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MODEL-DIRECTED INFORMATION SYSTEMS FOR MANAGEMENT OF THE FEDERAL COURTS*

JACK R. BUCHANAN† AND RICHARD D. FENNELL‡

To satisfy the diverse information needs of federal courts, a family of information management systems was developed, based upon formal mathematical models of judicial case processing embedded in interactive data base information systems for case tracking and caseload management. These case processing models embodied pertinent federal rules of procedure, regulatory statutes, and local rules of procedure as adopted by individual courts. This paper describes the particular model-directed system to track federal criminal cases. In this system, a model of criminal case processing was incorporated into the information management system as a series of parallel state diagrams in which the status of any given court case could be described as a set of state indicators and allowable next-actions.

Data entry is performed as a part of the court's obligation to maintain a permanent record of the proceedings (the "docket") in each case. Users of the information system interact with the model by posting transactions ("events") against court cases in the data base, thereby causing the cases to be moved through the model. Erroneous transactions are rejected with an appropriate diagnosis of the error based upon the state of the case with respect to the model. Use of such a model-directed information management system helps to ensure that the records of court cases being maintained are accurate and legally consistent. The embedded case processing model also permits the ready comparison of cases according to their procedural status, thereby providing an effective means for monitoring the progress of the court's caseload. Since the data base is structured according to elements of the procedural model, such model-directed systems are potentially very useful in providing effective management information, in addition to their obvious utility in information management.

As an analytical tool, the model provides the opportunity to understand the complexity and procedural details of the administration of individual courts. Such an analysis allows the comparison of procedural differences among courts in such a way as to facilitate the ability of the courts to better manage their caseloads and provide a higher level of service to the public. In addition, the data bases established as a result of the docketing process provide a valuable source of historical data for judicial administration research in court management methods. As an unexpected benefit, the model-directed information systems also became a valuable training aid to new court personnel. New users may post case status situations and possible sequences of transactions to the information system and be informed of the correctness of such a transaction sequence relative to the model, thereby revealing certain implications of the detailed procedures of the court.

(GOVERNMENT; INFORMATION SYSTEMS—DETERMINISTIC MODELS; PHILOSOPHY OF MODELING)

1. Introduction

In most complex organizations, the collection and transmittal of timely, correct, and consistent information that is useful to its recipients is a major challenge. Within a federal court, the problems of providing such information are aggravated by the fact that the court community is composed of several organizationally autonomous, though cooperating, government agencies and other organizations. In addition, the public at

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†Harvard University.
‡Federal Judicial Center, Washington, D.C.

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large participates as jurors, litigants, defendants, and witnesses. Each of these organizations and individuals has need for information with which to manage their affairs. As the research and development agency of the Federal Judiciary, the Federal Judicial Center in Washington, D.C., established the Courtran Project to undertake the design and implementation of a comprehensive set of information management systems intended to provide administrative assistance for caseload management within the federal court community.

As a basis for the development of these advanced information systems, analytic models of judicial case processing were constructed, using a mathematical formalism developed especially for this purpose, that describe the Federal Rules of Procedure [15], pertinent regulatory statutes such as the Speedy Trial Act of 1974 [28], and local rules of procedure as adopted by individual courts. These models reflect various aspects of the administrative process being supported and serve to direct the behavior of the resultant information systems. Such formal models have proven useful in that they can:

(1) Provide analytical tools to understand the administration of the courts with all their complexities and procedural details that have evolved over the years.

(2) Serve as a basis for a rigorous, though flexible, information system.

(3) Provide a framework, not only for improving the automated system itself, but for studying the underlying court procedures upon which the system is based.

(4) Allow succinct and unambiguous communication between court administrators and system analysts.

The information systems discussed here were designed to be "model directed" in that models of the court procedures for the various case types are embedded in the system, directing all responses to user input and monitoring the processing of cases relative to the correct procedures and regulatory statutes.

Following the passage of the Speedy Trial Act of 1974, the Federal Courts were given the mandate to monitor criminal case progress relative to specified time limits. At the same time, necessary funding was provided to develop large-scale computing systems to provide automated support for this and other court management applications. It was a unique opportunity to manage the delivery of high technology to this institution [4]. Data bases were designed that would eventually hold millions of records within a distributed network of large regional data centers. In addition to those required to comply with the Act, many major applications were identified [11], [23], including management of criminal, civil, bankruptcy, and appellate cases, scheduling and calendaring, juror utilization, document processing and archival maintenance, and electronic mail. The full set of applications currently planned under the Courtran Project and their present status is shown in Figure 1.

As the first Courtran application to undergo development, the Criminal Caseflow Management System became operational in late 1976. The initial set of pilot District Courts to receive this system were those in New York, Washington, D.C., Chicago, Detroit, San Francisco and Los Angeles. Beginning with these Districts, and expanding as our resources would permit, the system has now been successfully implemented in 15 of the largest metropolitan courts, out of a total of 95 District Courts, thereby providing case management facilities for nearly 50% of the total federal defendant felony filings. Implementation continues in additional courts.

