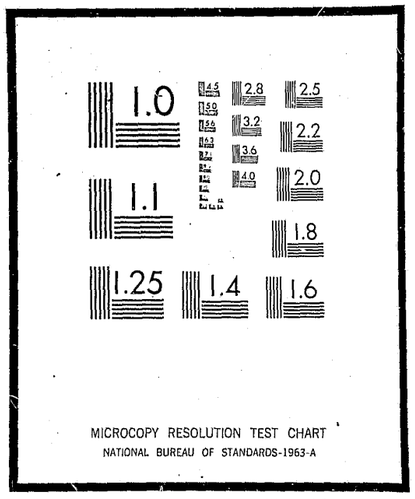

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AUTOMATED INFORMATION SYSTEMS SUPPORTING CRIMINAL INVESTIGATION

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PREFACE AND SUMMARY

This Working Note presents materials developed in three individual case studies, each describing the characteristics, operations, and performance of an information system that supports the police investigative function. The work was performed as part of a broad Rand study of criminal investigation, sponsored by the National Institute of Law Enforcement & Criminal Justice (NILECJ) of the Law Enforcement Assistance Administration (LEAA). The three information systems examined are:

- New York City Police Department's Latent Fingerprint Identification System
- Indianapolis Police Department's Stolen and Pawned Property System
- Los Angeles Police Department's Automated Field Interview System.

Our studies of these three systems were undertaken in the hope of learning what gains in identification and apprehension of offenders might be realized through the use of computerized information systems. Unfortunately, these case studies are not persuasive evidence that information systems like the ones studied can produce substantial increases in police effectiveness. But improvements over time may possibly reverse this finding.

We are publishing these case studies for the benefit of agencies who are considering the introduction of similar systems. Findings and suggestions pertaining to each of the three are presented in the concluding pages of each section of this Working Note. The full results of the criminal investigation study are presented in

R-1778-DOJ, *The Criminal Investigation Process: Volume III: Observations and Analysis.*

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I. INTRODUCTION

Our purpose in studying automated information systems that support criminal investigation was two-fold. We wanted, first of all, to identify the types of systems that currently exist and, secondly, to determine the effectiveness of such systems to provide this support.

The strategy we adopted to accomplish this was the use of a literature search, interviews, and site visits to identify existing systems and to determine which of these had data available to support an analysis of their effectiveness. The systems (or their components) could then be classified into types and several systems with available data could be selected and analyzed as case-studies.

The primary source for the literature search was the 1972 Directory of Automated Criminal Information Systems,* which includes both operational systems and systems under development. It is based on a survey conducted by the National Association for State Information Systems. The list of agencies to be surveyed was developed with the assistance from the State Planning Agencies for Law Enforcement and from the LEAA Regional Systems Specialists. It included 103 local jurisdictions.** The search of the literature additionally included the proceedings from the three Project SEARCH symposia,*** the California Criminal Justice Information System Inventory,**** and numerous other articles.

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*Law Enforcement Administration Agency, 1972 Directory of Automated Criminal Justice Information Systems, U.S. Government, 1972.

**It also included the 50 states.

***Project SEARCH, Proceedings of the National Symposium on Criminal Justice Information Systems and Statistics, 1970; Project SEARCH, Proceedings of the International Symposium on Criminal Justice Information and Statistics Systems, 1972; and Project SEARCH, Proceedings of the Second International Symposium on Criminal Justice Information and Statistics Systems, 1974.

****Office of Criminal Justice Planning, California Criminal Information Systems Inventory, unpublished.

Twenty-nine systems identified (with one exception) in the literature search were the subject of phone interviews in the next phase. The selection was made in such a manner that several of each type of system identified in the search would be included. In these interviews, we obtained the current status of each system (e.g., operational or under development), a description of the components of the systems that support investigation, the functions of these components, the existence of documentation on the system, and the availability of data on the use and effectiveness of the system.

Site visits were then made to nine systems. In these visits, we obtained documentation on each system, looked at and, if appropriate, collected data on the utilization and effectiveness. The operation of the system was observed and more detailed information, such as that obtained in the phone interviews, as well as information on the costs of systems, was obtained.

We then classified the identified systems and selected and analyzed three of the systems as case-studies, the reports of which are successive sections of the present volume.

IDENTIFICATION OF SYSTEM TYPES

Through our literature search, phone interviews, and site visits, we identified many existing systems supporting investigation. These can be classified according to the source and type of information on which they are based.* Most can exist either as an independent system or as a component of a larger system.

Physical Characteristics System

This type of system uses a data base compiled from arrest records consisting of physical characteristics and identifiers of

*We have excluded systems for organized crime and narcotics, simply because we have chosen, as in the rest of this study, not to deal with the investigation of these types of offenses. We have also excluded criminal associates systems because it is thought that the information provided by such a system could as easily be obtained with a manual system.

known offenders. Characteristics of an offender in a case under investigation can be queried against the data base to attempt an identification. A number of police systems contain a physical characteristic system as a component; examples include New Orlean's MOTION* system, Tulsa's TRACIS** system, and Oakland's CRIME system.

