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FBI Fingerprint Identification Automation Study: AIDS III Evaluation Report

Volume I: Compendium

November 15, 1980

Prepared for
U.S. Department of Justice
Federal Bureau of Investigation
Through an agreement with
National Aeronautics and Space Administration
by
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California
**Abstract**

A feasibility study is being conducted by the Jet Propulsion Laboratory for the Federal Bureau of Investigation through an agreement with the National Aeronautics and Space Administration. This volume of the report, Compendium, encompasses the primary features of the overall study, titled FBI Fingerprint Automation Study, which provides an evaluation of an automation system proposed by the prime contractor, Rockwell International. Objectives of the study are described, methods of evaluation are summarized, and conclusions are reached in an Executive Summary presented as Section I. This volume also includes a brief history of fingerprint automation activities within the FBI, the organization of the FBI, a Bibliography of documents and records, a data dictionary, and a reference set of all of the transparencies presented throughout the study. Detailed information is available within the larger work comprising nine volumes which are also described in this volume.
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SECTION I
EXECUTIVE SUMMARY

A feasibility study of the automation of fingerprint identification is being conducted by the Jet Propulsion Laboratory (JPL), California Institute of Technology, for the Federal Bureau of Investigation (FBI), U.S. Department of Justice, through an interagency agreement with National Aeronautics and Space Administration. This study, officially titled the FBI Fingerprint Automation Study, evaluates the prime contractor's (Rockwell International) proposed Automation of Identification Division System Model III (AIDS III).

The FBI's Identification Division maintains the United States national repository in the form of two fingerprint files, a criminal file and a civil file. It is the largest repository of this type in the world. The criminal file contains 77 million cards bearing the fingerprints of 22 million persons. The civil file contains 93 million cards with the fingerprints of 42 million persons. To identify a person positively, two sets of fingerprints are matched against each other. Until now this fingerprint identification process has been mostly manually operated.

The Identification Division receives an average of 44,000 pieces of mail for processing each day in the form of fingerprint cards, criminal inquiries, and requests for clearance for sensitive job applications. Normal processing of criminal and civil cards takes an average of 50 calendar days* using the manual system. Sixty million dollars per year was budgeted and $56 million was spent in FY79 for this operation. The 30% annual personnel turnover prevents staffing to the 3409 authorized complement (in December 1979).

The backlog of the present system's work load as of May 1980 is growing. The system, as presently staffed, may not be able to meet the needs of the user agencies and improvement of this system has become imperative. These conditions have prompted an effort to improve cost efficiency and system performance; the automated system is being considered as part of that effort.

The two major objectives of this study are: (1) to determine the technical, economic, and operational feasibility of the proposed automation of the identification process, the subject of this report, and (2) to devise and develop, in detail, alternative systems, both largely manual and fully automated systems, and rank them against the proposed automation system, the subject of a final report due in March 1981.

*76 working days, based on measurements made by JPL in December 1979 and May 1980 of fingerprint cards which received full identification processing (i.e., illegibles and other rejected cards were not included).
A. GENERAL

As stated, the major subject of this report is the technical, operational, and economic feasibility of the May 1980 AIDS III system. All three criteria of the feasibility study must be satisfied simultaneously. Figure 1-1 graphically contrasts AIDS III and the current system. Technical, operational, and economic feasibility are characterized by a single parameter and plotted on one of the three axes. The economic feasibility is characterized by the cost of a fingerprint search, operational feasibility is characterized by response time, and technical feasibility by the relative maturity of the technologies employed.

Evaluation of the tangible benefits of AIDS III (Volume IV) shows that the AIDS III mail room to mail room response time will be better than that of the present system with the present configuration and staffing level (3100 actual operating personnel in FY-79). To make the current system feasible and bring the internal processing time to 24 hours*, would require a staff of 3700 persons. AIDS III can perform the same tasks in three hours (except for the eight-hour delays through the manual system for 20% of the 1993 work load) with a 30% personnel reduction in the operational staff. The cost per fingerprint (technical) search will drop from $7.76 to $3.67**. The cost per transaction would be reduced from $5.45 to $4.35. The miss rate in fingerprint search will decrease from 24% to 5% (Volume III).

These figures imply that significant tangible benefits could result from automating the Identification Division system.

There are design uncertainties that include difficulties in the automated image retrieval for verification, database management, card transport, and the AIDS III-to-manual system interface.

Operational problems of the system include the inability of AIDS III to handle the design work load because of its marginal production capacity, disruption that would be caused during the transition, and the inability of the system to respond to changes in work load volume and mix.

The implications of these findings are:

(1) The present system is not feasible: long response time is growing (see Table 1-1).

---

*Mail room to mail room response time of 2 working days.

**Figure 1-1 shows the cost per fingerprint search as $8.26 for the current system staffed at 3700 persons. $7.76 is the current cost per search.
Figure 1-1. Feasibility Comparison of AIDS III vs Current System

Table 1-1. Measured Response Time (Calendar Days)

<table>
<thead>
<tr>
<th></th>
<th>Criminal</th>
<th>Applicant</th>
<th>Average Overall (Weighted by Volume)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ident</td>
<td>Non-Ident</td>
<td>Ident</td>
</tr>
<tr>
<td>Dec. 17, 1979</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample Size</td>
<td>44</td>
<td>32</td>
<td>97</td>
</tr>
<tr>
<td>Average</td>
<td>49.0</td>
<td>51.8</td>
<td>33.9</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>23.3</td>
<td>6.5</td>
<td>50.1*</td>
</tr>
<tr>
<td>May 7, 1980</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample Size</td>
<td>136</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Average</td>
<td>71.9</td>
<td>54.7</td>
<td>63.0</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>28.6</td>
<td>12.2</td>
<td>25.3</td>
</tr>
<tr>
<td>Median</td>
<td>68</td>
<td>51</td>
<td>55</td>
</tr>
</tbody>
</table>

*Criminal Only

**65.2 Criminal Alone
(2) If design problems are not solved the automation benefits will not be achieved. AIDS III may not be as cost-effective as estimated; e.g., the life-cycle costs of AIDS III may exceed the life-cycle costs of the current system.

(3) Automated image retrieval may not work efficiently, and the response times may suffer.

This report recommends that short term and long term solutions to the present situation should be sought.

Short term solutions include:

(1) Seek methods to reduce personnel turnover.

(2) Investigate and implement helpful changes to the manual system and AIDS II (the automated name search portion of the current system). JPL is developing organizational and procedural change recommendations for the current system.

(3) Investigate converting more of the manually operated card index to expand the automated name search capability of AIDS II.

Long term solutions are:

(1) Proceed with automation planning and development.

(2) Continue with the second phase of the JPL study.

(a) Alternatives to the current system and AIDS III will be developed.

(b) All candidates will be analyzed and ranked.

(3) Incorporation of high ranking candidate system(s) in pursuing a combination of short and long term solutions may be the most cost and operationally effective.

B. ECONOMIC FEASIBILITY

The economic feasibility of the AIDS III is discussed in Volume IV. AIDS III is evaluated for a set of economic feasibility measurements of life-cycle costs, implementation costs, annual operating expenditures, annual capital expenditures, and cost/benefit data. The economic feasibility is determined by comparing the evaluated measurement with the same measurements for the current system.

The economic feasibility issues of AIDS III have been studied to determine:

(1) If the life-cycle cost (1980-2004) of AIDS III is less than the life-cycle cost of the present system under a variety of future system workloads.
(2) If the estimated annual personnel cost savings are sufficient to justify AIDS III implementation cost.

(3) If the predicted improved performance of AIDS III over the present system justifies the AIDS III implementation costs.

(4) The planned annual expenditures.

(5) Which of the many uncertainties in the future economic and operational environment have a significant effect on the AIDS III cost estimates and the cost comparisons between AIDS III and the current system.

The study determined that AIDS III will achieve the cost savings necessary to offset the $50,591,000 implementation costs, if the system is implemented on schedule. The life cycle cost of AIDS III is $552,600,000 compared with $573,500,000 for the present system. A 10% discounted savings of $19,900,000 will be realized over the 25-year evaluation period and thus tangible benefits could result from automation of the Identification Division system. Figure 1-2 shows the planned annual expenditures of the AIDS III system.

The economic benefits of AIDS III are sensitive to uncertainties in cost. Figure 1-3 shows the effect on the life cycle of uncertainties in implementation costs and savings due to personnel reductions. If the estimates fall in the unfavorable corner of the ±25% uncertainty rectangle, then the life-cycle cost of the AIDS III could be greater than that of the current system. The ±25% uncertainty rectangle shown in Figure 1-3 is based on the Rockwell evaluation of their cost estimate uncertainties.

C. ENVIRONMENTAL ANALYSIS

The objectives of the environmental analysis were to determine the existing and future political, economic, legislative, and social trends that might affect the work load of the Identification Division. The development of scenarios helped to characterize the relationship of these drivers of potential change to the work load. External and internal models of the environment were used. The internal model characterizes the environment from the Identification Division's point of view. The external model takes into account points of view of agencies who are contributors of work and often are competitors who perform the same functions. This second model investigates the loci and methods of control of other agencies. The results of this study are seen in Volume VI of this report.

The environment of the Identification Division is complex. The control of the work load may be exercised by external agencies such as state and local officials. These external controls are not centrally located, and they are not used in unison to change the work load.
The Life Cycle Cost of the Current System is estimated to be $573.5M.

*The Life Cycle Cost of the Current System is estimated to be $573.5M.*

Figure 1-3. Variation of AIDS III Life Cycle With Implementation Cost and Personnel Reduction
There are two methods to determine user requirements, categorization and sampling in each category or a complete survey of all users. There is no known grouping of Identification Division users that would allow for sampling. For example, the per-capita submissions do not correlate with the population density of the states. Figure 1-4 shows the per-capita submission of criminal fingerprint cards for the 50 states and the District of Columbia. The states are ordered by population to show that high as well as low per-capita submissions can be found for states of all population ranges. A complete survey of the 50 states and the federal government agencies is suggested to determine the user requirements.

In projecting the future work load of the Identification Division with the internal model, it was determined that there would be very little change from 1993 work load specified in the Identification Divisions AIDS III Design guidelines. The guidelines also specify a 50% boundary above this 1993 work load. The external model indicates one possibility of an increase in the work load beyond the 50% boundary but this is near the end of the life cycle of the system (Figure 1-5). However, any significant increase in the work load will saturate the AIDS III system. This saturation will require an addition of processing capability or overtime. The recommendation of the study is that the work load capacity of the system be increased to make it capable of handling surges. Also, design guidelines that require systems designers to keep work station utilization below a specified value for nominal work load should be developed.

D. OPERATIONAL FEASIBILITY

Operational Feasibility, Volume III of this report, addresses whether the system design of AIDS III meets the functional and performance requirements of the FBI and if the required hardware and software are available, mutually compatible, and adequate.

The analysis of AIDS III indicates that all components of the various functions are feasible if the technical developments are successful. Analysis also indicates that the system is sensitive to surges in volume, and has a very low tolerance for equipment failure. If a single unit fails, the work load on other units will increase and many of the functions could not handle it. As a consequence, response time will increase or overtime will be necessary. To make the system operationally feasible, the JPL study had to add five work stations to the Rockwell concept.

Analysis of individual components indicates that AIDS III is sensitive to subsystem availability. The operational feasibility of AIDS III is marginal and if the subsystem availability falls below 93% in three specific cases, the system will saturate, queues will grow, and overtime will be necessary to maintain the required response time. Re-evaluation of the system configuration and its architecture is recommended to eliminate these potential problems.
Figure 1-4. 1978 Per-Capita Submission of Fingerprint Cards (States Ranked by Population)

Figure 1-5. Relation of Drivers to Work Load Projection
E. TECHNICAL FEASIBILITY

The purpose of the Technical Feasibility study (Volume II) is to survey current applicable technology, assess technical feasibility of the technology, project trends, compare competing technologies, assess the risk involved in committing to the technical approaches selected, and determine whether the technologies used will be obsolete and no longer cost-effective by the operational date.

The Technical Feasibility study concluded that the technologies needed to implement AIDS III are well established. However, the design specified by Rockwell International is deficient in the areas of process control, automated image retrieval, and data base management. These deficiencies jeopardize the operational and economic feasibility of AIDS III. It is recommended that the deficiencies in the design be corrected in these areas before committing to implementation.

F. TOP DOWN FUNCTIONAL ANALYSIS

The Top Down Functional Analysis was completed as a first, basic step in supplying the JPL team with a hierarchical functional description and an identification of those functions that are candidates for automation. The results of the TDFA are found in Volume VII of this report. Major findings indicated that not all functions that are candidates for automation are being automated by AIDS III; specifically 49 of the possible 58. For example, fingerprint classification, work load balancing, fingerprint card centerline determination, etc., are not being automated by AIDS III. The implications of this finding are that the potential advantages of automating the system may not be fully realized, and that the automated system may not be as cost-effective as some different approach.

It is recommended that an overall automation plan be developed for automating AIDS III. This plan should determine the priority and order in which functions are selected for automation. The plan should be re-examined as technology evolves and causes changes in the economic environment.

G. FUNCTIONAL REQUIREMENTS AND MEASURES OF EFFECTIVENESS

Functional requirements are the collection of the capabilities that a system and its subsystems must possess to fulfill the objectives of the system. Volume IX, Functional Requirements, states the functional, performance, and general requirements for the FBI Fingerprint Identification system, and has been used in evaluating the AIDS III system concept and will be used for evaluation of the alternative systems that will be studied in the second phase of this work.
Measures of Effectiveness (Volume VIII) provides quantitative and qualitative evaluation criteria and states the parameters used to assess the performance of a system in attempting to achieve its goals.

The combined major findings of these two volumes indicate that there are performance requirements that are either missing or unsubstantiated. For example, the Identification Division guidelines response time is not based on user requirements. Also, the system performance is not specified in terms of allowable miss rate. The implications of these findings indicate that functional and performance requirements could not be used as operational feasibility criteria. Sensitivity testing was employed as an operational and economic feasibility metric. This report recommends that performance requirements be developed based on federal and local government needs.

H. INTERRELATIONSHIP OF VOLUMES

Nine volumes support this automation study: Compendium (Volume I), Technical Feasibility (Volume II), Operational Feasibility (Volume III), Economic Feasibility (Volume IV), Current System Evaluation (Volume V), Environmental Analysis (Volume VI), Top Down Functional Analysis (TDFA, Volume VII), Measures of Effectiveness (Volume VIII), and Functional Requirements (Volume IX).

Figure 1-6 shows the interrelationship of these nine volumes. The evaluation of AIDS III started with the TDFA. This document provided a hierarchical description of the identification functions and is the basis for the other analysis. The Environmental Analysis study determined the external forces and their influence on the work load functions performed by the Identification Division. The current System Evaluation studied the internal working of the system and collected data on the history of work load volume and composition. The Measures of Effectiveness provided quantitative and qualitative evaluation criteria for assessing the system. The functional and performance requirements of AIDS III were developed on the basis of information gained in these early analyses.

The functional and performance data that appear in Volume IX are used as a basis for assessing technical and operational feasibility. Technical feasibility analysis supports the operational feasibility study by supplying technology evaluation and projections of the cost of new technology for the economic feasibility analysis. Operational feasibility provides information on AIDS III performance or benefits for economic assessment.

Current System Evaluation supplies the cost and benefit data of the current system to support economic feasibility analysis. Environmental Analysis gives work load projections based on scenarios representative of the external environment to support the economic feasibility analysis. These scenarios are then used in sensitivity tests of AIDS III. This sensitivity testing and cost estimation of AIDS III system performance was required because of the uncertainties in technical issues and cost estimates.
I. CONCLUSIONS AND RECOMMENDATIONS

The present system performance is not feasible because it takes the Identification Division 50 calendar days to respond to inquiries, there is a turnover in personnel of 30% per year, and it costs $56 million to $60 million a year to operate in the current mode. The AIDS III system provides performance and cost benefits only if the cost estimates are on target, technical problems are solved, and the operating margins are improved. The automation of the Identification Division and the improvement of the semi-automated system should be investigated further to find the most cost-effective solution that will meet user requirements. The continuation of the second phase of the JPL study is recommended.

