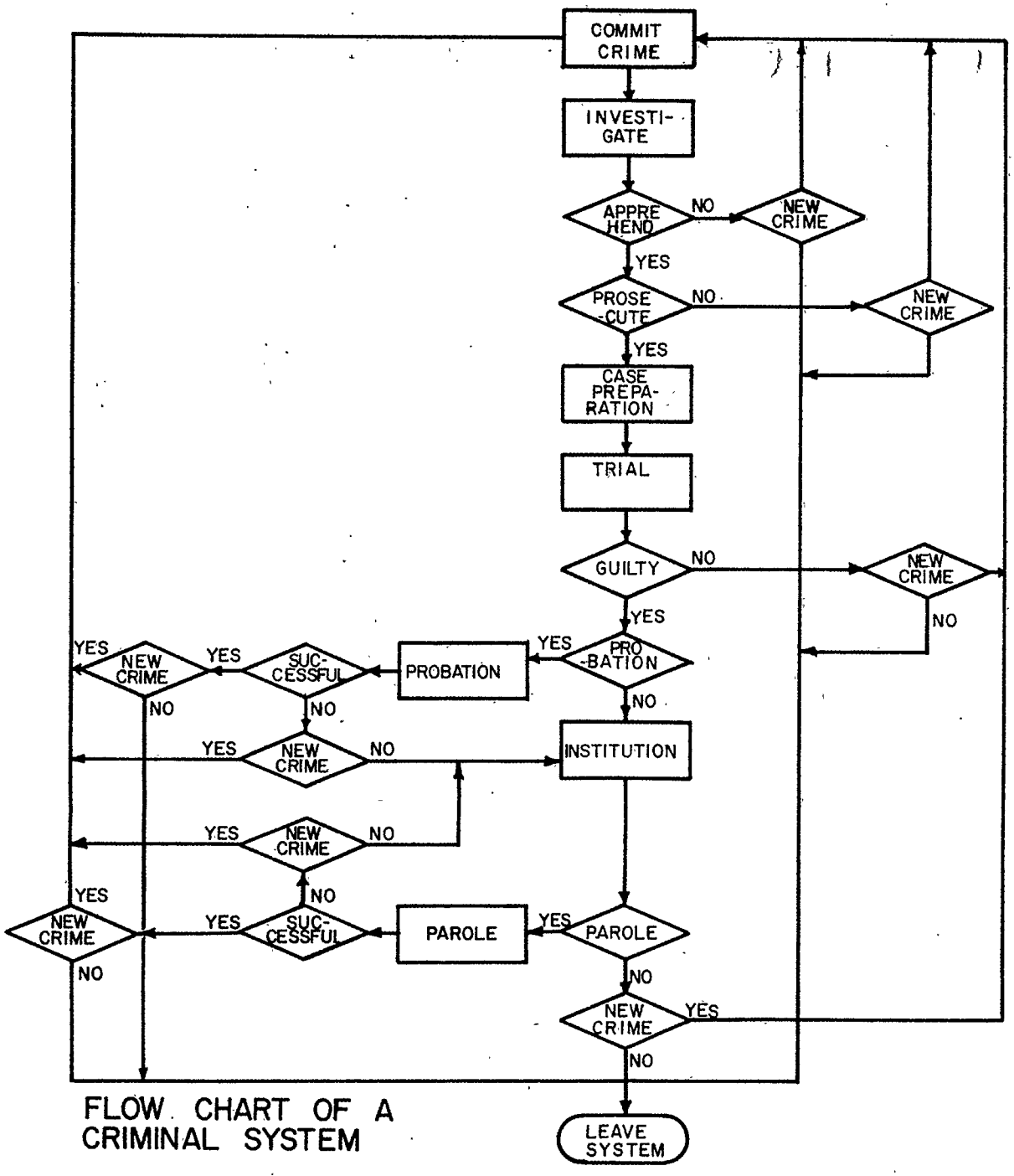