Vehicle Characteristics System

This type of system is based on the description of vehicles connected with arrests. Inquiries based on vehicle characteristics for cases under investigation can be queried with the system to try to obtain leads. We learned of only two such systems. One is a component of the Oakland CRIME system; the other is a component of the Los Angeles Automated Field Interview System (in Los Angeles field interview reports are completed for arrests).**

Modus Operandi System

This type of system serves three functions: (1) to name suspects for cases under investigation, (2) to determine unsolved crimes likely to have been committed by the same unknown criminal, and (3) to determine crimes likely to have been committed by an individual arrested for one particular crime. A data base of modus operandi (M.O.) elements for both solved and unsolved crimes, obtained from crime reports and/or follow-up investigations, forms the basis for such systems. The identity of the offender for the solved crimes is also included. M.O. elements from a crime under investigation can be used to query the system for crimes with matching elements. When a match is made to a solved crime, a suspect name is obtained; when it is made to an unsolved crime, another crime likely to have been committed by the same offender is obtained. M.O. elements from a

*Metropolitan Orleans Total Information On-Line Network.
**Tulsa Regional Automated Criminal Investigation System.
***Pattern Recognition and Information Correlation.

solved crime can be queried, a match indicating a crime likely to have been committed by the same offender. Very few such systems exist. Examples are the modus operandi components of Los Angeles's PATRIC* system and of the Law Enforcement Subsystem of Wichita Falls, Texas. St. Paul is currently in the process of developing an extensive modus operandi system expected to be implemented this year.

Mug Shot System

Existing in conjunction with a physical characteristics system, a modus operandi system, or a combination of the two, a mug shot system enables the automatic retrieval of photographs of arrestees whose physical characteristics and/or modus operandi elements match those of the offender in a case under investigation. An example of such a system is the component of the Oakland CRIME system with which mug shots can be accessed according to physical characteristics and crime type. Very few agencies have such systems.

Fingerprint System

Fingerprint systems, based on the inked prints of selected arrestees, serve two important and distinct purposes. Because these purposes have differing design implications, typically a system primarily serves one of the purposes. Latent fingerprint systems are designed to match a single latent print lifted from a crime scene to a single inked print of an arrestee. Inked fingerprint systems are instead designed to match a set of ten inked prints obtained from an arrestee to sets of prints from previous arrestees in order to tie the arrestee to his complete criminal history.

The New York fingerprint system (see Section II) is an example of an automated latent fingerprint system. The FINDER system currently being implemented by the Federal Bureau of Investigation is an example of an inked fingerprint system. Aside from the New York

*See Section IV.

system, all currently operational fingerprint systems (of either type) involve the encoding of prints. For such systems, the term "automation" can refer either to the searching or to both the encoding and searching of fingerprints. Systems automating only the searching function are common, the MIRACODE system being a prime example. No system automating both is now operational; the FINDER system presumably will be the first.

Field Interview System

This type of system automates the retrieval of information obtained from police field contacts. Based on suspect and/or vehicle characteristics for a case under investigation, inquiries can be made and suspects identified. This is a relatively common type of system; 29 of the 100 local agencies listed in the 1972 Directory were indicated as having such systems. The Los Angeles Automated Field Interview System (see Section IV) and the field interview components of the Oakland CRIME system and of the New Orlean's MOTION system are but a few examples.

Traffic Citation System

This type of system automates the retrieval of information obtained from traffic citations for the purpose of providing investigative leads.* Based on vehicle and/or suspect descriptors from a case under investigation citation data can be searched for matching descriptors in order to identify a suspect. Such systems are rare; the only examples we discovered were the citation components of the Oakland CRIME system and the Long Beach (California) Public Safety Information System.

Property System

Information on stolen articles or on both stolen and pawned articles form the basis for this type of system. The retrieval of

*Citation systems developed for other purposes such as reporting do not concern us here.

stolen article information is automated in order that items of concern can be queried to determine if they have been reported stolen. Systems also having information on pawned articles attempt to match pawned articles to stolen articles in order that they can be recovered and a lead obtained. In these systems, the information on pawned articles is itself sometimes used to provide leads. Most agencies have access to either a state or local system with stolen article information, but few agencies have systems handling both stolen and pawned articles. The only examples known to the author are the Indianapolis property system (see Section III), the Oklahoma City property system, and Norfolk's TESACS* system.

Worthless Document System

Descriptive information from forged documents, such as names, addresses, and identifying numbers, is automated in this type of system for the purpose of correlating forgery cases perpetrated by the same offender. The assignment of correlated cases can then be consolidated and, if appropriate, the combined case given a higher priority. The Los Angeles Automated Worthless Document Index is apparently the unique example of such a system.

THE SELECTION OF THREE CASE-STUDIES

In order to assess the effectiveness of these investigative systems, we conducted three in-depth studies. The selection of the systems for this analysis was based in part upon two general criteria: (1) the system should appear (based on the preliminary information) to be an exemplary system of its type and (2) there must exist data to permit an analysis of the effectiveness of the system.

One of the systems we selected was New York's new automated latent fingerprint system. We selected it since it represents the

*Tidewater Electronic Stolen Articles Control.

newest development in latent fingerprint systems (and since, because of this, it is one of the few systems not included in the very comprehensive study of (operational) latent fingerprint systems conducted by Project SEARCH.*) We preferred to study a latent rather than an inked fingerprint system, since the former is more closely tied to criminal investigation. Our assessment is given in Section II.