![Diagram of functional analysis and environmental analysis](image-url)
SECTION II
AIDS III DESIGN GUIDELINES EVALUATION

The design guidelines (Reference 1) published by the Identification Division to the contractor developing the AIDS III concept are a source of performance and functional requirements, constraints, objectives and instructions to the system developers. These guidelines are evaluated and discussed in Volume III, Operational Feasibility. Table 2-1 provides an assessment of the capability of AIDS III to meet these guidelines. The guidelines have been paraphrased for brevity.

Achievement of Guideline #7 (Minimize overtime) will be determined when the system is operational. However, due to the small reserve production capacity of AIDS III, pulses or surges in work load will exceed system capability and overtime will be required or response time will suffer.

Achievement of Guideline #2 (Semi-automatic classification not to preclude automatic classification) remains to be determined because the automatic classification technique using the Henry Fingerprint Classification System in a file of 22 million subjects is under development. There is nothing in the semi-automatic technique which precludes automatic classification, but the existence of a solution for automatic classification is not proven. The system design and data base management of the automated identification system might be better served by using a different classification scheme not based on the Henry system which is inherently poor. Of the 1024 major Henry classification categories, approximately one quarter of the population fall into one class, thus making the distribution of classes extremely non-uniform.

Achievement of Guideline #11 (Automated Technical Search (ATS) performance equal to or better than the M-41 Matcher) addresses part of the requirement for search performance. There is a trade-off between the probability of missing an individual in the file (miss rate) and the average number of candidates that result from a search (false drop rate). As the false drop rate is reduced, the miss rate tends to increase and vice versa. Figure 2-1 illustrates this.

It is recommended that tests be conducted to determine the false drop rate versus miss rate curve for the ATS. Having determined this relationship, the optimum operating point can be found. Without this analysis, the system may be operating at a point with an unnecessarily high miss rate.
Table 2-1. Evaluation of Guidelines*

<table>
<thead>
<tr>
<th>Guideline Reference Number*</th>
<th>Design Guideline</th>
<th>AIDS III Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Achieve cost savings</td>
<td>Yes**</td>
</tr>
<tr>
<td>1b</td>
<td>Improve quality of service</td>
<td>Yes***</td>
</tr>
<tr>
<td>7</td>
<td>Minimize overtime</td>
<td>To be determined (see text)</td>
</tr>
<tr>
<td>10</td>
<td>Hardware procurements not be based upon suggested configuration during evaluation phase.</td>
<td>Yes</td>
</tr>
<tr>
<td>1f</td>
<td>Non-disruptive implementation</td>
<td>Yes</td>
</tr>
<tr>
<td>1h</td>
<td>Parallel running of automated and manual systems to allow for file conversion</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>Semiautomatic classification system not to preclude future automatic system</td>
<td>To be determined (see text)</td>
</tr>
<tr>
<td>3</td>
<td>Manual fingerprint card retrieval system acceptable</td>
<td>Manual until automatic retrieval implemented</td>
</tr>
<tr>
<td>12</td>
<td>Three-byte minutiae storage and matching</td>
<td>Yes</td>
</tr>
<tr>
<td>13</td>
<td>Five Automatic Fingerprint Reader Systems (AFRS)</td>
<td>Yes</td>
</tr>
<tr>
<td>14</td>
<td>System based upon available technology</td>
<td>Yes****</td>
</tr>
<tr>
<td>16</td>
<td>Modular design for workload variations</td>
<td>Yes***</td>
</tr>
</tbody>
</table>

* Identification Division in AIDS III Design Guidelines, (Reference 1)
** See Volume IV, Economic Feasibility
*** See Volume III, Operational Feasibility
**** See Volume II, Technical Feasibility
Table 2-1. Evaluation of Guidelines* (Continuation)

<table>
<thead>
<tr>
<th>Guideline Reference Number*</th>
<th>Design Guideline</th>
<th>AIDS III Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1j</td>
<td>Remain within current Identification Division space allocation</td>
<td>To be determined, space requirements not consistent between Jan 80 and May 80 System descriptions.</td>
</tr>
<tr>
<td>1j</td>
<td>Fingerprint card to remain unchanged</td>
<td>Yes***</td>
</tr>
<tr>
<td>5</td>
<td>Workday to be 18 hrs/day, 5 days/week for routine processing; 24 hrs/day, 7 day/week for expedite processing</td>
<td>Yes***</td>
</tr>
<tr>
<td>6</td>
<td>Staffing to be at a ratio of 2 to 1 day shift to night shift</td>
<td>Yes***</td>
</tr>
<tr>
<td>1d</td>
<td>Preserve or improve the integrity, security of data</td>
<td>To be determined****</td>
</tr>
<tr>
<td>1c</td>
<td>Preserve existing legal and accountability features</td>
<td>Yes</td>
</tr>
<tr>
<td>1g</td>
<td>Subsystems to be tested separately before large scale implementation</td>
<td>Yes</td>
</tr>
<tr>
<td>1k</td>
<td>Supportive of National Crime Information Center Computerized Criminal History (CCH) program</td>
<td>Yes</td>
</tr>
<tr>
<td>1l</td>
<td>Not to preclude latent fingerprint search</td>
<td>To be determined but probably only limited latent capability</td>
</tr>
<tr>
<td>1m</td>
<td>Not to preclude alternative methods for data transmission between origin and Identification Division</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* Identification Division in AIDS III Design Guidelines, (Reference 1)

** See Volume IV, Economic Feasibility

*** See Volume III, Operational Feasibility

**** See Volume II, Technical Feasibility
Table 2-1. Evaluation of Guidelines* (Continuation)

<table>
<thead>
<tr>
<th>Guideline Reference Number</th>
<th>Design Guideline</th>
<th>AIDS III Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1c</td>
<td>Improve fingerprint identification accuracy relative to current system</td>
<td>Yes, based on pilot project results (ATSPS)***</td>
</tr>
<tr>
<td>4</td>
<td>Automated Subject Search to handle 14.5 million records; Automated Fingerprint Search to handle 14-26 million records</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>Workload to be 1973 actuals plus 25%, (29,200 fingerprint cards per day)</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>Response time to be: 0.95 probable for 8 hrs/30 min, 0.99 probable for 48 hrs/8 hrs, 0.999 probable for 96 hrs</td>
<td>Yes, with minor additions to system capacity based on JPL results***</td>
</tr>
<tr>
<td>11</td>
<td>Automated Technical Search (ATS) - based on minutiae and equal to or better than M-41 Matcher performance</td>
<td>M-41 Matcher to be used (see text)</td>
</tr>
<tr>
<td>15</td>
<td>ATS CPU requirements (8 sec/search)</td>
<td>To be determined, but probably true</td>
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<td>AFRS cards read/hour (210)</td>
<td>Yes, with planned firmware enhancement</td>
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<td>AFRS system availability (95%)</td>
<td>98% from FBI logs***</td>
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* Identification Division in AIDS III Design Guidelines, (Reference 1)
** See Volume IV, Economic Feasibility
*** See Volume III, Operational Feasibility
**** See Volume II, Technical Feasibility
Figure 2-1. Trade-off Between Miss Rate and False Drop Rate
SECTION III
ORGANIZATION OF THE FBI

The overall organization of the FBI that has been in effect since August 1979 is represented in Figure 3-1. William H. Webster is the present director of the FBI. The three executive assistant directors head functional groups that are subdivided into divisions. This study is concerned with the automation of the identification process within the Identification Division, shown at the lower left corner of Figure 3-1. The Technical Services Division (at the lower right corner) who is sponsoring this study, is responsible for the procurement of technical equipment and for the implementation of the communications and computer systems.

The organization of the Identification Division is shown in Figure 3-2. The sections can be related to a work breakdown of the manual identification process as follows:

1. Recording: Initial sorting of input mail.
2. Card Index: Name search.
4. Assembly: Creation and maintenance of criminal history records.
6. Posting: Special processing for fugitives.
7. Fingerprint Correspondence: Preparation of response to contributors.

An exception to the manual system work breakdown exists in the Automation and Research Section, which has been studying methods for automating the identification process for several years. This section is also responsible for the automated portions of the identification process.

The Technical Services Division is depicted in Figure 3-3. This division has sponsored the study to meet the objectives listed in the previous section. This study specifically is managed by the Office of Information Systems -- Research and Development.

The FBI is responsible for the operation of the National Crime Information Center (NCIC), a section of the Technical Services Division that includes the Computerized Criminal History (CCH) unit. The NCIC and the CCH have been operated as a computerized data base system for some years and, although their operations are not part of the study, they are a major interface to the automated identification system.
Figure 3-1. Organization of the FBI
Figure 3-2. Organization of the Identification Division

Figure 3-3. Organization of the Technical Services Division
SECTION IV

STATEMENT OF THE PROBLEM

The outmoded system within the Identification Division that calls for automation as a solution can be summarized by listing the characteristics of the present, primarily manually operated, identification process. Identification is established by matching two sets of fingerprints because this is considered the only positive and unique way to identify individuals. There is a possibility in the future of other techniques such as voice prints; however, this is not part of the study.

The FBI maintains two fingerprint files: the criminal file stored in the J. Edgar Hoover FBI Building in downtown Washington, D.C., and the civil file stored in the Harkins Building at Buzzard Point, Washington, D.C. The criminal file contains approximately 77 million fingerprint cards representing 22 million persons. An additional file of 14.5 million criminal history records is maintained on persons who have been charged with more than one crime. See Volume V, Current System Evaluation, for further details.

In the civil file, there are 93 million fingerprint cards representing 42 million persons. The civil file is not planned for automation since it is only rarely accessed, chiefly to identify disaster victims, amnesia victims, etc.

The criminal file is heavily used to identify persons charged with crimes, to determine prior criminal activity, and to verify that applicants for sensitive jobs do not have criminal records. Each day, the FBI Identification Division receives approximately 44,000 pieces of mail. These include 25,000 fingerprint cards — 12,000 criminal inquiries and 13,000 applications for sensitive jobs. An additional 19,000 pieces of miscellaneous correspondence complete the 44,000 total. In the case of suspected fugitives, the FBI usually receives the fingerprint card via facsimile transmission from the arresting agency. These searches can be conducted and reply made usually within a matter of hours. For normal processing of criminal and civil cards, the U.S. mail is used to transmit the correspondence to and from the Identification Division. (See Volume V, Current System Evaluation.)

In addition to searching the file for a prior record, a few agencies can request the FBI to retain the fingerprint card in order to add it to an existing file or to create a new file for a new criminal suspect. In recent years the FBI has agreed to retain the cards of only those persons charged with serious crimes. The distinction between serious and non-serious crime is made by staff lawyers.

The FBI regularly corresponds with 29,000 users who provide information; it also accepts cards for storage from 9600 contributors. The user community includes criminal justice agencies, federal, state, and local governmental agencies, and institutions such as banks and employment licensing organizations. There are also international exchange agreements with 80 foreign governments.
SECTION V

AUTOMATION PLAN OVERVIEW

For years the FBI has been developing an automation plan leading to AIDS. The history of automation in the Identification Division starts in 1934 with experiments with punch card equipment, specifically, card sorters. This effort was somewhat successful but eventually the size of the file grew too large to continue to use card sorters for data processing.

Figure 5-1 depicts the sequence of events from 1970 to the present which relate to the automation effort in the Identification Division. This figure also shows the plan for future automation through the implementation of AIDS III. The figure plan is based on Reference 2 which indicates the planned transition from AIDS II to AIDS III. It should be noted that:

(1) In 1967 research on fingerprint reading by computers was initiated. This led in 1968-69 to experiments with reading fingerprints and matching algorithms; demonstrations were performed at this time.

(2) In 1971 a systems requirement study was performed by what is now Rockwell International corporation in cooperation with the Identification Division.

(3) In 1972 a prototype computer capable of reading fingerprints was delivered. This system was called FINDER.

(4) In 1973 the first version of the AIDS began operations. This led in 1974 to automating the criminal records of all first offenders and the collection of a data base for AIDS began. In 1976-77 five Automatic Fingerprint Reader Systems (AFRS) were delivered to increase the capability for fingerprint reading automation. The conversion of criminal fingerprint files began in 1977.

Figures 5-2 through 5-5 show the steps from a manual identification system to AIDS III. In all cases the simplified flow diagram shows the major functions performed. The first step is a name search to see if a record already exists in a criminal file for the fingerprint card submitted. If this search is successful and a match is made, then the fingerprint card is extracted from the file. It is compared with the submitted fingerprint card (the search card) to assure identification since name and birthdate are not sufficient. The fingerprint identification is verified by a second person who is senior to the person who performed the identification. The results of the identification are transmitted via the correspondence section to the contributor. In the AIDS I design the generation of the response also causes the criminal record to be entered in the automated data base.
Figure 5-1. Significant Dates — FBI Fingerprint Identification Automation
As shown in the AIDS II diagram, the name search function has been automated as has the correspondence function. Finally, in AIDS III the name search, fingerprint search, and correspondence functions will all be performed by the computer.

In the event the name search fails to find the individual, a fingerprint search is performed. The fingerprint search begins with classifying the fingerprints so that only one portion of the file must be searched. If a match is made, the identification is verified by a second party, as in the case of a successful name search, and correspondence is generated for the contributor. If both the name and the fingerprint search fail to find a candidate, the contributor is informed that the individual does not have a record in the FBI criminal file. If the fingerprint card is connected with a serious charge, the FBI will establish a file for the individual and store the submitted fingerprint card in the file, if the law enforcement agency submitting the card so requests. This makes the information available to any other contributing law enforcement agency.

If a suspected criminal has a prior arrest record, an arrest record file is updated. It contains a "rap" sheet and all but the best fingerprint card for that individual. The best fingerprint card is designated the master and is kept in the master fingerprint file.
Figure 5-2. Manual Identification Process

Figure 5-3. Process With AIDS I
Figure 5-4. Process With AIDS II

Figure 5-5. Process With AIDS III
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APPENDIX A
DATA DICTIONARY

Originally, the AIDS III evaluation was to be completed by February 1980. As this date approached, it became obvious that additional design data was required to complete the evaluation.

The Data Dictionary, Table A-1, indicates the unspecified or insufficiently specified data elements required to complete the AIDS III evaluation. It is recognized that no system can be completely specified until the detailed design has been completed and even then there may be changes in a system as complicated as AIDS III. However, without a major portion of the missing or incomplete facts, the methodology which was to be employed could not be used.

The Data Dictionary is in the form of a matrix. The rows are the names of the data elements grouped by technical area. These are:

- **Process control**: Used for dynamic computer-based simulation.
- **Operations and system support**: Needed for both operational and economic feasibility.
- **Cost data**.
- **Data management**: Needed primarily for operational feasibility but which may raise technical feasibility issues when specified.

The columns of the matrix include:

- **Description**: Specific data elements.
- **Disposition or status**: Used to maintain an audit trail of documents submitted.
- **Quantity specified**: For quantifiable items with their associated uncertainty.
- **Description**: For items that can only be qualitatively specified.
- **Unit of measure**.
- **Derivation method**: How the quantity was derived (e.g., measured, calculated, estimated, other).
- **Date required by JPL**: To meet the August final evaluation due date.
- **Use in the evaluation**.

All data items were delivered by May 7, 1980.

