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A SIMULATION MODEL FOR WASHINGTON STATE JUVENILE DETENTION FACILITIES

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ABSTRACT

The first SLAM II network simulation model for Juvenile Detention Management in Washington State was built in 1989 by the Washington State Office of the Administrator for the Courts. The juvenile detention process can be viewed as a complicated queuing system from the juvenile's arrival at the detention facility to final release from the facility. The detention process is simulated through the use of RESOURCEs, AWAITs and GATEs that control the movement of the juveniles entering and leaving the system. The goal of this research is to help judges and court administrators apply Operations Research to court management and to examine how parameters as well as structure in the simulation model influence the detention system operation. For example, how does varying the arrival rate, the service rate, or service style affect bed usage and judge time in a detention center? Or, how do changes in legal procedures effect the structure of the model and detention facilities' operations.

1. INTRODUCTION

In 1989 the Research and Statistics Division of the Washington State Office of the Administrator for the Courts launched a project to apply operations research technology to court management. The Research and Statistics Division is seeking to build mathematical models for Washington State courts to address court congestion and delay.

Court delay in the United States is a concern as evidenced by the words of former Chief Justice Earl Warren:

"Interminable and unjustifiable delays in our courts are today compromising the basic legal rights of countless thousands of Americans and, imperceptibly, corroding the very foundations of constitutional government in the United States."

In Washington State superior courts, nearly 7,000 civil cases are still pending after 4 years. Such delays cause evidence to deteriorate, memories to fade, and witnesses to vanish or die. Such events too frequently force parties into unfair settlements, thus reducing public confidence in the courts and increasing complaints about the injustice court delay.

In *The Application of Operations Research to Court Delay*, Dr. Reed pointed out:

"A survey of the literature discussing the problems of judicial administration reveals that little attempt has been made to apply operations research to those problems. Communication between the two disciplines of operations research and judicial administration has been almost nonexistent. Communication in this area should be improved for both disciplines have much to contribute to each other."

This project is a pioneering effort to apply mathematical models to judicial administration, bridging operations research and judicial administration. The goal of this research is to help judges and court administrators apply Operations Research to court management and to study how parameters as well as structure in the simulation model influence the detention system operation. For example, how does varying the arrival rate, the service rate, or service style affect facility usage and judge time. Or, how do changes in the legal procedures effect the structure of the model and the statistics of interest?

Since operations research becomes an integral part of the administrative decision process, and since the administrative

decision process of the courts is unique, the applications of operations research to judicial administration could provide deeper insights into decision processes. By contributing to the solutions of judicial administration problems, operations research can raise its prestige with respect to other disciplines.

Although several techniques apply, simulation was chosen because simulation models are flexible, easy to construct, and easily understood by judges and court administrators. SLAM II simulation language is used because it has strong network functions.

2. BACKGROUND

The operation of juvenile detention facilities was chosen as the area for study because it is relatively simple to model, and data to build a good model is available. The model is to address the issue of resource allocation. These resources include judges, court hours, and detention facility size. The variables that drive resource consumption include arrival rates, lengths of stay, and judicial service times. Constraints include legal rules governing the detention procedure.

The Juvenile Detention SLAM network model represents juveniles entering and leaving the detention center and the juvenile court. The modeling task includes understanding the process, finding the key variables that influence court operation, and accounting for courts with different characteristics.

This initial model will be used to demonstrate the usefulness of modeling in other court levels including appellate as well as trial courts.

3. PROCESS DESCRIPTION

A juvenile detention center is a facility with a fixed number of beds that is used to detain juveniles during their legal processing. A juvenile is arrested and law enforcement determines that the juvenile is to be taken to juvenile detention. When a juvenile arrives at the facility a determination to hold or release the juvenile until a hearing is made. If there is legal justification a detention hearing is scheduled. If there is no legal justification for a hearing, the juvenile is released from the facility.