Secondly, we selected the Indianapolis property system to assess since (1) it handled both stolen and pawned property and (2) it handled nonserialized, as well as serialized articles. The latter makes the system, as far as we know, unique. This study is reported in Section III.

The third case-study was of Los Angeles's Automated Field Interview System. Besides having a wealth of data for evaluation, the system is particularly interesting since the inclusion of arrest data, as well as standard field interview data, in the system makes it equivalent, in our terms, to a combination of a physical characteristics system, a vehicle characteristics system, and a field interview system. Section IV is the report of this case-study.

No case-studies of other types of systems were conducted because of both the unavailability of existing data to assess the effectiveness of the systems and because of the resource limitations for this portion of the criminal investigation study.

*"Report on Latent Fingerprint Identification Systems," Project SEARCH Technical Memorandum No. 8, March 1974.

II. CASE STUDY: THE NEW YORK CITY LATENT FINGERPRINT IDENTIFICATION SYSTEM

In October 1974, the first automated optical latent fingerprint identification system to be used in operational environment was installed in the New York City Police Department.* Housed in the Latent Fingerprint Unit at the Department's Headquarters, the system now serves all five Boroughs of the City. It was developed by the McDonnell Douglas Electronics Company and consists of electro-optical and photographic equipment that automatically compares latent fingerprints with inked fingerprints..

PURPOSES OF THE NEW YORK SYSTEM

As for all latent fingerprint identification systems, the principal purpose of the New York system is to aid in the identification of latent fingerprints from cases under investigation. It assists in matching such prints to inked prints of known offenders taken at the time of their arrest. It is used when no specific suspects have been identified or when those tentatively identified have been eliminated. When the names of specific suspects are available, their fingerprints are checked manually outside of the system. This system is not used as an inked fingerprint identification system, that is, to match the inked prints of an arrestee to the inked prints of previous arrestees in order to tie the arrestee to his prior criminal record.**

*It is considered a prototype system being tested in an operational environment.

**The New York system was, however, tested as an inked fingerprint system in the Project SEARCH holography study. See third reference listed in the Bibliography.

DESIGN APPROACH OF THE NEW YORK SYSTEM

Most latent fingerprint identification systems are based on one of several fingerprint classification schemes. Each fingerprint is manually assigned a code, and latent and inked prints are compared by means of their respective codes with either a computer or search and retrieval equipment (such as Kodak's MIRACODE system). With the McDonnell Douglas system, however, latent and inked prints are compared optically, rather than by assigned codes.

The optical comparison is performed by a technique called matched filter correlation.* It is a process involving optical transformation and correlation of images using coherent light, such as in a laser beam. A measurable light intensity is produced which is proportional to the similarity of the images being compared.

Theory

The technique depends on a physical property of lenses, namely, if a photographic transparency of a two-dimensional pattern such as a fingerprint is placed in the front focal plane of a lens and illuminated by a coherent light beam, then the light pattern which appears at the back focal plane of the lens is a unique mathematical transformation of the input pattern, known as a Fourier transform. The technique relies also on a mathematical property of such Fourier transforms: the inverse Fourier transform of the product of the Fourier transforms of two patterns is a direct measure of the similarity of the patterns. Together these properties enable electro-optical systems to directly measure the similarity of two fingerprints.

Application

In the McDonnell Douglas system, master-file inked fingerprints and latent fingerprints are introduced for comparison on microfilm transparencies mounted in so-called aperture cards. In the comparison

*For a more detailed description of the technical basis of this system, see reference 1 or 2. The material presented here was drawn directly from them.

process, the inverse Fourier transform of the product of the Fourier transforms of the fingerprints being compared is measured to determine the inked prints most likely to match the latent print. This is accomplished in a series of operations:

1. The Fourier transform of the microfilm image of a latent print is produced by means of a lens and laser.
2. The transformed image is recorded photographically on a filter.
3. The Fourier transform of the microfilm image of an inked print is produced, again by means of lens and laser.
4. The latent print filter is illuminated with the transformed image of the inked print, the emergent light being proportional to the product of the Fourier transforms of the latent and inked prints.
5. The emergent light is focused with a lens to produce the necessary inverse Fourier transformation.
6. The intensity of the focused light is measured to determine the degree of match between the fingerprint images.

HARDWARE COMPONENTS OF THE NEW YORK SYSTEM

The McDonnell Douglas system has five distinct components. Two of these, the filter maker and the comparator, were developed specifically to perform the six operations mentioned above. The other three are for general use with aperture cards.

Filter Maker

The first two operations discussed above are performed by the filter maker. From an aperture card with a microfilm image of the latent print, this component produces a filter with a transformed image of the latent print. To produce a single filter from start to finish takes about 20 minutes. Only about half a minute is required, however, in the filter maker itself; the remainder of the time is for development. With current equipment which allows filters to be developed in batches of up to about 20, an entire batch can be produced in about 30 minutes.

Comparator

The vital hardware element of the system is the comparator, which has two components: one optical, the other digital.