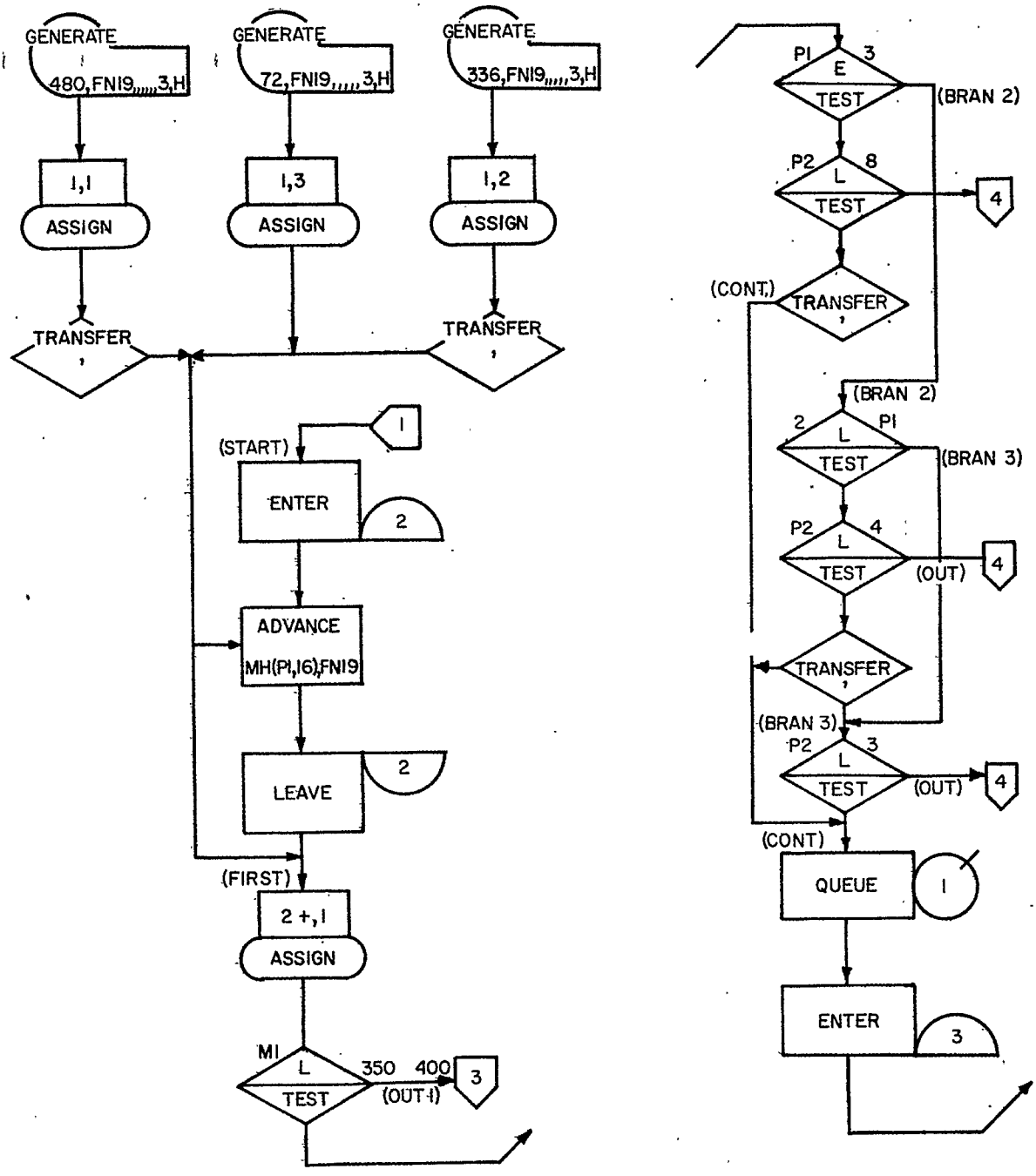