The maximum length of time awaiting the detention hearing or other hearings in Washington State varies by the legal justification for the hearing. If the juvenile does not have a hearing within this maximum time frame, the juvenile must be released. A complication is that weekend time might be excluded from the maximum time frame for some hearings.

After the hearing, some juveniles are released without subsequent hearings, some are released pending an adjudication hearing, while others are held awaiting the adjudication hearing. The maximal waiting length between the adjudication hearing and the detention hearing is 30 days. Following the adjudication hearing some juveniles are released without subsequent hearings, some are released pending a disposition hearing, while others are held for up to 14 days for the disposition hearing. These latter rules for time constraints include weekends. An exception to this process is a juvenile previously released and returning to the facility on new charges. Under these conditions, the juvenile will have adjudication hearing without a detention hearing.

Most courts establish a hearing schedule in advance. For example, detention hearings are held every day from 8:30 a.m. to 10:00 a.m., adjudication hearings are held every Tuesday from 10:30 a.m. to 11:30 a.m., and disposition hearings are held every Friday from 1:00 p.m. to 2:30 p.m., etc.

4. MODEL DESCRIPTION

There are two resources to be included in the model: bed capacity and judge time. If a juvenile is in the facility, a bed is occupied even if the juvenile temporarily leaves, say to attend a hearing. The bed is in service unless the juvenile is released. The judge is another resource. When a juvenile is in the hearing, the judge is busy. Other juveniles scheduled for hearings the same day must wait for the judge. When the hearing ends, the judge is free to serve the next juvenile. The judge service rate may vary. If the number of customers in the queue is over a given number, the judge may reduce the service time to accommodate all cases scheduled.

The Yakima juvenile court operation was studied to establish a detention facility model. The complete model is quite complicated, consisting of both network and discrete

modeling technology in SLAM II. The Yakima SLAM II model consists of 17 files, 25 attributes, and 14 user written functions. The model, executing on an IBM PC/AT 80286, requires approximately 15 minutes to simulate one year of court operation. The results from this complete model correspond closely with statistics describing actual court operation.

For demonstration purposes, only the simplified juvenile offender process from arrival to detention hearing is presented here. In addition, a hypothetical court rather than actual court is simulated. The detention facility's bed capacity is 20. The court is open from 8:00 a.m. to 5:00 p.m. weekdays and operates with one judge. Detention hearings are scheduled daily from 8:00 a.m. to 10:00 a.m. The average arrival time is one juvenile per four hours in any day. The average judge service time spent to hear a juvenile detention case is eighteen minutes. Both arrival time and service time are exponentially distributed. Also for demonstration purposes, only one maximum time frame constraining the time from arrival to the detention hearing is presented in the model. The proportion of juveniles being released after a detention hearing is based on actual court data.

When a juvenile is brought to a facility, the following is modeled:

a) If a bed is available it is assigned, otherwise the juvenile waits for a bed;

b) While awaiting a detention hearing, weekend time is ignored in determining legal process times;

c) If the court is not open, the juvenile waits;

d) If the judge is not available, the juvenile waits.

4.1. Court Schedule

To simulate a court, schedule is a critical issue. The time units in SLAM-II are arbitrary in that the units can represent seconds, minutes, hours, days, weeks, months, or years. However, time in many real applications needs to be specified. In court models weekdays, weekends, and holidays must be distinguished. In this respect, SLAM II is not very convenient when using only network nodes to control the event time. Of course, some FORTRAN subroutines can be written to solve such problems. But if holidays must be considered, the subroutines would be very complicated. The time unit in this model is hours. Holidays were not simulated to avoid this complication in the model.