For each case filed, the courts are required to maintain an official docket record containing entries for every legally significant event that occurs in the case. These events will also include those that are administratively significant in assisting judges

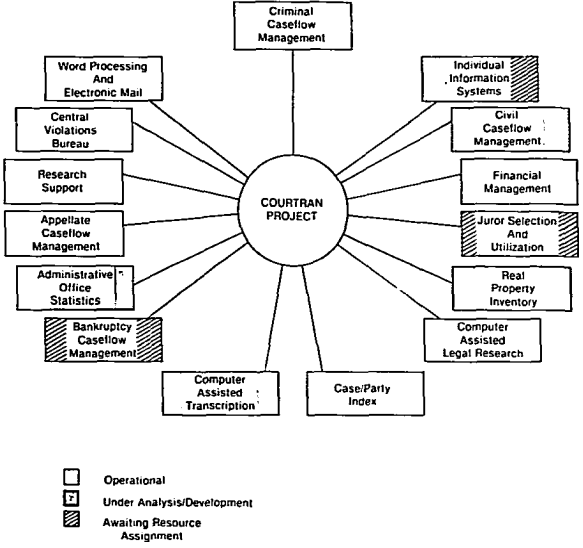

FIGURE 1. Federal Court Computer Applications.

and the administrative staff to manage the caseload of the court. Since the docket sheet serves as a central source of data pertinent to caseload management, the Criminal Caseflow Management System sought to automate the docketing process. This paper describes a comprehensive model-directed system that receives docket entries as input, validates the correctness of each event relative to established judicial procedure, effects state transitions within the system in order to reflect the progress of each case, and generates output reports intended to focus the judges' attention on the outstanding and future tasks that will require administrative planning as well as adjudication. Computer capabilities are thereby integrated to match the management needs of judges and other administrators in both collecting and focusing attention on relevant information.

§2 discusses a broad range of topics relative to court organization and function with references for further study, but within the content of this paper, attempts only to identify those processes that will underlie the design of court management systems. A formal model of criminal case processing is briefly described in §3 along with examples of its use in the interactive system. The implementation strategies employed are summarized in §4.

2. Court Organization and Function

A. *Organizational Structure*

At each federal District Court there is a court community which may be described as a network of cooperating organizations involved in the affairs of the court. In addition to the District Court itself, there are related government agencies, such as the offices of the U.S. Attorney, U.S. Marshal, and Public Defender; other courts such as

the state courts and U.S. Court of Appeals; and various participants, including attorneys, jurors, witnesses, litigants, and the public at large.

At the local level, the executive power of a court resides in the collegial authority of the judges, with one denoted as the Chief Judge, often functioning with an Executive Committee. The Clerk of the Court heads an organization [12] of deputy clerks and clerical workers ranging up to two hundred employees with the actual organizational structure varying widely from court to court, from a traditional hierarchy to multiple mini-court operations support units. The Clerk is appointed by the Chief Judge and is delegated varying levels of responsibility for managing court operations. The Office of the Clerk is the hub and nerve center for court information processing. It interfaces directly with various organizations within the court community. A graphical representation of information flow paths is shown in Figure 2. Both information collection and dissemination occurs along these paths. The computer equipment configurations and data base application systems utilized in the Courtran Project have been designed to enable maximal cooperation among the various organizations of the court community. This is done by establishing standards for information specification (e.g., docketing standards defined by the Administrative Office of the U.S. Courts, standards for coding offenses, developing probation information systems), and by providing, at the discretion of the court, direct access to all agencies that can benefit from information in the integrated data bases.

At the national level, the top administrative policy-making body in the Federal Judiciary is the Judicial Conference, which is chaired by the Chief Justice of the United States and consists of 22 other federal judges and the Directors of the Federal Judicial Center and the Administrative Office of the U.S. Courts. The promulgations and reports of this body have strong strategic and procedural impacts on the administrative functions of the Courts. Court procedures are also influenced by the findings and recommendations of American Bar Association committees. Judges in each court are quite autonomous, subject only to legal decision reversal by a higher court or impeachment for misconduct. However, they have respect for these institutions, and peer pressure among judges, together with the irresistible force of innovative ideas that have worked elsewhere, cause most judges to be receptive to constructive suggestions from policy-making or research-oriented sources. These sources, together with develop-

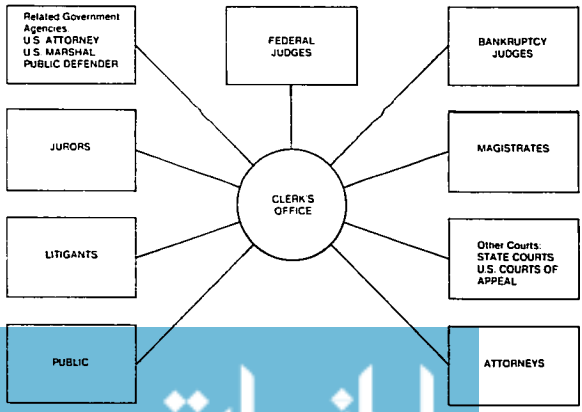

FIGURE 2. Paths of Information Flow within the Court Community.

ments in either statute law or influential decisions in case law, provide the external information for the strategic level of management [2] of a court.