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APPENDIX B

BRIEFING CHARTS
FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY

AIDS III EVALUATION EXECUTIVE SUMMARY

August 29, 1980
STUDY OBJECTIVES

- EVALUATE THE TECHNICAL, OPERATIONAL, AND ECONOMIC FEASIBILITY OF AIDS III
  - THE SUBJECT OF THE AUGUST 1980 REPORT
- PROPOSE, DEVELOP, EVALUATE, AND RANK ALTERNATIVES TO AIDS III
  - THE SUBJECT OF THE MARCH 1981 FINAL REPORT

ESSENTIAL ELEMENTS OF ANALYSIS

GENERAL

- DETERMINE IF THE MAY 1980 AIDS III SYSTEM IS TECHNICALLY, OPERATIONALLY, AND ECONOMICALLY FEASIBLE FOR AUTOMATING THE FBI IDENTIFICATION DIVISION
- DETERMINE IF ALL THREE FEASIBILITY CRITERIA WILL BE SATISFIED SIMULTANEOUSLY

ECONOMIC FEASIBILITY

- DETERMINE IF THE ESTIMATED ANNUAL PERSONNEL COST SAVINGS ARE SUFFICIENT TO JUSTIFY AIDS III IMPLEMENTATION COSTS
ESSENTIAL ELEMENTS OF ANALYSIS (cont)

ECONOMIC FEASIBILITY (cont)

- Determine if the predicted improved performance of AIDS III over the current system justifies the AIDS III implementation costs
- Determine the planned annual expenditures
- Determine which of the uncertainties in the future economic and operational environment have a significant effect on
  - AIDS III cost estimates
  - Cost comparisons between AIDS III and the current system

OPERATIONAL FEASIBILITY

- Determine if the system design meets the functional and performance requirements
- Determine if the required hardware and software are:
  - Available
  - Mutually compatible
  - Adequate
ESSENTIAL ELEMENTS OF ANALYSIS (cont)

TECHNICAL FEASIBILITY

- DETERMINE IF THE TECHNOLOGIES EMPLOYED BY THE SYSTEM ARE
  - COMMERCIAL AVAILABLE
  - UNDER DEVELOPMENT
  - ONLY CONCEPTUALLY DESIGNED

- DETERMINE THE RISKS INVOLVED IN COMMITTING TO THE TECHNICAL APPROACHES SELECTED

- DETERMINE IF THE TECHNOLOGIES EMPLOYED WILL BE OBSOLETE AND
  THUS NO LONGER COST EFFECTIVE BY THE OPERATIONAL DATE

ESSENTIAL ELEMENTS OF THE ANALYSIS (cont)

- ENVIRONMENTAL ANALYSIS

  - DETERMINATION OF POTENTIAL DRIVERS THAT CAN PRODUCE CHANGES IN
    THE WORK LOAD AND ANALYSIS OF THEIR IMPACTS:
    - ECONOMIC AND DEMOGRAPHIC TRENDS
    - TRENDS IN TECHNOLOGY
    - TRENDS IN POLITICAL CONCERNS
    - ANTICIPATED ACTIONS OF OTHER FEDERAL AGENCIES AND STATE AGENCIES
    - ANTICIPATED EVENTS

  - DEVELOPMENT OF SCENARIOS TO CHARACTERIZE THE RELATIONSHIPS OF THE
    DRIVERS AND THE WORK LOAD

  - ESTIMATION OF BOUNDS FOR EACH SCENARIO

  - STUDY OF THE LOCi AND MECHANISMS OF CONTROL IN EXTERNAL FEDERAL
    AND STATE AGENCIES:
    - BY USERS OF IDENTIFICATION DIVISION SERVICE
    - BY "STAKEHOLDERS"

  - ANALYSIS OF THE CLIMATE FOR CHANGE IN EXTERNAL AGENCIES

  - ASSESSMENT OF THE LIKELIHOOD OF CHANGE IN WORKLOAD
FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY
AIDS III EVALUATION EXECUTIVE SUMMARY

• The present system performance is not feasible
  • 50 day response time
  • 30% personnel turnover
  • 60 million a year budget

• AIDS III provides performance and cost benefits if
  • The cost estimates are on target
  • The technical problems are solved
  • The operating margins are improved

• Automating identification vs improving the semi-auto system should be investigated further
  • To find the most cost effective solution
    • Improved manual/AIDS II and/or ATS II as a near term solution
    • AIDS III or other automated system for long term

• Recommend continuing with the second phase of the JPL study

FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY
FEASIBILITY COMPARISON
AIDS III vs CURRENT SYSTEM

TECHNICAL OBSOLESCENCE vs MATURITY

MATURE
COMMERCIALLY AVAILABLE
PROOF OF PRINCIPLE
CURRENT SYSTEM STAFFED AT 3700

ECONOMIC COST PER F/P SEARCH

3.67
$8.26
3 hrs
24 hrs

OPERATIONAL (LOG SCALE)
PROCESSING TIME

35.7 work days
(50 calendar days present response time)
FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY
EXECUTIVE SUMMARY

CONTRACTUAL REQUIREMENT

• PERFORM A TOP DOWN FUNCTIONAL ANALYSIS OF ID (SEE VOLUME VII)

MAJOR FINDINGS

• 49 OF 58 POSSIBLE FUNCTIONS WHICH ARE CANDIDATES FOR AUTOMATION ARE BEING AUTOMATED BY AIDS III
  • e.g., FINGERPRINT CLASSIFICATION, WORK LOAD BALANCING, ...

IMPLICATIONS

• THE POTENTIAL ADVANTAGES OF AUTOMATION MAY NOT BE FULLY REALIZED
• THE SYSTEM MAY NOT BE AS COST EFFECTIVE AS A DIFFERENT APPROACH

RECOMMENDED ACTION

• DEVELOP A TOP-DOWN PLAN AND CRITERIA FOR AUTOMATING AIDS III
• DETERMINE THE PRIORITY AND ORDER IN WHICH FUNCTIONS ARE SELECTED FOR AUTOMATION
• RE-EXAMINE THE PLAN AS TECHNOLOGY EVOLVES AND CHANGES THE ECONOMIC ENVIRONMENT

---

FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY
EXECUTIVE SUMMARY

CONTRACTUAL REQUIREMENT

• DETERMINE FUNCTIONS PERFORMED BY MANUAL, AIDS I, AIDS II,
  (SEE VOLUME V) AND AIDS III (SEE VOLUME IX)

MAJOR FINDINGS

• THERE ARE MISSING AND UNSUBSTANTIATED PERFORMANCE REQUIREMENTS. e.g.
  • I.D. DIVISION GUIDELINE RESPONSE TIME IS NOT BASED ON USER REQUIREMENTS
  • SYSTEM PERFORMANCE IN TERMS OF ALLOWABLE MISS RATE IS NOT SPECIFIED

IMPLICATIONS

• FUNCTIONAL AND PERFORMANCE REQUIREMENTS (SEE VOLUME IX) COULD NOT BE USED PER SE AS OPERATIONAL FEASIBILITY CRITERIA
• SENSITIVITY TESTING WAS EMPLOYED AS AN OPERATIONAL AND ECONOMIC FEASIBILITY METRIC

RECOMMENDED ACTION

• DEVELOP PERFORMANCE REQUIREMENTS BASED ON FEDERAL AND LOCAL GOVERNMENT NEEDS
CONTRACTUAL REQUIREMENT

- PERFORM AN EVALUATION OF THE EXTERNAL, SOCIETAL ENVIRONMENT OF THE ID DIVISION (SEE VOLUME VI)

MAJOR FINDINGS

- THE ENVIRONMENT OF THE IDENTIFICATION DIVISION IS INTRICATE, COMPLEX, AND VARIABLE
- CONTROL MAY BE EXERCISED BY EXTERNAL AGENCIES
- EXTERNAL CONTROLS ARE NOT CONCENTRATED IN ONE CENTER AND THESE CONTROLS ARE NOT USED IN UNISON
- GROUPING OF USERS THAT CATEGORIZE THE ENVIRONMENT COULD NOT BE FOUND
  - e.g., PER CAPITA SUBMISSION TO THE DIVISION DO NOT CORRELATE WITH THE DEGREE OF POPULATION DENSITY OF THE STATES

IMPLICATIONS

- A COMPLETE SURVEY OF THE 50 STATES AND THE FEDERAL GOVERNMENT AGENCIES THAT USE THE IDENTIFICATION DIVISION SERVICE IS REQUIRED

RECOMMENDED ACTION

- ALL 50 STATES SHOULD BE INTERVIEWED OR SURVEYED TO DETERMINE USER REQUIREMENTS AND OTHER ENVIRONMENTAL ISSUES
CONTRACTUAL REQUIREMENT
• MEASURE CURRENT WORK LOAD (AVERAGE AND PEAK) (SEE VOLUME V)

MAJOR FINDINGS
• CURRENT SYSTEM BACKLOGS ARE GROWING
• AVERAGE RESPONSE TIME IS 50 DAYS

IMPLICATIONS
• THE CURRENT SYSTEM, AS PRESENTLY CONFIGURED AND STAFFED, MAY NOT MEET LAW ENFORCEMENT AND APPLICANT REQUIREMENTS

RECOMMENDED ACTION
• A WELL CONCEIVED PLAN IS IMPERATIVE EITHER TO IMPROVE AND/OR AUTOMATE THE SYSTEM
• THE SECOND PHASE OF THE JPL STUDY WILL RECOMMEND IMPROVEMENTS TO THE CURRENT SYSTEM, WHICH MAY ALLEVIATE THE PROBLEM AND INVESTIGATE AUTOMATION STRATEGIES TO IMPROVE THE BENEFITS OBTAINED FROM THE INVESTMENT IN AUTOMATION
CONTRACTUAL REQUIREMENT

- DETERMINE THE TECHNICAL FEASIBILITY OF AIDS III (SEE VOLUME II)

MAJOR FINDINGS

- CURRENT TECHNOLOGY IS SUFFICIENT TO CREATE A TECHNICALLY FEASIBLE VERSION OF AIDS III.
- HOWEVER, THE DESIGN SPECIFIED BY ROCKWELL INTERNATIONAL IS DEFICIENT IN THE AREAS OF PROCESS CONTROL, AUTOMATED IMAGE RETRIEVAL, AND DATA BASE MANAGEMENT.

IMPLICATIONS

- THESE DEFICIENCIES JEOPARDIZE THE OPERATIONAL AND ECONOMIC FEASIBILITY.

RECOMMENDED ACTION

- CORRECT THE DEFICIENCIES IN THE AIDS III DESIGN IN THE AREAS DESCRIBED IN VOLUME II USING A TOP-DOWN, SYSTEM ENGINEERING APPROACH.

CONTRACTUAL REQUIREMENT

- DETERMINE OPERATIONAL FEASIBILITY (SEE VOLUME III)

MAJOR FINDINGS

- JPL NEEDED TO ADD 5 WORK STATIONS TO ROCKWELL'S PROPOSED DESIGN TO ACHIEVE OPERATIONAL FEASIBILITY.
- AIDS III CAN BE MADE FEASIBLE IF ALL THE TECHNICAL DEVELOPMENTS ARE SUCCESSFUL.
- AIDS III IS SENSITIVE TO SUBSYSTEM AVAILABILITY.

IMPLICATIONS

- OPERATIONAL FEASIBILITY IS MARGINAL.
- IF SUBSYSTEM AVAILABILITY FALLS BELOW 93% IN THREE SPECIFIC CASES, THE SYSTEM WILL SATURATE AND QUEUES WILL GROW OR OVERTIME WILL BE REQUIRED TO MAINTAIN RESPONSE TIME.

RECOMMENDED ACTION

- RE-EVALUATE SYSTEM CONFIGURATION AND ARCHITECTURE TO ELIMINATE POTENTIAL PROBLEMS.
- IN THE SECOND PHASE OF THE JPL STUDY, ALTERNATIVE SYSTEMS WILL BE DEVELOPED WHICH WILL SEEK TO CORRECT THESE DEFICIENCIES.
FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY
EXECUTIVE SUMMARY

CONTRACTUAL REQUIREMENT

- EVALUATE TANGIBLE BENEFITS OF AIDS III (SEE VOLUME IV)

MAJOR FINDINGS

- AIDS III MAIL ROOM TO MAIL ROOM RESPONSE TIME WILL BE BETTER THAN THAT OF THE CURRENT SYSTEM
  - 50 DAYS FOR THE PRESENT CONFIGURATION AND STAFFING LEVEL
  - 24 HOURS FOR A CURRENT SYSTEM STAFFED AT THE 3,700 LEVEL
  - 3 HOURS FOR AIDS III (EXCEPT FOR 8-HOUR DELAYS THROUGH THE MANUAL SYSTEM FOR 20% OF THE 1993 WORK LOAD)
- THE COST PER FINGERPRINT (TECHNICAL) SEARCH WILL DROP FROM $7.76 TO $3.67
- THE COST PER TRANSACTION WILL BE $4.35 VICE $5.45
- THE MISS RATE IN FINGERPRINT (TECHNICAL) SEARCH WILL DECREASE FROM 24% TO 5% (REF VOLUME III)

IMPLICATIONS

- SIGNIFICANT TANGIBLE BENEFITS COULD RESULT FROM AUTOMATING THE IDENTIFICATION DIVISION SYSTEM
FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY
INTERRELATIONSHIP OF AIDS III EVALUATION REPORT VOLUMES

MEASURED RESPONSE TIME
(Calendar Days)

<table>
<thead>
<tr>
<th>CRIMINAL IDENT</th>
<th>CRIMINAL NON-IDENT</th>
<th>APPLICANT IDENT</th>
<th>APPLICANT NON-IDENT</th>
<th>AVERAGE OVERALL (WEIGHTED BY VOLUME)</th>
</tr>
</thead>
<tbody>
<tr>
<td>44</td>
<td>32</td>
<td>97</td>
<td>10</td>
<td>50.1*</td>
</tr>
<tr>
<td>49.0</td>
<td>51.8</td>
<td>33.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23.3</td>
<td>6.5</td>
<td>18.3</td>
<td></td>
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DECEMBER 17, 1979

<table>
<thead>
<tr>
<th>SAMPLE SIZE</th>
<th>44</th>
<th>32</th>
<th>97</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVERAGE</td>
<td>49.0</td>
<td>51.8</td>
<td>33.9</td>
<td></td>
</tr>
<tr>
<td>STD. DEV.</td>
<td>23.3</td>
<td>6.5</td>
<td>18.3</td>
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</table>

MAY 7, 1980

<table>
<thead>
<tr>
<th>SAMPLE SIZE</th>
<th>136</th>
<th>200</th>
<th>200</th>
<th>200</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVERAGE</td>
<td>71.9</td>
<td>54.7</td>
<td>63.0</td>
<td>24.6</td>
</tr>
<tr>
<td>STD. DEV.</td>
<td>28.6</td>
<td>12.2</td>
<td>25.3</td>
<td>5.0</td>
</tr>
</tbody>
</table>

*CRIMINAL ONLY **65.2 CRIMINAL ALONE

ORIGINAL PAGE IS OF POOR QUALITY
FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY

EXECUTIVE SUMMARY

I.D. DIVISION GUIDELINES PROJECT WORK LOAD

ID DIV. GUIDELINE: B + 50%

1.7% / YR.

37% INCREASE

BASELINE (B)

29200 COP CARD

7.6 x 10^6 CARDS

DAY

YR.