Figure 1 illustrates the court schedule by using three GATEs to control the juvenile court operation. GATE GAA controls weekdays and weekends, GATE GA0 controls the court open hours, and GA1 controls the schedule of detention hearings. The initial state of all three GATEs is closed because our model simulates court operation starting at Monday morning 0:00 a.m.. When the CREATE node generates an entity at 8:00 a.m., GATEs GAA, GA0 and GA1 are open. GATE GAA is open from Monday 8:00 a.m. to Friday 5:00 p.m. and is closed otherwise. Detention hearings are scheduled for two hours starting at 8:00 a.m. every weekday. After two hours, GA1 is closed i.e., the detention hearing is over at 10:00 a.m.. At 5:00 pm GATE GA0 is closed which implies the court is closed.

At the ASSIGN node A1, the ATRIB(1) is used to represent the day of the week, i.e., ATRIB(1) equals 1 through 5 for Monday to Friday. The initial value of ATRIB(1) is 0. When an entity passes by, ATRIB(1) automatically increases by 1. When ATRIB(1) equals 5, GATE GAA is closed and ATRIB(1) is reset to zero. After 63 hours, GAA is reopened. With a minor modification, adjudication and disposition hearings can be added to the model by using other GATEs with different schedules.

4.2. RESOURCEs and AWAITs

Figure 2 represents the main part of the demonstration model. Two resources RESOURCE BEDS and RESOURCE JUD are used for bed capacity and judge. Instead of using a QUEUE node, a RESOURCE node is used to represent bed capacity because a bed is freed only if a juvenile is released. If QUEUE node were used then a bed would be freed incorrectly when a juvenile leaves his bed temporarily, say if he attends detention hearing. Only a RESOURCE can simulate this situation properly. To simulate a single judge court, a QUEUE node could be used, however the RESOURCE node is used to permit greater flexibility in simulating judges' operation.

The arrival rate to the detention center is exponentially distributed with a mean value one juvenile per four hours.