A judge functions at both the strategic and operational levels in the organization, since the fundamental production unit for detailed adjudication and case disposition is a judge and his staff. The Clerk's Office largely carries out the management control level in the organization. This positions a judge as the consumer of legal details of a case, and as the instigator and person in control of many operational details of case processing. These dual managerial roles, together with a judge's inclination for specificity in dispute resolution, affect the type of information sought and the way in which it is used.

B. *Functions of the Court*

The fundamental functions of the courts are adjudication, legal policy formulation, and administration of the judicial process. Policy formulation results primarily from the precedential effects of decisions which accumulate over time, particularly from decisions of the Courts of Appeal. The administration of the judicial process is guided by national and local rules of procedure and is affected by the management skills exercised.

Generally accepted management practices are often incorporated into the rules. For example, Rule 2 of the Federal Rules of Criminal Procedure [15] provides that:

> [These rules] are intended to provide for the just determination of every criminal proceeding. They shall be construed to secure simplicity in procedure, fairness in administration and the elimination of unjustifiable expense and delay.

One aspect of "due process of law" that requires effective management concerns the gathering of all pertinent facts and other information for the consideration of the court. Indeed, the "process is the product," [17] and delay beyond that required for adequate case preparation (e.g., delay due to clerical copying, inadequate information access, or inefficient planning) affects both the accuracy and ultimate fairness of that product.

Judges process various forms of legal information (e.g., statutes, cases, briefs, testimony) to arrive at decisions. They must also process management information to eliminate "unjustifiable expense and delay" in case disposal. They may delegate some of the legal information processing, though not the responsibility, to law clerks. Legal issues may also be sharpened by briefs and memoranda prepared by counsel. With the help of their courtroom deputies for calendar control, and the Clerk's Office as the central information repository, judges seek to manage their caseloads. For each of his pending cases, a judge should have a list of scheduled events, briefing schedules, and motions to rule on.

The Chief Judge must be able to analyze the caseflow at the individual judge level and for the entire court. The age distribution of pending cases and the times to disposition for each judge are important inputs for assigning cases to judges, a task normally presided over by the Chief Judge. He must also have jury and attorney utilization information and any other data on court operation that may indicate the need for modification of local procedure rules. By better understanding the case disposal performance of various methods used (e.g., omnibus hearings [20] or other pre-trial activities), suggestions for improving national as well as local procedures may be formulated.

The court functions to be most affected by automation may be classified as follows:

(1) *Clerical Processing.* The integration of information from several sources will greatly reduce the clerical effort in redundant document creation, copying, and communication. Greater accuracy can be provided by one-time data entry with an interactive diagnostic system that checks syntax and logical consistency.

(2) *Management Control.* For effective case processing, the Office of the Clerk must manage all information pertaining to a party, case or judge where, for example, that information may come from the Clerk's Office, open court proceedings, the judge's chambers, the U.S. Attorney's Office, the Probation Division, or the U.S. Marshal. A system that assists the Clerk's Office in checking that all steps in a sub-process have been properly carried out and recorded will be most useful. The important tasks of allocation of court resources and scheduling can then be based more on hard data and less on intuition.

(3) *Caseload Management.* A judge must not only be assured that each case is on track but he must have an overview of his entire caseload to set priorities and schedule his time.

(4) *Judicial Procedure Revision.* As data are collected relative to models of the judicial process, we will understand better the operation of the courts under the various procedures prescribed by the Judicial Conference and Congress. Not only can these data be analyzed to provide suggestions for improvement of court management, but the same data could serve as the basis for studying the judicial procedures themselves.

C. *Court Information Processing*

Several distinct data compilations are made during the processing of a case filed in a federal court. These include:

(1) *A Transcript of Proceedings.* This is a verbatim record of the actual court proceedings, made by a Court Reporter using a stenographic typewriter.

(2) *The Docket Sheet.* The entries in this record represent all the legally significant events and show court actions in a case.

(3) *The Case File.* This file contains all submitted documents, briefs and memoranda for the case. This file may reside in a judge's chambers and/or the Clerk's Office.

The maintenance of the official court docket for each case is a major responsibility of the Clerk's Office. Since it is the most fundamental reference document used to determine case status and progress, it was selected as the initial application for automation. The line items in the docket are called "events" and correspond one-to-one to legally significant court transactions (e.g., defendant arraigned, motion for summary judgment denied). The computer system will necessarily be concerned with the form of event entries, but will be concerned with their substance only to the extent that it affects the application of rules of procedure or management practice. Examples of events that change the status of a case or schedule future activities will be illustrated in §3.

A data base containing the dockets of a court provides an extremely useful source of information for operational caseflow management. It may be aggregated to produce, as a byproduct [26], an important component of the internal strategic information needed by judges.

Since much of this information must be shared by the individuals shown in Figure 2, the construction of a centralized, integrated data base appears desirable, with the Clerk's Office being responsible for controlling the data collection and dissemination.