1986 1993 2004

(End of Life Cycle)

B - 14
AIDS III TECHNICAL FEASIBILITY

AUGUST 1980
# AFRS Aging

<table>
<thead>
<tr>
<th>SUBSYSTEM</th>
<th>AFFECTED COMPONENT</th>
<th>SYMPTOMS OF AGING</th>
<th>SOLUTIONS</th>
<th>OPERATIONAL EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CARD HANDLER</td>
<td>CARD Feeder</td>
<td>Frequent Card Jams with Good Cards</td>
<td>Periodic Vacuuming Adjustment Replacement</td>
<td>Reduced Throughput</td>
</tr>
<tr>
<td>SCANNER</td>
<td>PROGRAMMABLE CRT</td>
<td>INCONSISTENT GEOMETRIC IMAGES</td>
<td>ADJUSTMENT REPLACEMENT</td>
<td>DETERIORATION OF MINUTIAE DATA</td>
</tr>
<tr>
<td>LENS AND OPTICS</td>
<td>LENS DISPLACEMENT</td>
<td>CHANGE IN IMAGE SCALE AND TRUE RESOLUTION</td>
<td>ADJUSTMENT REPLACEMENT</td>
<td>REDUCED MINUTIAE DATA QUALITY</td>
</tr>
<tr>
<td></td>
<td>INTERNAL DUST</td>
<td>POOR CONTRAST IN GREY LEVEL</td>
<td>CLEANING</td>
<td>MISSING MINUTIAE DATA</td>
</tr>
<tr>
<td>SENSING</td>
<td>DARK CURRENT IN PHOTOMULTIPLIER TUBES</td>
<td>POOR IMAGE INTENSITY AND CONTRAST</td>
<td>REPLACEMENT MISSING MINUTIAE DATA</td>
<td></td>
</tr>
</tbody>
</table>

---

## File Protection

- **Magnetic Disk Failures** usually due to head crashes
- Can be caused by small dust particles
- Periodic dumps of disk should be performed
- Record of transactions since last dump should be retained

## Disk Back-up Alternatives

- **Standard Tape Recorders**
  - Designed for bursts of reading and writing
  - Dumping of disk files is continuous
- **Duplicate Disks**
  - Expensive unless removable cartridges are used
  - Cartridges only store about 8 MBYTES of data
- **Streaming Tape Recorders**
  - Designed to record and playback continuous streams of data at high rates
  - Far less expensive than conventional recorders
- **Streaming Cartridges**
  - Advantages of streaming tape recorders
  - Recording medium not directly handled by operator

---

B-16
FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY
AUTOMATED IMAGE RETRIEVAL

- Examined March, 1979 Rockwell report and May 1, 1980 work loads memo 80-007.
- Subsystem design is more concerned with equipment specification than file management.
  - No discussion about file indexing.
- Work station projections are inconsistent.
  - 26 file segments needed for image comparison requiring at least 26 work stations (March 1979).
  - Only 19 work stations shown in May 1, 1980 fold-out.
- Process control.
  - Unpredictable work load distribution at image comparison work stations may cause bottlenecks.
  - Efficiency drops when an inquiry card has candidates at several work stations.
- File security.
  - Protection against natural disasters and internal sabotage is not discussed.
- Photographic media is preferred over magnetic media as the information carrier.

PROPOSED JPL ALTERNATIVE TO MARCH, 1979 ROCKWELL IMAGE RETRIEVAL DESIGN

- Store the information in a sequential, chronological, photographic file indexed by sequence number.
- Procedure is as follows:
  
  STEP 1. Assign PCN to inquiry card.
  STEP 2. Encode each inquiry card.
  STEP 3. Perform candidate search to obtain the sequence numbers of the candidates.
  STEP 4. Create a "request for retrieval" record consisting of the sequence address of the candidate and the PCN of the inquiry.
  STEP 5. Sort the inquiries by sequence number so that the retrieval process is a batch process, minimizing film motion.
  STEP 6. Retrieve a copy of each candidate from the films.
  STEP 7. Print the PCN of the inquiry onto the copies.
  STEP 8. Sort the copies by PCN and merge the inquiries into this batch. (Now for each inquiry card, all the candidates are directly behind it.)
  STEP 9. Distribute the batches to smooth the work load of the examiners.

B-17
• REVIEWED MAY 1, 1980 ROCKWELL PROCESS CONTROL MEMO 80-008J

• CONVEYOR SYSTEM SHOULD BE TROUBLE-FREE

• CARD BUFFER STATION APPEARS UNRELIABLE
  • 36 INCH FREE-FALL MAY RESULT IN CARDS LANDING ON EDGES AND BEING SUBSEQUENTLY BENT
  • REMOVING BOTTOM CARD FROM 3600 CARD STACK MAY CAUSE SMEARING OF THE FINGERPRINTS
  • TASK OF SEPARATING EXACTLY ONE CARD IS OVER-SIMPLIFIED IN ROCKWELL DESIGN

• JPL ALTERNATIVES TO BUFFER DESIGN
  • HOPPER SHAKING TO ALIGN CARDS
  • DLH: EVERY MECHANISMS WITH CONTROLLED DROP ALTITUDE
  • LIFO REMOVAL OF CARDS BY SPRING LOADING THE HOPPER BOTTOM TO KEEP THE STACK AT A CONSTANT LEVEL

FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY
AUTOMATED CARD TRANSPORT

GENERAL OPERATION OF AUTOALLOCATOR

ORIGIONAL PAGE IS OF POOR QUALITY
AIDS III OPERATIONAL FEASIBILITY

August 26, 1980
### FBI Fingerprint Identification Automation Study

#### Operational Feasibility Report Summary

<table>
<thead>
<tr>
<th>Area of Study</th>
<th>Methodology Employed</th>
<th>Observations</th>
<th>Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional and Performance Requirements</td>
<td>Analysis of 10 Guidelines and Related Documents</td>
<td>• The rationale for the performance requirements and constraints has not been established, see Section IV.</td>
<td>Functional and performance requirements could not be used per se as operational feasibility criteria.</td>
</tr>
<tr>
<td>Component Availability</td>
<td>Calculation Based on MTBF and MTR</td>
<td>• Estimated availabilities are between 0.988 and 1.0.</td>
<td>At that level, the availabilities do not affect static or dynamic modeled processing capacity.</td>
</tr>
<tr>
<td>Production Capacity</td>
<td>Static Analysis</td>
<td>• Marginal without single-unit failures; unsatisfactory with single unit failures.</td>
<td>Marginally operational, re-evaluate system configuration and architecture to eliminate potential problems.</td>
</tr>
<tr>
<td>Dynamic Analysis (GPSS)</td>
<td>Card Processing Components</td>
<td>• Concept is incomplete.</td>
<td>Unknown impact on the AIDS III system.</td>
</tr>
<tr>
<td>Transportation between Work Station</td>
<td>Static and Dynamic Analysis</td>
<td>• Meets all response time requirements with five work stations added to four functions.</td>
<td>Marginally operational. If subsystem availability falls below 95% in two cases, the system will saturate and the backlog will grow.</td>
</tr>
</tbody>
</table>

---

**Operational Feasibility Report Summary (contd)**

<table>
<thead>
<tr>
<th>Area of Study</th>
<th>Methodology Employed</th>
<th>Observations</th>
<th>Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Configuration and Architecture</td>
<td>Technical Evaluation</td>
<td>• Hardware configuration and software performance requirements not fully specified.</td>
<td>Functional and performance requirements could not be used per se as operational feasibility criteria (see Volume II).</td>
</tr>
<tr>
<td>Search Performance</td>
<td>Analysis of:</td>
<td>• PERFORMS BETTER THAN THE MANUAL SYSTEM.</td>
<td>THIS APPROACH MAY NOT BE AS COST EFFECTIVE AS A COMMERCIAL GENERAL PURPOSE DBMS AND A HAKENBY ANALYSIS IS REQUIRED.</td>
</tr>
<tr>
<td><em>Fingerprint Technical Data Base Management</em></td>
<td>Automatic Technical Search Pilot System Results</td>
<td>• PERFORMS BETTER THAN THE MANUAL SYSTEM.</td>
<td>Reproduction of the master fingerprint file is required for automatic image retrieval.</td>
</tr>
<tr>
<td>File Conversions</td>
<td>Technical Evaluation</td>
<td>• A SPECIAL PURPOSE DATA BASE MANAGEMENT SYSTEM (DRMSS) IS TO BE DEVELOPED FOR AIDS III.</td>
<td>THIS IS A COMPUTER FILE TO COMPUTER FILE CONVERSION AND SHOULD BE STRAIGHT FORWARD.</td>
</tr>
<tr>
<td>Facilities</td>
<td>Technical Evaluation</td>
<td>• THE HIGH RESOLUTION DIGITAL IMAGES GENERATED BY THE TECHNICAL FILE CONVERSION WERE NOT SAVED.</td>
<td>ADDITIONAL INFORMATION IS REQUIRED FOR ANALYSIS.</td>
</tr>
</tbody>
</table>

---

**Additional Information Required for Analysis:**

- Facilities: Space requirements not consistent between January 1980 and May 1980 system descriptions.
- Safety and Fire Protection Requirements Incomplete.
FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY

FINGERPRINT CARD FLOW

- FINGERPRINT CARD FLOW
- MICROFILM IMAGE FLOW
- IDENTIFICATION DATA FLOW

COMPONENT WITHIN A WORK CELL
PART OF AN EXISTING SYSTEM

DATA SOURCES
- ROCKWELL DOCUMENTS (SEE REFERENCE LIST)
- IRS III SYSTEM CONCEPT
- IRS TECHNICAL HANDBOOKS
- MISCELLANEOUS MEMO'S AND DOCUMENTS
- FBI AIDS III DESIGN GUIDELINES
- INTERVIEWS WITH FBI PERSONNEL
- INTERVIEWS WITH ROCKWELL DESIGN PERSONNEL
- OBSERVATIONS OF SMAR TYPE FUNCTIONS

OPERATIONAL FEASIBILITY EVALUATION METHODOLOGY

DATA SOURCES
- CURRENT TECHNOLOGY EVALUATION SURVEY
- CURRENT SYSTEM EVALUATION SURVEY
- ENVIRONMENTAL EVALUATION SURVEY
- TOP-DOWN FUNCTIONAL ANALYSIS

DATA REQUIRED
- COMPONENT INTERFACES
- CURRENT SYSTEM EXPERIENCE
- DATA FLOW
- DATA TRANSFER RATES
- DOCUMENT FLOW
- MAINTENANCE DATA
- NUMBER OF DRIED
- OPERATIONAL COMPONENT DESCRIPTIONS
- POSSIBLE HANDS IN CRIMINAL VS CIVIL BUTTONS
- POSSIBLE RANGES OF FINGERPRINT CARD VOLUMES
- REQUIRED CAPACITIES
- SERVICE RATES (PRODUCTION)

PERFORMANCE/BENEFITS TO ECONOMIC FEASIBILITY

ALTERNATIVES

OUTPUTS

COMPONENT OPERATIONAL FEASIBILITY SYSTEM OPERATIONAL FEASIBILITY DESIGN AND IMPLEMENTATION STUDIES
- COMPONENT AVAILABILITY
- PRODUCTION CAPACITIES
- COMPONENT
- COMPUTER SUBSYSTEMS
- SYSTEMS SUPERVISOR
- COMPUTER SOFTWARE
- CONFIGURATION AND ARCHITECTURE ASSESSMENT
- SEARCH PERFORMANCE
- SUBJECT SEARCH
- TECHNICAL SEARCH
- AUTOMATED TECHNICAL SEARCH FOOD SYSTEMS

ENVIRONMENTAL EVALUATION FOR TASK

OPERATIONAL FEASIBILITY STUDY REVIEW AND EVALUATION

DATA GATHERING AND DOCUMENTATION REVIEW

DATA REVIEW AND ANALYSIS

DYNAMIC SIMULATION MODELING

STATIC SIMULATION MODELING

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FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY

STATIC CAPABILITY

<table>
<thead>
<tr>
<th>DESCRIPTION (ACRONYM)</th>
<th>% SPARE CAPACITY OF N UNITS AT 100% AVAILABILITY</th>
<th>% SPARE CAPACITY OF N-1 UNITS AT 100% AVAILABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUTOMATIC FINGERPRINT READER SYSTEM (AFRS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 165 CPH (JPL MEASUREMENT)</td>
<td>-20.1</td>
<td>-36.1</td>
</tr>
<tr>
<td>@ 250 CPH (PROPOSED ENHANCEMENT)</td>
<td>21.0</td>
<td>-3.2</td>
</tr>
<tr>
<td>CLASSIFICATION-A (CLASS-A)*</td>
<td>6.7</td>
<td>-6.7</td>
</tr>
<tr>
<td>CLASSIFICATION-B (CLASS-B)*</td>
<td>15.4</td>
<td>-23.1</td>
</tr>
<tr>
<td>CLASSIFICATION CHECK (CLCK)*</td>
<td>53.4</td>
<td>2.2</td>
</tr>
<tr>
<td>DATA ENTRY-A (DENT-A)*</td>
<td>20.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

* WORK CELL COMPONENT REDUCES CAPABILITY OF A WORK CELL BY THE PERCENT NOTED

<table>
<thead>
<tr>
<th>DESCRIPTION (ACRONYM)</th>
<th>% SPARE CAPACITY OF N UNITS AT 100% AVAILABILITY</th>
<th>% SPARE CAPACITY OF N-1 UNITS AT 100% AVAILABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATA ENTRY-B (DENT-B)</td>
<td>3.3</td>
<td>0.8</td>
</tr>
<tr>
<td>FILM PROCESSING/COMPOSER (FLAB)</td>
<td>104.7</td>
<td>2.3</td>
</tr>
<tr>
<td>IMAGE CAPTURE MICROFILM (MFILM)</td>
<td>18.5</td>
<td>-1.2</td>
</tr>
<tr>
<td>IMAGE COMPARISON IDENT. (ICI)</td>
<td>10.9</td>
<td>5.1</td>
</tr>
<tr>
<td>IMAGE COMPARISON VERIFY (ICV)</td>
<td>15.7</td>
<td>6.8</td>
</tr>
<tr>
<td>PROCESS CONTROL NUMBER APPL. (PCN)</td>
<td>63.3</td>
<td>-18.3</td>
</tr>
<tr>
<td>ON LINE INQUIRY (QUERY)</td>
<td>40.6</td>
<td>-100.0</td>
</tr>
<tr>
<td>SEARCH REVIEW (SEAR)</td>
<td>14.1</td>
<td>6.5</td>
</tr>
<tr>
<td>SEMI-AUTOMATIC F/P READER (SAR)</td>
<td>16.7</td>
<td>0.0</td>
</tr>
<tr>
<td>VERIFY DATA ENTRY-A (VDENT-A)*</td>
<td>20.0</td>
<td>0.0</td>
</tr>
<tr>
<td>VERIFY DATA ENTRY-B (VDENT-B)</td>
<td>3.3</td>
<td>0.8</td>
</tr>
<tr>
<td>WAND OUT OF SYSTEM (WAND)</td>
<td>55.0</td>
<td>24.0</td>
</tr>
<tr>
<td>WORK CELL</td>
<td>0.0</td>
<td>-6.5</td>
</tr>
</tbody>
</table>
**FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY**

**DATA BASE MANAGEMENT SYSTEMS**

JPL recommends a make/buy analysis of a commercially available general purpose data base management system (DBMS) for the following reasons:

- AIDS III file structures are compatible with a general purpose DBMS
- There are cost savings in implementation and maintenance
  - Automatic file access control and data security
  - Automatic audit trail and backup
- Upgrades have a minimum impact
  - Operating system
  - CPU
  - Disks
  - Data element revisions and additions
- DBMS parameters can be adjusted to meet specific needs
- Query languages are available

---

**AUTOMATED SUBJECT SEARCH BASIS OF EVALUATION**

<table>
<thead>
<tr>
<th>MANUAL NAME SEARCH</th>
<th>AIDS II AUTOMATED NAME SEARCH</th>
<th>AIDS III AUTOMATED NAME SEARCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>• NAME AND SEX</td>
<td>• SELECTED PERSONAL AND PHYSICAL DESCRIPTION</td>
<td></td>
</tr>
<tr>
<td>• MANUAL FILE UPDATE</td>
<td>• FBI NUMBER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• SOCIAL SECURITY NO.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• ORIGINATING AGENCY ID. NUMBER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• NAME</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• FINGERPRINT CLASSIFICATION</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• DATE OF BIRTH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• PLACE OF BIRTH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• RACE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• SEX</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• SPECIFICATIONS BASED UPON AIDS II</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• NO CHANGES IN DATA ELEMENTS USED</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• NO CHANGES TO SCREEN FORMATS AND IDENTIFICATION RESPONSES</td>
<td></td>
</tr>
</tbody>
</table>

B-24
### FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY

#### AUTOMATED SEARCHES VS MANUAL SYSTEM TEST RESULTS

<table>
<thead>
<tr>
<th>Type of Search</th>
<th>Date of Report</th>
<th>Searches Poss. No. of Idents</th>
<th>Misses in Manual Found in Automated System</th>
<th>Misses in Automated Found in Manual System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criminal Name (Subject)</td>
<td>01/25/80</td>
<td>236</td>
<td>1262*</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>9.51%</td>
<td>0.051</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Misses %</td>
<td>Rate per Search</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>28</td>
<td>2.22</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Misses %</td>
<td>Rate per Search</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.012</td>
<td></td>
</tr>
<tr>
<td>Civil Name (Subject)</td>
<td>01/25/80</td>
<td>296</td>
<td>296*</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8.78%</td>
<td>0.088</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Misses %</td>
<td>Rate per Search</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>1.69</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Misses %</td>
<td>Rate per Search</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.017</td>
<td></td>
</tr>
</tbody>
</table>

*Based on tech search, there were 136 misses for criminal and 10 for civil by both manual and automated name search.