The optical component, by performing the last four of the six operations listed above, accomplishes the actual image comparison of latent with inked fingerprints. It transforms the aperture-card image of an inked print, illuminates the latent print filter with this transformed image, focuses the emergent light, and measures the intensity of the light to determine the degree of match. It is, in fact, able to compare the latent image simultaneously with the ten rolled inked print images contained on each master-file aperture card. By the use of masks, the system also has the capability to compare the latent with the inked prints of selected fingers only. The comparator sorts the input master-file cards into four hoppers according to the degree of match between the latent print and the most closely matched of the ten rolled prints on each card. Those cards with the highest degree of match are placed in the first hopper; those with the lowest are placed in the fourth. The degrees of match assigned to the four hoppers can be altered with what is called the automatic reference control (ARC) gain. By adjusting the ARC gain, cards sorted into a single bin can be more finely segregated.

Prior to the comparison performed by the optical component, the digital component can screen master-file aperture cards by comparing the information keypunched onto them with any corresponding information known for the case in which the latent print was obtained. The suspect's race, sex, and fingerprint pattern types for each finger can be recorded on comparator registers for the purposes of this screening. A code select control allows the comparison of fingerprint types to be made on the basis of a match with either all or at least one of the registered fingerprint pattern types.* The digital component rejects all records not matching the registered information, the rejected records being assigned to the fourth hopper.

The comparator is able to process master-file aperture cards at a rate of about four per second.

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*The comparison is made on the basis of a match with all registered types whenever the control is set in either the KP or AND positions. It is made on the basis of a match with at least one of the registered types whenever the control is in the OR position.

Other Components

The remaining hardware components of the system are for aperture-card preparation and viewing. The aperture-card camera processor produces aperture cards from latent prints for use in the filter maker and viewer and from standard inked-fingerprint cards for inclusion in a master-file of recidivists. It makes photographic reductions and from them produces silver-halide-film aperture cards. Each card takes about 45 seconds to produce.

The aperture-card diazo copier makes inexpensive diazo aperture card copies from the silver-halide originals for operational use in the comparator. Each copy takes only three or four seconds to produce.

The aperture-card viewer, the final component, provides the means by which fingerprint technicians perform the final manual comparisons of inked with latent prints. Aperture card transparencies of latent and inked prints can be simultaneously projected onto a screen for comparison. In New York, four such viewers are used.

THE MASTER FILE IN THE NEW YORK SYSTEM

Any latent fingerprint identification system is dependent upon a master file of inked impressions against which latent prints can be checked. Files are usually constructed by selecting the inked prints taken at the time of arrest of certain classes of arrestees.

Print Selection for the Master File

In New York, a fingerprint file had been selected and maintained for the previous manual system. This existing file became the master file for the new automated system. It contains the inked prints of some 135,000 recidivists in selected crime categories who have been arrested at least once during the past seven years. Approximately 60 percent of those included are burglars and another 25 percent are robbers. Most of the remainder have either narcotics or sex crime records, though a few hijackers and terrorists are also included.

Master File Creation

The manual system had used the standard 8" by 8" fingerprint cards containing a rolled and a flat impression of each of the arrestee's fingers. For the new system, they were converted to aperture cards in which a microfilm transparency of the standard card is mounted into the

aperture. Furthermore, information about the arrestee and the crime for which he was arrested was keypunched directly onto the aperture cards. This information includes the race and sex of the arrestee, a fingerprint pattern type for each of his fingers, his identification number,* the type of crime for which he was arrested, the precinct in which the crime was committed, and the month and year of arrest.** Fingerprint patterns are classified by a one-digit code simply as plain arch, tented arch, radial loop, ulnar loop, or whorl.

Master File Maintenance

To update the file, approximately 100 aperture cards with prints of recent arrestees are added daily. As yet, no cards have been purged from the file.

Master-file aperture cards are actually maintained in duplicate. One file consists of relatively expensive silver originals, the other of inexpensive working diazo copies. When a diazo copy becomes torn or worn, another diazo copy is made from the corresponding silver original.

Both copies of the master file are organized into subfiles according to the type of offense and precinct of occurrence.

LATENT PRINT SEARCH PROCESS IN THE NEW YORK SYSTEM

A latent print is dusted at the scene of a crime by a police officer. The print is photographed and sent to the Latent Fingerprint Unit at Headquarters. There the search process to match the latent print with the inked print of a previous arrestee is undertaken.

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*The identification number may be either the New York City booking number or the New York State Identification and Intelligence System (NYSIIS) number.

**The month and year of arrest has been keypunched only on cards added to the original aperture card file.

Screening

All prints received at the Latent Unit are screened in the series of steps shown in Fig. 1 to determine if they should be searched. The data shown are based on the more than 2000 prints received by the Latent Unit between 1 January and 30 May 1975.

Each latent print received is first checked to see if it contains all of the necessary points of identification. Twenty-six percent of the prints are found to be without these points, are of no value, and are not searched.

A check is then made against prints of persons having legitimate access to the crime scene; another 26 percent are not searched because they match such elimination prints.