The data inputs for entry onto the docket sheet are obtained from a variety of sources, including open court proceedings as recorded by a judge's Minute Clerk, directly from a judge's chambers, or from the Clerk's Office itself through filings made by attorneys, court-related agencies, such as the U.S. Marshal's Office, or the public. The associated documents are then given to a Docket Clerk in the Clerk's Office, who enters the appropriate summary information on the docket sheet. This activity is known as "docketing." With an automated system, interactive docketing, or "event posting," may be done using a computer terminal. These automated records will eventually supplant completely the manually maintained dockets, and have done so in several courts already.

The data contained in the criminal case data base include:

–Parties
–Offenses
–Docketed events, in chronological sequence for each case
–Judges
–Attorneys
–Time intervals and schedule regulations
–Related cases.

The relationships that exist among these entities should be represented in the data base in a form that allows for efficient extraction of management information. The information will also become the basis for preparing various required national statistical reports on case management and the administration of justice.

A simplified data base diagram is shown in Figure 3, using the descriptive notation of Bachman [3], where the boxes represent record types and the lines represent set relationships. When a case is opened, a DOCKET record is established for each defendant (DFT). Defense counsel (ATTY), prosecutors (U.S. ATTY), a JUDGE and alleged OFFENSE are linked to the DOCKET, if known at that time. A variety of different EVENT types may then be posted as the case proceeds, including pertinent SPEEDY TRIAL information. A network-type data base management system based on the CODASYL [9] model is used. This allows record types to be defined in which to store information about parties, court officers, and administrative aspects of a case. Under the CODASYL model these records may be grouped logically into sets as represented in Figure 3. The actual data base contains some 40 different record types related within about 50 different sets.

Data on elapsed time between certain events is maintained and analyzed relative to the limits set by the Speedy Trial Act of 1974. The purpose of the Act is to provide for prompt disposition of criminal cases by specifying time limits for procedural intervals in which the various pretrial proceedings must take place. As amended in August 1979, the elapsed time permissible between arrest and indictment is 30 days, and between indictment and the start of trial is 70 days. The implementation of the law has been phased with sanctions of case dismissal after July 1, 1980. The Act itself should be studied for more detailed information [28]. The important aspect for present considerations is that the time accounting within the procedural categories required by the Act must be appropriately reflected within the structure of the computer model and system procedures.

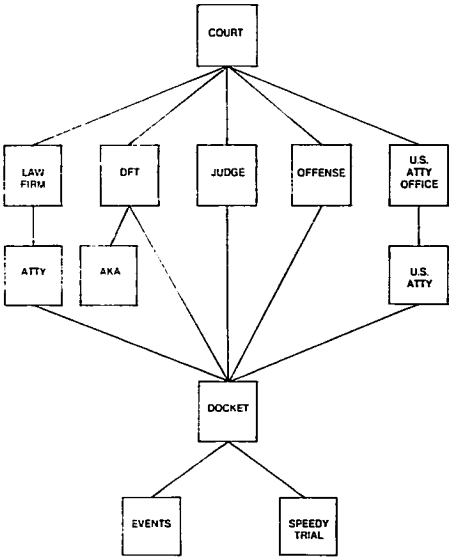

FIGURE 3. Simplified Criminal Data Base.

A management information system to aid in implementing this law must have sophisticated exception reporting and early warning capabilities. This is especially true when we consider that the Act provides for a variety of "excludable time intervals" which effectively stop the "clocks." For example, if a defendant goes fugitive or is sent to a hospital for psychiatric evaluation, the procedural clock (e.g., the clock measuring the procedural interval "arrest to indictment") which was running at the time the excludable interval began must be suspended until the defendant is returned for further court processing. To further complicate matters, multiple excludable time intervals must be able to be accounted for simultaneously. Time interval computation and reporting is essential for compliance with the regulatory schedule. Also, reporting at the national level regarding performance under this law is required of each District Court.

From the clerk's point of view, upon posting certain events that are significant with respect to the Speedy Trial Act, the criminal case processing model will allow the system to remind him to either begin or end excludable time intervals, or the starting and stopping of the procedural intervals may be handled automatically. The monitoring facility relative to Speedy Trial would, for example, prompt a judge regarding the status of defendants' cases, including excludable interval accounting, that are about to exceed the time limits.

D. *A Period of Administrative Innovation in the Courts*

Traditionally, judges and society in general have put a premium on judicial independence. In some cases this has led judges to resist administrative changes which they saw as impinging on judicial independence. The normal resistance of any organization to change and the natural conservatism of the courts have required that

proposed modern management techniques be well established elsewhere and, where possible, their potential impact on the courts be carefully scrutinized. Nevertheless, to obtain some of the benefits of these techniques, changes may be warranted in judges' administrative roles as distinguished from their adjudicative role.

There has been a reluctance to introduce information and methods contributed by nonlegal disciplines other than through witnesses. For example, when Judge Charles Wyzanski hired economist Carl Kaysen to assist him with the complicated United Shoe anti-monopoly case in 1950, he had to hire him as a "law clerk" [8].

However, in recent years, the Federal Courts appear to be open to administrative innovation as never before. Rather than compromising a judge's judicial independence or gaining efficiency at the expense of fairness of the process, specific administrative methods that have been adopted are either neutral or beneficial with respect to these considerations. Chief Justice Warren E. Burger has repeatedly stressed the ways in which modern management methods improve the efficiency and fairness of our judicial proceedings [6], [7]. He and other top officials in the Judiciary have created a climate and have adopted concrete measures conducive to administrative innovation. In general, judicial independence is enhanced by giving judges better management control over their caseloads, and administrative predictability associated with systematic management practices provides an important component of fairness.