---

### FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY

#### ESTIMATED OPERATIONAL COMPONENT/SUBSYSTEM DATA TRANSFER REQUIREMENTS SUMMARY

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Number of Messages/Hour</th>
<th>Number of Bytes Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Entry and Display</td>
<td>23.3K</td>
<td>1,354K</td>
</tr>
<tr>
<td>Image Retrieval</td>
<td>7.3K</td>
<td>185K</td>
</tr>
<tr>
<td>PCN and Image Capture</td>
<td>6.1K</td>
<td>37K</td>
</tr>
<tr>
<td>Subject Search and Response Generation</td>
<td>21.5K</td>
<td>783K</td>
</tr>
<tr>
<td>System Supervisor</td>
<td>61.2K</td>
<td>2,055K</td>
</tr>
<tr>
<td>Technical Search</td>
<td>8.3K</td>
<td>2,614K</td>
</tr>
</tbody>
</table>
## FBI Fingerprint Identification Automation Study
### AIDS III Performance
#### Enhanced Number of Servers

<table>
<thead>
<tr>
<th>Fraction of Prints</th>
<th>Process Time Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.999</td>
<td>3.8 hours</td>
</tr>
<tr>
<td>0.990</td>
<td>3.0 hours</td>
</tr>
<tr>
<td>0.950</td>
<td>2.9 hours</td>
</tr>
</tbody>
</table>

## FBI Fingerprint Identification Automation Study
### Comparison of AIDS III Design and Minimum Enhancement for Successful Simulation

<table>
<thead>
<tr>
<th>Abbreviation or Acronym</th>
<th>Description</th>
<th>AIDS III Design</th>
<th>Minimum Feasible Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFRS</td>
<td>Automatic Fingerprint Reader System</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>AUTOCOR</td>
<td>Automated Correspondence</td>
<td>22</td>
<td>24</td>
</tr>
<tr>
<td>CSORT</td>
<td>Centerline Sort</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>ICI</td>
<td>Image Comparison Identification</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>ICV</td>
<td>Image Comparison Verification</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>MFILM</td>
<td>Image Capture Microfilm</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>PCN</td>
<td>Process Control Number Application-Cards</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>QC</td>
<td>Quality Control Check</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>SAR</td>
<td>Semi-Automatic Fingerprint Reader</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>SEAR</td>
<td>Search Review</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>WAND</td>
<td>Wand Out of System</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>WORK CELL</td>
<td>Work Cell</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

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FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY

CONCLUSIONS

• AIDS III can be made feasible if all the technical developments are successful
  • Sensitive to subsystem availability
  • With a subsystem availability of less than 95% (for 2 cases) the system will saturate and the backlog will grow

• The real-time process control is unnecessarily complicated

• The subsystems are highly interdependent, defeating the principles of a "loosely coupled architecture"

• A commercially available general purpose data base management system can handle the AIDS III requirements
  • No special file requirements
  • Files are independent

• The special classifier terminals are not cost effective
  • Nonstandard
  • Requires an additional step in the classification process
  • Requires operator to have both classification and data entry skills

FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY

JPL RECOMMENDATIONS TO THE FBI

• Reevaluate system configuration and architecture to eliminate potential problems

• Simplify process control concept
  • Do not use real-time simulation in AIDS III for monitoring and controlling work flow

• Review choice of the hardware configuration

• Review data base management system (DBMS) usage

• Review development of the special classifier terminals

• Develop a series of prototypes to aid in these decisions
  • Search review (SEAR) consoles development
  • Image comparison terminals development
  • DBMS usage
AIDS III

SIMULATION MODEL

August 27, 1980
### FBI FINGERPRINT IDENTIFICATION
### AUTOMATION STUDY
### AIDS III SENSITIVITY TO EQUIPMENT AVAILABILITY
### (ESTIMATED)

<table>
<thead>
<tr>
<th>WORK STATION</th>
<th>AVAILABILITY USED FOR SIMULATION</th>
<th>ESTIMATED MINIMUM AVAILABILITY*</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCN</td>
<td>0.9906</td>
<td>0.6102</td>
</tr>
<tr>
<td>MFILM</td>
<td>0.9996</td>
<td>0.8152</td>
</tr>
<tr>
<td>WAND</td>
<td>0.9986</td>
<td>0.6608</td>
</tr>
<tr>
<td>WORK CELL</td>
<td>1.0000</td>
<td>0.9356</td>
</tr>
<tr>
<td>AFRS</td>
<td>0.9882</td>
<td>0.8607</td>
</tr>
<tr>
<td>SAR</td>
<td>1.0000</td>
<td>0.7874</td>
</tr>
<tr>
<td>SEAR</td>
<td>0.9997</td>
<td>0.9136</td>
</tr>
<tr>
<td>ICI</td>
<td>0.9972</td>
<td>0.9425</td>
</tr>
<tr>
<td>ICV</td>
<td>0.9972</td>
<td>0.9058</td>
</tr>
<tr>
<td>AUTOCOR</td>
<td>1.0000</td>
<td>0.9541</td>
</tr>
</tbody>
</table>

*At the indicated availability rates, utilization would reach 1.0.

### FBI FINGERPRINT IDENTIFICATION
### AUTOMATION STUDY
### SIMULATION DECISIONS

- **WORK CELL SIMPLIFICATION**
  - WORK CELL MODELED IN DETAIL
  - BLACK BOX REPRESENTATION IN AIDS III MODEL NECESSARY BECAUSE OF GPSS LIMITATIONS

- **BATCH SIZE**
  - 25 SELECTED AS BEST SIZE
  - RESPONSE TIME SCALED FOR BATCH SIZE

- **WORK SHIFTS**
  - SERVICE TIMES DOUBLED FOR SECOND SHIFT TO REPRESENT HALF STAFFING

- **MICROFILM PROCESSING DELAY**
  - NO TRANSACTIONS ENTERED IMAGE COMPARISON FUNCTION UNTIL IT HAD ACCUMULATED 159.7 min (9582 sec)

- **TRANSPORTATION TIME**
  - MOST OUTPUT GOES DIRECTLY TO A BELT MOVING AT 100 ft/min, TRANSPORTATION TIMES ARE NEGLIGIBLE

- **OUTPUT HOPPER TIME (AVERAGE)**
  - PCN - 10 min
  - CSORT - 5 min
**FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY**

**COMPARISON OF WORK CELL SIMPLIFICATION METHODS**

<table>
<thead>
<tr>
<th>No. OF WORK STATIONS</th>
<th>No. SERVERS PER WORK STATION</th>
<th>SERVICE TIME PER WORK STATION</th>
<th>INPUT/OUTPUT RATE</th>
<th>AVERAGE TOTAL THROUGHPUT TIME</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1</td>
<td>55 sec</td>
<td>60/hr</td>
<td>1521 sec</td>
<td>ORIGINAL SYSTEM FULLY MODELLED</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>165 sec</td>
<td>21/hr</td>
<td>2570 sec</td>
<td>MAXIMUM INPUT/OUTPUT GREATLY REDUCED TOTAL AVERAGE THROUGHPUT TIME GREATLY INCREASED AVERAGE QUEUE LENGTH MUCH LONGER</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>165 sec</td>
<td>60/hr</td>
<td>610 sec</td>
<td>TOTAL AVERAGE THROUGHPUT TIME GREATLY REDUCED AVERAGE QUEUE LENGTH INCORRECT</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>55 sec</td>
<td>60/hr</td>
<td>411 sec</td>
<td>TOTAL AVERAGE THROUGHPUT TIME GREATLY REDUCED AVERAGE QUEUE LENGTH CORRECT</td>
</tr>
</tbody>
</table>

* AVERAGE THROUGHPUT ADJUSTED EXTERNALLY TO THE MODEL

---

**FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY**

**AVERAGE WAIT TIMES**

(IN UNITS OF AVERAGE SERVICE TIMES)

<table>
<thead>
<tr>
<th>p</th>
<th>NUMBER OF SERVERS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td>0.4</td>
<td>0.02</td>
</tr>
<tr>
<td>0.5</td>
<td>0.05</td>
</tr>
<tr>
<td>0.6</td>
<td>0.12</td>
</tr>
<tr>
<td>0.7</td>
<td>0.25</td>
</tr>
<tr>
<td>0.8</td>
<td>0.55</td>
</tr>
<tr>
<td>0.9</td>
<td>0.76</td>
</tr>
<tr>
<td>0.95</td>
<td>3.5</td>
</tr>
<tr>
<td>0.98</td>
<td>9.5</td>
</tr>
</tbody>
</table>

B-30
AVERAGE WAIT TIME - MULTI-SERVER QUEUE

AVERAGE WAIT TIME = \( \frac{B}{M} x \frac{T_S}{1 - \rho} \)

- **M** = NUMBER OF SERVERS
- **T_S** = MEAN SERVICE TIME
- **B** = PROBABILITY THAT ALL SERVERS ARE BUSY
- **\( \rho \)** = UTILIZATION = \( \frac{INPUT \ VOLUME \times T_S}{M} \)

ASSUMPTIONS:
1. POISSON ARRIVAL PATTERN
2. EXPONENTIAL SERVICE TIMES
3. ALL SERVERS EQUALLY LOADED
4. FIRST-IN, FIRST-OUT SERVICING
5. NO ITEMS LEAVE THE QUEUE EXCEPT TO BE PROCESSED
FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY

ECONOMIC FEASIBILITY

August 26, 1980
IS AIDS III ECONOMICALLY FEASIBLE?

- EVALUATE COST AND BENEFIT MEASURES FOR AID III
  TIME FRAME 1980 - 2004
- COMPARE WITH THE SAME MEASURES EVALUATED FOR
  THE CURRENT SYSTEM
- TEST SENSITIVITY OF THE COST AND BENEFIT MEASURES
  TO CHANGES IN
  - WORK LOAD VOLUME AND MIX
  - IMPLEMENTATION SCHEDULE

FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY
ECONOMIC FEASIBILITY

<table>
<thead>
<tr>
<th>COSTS</th>
<th>BENEFITS</th>
<th>COST/BENEFIT RATIOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIFE CYCLE COST</td>
<td>RESPONSE TIME</td>
<td>COST PER TRANSACTION</td>
</tr>
<tr>
<td>IMPLEMENTATION COST</td>
<td>ACCURACY</td>
<td>COST PER F/P (TECH) SEARCH</td>
</tr>
<tr>
<td>ANNUAL COSTS</td>
<td>SATURATION VOLUME</td>
<td>COST PER NAME (SUBJECT) SEARCH</td>
</tr>
<tr>
<td>IMPLEMENTATION</td>
<td>NUMBER OF EMPLOYEES</td>
<td></td>
</tr>
<tr>
<td>LABOR</td>
<td>EMPLOYEE SKILL MIX</td>
<td></td>
</tr>
<tr>
<td>OPERATING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAYBACK PERIOD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CUMULATIVE COST</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY
ECONOMIC FEASIBILITY

SOURCES OF DATA

- AIDS III COSTS
  - ROCKWELL DOCUMENTATION
  - DISCUSSIONS WITH FBI IDENT DIVISION

- CURRENT SYSTEM COSTS
  - FBI IDENT DIVISION SUMMARY COST DATA AND BUDGETS
  - CURRENT SYSTEM EVALUATION REPORT, VOLUME V (JPL)

- SYSTEM PERFORMANCE (AIDS III, CURRENT)
  - IDENTIFICATION DIVISION DESIGN GUIDELINES (FBI)
  - SYSTEM SIMULATION (JPL)
  - SYSTEM ANALYSIS (JPL)

BASE CASES

BASE CASE FOR AIDS III
- WORK CELL DESIGN CONCEPT (MAY 1980)
- IMPLEMENTATION PLAN
  AIDS III READY 1987
  AUTO. IMAGE RETRIEVAL READY 1990
- IMPROVED AFRS THROUGHPUT
- INCLUDES RESIDUAL MANUAL, AUTOMATION AND RESEARCH,
  LATENT SECTION, AND FRONT OFFICE

BASE CASE FOR CURRENT SYSTEM
- MANUAL SYSTEM WITH AIDS III
- 3450 EMPLOYEES IN 1986
- NUMBER OF EMPLOYEES NEEDED TO OPERATE AIDS II
  PORTION OF CURRENT SYSTEM IS DERIVED FROM THE
  AIDS III DESIGN

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**FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY**

**ECONOMIC FEASIBILITY MEASURES**

**BASE CASE: DESIGN WORK LOAD 1986-2004**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AIDS III</td>
<td>$553.6M</td>
<td>$50.6M</td>
<td>$46.9M</td>
<td>2398</td>
<td>$1296M</td>
</tr>
<tr>
<td>CURRENT SYSTEM</td>
<td>$573.5M</td>
<td>0*</td>
<td>$58.8M</td>
<td>3389</td>
<td>$1456M</td>
</tr>
<tr>
<td>CURRENT SYSTEM WITH EXPANDED COMPLIMENT</td>
<td>$595.7M</td>
<td>0*</td>
<td>$60.7M</td>
<td>3528 (1993) 3600 (1986)</td>
<td>$1507M</td>
</tr>
</tbody>
</table>

*ADDITIONAL CAPITAL EQUIPMENT MAY BE NEEDED TO MAINTAIN AND EXPAND AIDS II THROUGH 2004.