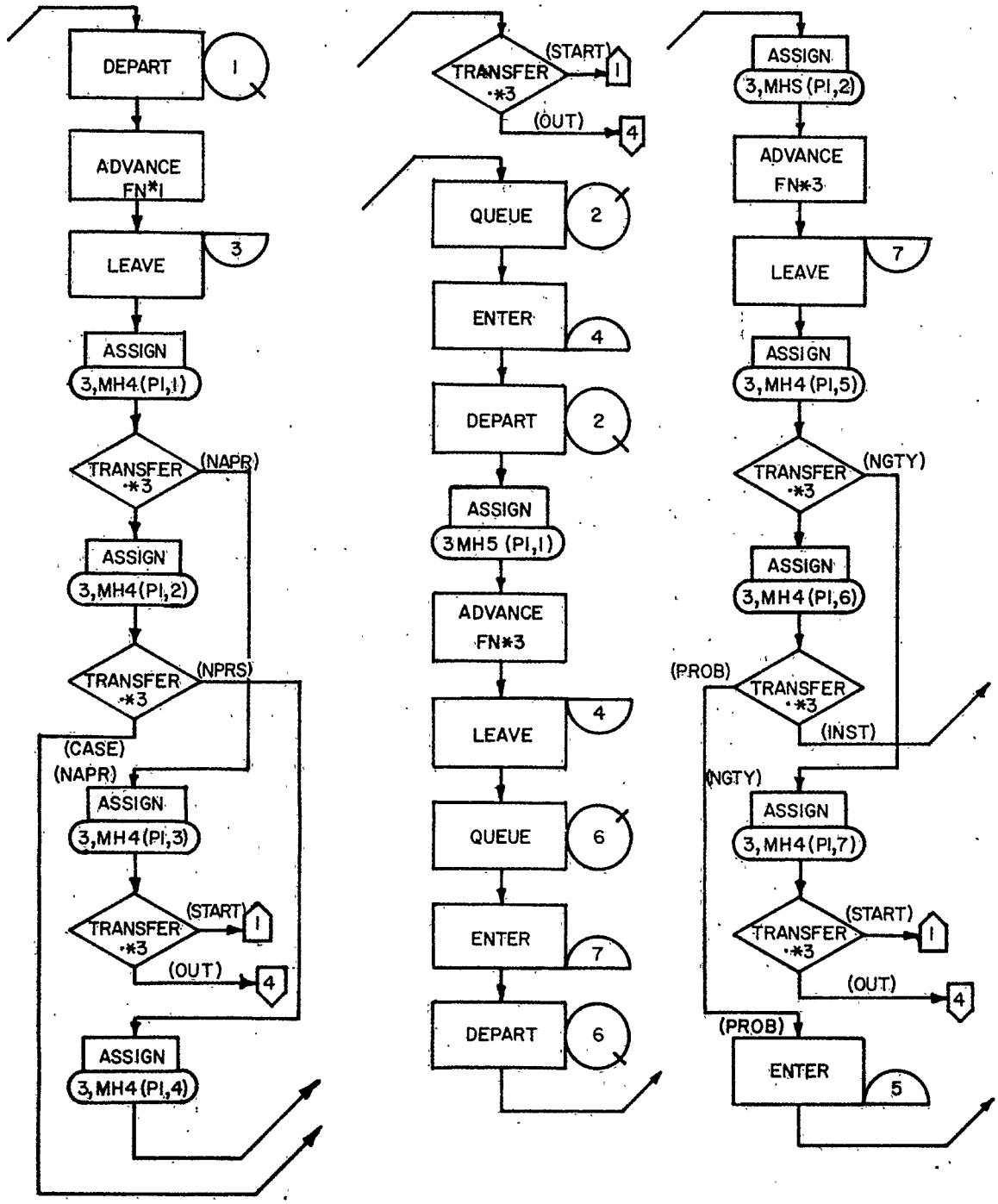
FLOW CHART OF A CRIMINAL SYSTEM

Figure 1



THE GPSS MODEL OF A CRIMINAL JUSTICE SYSTEM

Figure 2