Examples of management innovations introduced in recent years that have had these effects are: standards for record keeping and docketing as prescribed by the Administrative Office of the United States Courts; uniform data base definitions that enable consistent statistical collection [1]; standard computer-generated docket sheets across Federal Courts; omnibus hearing scheduling [20]; systematic calendaring based on either central or individual calendar methods [12]; and case assignment based on analytic methods of case weighting [13].

E. *The Development of Standards and Administrative Trends*

The increased demand for legal services relative to the resources available [14] has made it clear that the resources must be increased, new procedures for the just settlement of disputes must be found, and management practices using our current procedures must be made more efficient [22]. The increased work load of federal judges has also motivated the delegation, or decentralization, of certain administrative tasks to a new breed of management-educated Clerks of Court to which the title "Court Executive" seems more appropriate [27].

The use of standardization as a coordinating mechanism has always been important for court management but has become more feasible with the introduction of computer technology. Legal training, court practice, and, increasingly, formal management education develop standards of nomenclature, concepts and approaches to problems. Standardization in the process of judicial administration is developed by adopting formal rules of procedure which are, generally speaking, refinements or generalizations of existing procedure and tradition. Even case outcomes are defined by standard classes of disposition, i.e., verdicts, permissible sentences, dispositions, etc. Legal precedence has a standardizing effect on both the process and the outcome of cases.

Improved court management in part, and information system design in particular, will depend on distinguishing those administrative and judicial activities which can be routinized into standard operating procedures and ultimately mechanized. The process of information collection for more judicial tasks may also be standardized.

The courts have been described as "labor intensive professional service organizations in the public sector, structured around the decision activities of judges" in which there has been a progressive transformation of adjudication into administration [17]. Standardization and decentralization of administration evolving simultaneously will tend to give rise to the structural configuration of a "professional bureaucracy" [21]. Within this structure there are strong incentives to improve productivity, including that of the judge.

Nearly 70% of all actions against federal criminal defendants and 85% of those actions resulting in conviction are terminated by pretrial pleas or nolo contendere [1]. The process of plea bargaining is largely administrative. Though a judge will preside over the process, many administrative tasks require information transfer between the offices of the U.S. Attorney and the court. Pretrial settlements of civil cases further reduce the demand for trial and thereby increase the relative amount of administrative activity to be dealt with efficiently.

The successful implementation of the Criminal Caseflow Management System in the courts described in this paper required standardization of docket-related and reporting activities. It affirmed the previously questioned proposition that such uniformity was possible among the Federal Courts and if carried out would not reduce flexibility and responsiveness.

In general, faced with growing caseloads and the expansion of administrative activities in the courts, the increased use of modern management techniques and systems, rather than being harbingers of a mechanistic, inflexible system of justice, can assist the judges and court administrators in providing a competent, efficient and eminently more humane treatment of individuals.

3. Model of Criminal Case Processing

In this section, the model of criminal case processing will first be described and then its significance for administrative use of the system will be explained. The key success factor in the design of an elaborate model-directed system is to match the levels of model sophistication to that of the actual court administrative process. Implementation of such a system is feasible only as managers in the courts view it as an extension of themselves in collecting, organizing, and utilizing needed information.

Case management in the Federal Courts may be viewed as a structured process whereby a case flows through a sequence of stages as a result of actions administered by the judge, but initiated by the parties to the case, the judge, or the Office of the Clerk. The actions, referred to as "events," are recorded on the docket sheet and preserved as official court records. Events operate on "subjects." The possible subjects in criminal cases are:

(1) The defendant (the plaintiff in federal criminal cases always being the United States),

(2) A particular count of an indictment or information filed against the defendant,

(3) A particular motion filed during the case, or

(4) A particular appeal (interlocutory or otherwise) filed during the case.

Each of the subjects within a given case moves through a series of logical stages, called "statuses," as the case progresses. Figure 4 illustrates a simplified "status diagram" for defendant subjects. There is a different status diagram for each of the four subject types. This portion of the model is similar to a conventional finite state diagram in which the nodes are statuses and the allowable paths (arcs) are events. The

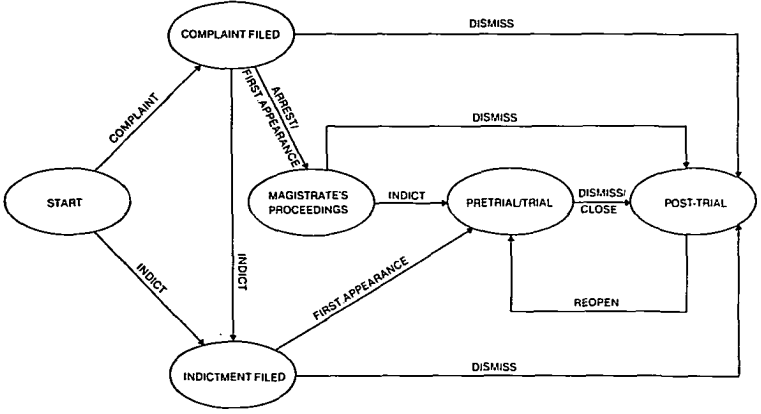

FIGURE 4. Simplified Defendant-Based Status Diagram.

actual status diagrams for all four subject types contain a total of 45 statuses and several hundred distinct events.