PAYBACK YEAR FOR AIDS III IS 1992

---

**FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY**

**ANNUAL COSTS**

**BASE CASE SCENARIO**

![Graph showing annual costs](image)
NUMBER OF EMPLOYEES
BASE CASE

1993 AVERAGE SALARY AIDS III $16400
1993 AVERAGE SALARY CURRENT SYSTEM $15300

CURRENT SYSTEM

SAVE 900 - 1000 EMPLOYEES

AIDS III

NO. OF EMPLOYEES

1980 1990 2000

FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY

VARIATION OF AIDS III UNDISCOUNTED
PAYBACK PERIOD WITH IMPLEMENTATION
COST AND PERSONNEL REDUCTIONS

P: PAYBACK PERIOD
(YEARS)

AIDS III IMPLEMENTATION COSTS

PERSONNEL REDUCTIONS - 1993

$100M

$50M

±25%

±50%

UNCERTAINTY REGIONS

±25%

±50%

P = ∞  P = 20  P = 9  P = 7  P = 5

P = 4  P = 3

n = 36

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FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY

VARIATION OF AIDS III LIFE CYCLE COST WITH IMPLEMENTATION COST AND PERSONNEL REDUCTION

* The Life Cycle Cost of the Current System is estimated to be $573.5M

COMPARISON OF PERFORMANCE BENEFITS FOR AIDS III AND CURRENT SYSTEM 1993 DESIGN WORK LOAD

<table>
<thead>
<tr>
<th>MAIL ROOM TO MAIL ROOM RESPONSE TIME (95TH PERCENTILE) WORKING HOURS</th>
<th>FINGERPRINT (TECH) SEARCH ACCURACY</th>
<th>SATURATION VOLUME</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIDS III</td>
<td>3 HOURS(^1)</td>
<td>MISS RATE 5%</td>
</tr>
<tr>
<td>CURRENT SYSTEM - 1993 (3500 - 3700 EMPLOYEES)</td>
<td>24 HOURS</td>
<td>MISS RATE 24%</td>
</tr>
</tbody>
</table>

1. IN 1993 20% OF THE CARDS NEED A MANUAL NAME SEARCH. THIS WILL ADD 8 - 16 HOURS TO THE RESPONSE TIME FOR THESE CARDS.
2. THE NUMBER OF EMPLOYEES NEEDED TO OPERATE CURRENT SYSTEM - 1993 TO ACHIEVE A 24 HOUR RESPONSE TIME DEPENDS ON SUBSYSTEM UTILIZATIONS DESIRED. STAFFING RESULT IN UTILIZATIONS BETWEEN 0.90 (FOR 3700 EMPLOYEES) TO 1.0 (FOR 3500).
### FBI Fingerprint Identification Automation Study

#### Cost/Benefit Ratios

<table>
<thead>
<tr>
<th></th>
<th>1993 Cost per Transaction (Docs + Cards)</th>
<th>1993 Cost per Name (Subject) Search</th>
<th>1993 Cost per Fingerprint (Tech) Search</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIDS III</td>
<td>$4.35</td>
<td>$1.13</td>
<td>$3.67</td>
</tr>
<tr>
<td>CURRENT SYSTEM</td>
<td>$5.45</td>
<td>$1.13</td>
<td>$7.76</td>
</tr>
<tr>
<td>CURRENT SYSTEM (Expanding Compliment)</td>
<td>$5.63</td>
<td>$1.16</td>
<td>$8.26</td>
</tr>
</tbody>
</table>

#### Required Staffing and Response Times (95th Percentile) for AIDS III and Current Systems

<table>
<thead>
<tr>
<th>Projected Work Loads</th>
<th>System Size</th>
<th>Daily FP Cards*</th>
<th>Year</th>
<th>AIDS III Empl</th>
<th>Response Time</th>
<th>CURRENT Empl</th>
<th>Response Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASE CASE</td>
<td>ENHANCED</td>
<td>~27,600</td>
<td>1993</td>
<td>2388</td>
<td>2.9</td>
<td>3748</td>
<td>24.8</td>
</tr>
<tr>
<td>CONSTANT GROWTH</td>
<td>ENHANCED</td>
<td>~31,000</td>
<td>1993</td>
<td>2650</td>
<td>2.8</td>
<td>4174</td>
<td>24.8</td>
</tr>
<tr>
<td>MIXED GROWTH</td>
<td>ENHANCED</td>
<td>~35,000</td>
<td>1993</td>
<td>3085</td>
<td>3.0</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>ENHANCED</td>
<td>~42,000</td>
<td>2004</td>
<td></td>
<td>3563</td>
<td>3.2</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>III IMPLEMENTED</td>
<td>ENHANCED</td>
<td>~29,000</td>
<td>1993</td>
<td>2584</td>
<td>3.1</td>
<td>3748</td>
<td>**</td>
</tr>
<tr>
<td>0.8 BASE WORK LOAD</td>
<td>BASE CASE</td>
<td>~22,100</td>
<td>1993</td>
<td>2388</td>
<td>2.8</td>
<td>3748</td>
<td>24.6</td>
</tr>
<tr>
<td>1.2 BASE WORK LOAD</td>
<td>BASE CASE</td>
<td>~33,100</td>
<td>1993</td>
<td>2388</td>
<td>**</td>
<td>3748</td>
<td>**</td>
</tr>
<tr>
<td>0.8 BASE WORK LOAD</td>
<td>RESCALED</td>
<td>~22,100</td>
<td>1993</td>
<td>2051</td>
<td>2.9</td>
<td>3180</td>
<td>24.9</td>
</tr>
<tr>
<td>1.2 BASE WORK LOAD</td>
<td>RESCALED</td>
<td>~33,100</td>
<td>1993</td>
<td>2797</td>
<td>2.9</td>
<td>4464</td>
<td>24.9</td>
</tr>
</tbody>
</table>

*Does not include resident alien cards

**System overloaded and unstable

***Results in preparation
# FBI Fingerprint Identification Automation Study

## Sensitivity to Changes in Implementation Schedule

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Early Schedule</strong></td>
<td>1985</td>
<td>1985</td>
<td>$547.2M</td>
<td>1989</td>
</tr>
<tr>
<td><strong>Late Schedule</strong></td>
<td>1989</td>
<td>1992</td>
<td>$564.9M</td>
<td>1993</td>
</tr>
</tbody>
</table>

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COST DATA ANALYSIS

August 27, 1980
FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY
AIDS III — CURRENT SYSTEM: COST ANALYSIS MODEL

READ INPUT
CALCULATE ANNUAL LABOR COUNTS
CALCULATE ANNUAL LABOR COST
CALCULATE ANNUAL OPERATING COST
CALCULATE TOTAL ANNUAL COST
CALCULATE CUMULATIVE ANNUAL COST
CALCULATE ANNUAL DIFFERENCES
CALCULATE LIFE CYCLE COST
CALCULATE VARIOUS RATIOS
WRITE OUT RESULTS

FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY
CALCULATE ANNUAL LABOR COUNTS
BASE CASE ASSUMPTIONS

<table>
<thead>
<tr>
<th>INITIAL 1980 LABOR COUNTS</th>
<th>FRONT OFFICE LATENT PRINTS AUTOMATION AND RESEARCH</th>
<th>FINGERPRINT SEARCH MANUAL AND AUTOMATED</th>
<th>NAME SEARCH AND RESPONSE GENERATION MANUAL AND AUTOMATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPLICANT PORTION</td>
<td>AVERAGE</td>
<td>67%</td>
<td>35%</td>
</tr>
<tr>
<td>CRIMINAL PORTION</td>
<td></td>
<td>33%</td>
<td>65%</td>
</tr>
</tbody>
</table>

APPLICANT ESCALATION RATES
1.7% THROUGH 1986
0.0% 1987 - 2004

CRIMINAL ESCALATION RATES
1.7% THROUGH 1986
0.0% 1987 - 2004

AUTOMATION INDICES (WEIGHTED AVERAGES) ARE USED TO DETERMINE MANUAL TO AUTOMATED MIX

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FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY

AUTOMATION INDICES

FINGERPRINT (TECH) SEARCH

SUBJECT SEARCH

RESPONSE GENERATION

% OF FUNCTION PROCESSED BY AUTOMATED SYSTEM

YEAR


FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY

CALCULATE ANNUAL LABOR COST

- FRONT OFFICE LABOR COUNT \( \times \) $14,934
- LATENT PRINTS LABOR COUNT \( \times \) $24,519
- AUTOMATION AND RESEARCH LABOR COUNT \( \times \) $19,746
- FINGERPRINT (TECHNICAL) SEARCH, NAME SEARCH, AND RESPONSE GENERATION LABOR COUNTS
  - MANUAL PORTION \( \times' \) $13,903
  - AUTOMATED PORTION \( \times \) $15,969
FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY
ANNUAL OPERATING COSTS BASE CASE

ANNUAL OPERATING COSTS (MILLIONS OF 1980 DOLLARS)


YEAR

AIDS III
CURRENT SYSTEM

FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY BASE CASE

ANNUAL IMPLEMENTATION COSTS (MILLIONS OF 1980 DOLLARS)


YEAR

TOTAL: $53.84 MILLION

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FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY
ANNUAL LABOR COSTS
BASE CASE

ANNUAL LABOR COSTS
(MILLIONS OF 1980 DOLLARS)

CURRENT SYSTEM

AIDS III

YEAR


FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY
ANNUAL LABOR COST SAVINGS
WITH AIDS III IMPLEMENTATION
BASE CASE

ANNUAL SAVINGS
(MILLIONS OF 1980 DOLLARS)

YEAR

### FBI Fingerprint Identification Automation Study

#### Total Cumulative Costs
**Base Case**
- AIDS III Total: \$1295.92 Million
- Current Total: \$1456.10 Million

#### Workload Projection

<table>
<thead>
<tr>
<th>Workload Projection</th>
<th>Base Case Scenario</th>
<th>1.7% Constant Growth Scenario</th>
<th>Mixed Growth Rates Scenario #1</th>
<th>Interstate Identification Index (III) Scenario #2 &amp; #5</th>
<th>Automation of FBI Identification Scenario #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIDS III</td>
<td>553.6</td>
<td>579.0</td>
<td>621.3</td>
<td>566.9</td>
<td>566.7</td>
</tr>
<tr>
<td>Current System</td>
<td>573.5</td>
<td>605.2</td>
<td>658.5</td>
<td>592.2</td>
<td>593.5</td>
</tr>
</tbody>
</table>
FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY

COST AND BENEFIT MEASURES
FOR FINGERPRINT
IDENTIFICATION SYSTEMS

August 27, 1980
FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY
ECONOMIC FEASIBILITY

- PRESENTATION OF COST AND BENEFIT MEASURES
  - METHODOLOGY
  - RESULTS
    - VARIATION OVER TIME
    - VARIATION WITH WORK LOAD
    - SELECTED COST/BENEFIT RATIOS
    - DIFFERENCES IN MEASURES BETWEEN THE CURRENT AND AIDS III SYSTEMS

FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY
METHODOLOGY FOR COST
AND BENEFIT MEASURES

COST AND EMPLOYMENT MODEL
AUTOMATED TECHNICAL SEARCH PILOT SYSTEM STUDY
CURRENT SYSTEM SIMULATION
AIDS III SIMULATION

COSTS AND EMPLOYEES
ACCURACY
RESPONSE TIMES
RESPONSE TIMES

COST AND BENEFIT ANALYSIS
COSTS AND BENEFITS
FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY

INDIVIDUAL MEASURES - COSTS

- LIFE CYCLE COST
- ANNUAL OPERATING COST
- ANNUAL IMPLEMENTATION COST
- ANNUAL LABOR COST
- TOTAL ANNUAL COST
- TOTAL IMPLEMENTATION COST
- CUMULATIVE COST

FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY

INDIVIDUAL MEASURES - PERFORMANCE AND EMPLOYMENT

- PERFORMANCE
  - ACCURACY
  - RESPONSE TIME
  - SATURATION VOLUME

- EMPLOYMENT
  - NUMBER OF EMPLOYEES
  - SKILL MIX

B-48
### FBI Fingerprint Identification Automation Study

**Accuracy Comparison Based on Automated Technical Search Pilot System Study for Base Case Work Load**

<table>
<thead>
<tr>
<th></th>
<th>Current</th>
<th>AIDS III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Applicant Criminal</td>
<td>Applicant Criminal</td>
</tr>
<tr>
<td>Comparative Find Rates</td>
<td>60% 81%</td>
<td>96% 94%</td>
</tr>
<tr>
<td>FP Card Daily Volume</td>
<td>11,600 13,800</td>
<td>11,600 13,800</td>
</tr>
<tr>
<td>Number of Fingerprint (Technical) Searches</td>
<td>8,350 3,725</td>
<td>8,350 3,725</td>
</tr>
<tr>
<td>Number in File (Approx)</td>
<td>200 500</td>
<td>200 500</td>
</tr>
<tr>
<td>Number Found</td>
<td>120 405</td>
<td>192 470</td>
</tr>
</tbody>
</table>

### FBI Fingerprint Identification Automation Study

**Required Staffing and Response Times (95th Percentile) for AIDS III and Current Systems**

<table>
<thead>
<tr>
<th>Projected Work Loads</th>
<th>System Size</th>
<th>Daily FP Cards*</th>
<th>Year</th>
<th>AIDS III</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EMPL RESP TIME</td>
<td>EMPL RESP TIME</td>
</tr>
<tr>
<td>Base Case</td>
<td>Enhanced</td>
<td>-27,000</td>
<td>1993</td>
<td>2388 2.9</td>
<td>3748 24.8</td>
</tr>
<tr>
<td>Constant Growth</td>
<td>Enhanced</td>
<td>-31,000</td>
<td>1993</td>
<td>2650 2.8</td>
<td>4174 24.8</td>
</tr>
<tr>
<td>Mixed Growth</td>
<td>Enhanced</td>
<td>-37,300</td>
<td>2004</td>
<td>3163 2.9</td>
<td>5009 24.9</td>
</tr>
<tr>
<td></td>
<td>Enhanced</td>
<td>-35,000</td>
<td>1993</td>
<td>3085 3.0</td>
<td>***</td>
</tr>
<tr>
<td>III Implemented</td>
<td>Enhanced</td>
<td>-37,300</td>
<td>1993</td>
<td>3163 3.2</td>
<td>***</td>
</tr>
<tr>
<td>0.8 Base Work Load</td>
<td>Base Case</td>
<td>-22,100</td>
<td>1993</td>
<td>2388 2.8</td>
<td>3748 24.6</td>
</tr>
<tr>
<td>1.2 Base Work Load</td>
<td>Base Case</td>
<td>-33,100</td>
<td>1993</td>
<td>2388 2.8</td>
<td>3748 24.6</td>
</tr>
<tr>
<td>0.8 Base Work Load</td>
<td>Rescaled</td>
<td>-22,100</td>
<td>1993</td>
<td>2388 2.8</td>
<td>3748 24.6</td>
</tr>
<tr>
<td>1.2 Base Work Load</td>
<td>Rescaled</td>
<td>-33,100</td>
<td>1993</td>
<td>2797 2.9</td>
<td>4464 24.9</td>
</tr>
</tbody>
</table>

* Does not include resident alien cards

** System overloaded and unstable

*** Results in preparation
FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY
DELAY TIME IN WORK CELL VS
WORK LOAD ARRIVALS AT RATE
AIDS III SYSTEM DESIGN

SATURATION
8% OVERLOAD
70 min
DESIGN
24 min
5% UNDERLOAD
21 min

CARDS PER HOUR
(ARRIVALS AT WORKCELL)

FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY
NUMBER OF EMPLOYEES REQUIRED FOR AIDS III AND
CURRENT SYSTEMS WITH BASE CASE SCENARIO

NUMBER OF EMPLOYEES REQUIRED FOR AIDS III AND
CURRENT SYSTEMS WITH BASE CASE SCENARIO

YEAR

B-50
VARIATION OF COSTS WITH WORK LOAD ASSUMING
RESPONSE TIME HELD ABOUT THE SAME

<table>
<thead>
<tr>
<th>WORK LOAD (% OF BASE CASE)</th>
<th>TOTAL ANNUAL COST (IN MILLIONS OF 1980 DOLLARS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CURRENT</td>
</tr>
<tr>
<td>80%</td>
<td>55.2</td>
</tr>
<tr>
<td>100%</td>
<td>65.0</td>
</tr>
<tr>
<td>120%</td>
<td>77.5</td>
</tr>
</tbody>
</table>

- CURRENT SYSTEM
- AIDS III

- SYSTEM RESCALED
- WORK LOADS VARIED: ±20% FROM DESIGN WORK LOAD

SELECTED COST/BENEFIT RATIOS

- TOTAL ANNUAL COST PER NUMBER OF TRANSACTIONS PER YEAR
  (TOTAL ANNUAL COST PER TRANSACTION)
- COST OF TECH. SEARCH PER NUMBER OF TECH. SEARCHES PER YEAR
  (COST PER TECH. SEARCH)
- COST OF SUBJECT SEARCH PER NUMBER OF SUBJECT SEARCHES PER YEAR
  (COST PER SUBJECT SEARCH)
- CUMULATIVE COST PER CUMULATIVE NUMBER OF TRANSACTIONS
  (CUMULATIVE COST PER TRANSACTION)
FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY

TOTAL ANNUAL COST PER TRANSACTION OVER TIME WITH BASE CASE OF 1.7% GROWTH TO 1986, ZERO AFTERWARD

$6.40
$4.80
$3.20
$1.60


YEAR

$5.47 CURRENT SYSTEM
$4.33 AIDS III

FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY

COST PER F/P (TECH) SEARCH 1980-2004 WITH BASE CASE

$10.00
$7.50
$5.00
$2.50


YEAR

$7.76 CURRENT SYSTEM
$3.67 AIDS III

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ORIGINAL PAGE IS OF POOR QUALITY
FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY
CUMULATIVE COST PER TRANSACTION 1980-2004 FOR BASE CASE