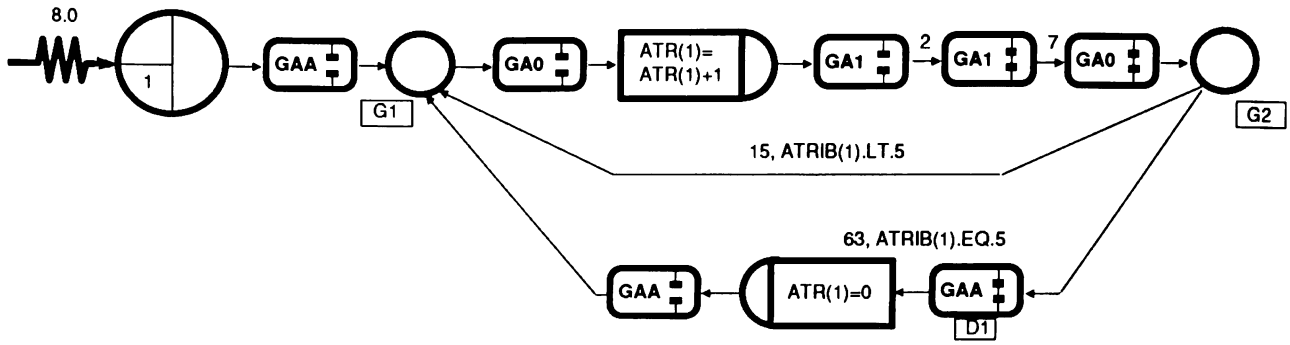

Figure 1: Court Schedule

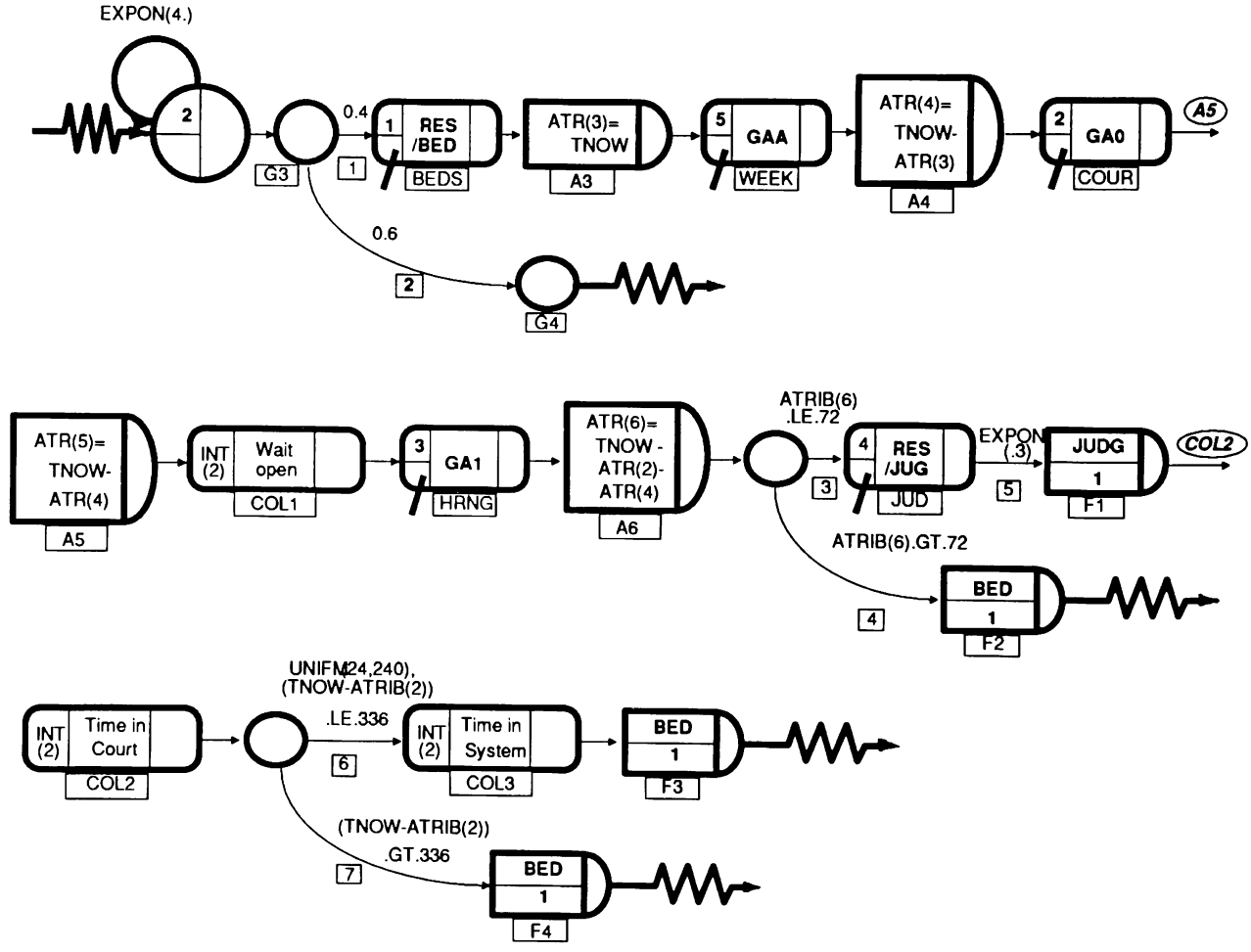

Figure 2: Detention Hearing

Sixty percent of the arrivals are released without a detention hearing because there is no legal justification for a hearing. The remaining juveniles will be assigned if a bed is available. Otherwise they will wait for a bed at the AWAIT node BEDS. If the arrival time is during weekdays, GATE GAA is open and there is no weekend time adjustment for the hearing time constraint. However, for weekend arrivals, GATE GAA is closed and a time adjustment is calculated by using both ATRIB(4) and ATRIB(3). If GATE GA0 is open, then the court is open. Otherwise, the juvenile will wait at the AWAIT node COUR for the court to open. A COLCT node is given here to collect waiting time statistics. When GATE GA1 is open, a detention hearing is in progress. First, ATRIB(6) is calculated and compared with the 72 hour time constraint between arrival and detention hearing. If ATRIB(6) is greater than 72 hours, then the juvenile and associated bed must be released because the detention hearing is not held on time. After a detention hearing, a FREE node is used to release the judge for the next hearing. After the detention hearing, some juveniles as well as the beds they occupy are released while others continue to stay in the facility awaiting an adjudication hearing.