A manual comparison is then made with prints of any suspects thus far developed through investigation. About four percent of all prints received are identified on the basis of such suspect identification.* The remaining 44 percent of the prints are checked in the final screening step to determine the type of search that can be made. Some can be searched on the comparator, others only manually, and some not at all.

Some prints, though they are adequate to check a specific suspect or to be used as evidence in court, are inadequate in quality or are too fragmentary to be searched either manually or with the comparator.

A few prints are prints of palms, second joints or fingertips. Because inked prints of these types are not routinely taken of arrestees, such prints can be identified only by taking and checking corresponding prints of an in-custody suspect. None of these can be searched by man or machine.

Other prints are obtained from prints or textured surfaces. Unfortunately, the comparator cannot distinguish the fingerprint patterns from patterns introduced by such surfaces. Consequently, these prints are

*A small number of additional suspect identifications are made after prints have been unsuccessfully searched against master file prints.

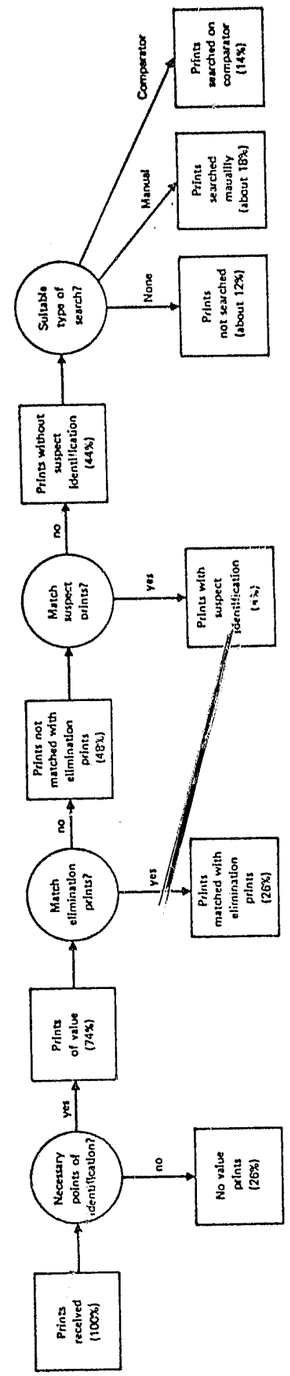

Fig. 1—Screening of latent prints

unsuited for search on the comparator. Such prints may, however, be searched manually. Whether an individual print is manually searched depends upon the seriousness of the offense, the rarity of the fingerprint pattern type, the existence of distinctive characteristics in the print, and the extent of information on the suspect, including in particular the fingerprint pattern types of other fingers.

Some prints are too fuzzy for a good quality filter to be made. Such prints cannot be searched on the comparator, though these too can be checked manually. Whether or not the manual search is performed depends upon the criteria just mentioned.

The remainder of the prints can be searched on the comparator. Of the 44 percent checked in the final step, it is thought that about 18 percent are manually searched and about 12 percent not searched at all. It is known that 14 percent of the prints are searched on the comparator.

Comparator Search

In order to perform a search on the comparator, the photograph of the latent to be searched is first converted to a silver aperture card. This is accomplished with the aperture-card camera processor. A filter is then produced from this card with the filter maker.

The comparator is then used to perform the search. The filter of the latent print is mounted in the comparator. If it can be determined that the latent was produced by a specific finger or by one of several fingers, a mask blocking out the prints of other fingers on master file aperture cards is inserted into the comparator. By this means the optical component compares the latent print with only the prints of fingers that might have produced it.

Any information on the race, sex, and fingerprint pattern types of the suspect in the case for which the search is being made is registered on the comparator for a digital check against corresponding information keypunched onto the master file aperture cards. The code select control is set to indicate whether all or at least one of the fingerprint pattern types indicated on the aperture cards must be the same as the registered

pattern types. The ARC gain is set to regulate the degrees of match to be allocated to the four output hoppers.

Master file aperture cards are then selected for comparison with the latent print, the selection being based on the type and precinct of occurrence of the offense for which the identification is being sought. The chosen cards are placed in an input hopper in the comparator.

The comparator is then started; aperture cards are fed in at the rate of four per second. Cards not passing the digital check are output in the fourth hopper. Cards passing this check are assigned to one of the four hoppers as a function of the highest degree of match with the latent among the 20 prints on the card. Those cards with the highest degrees of match are assigned to the first hopper; those with the lowest degrees of match are assigned to the fourth hopper, along with those not passing the digital check. When appropriate, the ARC gain is adjusted and the cards from certain bins rerun to obtain a finer ranking by the degrees of match.

A set of aperture cards from bins with higher degrees of match are then selected for manual search. The prints on these cards are visually compared with the latent print on an aperture card viewer by a fingerprint technician. If the technician does not know which finger produced the print, he must check ten prints on each card. If he knows the print to be from one of several fingers he need only check the prints for those fingers on each card. If a match is found, a final check is made with the original 8" by 8" fingerprint card.

UTILIZATION AND PERFORMANCE OF SYSTEM

To observe how the new system was being used and what results were being obtained, we selected a sample of 100 case-searches for detailed examination. At the time of our examination, the system had been used for about 170 searches. We chose the most recent hundred; they spanned the period of 30 January to 27 March 1975.