SELECTED OTHER RATIOS

- TOTAL TRANSACTIONS PER YEAR PER TOTAL NUMBER OF EMPLOYEES (MEASURES PRODUCTIVITY)
- ANNUAL LABOR COST PER TOTAL NUMBER OF EMPLOYEES (MEASURES LABOR COST AND REFLECTS SKILL MIX)
- TOTAL ANNUAL COST PER TOTAL NUMBER OF EMPLOYEES
FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY
APPROXIMATE ANNUAL TRANSACTIONS PER EMPLOYEE
1980-2004 FOR ALL FIVE CASES

YEAR

APPROXIMATE ANNUAL LABOR COST
PER EMPLOYEE 1980-2004 FOR ALL FIVE CASES

YEAR
FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY
TOTAL ANNUAL COST PER EMPLOYEE 1980 - 2004
FOR BASE CASE (OTHER SCENARIOS SIMILAR)

- DIFFERENCES IN BENEFIT MEASURES
- ACCURACY
- RESPONSE TIME

- DIFFERENCES IN EMPLOYMENT MEASURES
- DIFFERENCES IN NUMBER OF EMPLOYEES
- DIFFERENCES IN SKILL MIX
**FBI Fingerprint Identification Automation Study**

**Difference in Benefit Measures Between AIDS III and the Current System**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Current System</th>
<th>AIDS III</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy (F/P Search Miss Rate)</td>
<td>~25%</td>
<td>~5%</td>
<td>~20%</td>
</tr>
<tr>
<td>Mail Room to Mail Room Response Time (95th Percentile)</td>
<td>~25 hours</td>
<td>~3.0 hours</td>
<td>~22 hours</td>
</tr>
<tr>
<td>Number of Employees</td>
<td>~3500 to 3700</td>
<td>~2400</td>
<td>~1,000 to 300</td>
</tr>
</tbody>
</table>

**Difference in Skill Mix Between AIDS III and Current System for 1986 With Design Work Load**

- **Additional Employees with AIDS III**
- **Fewer Employees with AIDS III**

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FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY
EMPLOYEES SAVED WITH AIDS III VERSUS CURRENT SYSTEM WITH BASE CASE SCENARIO

YEAR

DIFFERENCE IN NUMBER OF EMPLOYEES MINUS NO. OF AIDS III EMPLOYEES


190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10

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FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY

ENVIRONMENTAL ANALYSIS
FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY

QUANTITATIVE DESCRIPTION OF THE WORK LOAD

- DISTRIBUTION OF SUBMISSIONS:
  - APPLICANT VS CRIMINAL
  - STATE AGENCIES, FEDERAL AGENCIES

- DISTRIBUTION OF ACTIVITIES BY TYPE OF SUBMISSIONS

FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY

CHARACTERISTICS OF STATE CRIMINAL AND APPLICANT SUBMISSIONS

- NUMBERS AND RATES OF SUBMISSIONS NOT ENTIRELY DETERMINED BY STATE POPULATIONS

- CRIME RATES EXPLAIN ONLY 50% OF VARIANCE OF CRIMINAL SUBMISSIONS

- RATES OF SUBMISSIONS VARY OVER TIME FOR INDIVIDUAL STATES
FBI Fingerprint Identification Automation Study

Total Fingerprints Received by the Identification Division

<table>
<thead>
<tr>
<th>Year</th>
<th>Criminal</th>
<th>Applicant</th>
<th>Military</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>3.6</td>
<td>1.8</td>
<td>0.8</td>
</tr>
<tr>
<td>1971</td>
<td>3.4</td>
<td>2.2</td>
<td>0.6</td>
</tr>
<tr>
<td>1972</td>
<td>3.2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
<tr>
<td>1973</td>
<td>3.0</td>
<td>2.2</td>
<td>0.2</td>
</tr>
<tr>
<td>1974</td>
<td>2.8</td>
<td>2.4</td>
<td>0.8</td>
</tr>
<tr>
<td>1975</td>
<td>2.6</td>
<td>2.4</td>
<td>0.6</td>
</tr>
<tr>
<td>1976</td>
<td>2.2</td>
<td>2.2</td>
<td>0.4</td>
</tr>
<tr>
<td>1977</td>
<td>1.8</td>
<td>2.2</td>
<td>0.2</td>
</tr>
<tr>
<td>1978</td>
<td>1.4</td>
<td>1.8</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Applicant Submissions and Employment

<table>
<thead>
<tr>
<th>Year</th>
<th>Law Enforcement</th>
<th>Federal Government</th>
<th>Total Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>1.0</td>
<td>0.5</td>
<td>1.5</td>
</tr>
<tr>
<td>1971</td>
<td>0.8</td>
<td>0.4</td>
<td>1.2</td>
</tr>
<tr>
<td>1972</td>
<td>0.6</td>
<td>0.3</td>
<td>0.9</td>
</tr>
<tr>
<td>1973</td>
<td>0.4</td>
<td>0.2</td>
<td>0.6</td>
</tr>
<tr>
<td>1974</td>
<td>0.2</td>
<td>0.1</td>
<td>0.3</td>
</tr>
<tr>
<td>1975</td>
<td>0.1</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>1976</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>1977</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>1978</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>
FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY
CRIME STATISTICS

- CRIMINAL SUBMISSIONS
- UNIFORM CRIME REPORTS
- CRIMES AGAINST PROPERTY

(TIME)

TOTAL ID ACTIVITY BY SOURCE (FY 1979)

2,335,000

STATE WORK LOAD
53%

2,581,000

FEDERAL WORK LOAD
47%

922,000

CRIMINAL
CHECK
15%

307,000

APPLICANT
CHECK
14%

APPLICATION CHECK
11%

APPLI-CANT CHECK
11%

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**FBI Fingerprint Identification Automation Study**

**Breakdown of Submissions Work Load**

**Criminal Submissions 43%**

- 73% Match with Name Check, No F/P Search Required
- 27% No Match with Name Check, F/P Search Required

**Applicant Submissions 57%**

- 95% No File, F/P Search Required
- 5% Record on File, No F/P Search Required

*% of Total Submissions to Identification Division*

---

**FBI Fingerprint Identification Automation Study**

**Characteristics of Users and User Environment**

- **Patterns of Use in States Vary Widely**
- **Determinants of State Submissions Are Complex and Diffuse**
- **State Submissions Are Voluntary and Idiosyncratic**

---

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CHARACTERISTICS OF THE WORK LOAD DETERMINED BY USERS:
THE INTERNAL MODEL

- EXISTING WORK LOAD ANALYZED IN TERMS OF RESPONSE TO USERS

- USER NEEDS DETERMINED BY EXTERNAL ENVIRONMENT:
  - STATUTORY, LEGISLATIVE REQUIREMENTS ON IDENTIFICATION
  - CENTRALIZED CRIMINAL INFORMATION SERVICES
  - TRANSIENT IMPULSES IN THE IDENTIFICATION SYSTEM

- CONGRUENCE OF IDENTIFICATION DIVISION SERVICES WITH USER NEEDS

DIAGRAM OF INTERNAL MODEL
I.D. AND RECORD KEEPING ENVIRONMENT

MODEL OF INTERNAL ENVIRONMENT VIEWPOINT

1. LAW ENFORCEMENT AGENCIES
2. STATE IDENTIFICATION BUREAUS
3. NATIONAL BANKS
4. SECURITIES FIRMS
5. CIVIL SERVICE COMMISSION
6. OTHER GOVERNMENT AGENCIES
## FBI Fingerprint Identification Automation Study

### Drivers and Effects

#### Direction of Induced Change in Work Load

<table>
<thead>
<tr>
<th>Type of Driver</th>
<th>Record Keeping</th>
<th>F.P. Search</th>
<th>Criminal Submissions</th>
<th>Applicant Submissions</th>
<th>Upper/Lower Bound of Effects</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic Trends</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stagnant Economy</td>
<td>-</td>
<td></td>
<td>+</td>
<td>-</td>
<td>Present Rate of Growth Maintained at 11.7% per annum: Upper Bound</td>
<td></td>
</tr>
<tr>
<td>Fiscal Constraints: Federal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hiring Freeze</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td>-1 Million: Lower Bound</td>
<td></td>
</tr>
<tr>
<td>Reduction in LEAA Funds</td>
<td>+</td>
<td></td>
<td>+</td>
<td>-</td>
<td>Varies by State</td>
<td>Lower Bound</td>
</tr>
<tr>
<td>FES for Applicant Services of Identity, Division</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td>-1 Million: Lower Bound</td>
<td></td>
</tr>
<tr>
<td>Tougther Criteria for Submissions</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td>-1 Million: Lower Bound</td>
<td></td>
</tr>
<tr>
<td>Fiscal Constraints: State</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-1 Million: Lower Bound</td>
<td></td>
</tr>
<tr>
<td>Hiring Freeze</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced Funds for In-State I.D.</td>
<td>+</td>
<td></td>
<td>+</td>
<td>-</td>
<td>Varies by State</td>
<td>See Text</td>
</tr>
</tbody>
</table>

#### Demographic Trends

<table>
<thead>
<tr>
<th>Type of Driver</th>
<th>Record Keeping</th>
<th>F.P. Search</th>
<th>Criminal Submissions</th>
<th>Applicant Submissions</th>
<th>Upper/Lower Bound of Effects</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in Median Age</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td>Reduction in All Activities 0.5% per annum: Lower Bound</td>
<td></td>
</tr>
<tr>
<td>Slower Growth of Pop.</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td>Reduction in All Activities 1% per annum: Lower Bound</td>
<td></td>
</tr>
<tr>
<td>Mobility Decline</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td>Data Do Not Permit Projection</td>
<td>See Text</td>
</tr>
</tbody>
</table>

#### Legislative/Judicial Actions

<table>
<thead>
<tr>
<th>Type of Driver</th>
<th>Record Keeping</th>
<th>F.P. Search</th>
<th>Criminal Submissions</th>
<th>Applicant Submissions</th>
<th>Upper/Lower Bound of Effects</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speedy Disposition of Criminal Charges</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td>Varies by State</td>
<td>See Text</td>
</tr>
<tr>
<td>Decriminalization of Victimless Crimes</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td>Effects Negligible</td>
<td>See Text</td>
</tr>
<tr>
<td>Legalization of Casino Gambling</td>
<td>+</td>
<td></td>
<td>+</td>
<td>+</td>
<td>Not Estimated</td>
<td>See Text</td>
</tr>
</tbody>
</table>

---

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### FBI Fingerprint Identification Automation Study

#### Drivers and Effects (Cont'd)

**Direction of Induced Change in Workload**

<table>
<thead>
<tr>
<th>Type of Driver</th>
<th>Record Keeping</th>
<th>F.P. Search</th>
<th>Criminal Submissions</th>
<th>Applicant Submissions</th>
<th>Upper Lower Bound of Effects</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legislative/Judicial Actions (Cont'd)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticipated Legislative/Judicial Actions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased Immigration Quota</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td>+500,000 Applicant Submissions/YEAR</td>
<td></td>
</tr>
<tr>
<td>Inclusion of Women in Draft</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase in Foreign Workers</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td>+45,000 Applicant Submissions/YEAR</td>
<td></td>
</tr>
<tr>
<td>Possible Legislative Actions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>National Gun Registration</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td>+2 Million per Annual Upper Bound</td>
<td>199. Million 'First Year' Registrants, New Agency Likely</td>
</tr>
<tr>
<td>National I.D. System</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td>+2 Million per Annual Upper Bound</td>
<td>320 Million 'First Year' Registrants New Agency Likely</td>
</tr>
<tr>
<td>Change in State Licensing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interstate I.D. Index</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### FBI Fingerprint Identification Automation Study

#### Drivers and Effects (Cont'd)

**Original Page Is of Poor Quality**

<table>
<thead>
<tr>
<th>Type of Driver</th>
<th>Record Keeping</th>
<th>F.P. Search</th>
<th>Criminal Submissions</th>
<th>Applicant Submissions</th>
<th>Upper Lower Bound of Effects</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possible Events</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Civil Disorder, Terrorism</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outbreak of War</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td>+5 Million Total; 40 Million in a Military Draft; Upper Bound</td>
<td>See Text</td>
</tr>
<tr>
<td>Technological Trends</td>
<td></td>
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<tr>
<td>New Non-Fingerprint I.D. Technologies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+2 Million; Upper Bound</td>
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<tr>
<td>Electronic &quot;Mail&quot;</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td>Not Estimated</td>
<td>To Be Estimated in 2nd Phase Study</td>
</tr>
<tr>
<td>Improved Information Systems</td>
<td>+</td>
<td>+</td>
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<td></td>
<td>Not Estimated</td>
<td>To Be Estimated in 2nd Phase Study</td>
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<tr>
<td>Other</td>
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<td></td>
<td>+25,000 Name Checks; Upper Bound</td>
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</table>

**Other**

**INM Olympics**

---

*Original page is of poor quality*
# FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY

## SCENARIOS

### SCENARIOS LEADING TO INCREASED WORK LOAD

1. **INCREASE IN SUBMISSIONS FROM STATES**
   - a. State submissions reach 1970 volume and remain constant
   - b. State submissions continue to grow at present rate indefinitely

2. **CRIMINAL SUBMISSIONS INCREASE AT 1.4% PER ANNUM**

3. **INCREASE FROM INSTALLATION OF NEW TECHNICAL CAPABILITY**
   - a. Full fingerprint search on all submissions
   - b. Immediate (4-8 hour) response to inquiries increases state criminal submissions

### SCENARIO INDICATING NO CHANGE

4. Present distribution and volume of work load remains constant.

### SCENARIO LEADING TO DECREASED WORK LOAD

5. Development of interstate identification index removes record keeping function for participating states.

## SCENARIO SOURCES AND DRIVING EFFECTS

<table>
<thead>
<tr>
<th>ORIGIN OF SCENARIO</th>
<th>INCREASE</th>
<th>DECREASE</th>
<th>NO CHANGE</th>
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<tbody>
<tr>
<td>HISTORICAL</td>
<td></td>
<td></td>
<td>1 + 2</td>
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<tr>
<td>FEDERAL POLICY</td>
<td>NO SCENARIOS, WILL NOT BE A DRIVER</td>
<td></td>
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<tr>
<td>PROJECTION OF USERS</td>
<td>4</td>
<td>5</td>
<td></td>
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<tr>
<td>JUDICIAL</td>
<td>NO SCENARIOS, WILL NOT BE A DRIVER</td>
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</tr>
<tr>
<td>TECHNOLOGICAL</td>
<td>3</td>
<td></td>
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</tbody>
</table>

B-66
FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY
RELATION OF DRIVERS TO WORK LOAD PROJECTION

- World War
- Basecase + 50%
- National Identification or Gun Control
- Increased Immigration Quota
- Limited War
- Automation of FBI Identification
- Interstate Identification Index
- Basecase
- Tighter Criterion Offenses
- Federal Hiring Freeze or Charge
- End of Life Cycle

<table>
<thead>
<tr>
<th>SCENARIO</th>
<th>APPLICANT SUBMISSION RATE</th>
<th>PERIOD</th>
<th>CRIMINAL SUBMISSION RATE</th>
<th>PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Case, Scenario #4</td>
<td>1.7%</td>
<td>1980-1986</td>
<td>1.7%</td>
<td>1980-1986</td>
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<tr>
<td></td>
<td>0.0%</td>
<td>1987-2004</td>
<td>0.0%</td>
<td>1987-2004</td>
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<tr>
<td>1.7% Constant Growth, Extension of Guideline</td>
<td>1.7%</td>
<td>1980-2004</td>
<td>1.7%</td>
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<tr>
<td>Mixed Growth Rates, Scenario #1 &amp; #2</td>
<td>6.5%</td>
<td>1980-1985</td>
<td>1.4%</td>
<td>1980-2004</td>
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<tr>
<td></td>
<td>2.0%</td>
<td>1986-2004</td>
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<tr>
<td>Interstate Identification Index, Scenario #1 &amp; #5</td>
<td>6.5%</td>
<td>1980-1985</td>
<td>-0.85%</td>
<td>1980-1992</td>
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<td></td>
<td>0.0%</td>
<td>1986-2004</td>
<td>0.0%</td>
<td>1993-2004</td>
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<tr>
<td>Automation of FBI Identification, Scenario #3</td>
<td>2.87%</td>
<td>1980-1992</td>
<td>0.35%</td>
<td>1980-1992</td>
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<td></td>
<td>0.0%</td>
<td>1993-2004</td>
<td>0.0%</td>
<td>1993-2004</td>
</tr>
</tbody>
</table>
ENVIRONMENT OF ID IS COMPLEX:

- DIFFERENCES IN USES BY FEDERAL, STATE AND LOCAL AGENCIES
- DIFFERENCES IN REPORTING AND RECORD KEEPING PRACTICES IN USER AGENCIES
- CONTROLS OF INPUTS AND POLICY DISPARATE AND VARIABLE

EFFECTS OF DRIVERS/SCENARIOS LIE WITHIN GUIDELINES:

- RESULTS OF PRESENT TRENDS APPROACHING STEADY STATE - IMPLY LITTLE CHANGE IN VOLUME OR DISTRIBUTION OF WORK LOAD
- CHANGES RESULTING FROM PROJECTED EVENTS HAVE MINIMAL EFFECTS
- EVENTS WITH LARGE EFFECTS ARE JUDGED UNLIKELY
- INTRODUCTION OF NEW TECHNOLOGIES AFFECTING WORK LOAD LIE OUTSIDE TIME FRAME OF STUDY

B-68
STATUS OF EXTERNAL MODEL

- Principal actors in the external environment are:
  - FBI Identification Division
  - Agencies of Federal Government
  - Agencies of State Governments and of Local Law Enforcement

- Competition between the Federal and State and Local Agencies
  - For control of the two identification functions
  - Criminal History Record Keeping
  - Applicant Identification

- States will not give up control to Federal Agencies because:
  - A. Political/Legal
    Record keeping of Criminal Histories is considered by the States to be their business
  - B. Managerial/Technical
    More accurate and timely record keeping can be done by the States

DIAGRAM OF EXTERNAL MODEL

I.D. AND RECORD KEEPING ENVIRONMENT

EXTERNAL MODEL

FBI I.D. DIV

STATE I.D. DIV

FBI I.D.