In the demonstration model, only one month (31 days) of the detention center operation is simulated.

5. RESULTS

5.1. Demonstration Simulation

The SLAM II juvenile detention program simulated a 31 day operation of a hypothetical detention center. The output showed that 191 juveniles were brought into the facility during the month and 114 were released without a detention hearing. One juvenile was released because the 72 hour time constraint between arrival and detention hearing was violated. Therefore 77 juveniles were scheduled for a detention hearing.

Based on means and standard deviations, most of the 77 juveniles stayed overnight waiting for the court open. Again, based on summary statistics, most hearings were held within 20 hours of arrival to the facility. On an average there were 14 empty beds and the judge was busy in detention hearings for 25 of the 46 scheduled detention hearing hours (55 percent utilization). At this arrival rate, the current bed capacity and judgeship were sufficient. Therefore, the detention hearing length could be reduced to free the judge for other activities. After the detention hearing, 20 juveniles were scheduled for an adjudication hearing, 55 were released and 2 were still in process. The average waiting time for the adjudication hearing was 5.5 days.

To demonstrate the effect of increasing arrival rate, the rate was increased to one juvenile arriving per hour. At this rate, the current bed capacity and judgeship were insufficient. On an average, 2.7 juveniles were awaiting a bed and the average waiting time was 7.4 hours. The detention hearing time exceeded the scheduled time by an average of two hours per day. During detention hearing, 50 percent of juveniles were awaiting the judge and the average waiting time was 1.7 hours. In addition, 46 juveniles were released because they exceeded the 72 hour hearing rule. Such releases would be a serious problem. So either detention hearing time would have to be increased, or another judge assigned to detention hearings.

To further illustrate the model's usefulness, the detention hearing time was increased to four hours per day for one judge. This produced little improvement. On the average, 43 percent of the juveniles were still awaiting the judge and the waiting time was 1.4 hours although the judge was 82 percent busy.

As an alternative solution, two judges working two hours each per day, were added to the model. Each judge spent 45 hours hearing cases and was 98 percent busy. The proportion of juveniles awaiting detention hearings was reduced to 20 percent and the waiting time reduced to 36 minutes. The modeling exercise indicated that adding another judge for detention hearings is better than doubling the hearing time for one judge.

Historical data shows that on an average juvenile offender filings increase about 10 percent per year. At such a rate it will take seven years for the arrival rate to grow from one juvenile per hour to one juvenile per two hours. Another simulation revealed that the bed and hearing capacity will reach their limits at one juvenile arriving per two hours.

5.2. Actual Simulations

Both Yakima county and Snohomish county detention facilities have agreed to work on building simulation models for their courts. The models are dependent upon determining distribution of the following data elements.

1. Arrival of juveniles.
2. Service time and waiting times for detention hearings.
3. Service time and waiting time for adjudication hearings.
4. Service time and waiting time for disposition hearings.
5. Branching probabilities for detention, adjudication, and disposition hearings.

The complete Yakima County model along with output analyses will be available by the end of 1989. The advantages of applying Operations Research technology to the court system will soon be available for judge and court administrator review.

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BIOGRAPHY

Dr. Minghui Yang received both his M.S. and Ph.D degrees in Operations Research from Oregon State University. Since April 1988, he serves in Research Division of the Office of the Administrator for the Courts, Washington State as a research specialist. With a background in systems engineering and electrical engineering, he was a visiting scholar at Department of Operations Research, Stanford University in 1982. He taught at Northern Jiaotong University, Beijing, China before he came to the United States. His main research interest is in stochastic modeling and its applications.

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