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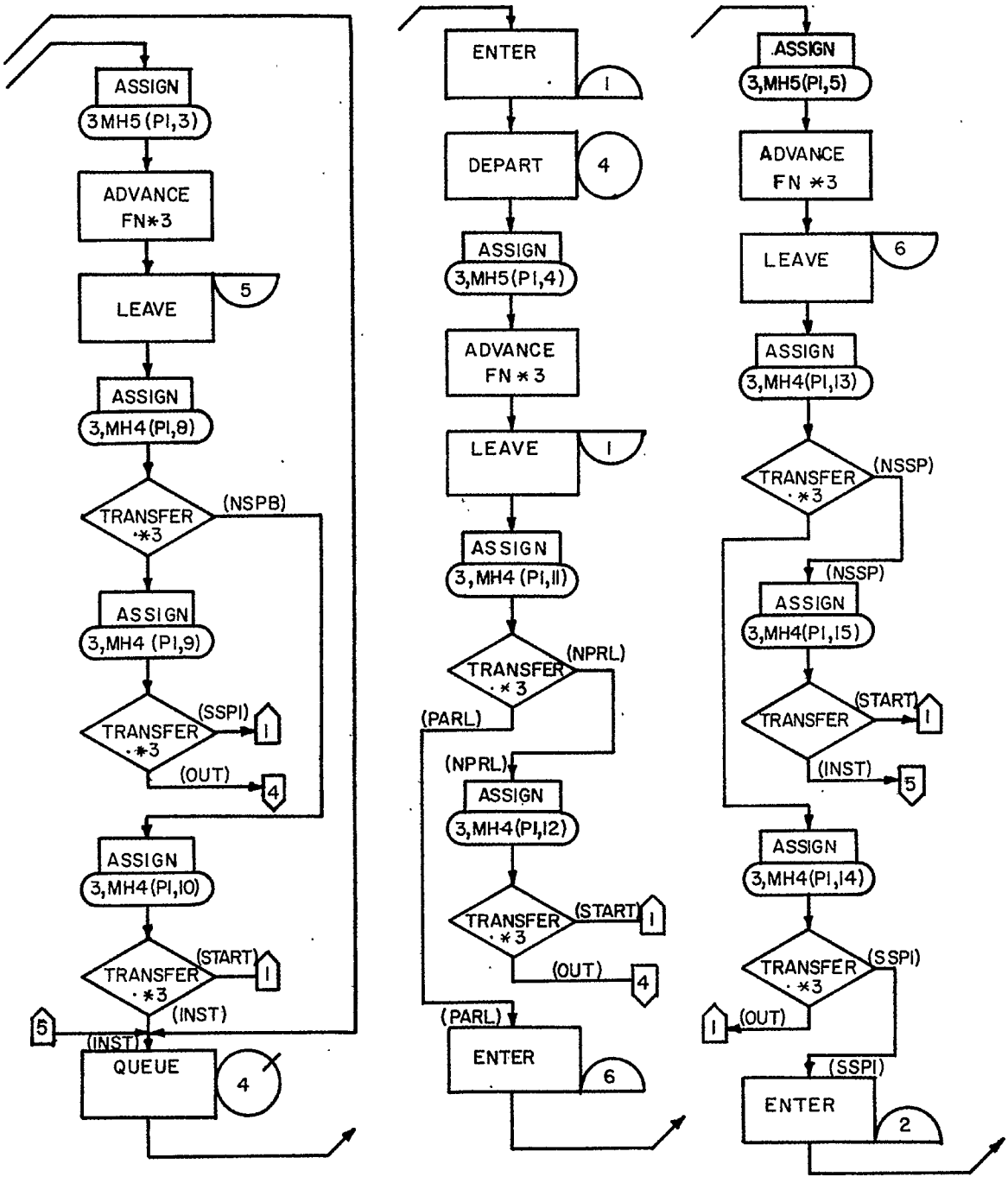

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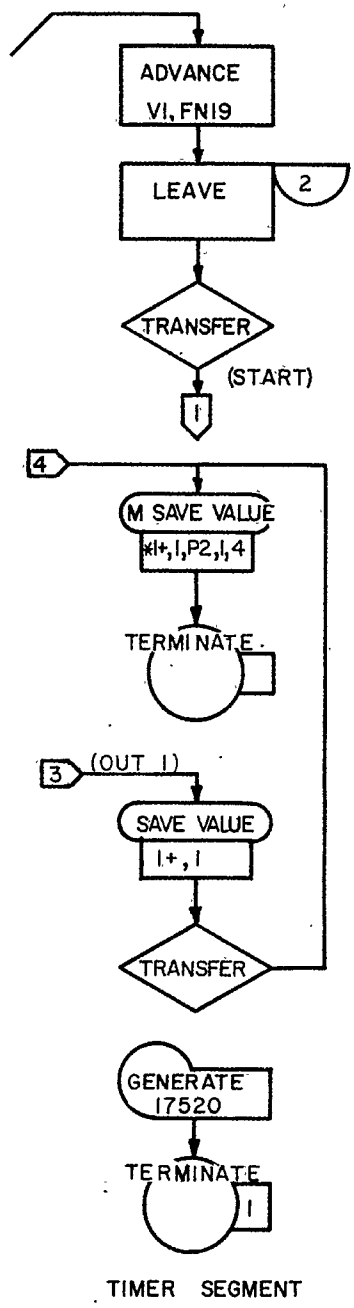