STATE I.D.

OPM

OTHER FEDERAL GOVT AGENCIES

PRIVATE SECTOR

POLICE DEPT. & LAW ENFORCEMENT AGENCIES

FUTURE? COMPETITION?

MODEL OF EXTERNAL ENVIRONMENT VIEWPOINT

B-69
FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY

STATEMENT OF EXTERNAL MODEL PROBLEMS

Dissatisfaction was expressed by external agencies about:

- Slowness of response time
- Accuracy and completeness of disposition information

Conflicting ideas exist about:

- Adequacy of privacy safeguards
- Locus of control
- Whether or not identification and criminal history record keeping should be separated
- Amount and type of reporting to the I.D. required of the States
- Amount of service required of the I.D. to the States and local
- Local law enforcement agencies

Resources available to agencies which are driving factors on potential work load are:

- Money for purchase of technology
- Legislative/regulatory powers

FBI FINGERPRINT IDENTIFICATION AUTOMATION STUDY

WORKING HYPOTHESES ABOUT EXTERNAL ENVIRONMENT

- Activities of the I.D. can be controlled through expenditures for technology instead of through legislative/regulatory restrictions
- Federal influence will be monetary; State's influence will be legislative/regulatory
- Outcomes of competition between State and Federal agencies will reveal future changes in internal I.D. environment which can be projected as drivers and scenarios
- Projections of drivers and scenarios will reveal trends in work load

- Projections:
  - A. Long-term Scenario
    There will be a clear division and no duplication of labor between Federal and State agencies
  - B. Intermediate Scenario
    There will be overlap and duplication of functions

- Conclusions:
  - Will continue to be overlap of functions between the State and Federal agencies in 1993

B-70
LOCUS OF CONTROL

- FEDERAL LEVEL
  - JUDICIARY
  - CONGRESSIONAL
  - EXECUTIVE

- STATE LEVEL
  - JUDICIARY
  - LEGISLATIVE
  - EXECUTIVE

SCOPE OF CONCERNS BY SECTOR

FEDERAL AND STATE JUDICIARY

- ADVERSARY PROCESS REQUIRES:
  - PRESENCE OF AN ISSUE RAISED BY AN INDIVIDUAL
  - DIFFICULT TO PREDICT WHICH ISSUES WILL BE LITIGATED
  - DIFFICULT TO PREDICT HOW ISSUES WILL BE FORMULATED

- JUDICIARY HAS CONTROL ONLY OVER RESOLUTION - NOT OVER WHICH ISSUES ARE RAISED
EXECUTIVE

- LEAA - OUT OF BUSINESS
- OMB - WILL ONLY RESPOND TO BUDGET PROPOSALS
- IDENTIFICATION DIVISION -
  - COULD USE ABILITY TO REGULATE LICENSING AND APPLICANT CHECKS TO CENTRAL WORK LOAD
  - COULD USE ELECTRONIC COMMUNICATIONS AND IMAGE TRANSFER TO SHORTEN RESPONSE TIME TO A POINT WHERE USE PATTERNS WOULD CHANGE
  - END-TO-END RESPONSE TIME OF 8 TO 48 HOURS
  - COULD RETURN RECORD KEEPING TO THE STATES
- NO INDICATION FROM IDENTIFICATION DIVISION THAT THEY PLAN OR WISH TO IMPLEMENT ANY OF THE ABOVE

JUSTICE DEPARTMENT

- MOST LIKELY SOURCE OF CHANGE
  - CHANGE, IF IT IS TO OCCUR, WILL HAVE TO ARISE AT EXECUTIVE LEVELS
  - OTHER AGENCIES ARE EXPECTING JUSTICE DEPARTMENT TO TAKE THE INITIATIVE
  - III - INTERSTATE IDENTIFICATION INDEX - A POINTER SYSTEM WHICH DIRECTS INQUIRIES TO STATE WHERE RECORDS ARE KEPT. THIS PLAN IS IN THE PILOT STAGE.
FBI FINGERPRINT IDENTIFICATION
AUTOMATION STUDY

SCOPE OF CONCERNS BY SECTOR (Cont'd)

STATE EXECUTIVE AND LEGISLATIVE

- State policy on identification is responsive to pressures from trends within states and to fiscal and policy controls imposed by federal agencies.

- Dissatisfaction with aspects of identification division services at state and local levels is not likely to lead to policy initiatives.

CONGRESS

- FBI oversight -

- No pressure for change originating here.

  - Lack of time and technical skill to assess technical factors.

  - Lack of time for detailed budget review.

  - Action limited to response to administrative action by the Justice Department.
CONGRESS (CONTINUED)

- REVISION OF FBI CHARTER
  - FOCUS ON LIMITS TO FBI ACTIVITIES
- EXPRESSED CONCERNS
  - THE ABILITY OF THE FBI TO KEEP ACCURATE RECORDS
  - THE ABILITY OF THE FBI TO CONTROL INFORMATION ONCE IT IS DISSEMINATED

CONCLUSIONS ABOUT EXTERNAL ENVIRONMENT

- FEDERAL AND STATE AGENCIES EXTERNAL TO THE FBI ARE CAPABLE OF INITIATING CHANGES THAT WILL AFFECT THE DIVISIONAL WORK LOAD THROUGH THE USE OF FISCAL AND POLICY CONTROLS
- NO STRONG DIRECT PRESSURES ARE APPARENT THAT WOULD LEAD TO CHANGES INITIATED BY EXTERNAL FEDERAL AND STATE AGENCIES, WITH THE EXCEPTION OF III
Page intentionally left blank
## APPENDIX C

### ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>ACS</td>
<td>Automated Classification System</td>
</tr>
<tr>
<td>AFRS</td>
<td>Automated Fingerprint Reader System</td>
</tr>
<tr>
<td>AHU</td>
<td>Anti-Halation Underlayer</td>
</tr>
<tr>
<td>AIDS</td>
<td>Automated Identification Division System</td>
</tr>
<tr>
<td>ANS</td>
<td>Automated Name Search</td>
</tr>
<tr>
<td>ATS</td>
<td>Automated Technical Search</td>
</tr>
<tr>
<td>ATSPS</td>
<td>Automated Technical Search Pilot System</td>
</tr>
<tr>
<td>AUTOCOR</td>
<td>Automated Correspondence Station (part of AIDS)</td>
</tr>
<tr>
<td>AUTORESP</td>
<td>Automated Response Generation (part of AIDS)</td>
</tr>
<tr>
<td>A&amp;R</td>
<td>Automation and Research Section of Identification Division</td>
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<tr>
<td>BER</td>
<td>Bit Error Rates</td>
</tr>
<tr>
<td>BLO</td>
<td>Blocking Out</td>
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<tr>
<td>CCA</td>
<td>Computerized Contributor Abbreviated Name</td>
</tr>
<tr>
<td>CCH</td>
<td>Computerized Criminal History (part of NCIC)</td>
</tr>
<tr>
<td>CCN</td>
<td>Computerized Criminal Name</td>
</tr>
<tr>
<td>CCNR</td>
<td>Computerized Criminal Name and Record (part of AIDS)</td>
</tr>
<tr>
<td>CCR</td>
<td>Computerized Criminal (Arrest) Record (part of AIDS)</td>
</tr>
<tr>
<td>CIR</td>
<td>Computerized Ident Response File (part of AIDS)</td>
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<td>CLASS-A</td>
<td>Classification-A</td>
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<tr>
<td>CLASS-B</td>
<td>Classification-B</td>
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<td>CLASS-C</td>
<td>Classification-C</td>
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<td>CLICK</td>
<td>Classification Check</td>
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<td>CNR</td>
<td>Computerized Non-Ident Response File</td>
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<td>COA</td>
<td>Cutoff Age</td>
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<tr>
<td>CPU</td>
<td>Central Processing Unit</td>
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<tr>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>CRS</td>
<td>Computerized Record Sent File (part of AIDS)</td>
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<td>CRT</td>
<td>Cathode Ray Tube</td>
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<tr>
<td>CSORT</td>
<td>Centerline Sort</td>
</tr>
<tr>
<td>DATE STP</td>
<td>Date Stamp, Count and Log</td>
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<tr>
<td>DBMS</td>
<td>Data Base Management System</td>
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<tr>
<td>DEDS</td>
<td>Data Entry and Display Subsystem (part of AIDS III)</td>
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<tr>
<td>DENT</td>
<td>Data Entry</td>
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<td>DENT-A</td>
<td>Data Entry-Cards</td>
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<tr>
<td>DENT-B</td>
<td>Data Entry-Documents</td>
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<tr>
<td>DOA</td>
<td>Date of Arrest (on f/p card)</td>
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<tr>
<td>DOB</td>
<td>Date of Birth (on f/p card)</td>
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<tr>
<td>ECL</td>
<td>Emitter Coupled Logic</td>
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<td>EMI</td>
<td>Electromagnetic Interference</td>
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<td>ENC</td>
<td>Encode Input Data-Cards</td>
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<tr>
<td>ENCDOC</td>
<td>Encode Input Data-Documents</td>
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<td>ENCK</td>
<td>Encode Check-Cards</td>
</tr>
<tr>
<td>ENDOCCK</td>
<td>Encode Check-Documents</td>
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<td>ERR</td>
<td>Update Error File</td>
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<td>EYE</td>
<td>Color of Eyes (on f/p card)</td>
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<td>FBI</td>
<td>Federal Bureau of Investigation</td>
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<tr>
<td>FEP</td>
<td>Front End Processor</td>
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<td>FIFO</td>
<td>First-In-First-Out</td>
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<tr>
<td>FLAB</td>
<td>Film Lab Processing/Computer</td>
</tr>
<tr>
<td>FLOAD</td>
<td>Film Load</td>
</tr>
<tr>
<td>FPC</td>
<td>Fingerprint Classification</td>
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<tr>
<td>FPCS</td>
<td>Fingerprint Correspondence Section of the Identification Division</td>
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<td>f/p</td>
<td>Fingerprint</td>
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<tr>
<td>Acronym</td>
<td>Definition</td>
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<tr>
<td>GDBMS</td>
<td>General Purpose Data Base Management System</td>
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<tr>
<td>GEO</td>
<td>Geographic Location (on f/p card)</td>
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<td>GPSS</td>
<td>General Purpose Simulation System</td>
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<td>MAI</td>
<td>Color of Hair (on f/p card)</td>
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<td>HGT</td>
<td>Height (on f/p card)</td>
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<td>IBM</td>
<td>International Business Machines Corporation</td>
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<td>ICI</td>
<td>Image Comparison Identification</td>
</tr>
<tr>
<td>ICRQ</td>
<td>Image Comparison Request</td>
</tr>
<tr>
<td>ICS</td>
<td>Image Comparison Subsystem (part of AIDS III, actually used for image retrieval for manual comparison)</td>
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<tr>
<td>ICV</td>
<td>Image Comparison Verification</td>
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<td>ID, I.D.</td>
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<td>IDENT</td>
<td>Identification</td>
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<tr>
<td>JPL</td>
<td>Jet Propulsion Laboratory</td>
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<tr>
<td>KIPS</td>
<td>Thousands of Instructions per Second (as executed by a computer)</td>
</tr>
<tr>
<td>LEAA</td>
<td>Law Enforcement Assistance Agency</td>
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<tr>
<td>MAIL</td>
<td>Open Mail and Sort</td>
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<tr>
<td>MVILM</td>
<td>Image Capture Microfilm</td>
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<td>MIPS</td>
<td>Millions of Instructions per Second (as executed by a computer)</td>
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<td>MIF</td>
<td>Minutiae Master File</td>
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<td>MOE</td>
<td>Measures of Effectiveness</td>
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<tr>
<td>MTBF</td>
<td>Mean Time Between Failures</td>
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<td>MTR</td>
<td>Master Transaction Record</td>
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<td>MTTR</td>
<td>Mean Time to Repair</td>
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<tr>
<td>NAM</td>
<td>Name (on f/p card)</td>
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<td>NASA</td>
<td>National Aeronautics and Space Administration</td>
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<td>NCIC</td>
<td>National Crime Information Center</td>
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</table>
NCR National Cash Register Company
OCA Local Identification Number (on f/p card)
OCR Optical Character Recognition
OMB Office of Management and Budget
ORI Originating Agency Identification Number (on f/p card)
PCN Process Control Number
PICS PCN and Image Capture Subsystem (part of AIDS III)
PMT Photomultiplier Tubes
POB Place of Birth (on f/p card)
QC Quality Control
QUERY On-Line Query
RAC Race (on f/p card)
READ Quality Control Check, Read, Annotate
RFI Radio Frequency Interference
RH Relative Humidity
RVF Ridge Valley Filter
SACS Semi-Automatic Classification System
SAR Semi-Automatic Fingerprint Reader
SEAR Search Review
SEX Reported Sex of a Subject (on f/p card)
SID State Identification Number
SKN Skin Tone (on f/p card)
SOC Social Security Number (on f/p card)
SPM Search Processor Module
SS System Supervisor Subsystem (part of AIDS III)
SSM Subject Search Module
SSRG Subject Search and Response Generation Subsystem (part of AIDS III)
<table>
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<tr>
<th>Acronym</th>
<th>Description</th>
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<td>TDFA</td>
<td>Top Down Functional Analysis</td>
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<tr>
<td>TFC</td>
<td>Technical File Conversion</td>
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<td>TR</td>
<td>Transaction Record</td>
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<tr>
<td>TRC</td>
<td>Transaction Control File</td>
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<td>TSS</td>
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<tr>
<td>TTL</td>
<td>Transistor - Transistor Logic</td>
</tr>
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<td>VDENT-A</td>
<td>Verify Data Entry-Cards</td>
</tr>
<tr>
<td>VDENT-B</td>
<td>Verify Data Entry-Documents</td>
</tr>
<tr>
<td>VLSI</td>
<td>Very Large Scale Integration</td>
</tr>
<tr>
<td>WAND</td>
<td>Wand Out of System</td>
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