At any point in time, each event subject of a case is in exactly one status. In a given status only certain events may be posted against that subject. A subject must follow a continuous path of arcs through the diagram. Thus, a legal process is specified by defining the relevant stages (statuses) in the process and the various allowable actions (events), where each arc is labeled with the name of the associated event that may occur to a subject moving that subject from one status to another, or perhaps the same, status. The graphical representation of such a legal process is a status diagram.

Statuses are chosen to represent the major stages in the legal process convenient for analysis of case progress and status reporting. Events represent possible court transactions. For example, in modeling the criminal legal process, the statuses might be chosen to correspond to a refinement of the status categories of the Speedy Trial Act, thereby making it possible to list all defendants or counts which have progressed to a certain stage in litigation and to determine the time which a defendant or any of his counts has spent in any given status. The events are defined in a "dictionary" by specifying:

(1) The event's name, such as "PRL.XM.S" for "preliminary examination set."

(2) The subject type to which the event may apply (e.g., "PRL.XM.S" would apply to "defendant" subjects but not to "motion" subjects).

(3) The STATUS transition, if any (e.g., "PRL.XM.S" can occur only if the defendant is in the "Magistrate's Proceedings" status, and the event will not cause a status change).

(4) The formal parameters necessary to specify the data contents of the event (e.g., "PRL.XM.S" requires that the scheduled date of the examination be supplied).

(5) The Speedy Trial time accounting actions necessary as a result of posting the event.

(6) Any special preconditions that must be satisfied in order for the event to be posted.

(7) Any special semantic actions that must be performed upon posting the event.

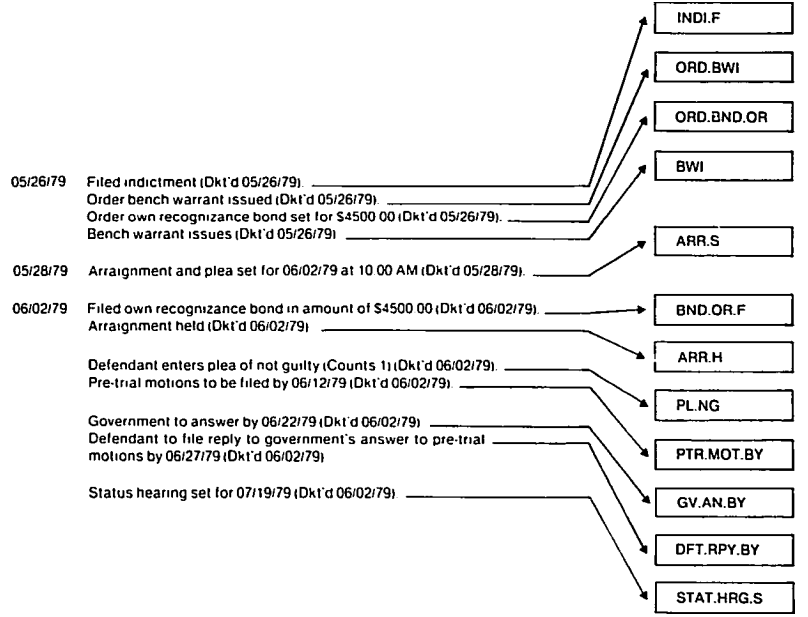

FIGURE 5. Docket Entries Generated by Posting Events.

(8) The text that is to be printed on a docket sheet when this event is reported.

Figure 5 shows the docket entries produced by the posting of the events indicated by the associated mnemonic event names. As noted in (4) above, the parameters shown in the docket entries are prompted for as directed by the event definition.

In addition to the event sequencing constraints represented by the status diagram, arbitrary sequencing relationships may be specified to control the order in which events may be posted within any given status. These relationships are represented graphically as "sequence diagrams" and extend the finite state nature of the status diagram. In addition to strict event sequences, sequence diagrams may denote forks and joins, optional sequences, and parallel paths. The state of any given subject with respect to the progress of a case may be described as the status containing the subject plus a vector of "program counter" values indicating the subject's position along each possible parallel path in the sequence diagram which further defines the status.

Figure 6 depicts a simplified event sequence diagram for defendant subjects in the "Magistrate's Proceedings" status, showing allowable sequences for setting, resetting, holding and continuing preliminary examinations and initial appearances before a magistrate. The "{", "}" indicate that the enclosed sequence may be repeated zero or more times. The "[","]" indicate that the subsequence is optional. The vertical bars denote a fork and join operation on the enclosed independent event sequences. The dotted line indicates that the DISMISS event may be posted at any time between the fork and join to interrupt and curtail the parallel sequences. All constructs may be arbitrarily nested as required to describe the desired event sequencing rules.