Offense Types

The types of offenses for which searches in our sample were made is shown in Table 1. Seventy-five percent are burglaries; 12 percent are robberies. The remainder are mostly homicides or rapes.

Table 1

OFFENSE TYPE DISTRIBUTION

Type of Offense	Percent of Case-Searches[a]
Burglary	75
Robbery	12
Rape	7
Homicide	4
Other	2
Total	100

[a]100 case-searches made by the New York System between 30 January and 27 March 1975.

Multiple Filters

Sometimes more than one latent print is lifted in a case. If more than one passes each of the screening checks on latent prints, a filter for each print may be produced to be used in the comparator for comparison with master-file aperture cards. Among the 100 case-searches we examined, 10 percent used two filters; all others used only one.

Comparator Component Use

As discussed previously, the comparator has both an optical and a digital component. These components may be used jointly or individually to perform a search. When no information is recorded on the registers for the digital check, only the optical component functions. When the code select control is set in the KP (for Keypunch) position, only the digital component functions.

Table 2 shows the frequencies with which the two components of the comparator are used in the case-searches. A component is considered to be used in a search if it was used in processing at least some of the master file records in that search. In 89 percent of the 100 searches, both components were used. The digital component was used alone in 9 percent of the cases and the optical component alone was used in the remaining 2 percent.

Table 2

COMPARATOR COMPONENT USE

Components Used	Percent of Case-Searches[a]
Digital and optical	89
Digital only	9
Optical only	2
Total	100

NOTE: A component is considered to be used in a case-search if it was used to process at least some master file records in that search.

[a]100 case-searches made by the New York System between 30 January and 27 March 1975.

Digital Component Check

When the digital component of the comparator is used, information coded onto master file aperture cards is checked against corresponding information known for the case for which the identification is being sought. Race, sex, and a fingerprint pattern type for each finger are

included on the master file cards.* In the digital check, this information is compared with corresponding information for the case at hand. Recidivist records that do not match are rejected outright, records that do match are retained for further comparison, usually with the optical component of the comparator.

In those cases in which a victim or witness sees an offender, his race and sex will typically be known. This information can be recorded in race and sex registers on the comparator in order that recidivist records with differing race or sex will be eliminated as potential matches. In our sample of 100 case-searches, race was indicated in only 11 percent, and sex was indicated in only 7 percent.

Some information is always available on fingerprint pattern types. The latent print itself provides the fingerprint type of at least one finger, though there may be uncertainty as to which finger. Frequently, partial latent prints of adjacent fingers are sufficiently complete to also be categorized. Such information can, like race and sex, be recorded on comparator registers for comparison with master file cards.

For fingerprint pattern types, the comparator provides two logical modes for the comparison. One mode uses and logic. In this mode, the comparator rejects all master file cards that do not match all of the fingerprint types indicated on the register. The other mode uses or logic. Only master file cards that do not match at least one of the fingerprint pattern types indicated on the registers are rejected in this mode.

If, for example, the technician knows from a latent print of one finger and a partial latent print from an adjacent finger that the offender's second and third right-hand fingers are both plain arches, he could code this type in the registers for these two fingers and select the and mode. The comparator would then reject all records for which

*Precinct and offense type are also included. Because of the organization of the master file into subfiles according to precinct and offense type, the selection of master file cards from certain precincts and of certain offense types is made in the selection of the subfiles to be processed. Consequently, there is no need for a capability to check on either the precinct or offense type. In fact, the component provides the capability to check the latter, but not the former.

both the second and third right-hand fingers are not plain arches. On the other hand, if, from a single latent print, he knows only that the offender has a double-loop whorl on one unknown finger, he could code this type on all ten fingerprint registers and select the or mode. The comparator would then reject all records for which at least one finger was not a double-loop whorl.

Table 3 shows the relative frequency with which the modes were selected in our sample. In 75 percent of the case-searches, the and mode was used exclusively; the or mode was used exclusively in 18 percent of the searches.* Four percent used both modes. Three percent used no mode; no fingerprint pattern types were recorded on the register in these cases.

Table 3

DISTRIBUTION OF LOGICAL MODE

Mode	Percent of Case-Searches[a]
And	75
Or	18
Both	4
None	3
Total	100

[a]100 care-searches made by the New York System between 30 January and 27 March 1975.

A description of the fingerprint patterns coded in our sample cases is shown in Table 4. The average number of patterns and the average number of fingers per pattern is given according to the logical mode employed.** In the and mode, an average of 1.2 patterns with an average

*When only a single fingerprint pattern type is coded, the digital component functions identically in either the and or or mode. All such instances are considered to have used the and mode.

**About half of the cases using multiple patterns employed two filters.

of about two fingers per pattern were coded. In the or mode, the number of patterns coded averages only slightly less, but the number of fingers coded per pattern averages more than seven. In those few instances when both modes were used, an average of 2.2 patterns with about seven fingers per pattern were coded. The use of no logical mode corresponds, of course, precisely to those cases for which no patterns were coded.