Figure 2 (continued)

The second type of event in the simulation model is the decision event and a listing of the decision events in the model follows:

(1) The criminal is apprehended
(2) The criminal is prosecuted
(3) The criminal is a repeat offender
(4) The criminal is a repeat offender when not prosecuted
(5) The criminal is found not guilty
(6) The criminal receives probation
(7) The criminal is a repeat offender when not found guilty
(8) The criminal has a non-successful probation
(9) The criminal is a repeat offender when classified as a successful probation
(10) The criminal is a repeat offender when classified as a non-successful probation
(11) The criminal does not receive parole
(12) The criminal is a repeat offender when he does not receive parole
(13) The criminal is classified as a non-successful parole
(14) The criminal is classified as a successful parole
(15) The criminal is a repeat offender when classified as a non-successful parole

These events are modeled using statistical transfers in the model. Therefore, the probability of the event occurring is part of the input to the model.

After a transaction is created, the type of crime allegedly committed is kept in parameter one. Parameter two records the total number of crimes commited by this individual. Parameter three is used exclusively for indirect addressing and has no physical significance. Functions 1-19 describe the distribution of the stochastic time related events in the model. Table 2 contains a complete list of these functions.

Five half-word matrix savevalues are used in the model. Matrix savevalues 1-3 are counters that provide additional output in information. Matrix savevalue four provides values used in the model at statistical transfer blocks. An example is the percentage of individuals who repeat crimes. Matrix savevalue six is used to provide function numbers 1-18. In order to utilize matrix savevalues 5 and 6 indirect addressing of block operands is used. Table 3 provides a complete description of the matrix savevalues used in the GPSS model.

Storages are used within the model to collect statistics on the institution, investigator, and courtroom utilization. Also, queues are employed to gather data on the backlogs of crimes for investigation, of cases for trial and criminals waiting for incarveration.

The model uses indirect addressing extensively for referencing functions that describe time distributions and in conjunction with statistical transfers. The use of indirect addressing allows the GPSS coding to be compact and gives the model its generality and flexibility.

Following the principal model segment, simulating the criminal justice system, a timer model segment is provided. The timer transaction is set to occur at the end of two simulated years. The use of appropriate control cards allows the analyst to run the model for the desired length of time.

Discussion

Although the criminal justice system (Figure 1) is a superficial abstraction of the real world, it can still provide valuable information concerning responses to changes in the system. Changes in system parameters and their corresponding effect on the model can be observed without suffering any of the consequences involved in modifying the actual criminal justice system. This advantage is particularly desirable in the study of social and governmental systems such as the criminal justice system.

The simulation model can be utilized in different ways to study a criminal justice system. The model can be run on an existing system configuration to establish the system performance. Then, the impact of policy decision can be incorporated in order to assess their possible impacts on the system. For example, the potential impact on the criminal justice system of a successful counseling program could be determined using this model, or the effects of an increased incidence of crimes could be assessed quantitatively. Although the model does provide answers to "What if questions", the user still must exercise judgement when analyzing the effects of policy decisions on the criminal justice system.

The simulation model presented in this paper is flexible and can be adapted to represent a specific criminal. A user can specify the parameters of a criminal justice system and utilize the model without changing the basic model structure.

TABLE 1

TABLE OF DEFINITIONS

GPSS ENTITY	INTERPRETATION
Model Segment 1	The Criminal Justice System
Transaction	Criminals
Parameter 1	The Criminal Type (1, 2 or 3)
Parameter 2	A counter used to record the number of crimes this individual has committed
Parameter 3	A value used in the model for indirect addressing
Model Segment 2	
Transaction	Timer