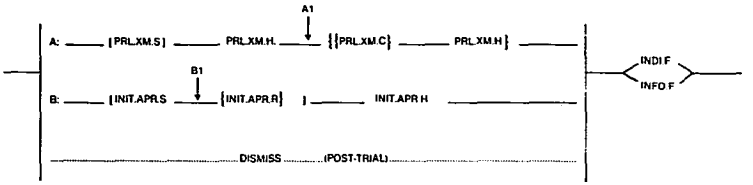

FIGURE 6. Event Sequence Diagram for "Magistrate's Proceedings."

For example, according to Figure 6, before an indictment (INDI.F) or information (INFO.F) event can be posted, a preliminary examination must first be held (PRL.XM.H), with or without previously being set (PRL.XM.S), and then optionally continued (PRL.XM.C) and re-held (PRL.XM.H) an arbitrary number of times. Similarly an initial appearance (INIT.APR.H) must also be held before exiting the parallel sequences. However, at any time during this preliminary examination sequence, DISMISS may be posted, thereby escaping from the sequence and causing a status change to the "Post-Trial" status (see Figure 4). Suppose a defendant is in the "Magistrate's Proceedings" status, at point *A*1 on path *A* and at point *B*1 on path *B*. The system can then respond intelligently to further user input by, for example, rejecting a PRL.XM.S event since path "*A*" disallows such an event from point "*A*"; or accepting the input of any of PRL.XM.C, PRL.XM.H, INIT.APR.R, or INIT.APR.H, or rejecting the input of INDI.F or INFO.F, and giving the diagnostic that INIT.APR.H must occur before the parallel sequence of paths "*A*" and "*B*" can be exited.

The event dictionary, status diagrams, and sequence diagrams are the formalisms used to represent court-oriented knowledge within the model. The status and sequence diagrams together have "computational power" equivalent to Holt-Petri Nets [19] but provide a simpler communication by their separation. This information is declaratively specified in tables rather than being, for example, procedurally embedded in the programs. The system acts essentially as a table-driven interactive interpreter which accepts proposed events from the user and tries to apply the semantic actions of each event to transform the current state of its subject. The intelligence of the system is exhibited by its responses to proposed events and the reports produced for effective case monitoring. Not only can the system detect when an event is invalid based on the current state of its subject, but the system can also offer diagnostic advice as to which events are allowable at that time and which events need to be posted first in order that the attempted events become valid.

There are several administrative functions carried out by judges and clerks that are directly related to the structure and content of the model, in addition to the reporting and analytical capabilities that have been developed. These include the following.

First, correctness of the information collected and disseminated is an important responsibility of all court officials. The model-directed system has an impact on data base integrity by checking the accuracy of individual data items and events entered and verifying their consistency with previously collected information. The timeliness of the interactive feedback allows errors to be corrected when source documents are easily available and the information is current. This diagnostic capability is illustrated by an excerpt from a user dialogue shown in Figure 7. The system prompts for all

```
.run CRIMNL

                Welcome to CRIMNL -- Friday, August 31, 1979 at 9:40 AM

*docket to case 79CR5544-1
Entering docketing mode---
----------
Event name = prl.xm.h
 » PRL.XM.H means: Preliminary examination held
Date of occurrence (8/31/79) = 8/21/79
 » PRL.XM.H event docketed for 79CR5544-1.
--------
--------
Docket  (79CR5544-1) =
Event name = init.apr.s
 » INIT.APR.S means: Initial appearance hearing set for SDATE
Date of occurrence (8/21/79) =
Scheduled date (BLANK) = 8/29/79 @ 10:00 AM
 » INIT.APR.S event docketed for 79CR5544-1.
--------
--------
Docket  (79CR5544-1) =
Event name = init.apr.r
 » INIT.APR.R means: Initial appearance hearing reset to SDATE
Date of occurrence (8/21/79) = 8/28/79
Scheduled date (BLANK) = 8/31/79 @ 2:00 PM
 » INIT.APR.R event docketed for 79CR5544-1.
--------
--------
Docket  (79CR5544-1) =
Event name = INDI.F
 » INDI.F means: Indictment filed
Date of occurrence (8/29/79) = 8/30/79

***  INDI.F -- OUT OF SEQUENCE --
  Event sequencing error during Magistrate's Proceedings for Defendant = 1
  A possible path is: INIT.APR.H, then INDI.F

***  INDI.F event NOT docketed for 79CR5544-1.
--------
```

FIGURE 7. Illustrative Dialogue for Docketing Events.

necessary data items or event subsequences to establish validity and provides diagnostic advice to the clerical staff.

Second, the critical points in a case at which administrative action is required correspond to the statuses in the model, and the clerical transactions to be processed correspond to events. The model gives a practical administrative view of the information, allowing a judge to tell if a case is "on track." This is particularly crucial for meeting Speedy Trial deadlines, where extensive computation is often needed to process excludable time intervals. Likewise, the question, "Which cases are ready for trial?" is often not easy to answer, particularly in civil cases, because of a complex set of prerequisite events and information submittals. As concrete examples, consider preparation for an omnibus hearing [20] or keeping track of a motion for a "bill of particulars" and the corresponding responses. The model relates a proposed event to its prerequisites, and is able to inform the user of missing prerequisite events or pending, unfinished event sequences.