Table 4

CODED FINGERPRINT PATTERNS
BY LOGICAL MODE

Mode	Coded Fingerprint Patterns	
	Average Number of Patterns	Average Number of Fingers per Pattern[a]
And	1.2	1.9
Or	1.1	7.3
Both	2.2	6.6
None	0.0	0.0
Overall	1.2	3.0

[a]Computed as the average, across identifications, of the number of fingers per pattern, when only one pattern is used, or the average number of fingers per pattern, when more than a single pattern is used. These results apply to 100 case-searches made by the New York System between 30 January and 27 March 1975.

Optical Component Check

When the optical component of the comparator is used, an actual image comparison of the latent print with inked prints is made. The comparator has the capability of optically comparing the latent print simultaneously with the ten rolled-print images on each master file card. It also has the capability, however, of making the comparison only with the prints of selected fingers on each card. This is accomplished by the use of masks that block out the prints of all but the

selected fingers on the master file aperture cards. When a fingerprint technician has a latent print that he knows to be the print of a right index finger, for example, he would typically use a mask that blocks out all prints on master file aperture cards except that finger. By this means, the comparator would compare the latent print with only the right index finger on each aperture card.

The distribution of the number of fingerprints on each master file card optically compared with the latent is shown in Table 5. In 66 percent of the sample of 100 cases, only a single fingerprint from each card was compared with latent print. Five fingers from each card were compared in 8 percent of the 100 cases. In 15 percent of the cases, no mask was used and all ten fingers were optically compared. No aperture card fingerprints were compared to the latent in 9 percent of the cases; only the digital component of the comparator was used in these instances.

Table 5

DISTRIBUTION OF OPTICALLY
COMPARED FINGERPRINTS
PER MASTER FILE
APERTURE CARD

Number of Fingerprints Compared	Percent of Case-Searches[a]
0	9
1	66
3	1
5	8
7	1
10	15
Total	100

NOTE: For case-searches using two filters and different size masks for each filter, the average number of fingers in the masks is used.

[a]100 case-searches made by New York System between 30 January and 27 March 1975.

Selection of Recidivist Subfiles

In attempting to identify a latent print, the fingerprint technician must select records from the master file of inked prints of recidivists to be compared with the latent print. As discussed previously, these inked-print records are subfiled according to both the offense type and the precinct indicated in the arrest reports on which the records are based. The technician selects the records from several such offense-precinct subfiles for comparison with the latent print.

Table 6 shows, for our sample of 100 case-searches, the average number of subfiles selected of each offense type, according to the offense type of the case in which the latent print was obtained.

Table 6

OFFENSE-PRECINCT SUBFILES SELECTED
BY CASE OFFENSE TYPE

Case Offense Type	Average Number of Subfiles Processed per Case-Search,[a] by Subfile Offense Type					
	Burglary	Robbery	Narcotics	Sex Crimes	Other	Total
Burglary	5.1	0.3	3.2	0.0	0.0	8.7
Robbery	0.5	6.2	1.2	0.0	0.0	8.0
Rape	3.4	2.2	1.6	2.6	0.0	9.8
Homicide	3.2	3.5	4.8	0.0	0.0	11.5
Other	2.5	5.5	1.0	0.0	0.0	9.0
Overall	4.2	1.4	2.8	0.2	0.0	8.8

NOTE: Successful identifications are excluded because of termination of processing at the point of identification.

[a]100 case-searches made by New York System between 30 January and 27 March 1975.

The entries indicate the average number of precincts selected for the indicated subfile offense type. In burglary cases, shown in the first row, an average of 5.1 burglary-precinct subfiles, 0.3 robbery-precinct subfiles, and 3.2 narcotics-precinct subfiles were selected. That is, the inked prints of recidivists for burglaries in about five precincts and for narcotics crimes in about three precincts were selected for

comparison with the latent print. In robbery cases, on the average, six robbery-precinct subfiles and one narcotics-precinct subfile were selected. Recidivist records for burglary, robbery, narcotics crimes, and sex crimes were selected from two or three precincts for the attempted identification in rape cases. In homicide cases, an average of three burglary, three robbery, and five narcotics-precinct subfiles were selected. Overall, about nine offense-precinct subfiles were selected for an average case-search.

Screening of Inked Prints

The performance of an automated latent fingerprint system is best assessed by its ability to screen out inked prints not matching, or at least unlikely to match, a given latent print. One would like to screen as large a proportion of the inked prints as possible, while maintaining a low likelihood of eliminating a matching print. In observing a system in an operational setting, one can typically determine the proportion of prints screened out, though one cannot learn the proportion of matches erroneously eliminated in the screening process, because these eliminated matches are rarely discovered. A test situation is needed to estimate the latter failures.

The McDonnell Douglas system does not screen individual prints but rather sets of ten prints on master file aperture cards. These aperture cards are screened by both the digital and the optical components. Because it is the optical component that is the novel feature of this system, we are particularly interested in assessing its performance.

The screening accomplished by the digital component is dichotomous: cards are segregated into those potentially containing a match and those not. The amount of screening accomplished by this component is measured simply by the proportion of aperture cards classed as not potentially containing a match.

The optical component differs in that cards are not dichotomously separated, but rather are sorted according to the degree of match of the most closely matched print on each card. The amount of screening actually accomplished by this component can be measured as the proportion of cards passing the digital check that are not manually examined after optical processing.