TABLE 2

TABLE OF FUNCTIONS

Number	Description
1	Function describing the distribution of time for the investigation of Type 1 crimes.
2	Function describing the distribution of time for the investigation of Type 2 crimes.
3	Function describing the distribution of time for the investigation of Type 3 crimes.
4	Function describing the distribution of time for case preparation of Type 1 crimes.
5	Function describing the distribution of time for case preparation of Type 2 crimes.
6	Function describing the distribution of time for case preparation of Type 3 crimes.
7	Function describing the distribution of time for the trial of Type 1 crimes.
8	Function describing the distribution of time for the trial of Type 2 crimes.
9	Function describing the distribution of time for the trial of Type 3 crimes.
10	Function describing the distribution of time for probation of Type 1 crimes.
11	Function describing the distribution of time for probation of Type 2 crimes.
12	Function describing the distribution of time for probation of Type 3 crimes.
13	Function describing the distribution of time for the institutionalization of Type 1 crimes.
14	Function describing the distribution of time for the institutionalization of Type 2 crimes.
15	Function describing the distribution of time for the institutionalization of Type 3 crimes.
16	Function describing the distribution of time for parole of Type 1 crimes.
17	Function describing the distribution of time for parole of Type 2 crimes.
18	Function describing the distribution of time for parole of Type 3 crimes
19	Function describing the cumulative exponth the mean equal to one.

TABLE 3

TABLE OF MATRIX SAVEVALUES

GPSS Half-Word Number	Matrix Savevalues Description
1	Dimension: 1 row, 3 columns A counter used to record the number of crimes (column number) committed by a Type 1 criminal
2	Dimension: 1 row, 4 columns A counter used to record the number of crimes (column number) committed by a Type 2 criminal.
3	Dimension: 1 row, 8 columns A counter used to record the number of Type 3 crimes (column number) committed by criminals who have left the system.
4	Dimension: 3 rows, 16 columns The row number indicates the criminal type. The following information is stored in each column according to criminal type:

Col.	Description*
1	Provides the percentage of criminals not apprehended.
2	Provides the percentage of criminals not prosecuted.
3	Provides the percentage of criminals who repeat crimes.
4	Provides the percentage of criminals who repeat crimes when not prosecuted.
5	Provides the percentage of criminals who are found not guilty.
6	Provides the percentage of criminals who receive probation.
7	Provides the percentage of criminals who repeat crimes when found not guilty.
8	Provides the percentage of criminals who are classified as a non-successful probation.
9	Provides the percentage of criminals who repeat crimes when classified as a successful probation.
10	Provides the percentage of criminals who repeat crimes when classified as a non-successful probation.
11	Provides the percentage of criminals who do not receive parole.
12	Provides the percentage of criminals who repeat crimes and who do not receive parole.
13	Provides the percentage of criminals who are classified as a non-successful parole. (cont.)

*Percentages in parts per thousand.

Table 3 continued

	14	Provides the percentage of criminals who repeat crimes when classified as a successful parole.
	15	Provides the percentage of criminals who repeat crimes when classified as a non-successful parole.
	16	Provides the mean delay time between commissions of a crime.
5		Dimension: 3 rows, 5 columns The row number indicates the criminal type. The following information is stored in each column according to criminal type.
	Col.	Description
	1	Function number to be used for case preparation time.
	2	Function number to be used for trial time.
	3	Function number to be used for duration of probation.
	4	Function number to be used the length of time of institutionalization.
	5	Function number to be used for the duration of parole.

TABLE 4

TABLE OF DEFINITIONS

Savevalue

1	The savevalue used to count the number of individuals who remained in the system for at least 40 years.

Queues

1	The queue used to obtain statistics on the backlog of cases waiting for investigation.
2	The queue used to obtain statistics on the backlog of crimes waiting case preparation.
4	The queue used to collect statistics on the criminals waiting to enter the institution.
6	The queue used to collect statistics on the backlog of cases waiting for trial.

Storages	Description
1	Represents the institution with a maximum capacity specified by the user.
2	Represents a pool of criminals where they spend time between crimes. No limit is placed on the number of entries.
3	Represents a pool of crimes being investigated. The maximum capacity signifies the maximum number of simultaneous investigation. The limit is specified by the user.

Table 4 continued

4	Represents the pool of crimes in case preparation. No limit on the number of entries.
5	Represents a pool of criminals where their probation can be spent. No limit on the number of entries.
6	Represents a pool of criminals where their time on parole can be spent. No limit on the number of entries.
7	Represents the number of trial room courts that operate simultaneously. The maximum number is user specified.

References

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