Third, administrative complexity is greatly increased by activities that generate parallel paths in case processing. For example, consider multiple counts with differing pleas or scheduling, motions that require processing but are not on the critical path and may get "lost," appeals to the Circuit Courts that may or may not halt District Court processing, and assignments made by judges to the parties (e.g., a briefing schedule) to be completed at a later point. The model is specifically designed to organize and monitor these kinds of activities.

Fourth, sustaining a satisfactory rate of progress in disposing of a case is aided by the automatic status transitions caused by posting events. The system can prompt for an expected next action by directing a judge's attention to the state of each case and scheduled events.

Fifth, the Clerk can respond to a judge's request for information more quickly and with regularity if desired, rather than having to administer time-consuming analyses outside of the regular administrative process. The courts will thereby become more acquainted with the potential for "management information" as opposed to only "information management."

Finally, an ongoing task of the judges and their administrative staffs is to analyze the procedures themselves and their own administrative implementations to suggest revisions in either local or national rules of procedure. The system is designed to make such information available in a form which supports such studies.

4. Implementation Strategies

The introduction of large, sophisticated information systems into organizations with practically no history of computer utilization or technological norms poses a high risk of implementation failure. The court impact was potentially increased by initially taking such a comprehensive approach to the fundamentally important court functions of docketing and reporting. The problems of how to stimulate sufficient "organizational learning" [16], [18] to rapidly advance through the normal stages of EDP growth [24] were posed during the early planning phase. Achieving ultimate feasibility of implementation within the court organizations was the primary objective in early project staffing and organization, equipment selection, system design and development.

The commitment by the judges was strong for reasons discussed in §2, and the Clerks and other key administrators generally understood the logical information processing involved in caseflow management very well. Standards, such as the federal rules of procedure, and regulatory statutes provided a uniform basis for discussion, although local interpretations, locally formulated rules, and organizational structures varied among the courts, which resulted in rather unstructured system design problems overall. The challenge to project management was to bring the technology to the courts by functioning as court administrators and representing the logical patterns of case processing in systems which minimally distorted the intent, organizational work patterns, nomenclature, and functionality of the various operating roles.

The detailed strategies employed for implementation were based on several fundamental principles and methods which may be summarized as follows:

(1) A working committee of the Clerks from a pilot group of courts was formed for system planning several months prior to equipment selection. Explicit assignments

were carried out by the Clerks and their staffs. The initial group of six courts were located in Chicago, San Francisco, Los Angeles, Detroit, New York and Washington, D.C. The group was large enough to exhibit most substantive variations. The project was always represented as "their system."

(2) The system was designed to be implemented without initially changing the information flow between organizational units within the court community. This resulted in the Office of the Clerk having to perform both data entry and report generation for other units. A second phase implementation will involve some decentralization or distribution of these functions and related management control responsibilities to the sources with the greatest expertise or local context for data entry, reporting, or further data analysis. Data base administration would continue to reside in the Clerk's Office, enforced by uniform system standards and conventions.

(3) The operation of the system from terminals located in the courts should not require computer professionals on the staffs of the individual courts. The design of the system was carried out by the participating courts in conjunction with a centralized multi-disciplinary team of computer scientists, lawyers, psychologists and technical writers, but the terminal operation and system utilization requirements have been carefully designed to match the skills of the participating court personnel.

(4) User training was done primarily by peers who work in the courts. Part of the commitment by a court to participate in the program was a commitment to help train the staffs of other courts. This not only magnified the efforts of the relatively small staff at the Federal Judicial Center, but was effective in lowering the intimidation level and in communicating local court responsibility.

(5) By developing a formal modeling language to describe court processes that is at the level of understanding of a competent court administrator, the Clerks have been able to actively participate in system design and can modify system behavior through a medium they understand. The system operation is actually driven by a model defined using the language analogous to a table-driven interpreter. A flexible software system may be thereby provided that is responsive to the custom needs of the different courts when initially implemented, and over time as their needs change. For example, the primary subsets of the total set of events used by each court need not be identical, but the same event must mean the same thing to all. The model has become accepted to the point that the system is used as a training tool for the instruction of docket clerks in criminal procedure.

(6) The descriptive power of status diagrams, events and sequencing is sufficient to specify the processing for civil, bankruptcy and appellate cases, as well as criminal cases. This has motivated the preliminary design of a Generalized Event-Driven System [14] to eventually unify all of these applications, thus involving the user in a familiar framework, simplifying the design of additional new systems, improving reliability, and reducing maintenance.

In general, the project has been managed to maximize the involvement of court administrators by structuring their participation as part of working teams, and providing them with the means to communicate their needs unambiguously that the methods and systems developed may become engraved in the granite of the practice and procedures of the courts.

The Criminal Caseflow Management System is programmed in SAIL [25] using the DBMS-10 data base management system [10] with an internally developed data manipulation facility [5] and runs on DECsystem-10 computers at two data centers

located in Washington, D.C., accessible from terminals located in various user courts nationwide via a value-added network.[1]

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