Information on the screening of master file aperture cards is shown in Table 7, according to the logical mode used in each of the case-searches. Unfortunately, the information is incomplete primarily because under some conditions,* the digital and optical components function simultaneously, making it impossible to determine the number of cards passing the digital component check; and secondarily, because of unrecorded information. The rows of the table correspond to the various logical modes, the cases using the AND mode being divided into those with complete information and those with incomplete information. The first column gives the number of case-searches using each logical mode. The three remaining columns indicate the average number of aperture cards at each of three processing steps. The first of these three shows the number of cards input into the system, the second shows the number of cards passing the digital component check, and the last gives the number of cards examined manually by a fingerprint technician.

Complete information for all three processing steps was obtainable for only the 52 sampled case-searches listed in the first row. Each used the AND mode. On the average, about 3900 master file aperture cards were input for these searches, of which about 1100 (28 percent) passed the digital component check. The digital component was able to screen out 72 percent of the input cards as not potentially containing a match to the latent print. Of the 1100 cards passing the digital component check, 290 (26 percent) were manually examined. The optical component was used to rank the 1100 cards passing the digital check and the top 26 percent of these were selected for manual examination.

Complete information was not obtainable for all three processing steps for the other 48 case-searches. The input of cards was roughly 3500 for each of the various mode classifications, aside from none. The number of cards passing the digital check could usually not be obtained. The seven cases using the AND mode and falling in Category 2, for which the number passing the digital was obtained, represented about the same proportion of the cards input as those falling in Category 1.

*When the code select control is set in either the AND and OR setting.

Table 7

PROCESSING OF MASTER FILE APERTURE CARDS

Logical Mode	Number of Case-Searches	Average Number of Aperture Cards Processed by Processing Step		
		Input	Passing Digital Component Check	Manually Examined
AND (Category 1)[a]	52	3911	1104	290
AND (Category 2)[b]	23	3413	1090[c]	513[c]
OR	18	3752	(d)	523[c]
Both	4	3439	(d)	680[c]
None	3	2241	2038[c]	344
Overall	100	3702	(d)	368[c]

NOTE: If more than one fingerprint pattern or more than one filter is used, aperture cards are usually processed more than a single time. The figures shown for cards input and cards passing digital component check indicate distinct cards, while the figures shown for cards manually examined indicate total cards.

[a]The term Category 1 designates those case-searches using the AND mode for which data for all three of the processing steps could be obtained.

[b]The term Category 2 designates those case-searches using the AND mode for which data for at least one of the three processing steps could not be obtained.

[c]Based on incomplete information.

[d]Indeterminate.

While no information was available on cases using the OR mode, it can be assumed on the basis of the less restrictive nature of that mode that the number of cards passing the digital component check was substantially larger.

Overall, an average of about 3700 cards per case are input, of which about 10 percent are ultimately examined by a fingerprint technician. While the proportion of input cards passing the digital component check and the proportion of those passing the check that were manually examined could not be precisely ascertained, we estimate that about 40 percent of the input cards pass the digital check and of these about 25 percent are examined by a fingerprint technician.

Identifications

The ultimate goal of a latent fingerprint system is to enable fingerprint technicians to match a latent print to the inked print of a previous arrestee. The frequency with which our sample of 100 case-searches culminated in identification of a latent print is shown in Table 8 by type of offense. Overall, 5 of the 100 searches culminated successfully, 3 identifications being in burglary cases, 2 in rape cases. As of 25 June 1975, a total of 370 case-searches had been made with the new system. Sixteen of these, or 4.3 percent, led to a successful identification of the latent print.

Table 8

IDENTIFICATIONS BY OFFENSE TYPE

Type of Offense	Number of Case-Searches[a]	Number of Identifications
Burglary	75	3
Robbery	12	0
Rape	7	2
Homicide	4	0
Other	2	0
Total	100	5

[a]Made by the New York System between 30 January and 27 March 1975.

Optical Component Test

About 25 percent of the master file cards passing the digital check and ranked by the optical component were estimated to be manually examined. The 25 percent rate is, for the most part, set as a matter of policy--a policy based on the results of a test of the optical component.

This test consisted of a comparison of 50 latent fingerprints against a master file of 2500 aperture cards of inked prints that contained a match for each of the 50 latent prints. Each latent print was searched against the entire master file. The digital component was not used. Masks were sometimes used, the intent being to use masks when they would be used in an actual attempted identification. Cards in the

master file were ranked in order of closest match with the latent print, and the percentile ranking in the file of the correct match was noted.

The results of that test are shown in Table 9, which gives the cumulative distribution of the percentile rank of the card containing the matching print. For 36 percent of the latent prints, the correct match was in the top 5 percent of the ranked master file. The top 25 percent of the ranked file included 94 percent of the correct matches.

Table 9

OPTICAL COMPONENT TEST RESULTS: CUMULATIVE DISTRIBUTION OF PERCENTILE RANK OF CARD WITH MATCH

Range of Percentile Rank of Card with Match	Percent of Cases
0-5	36
0-10	56
0-15	76
0-20	88
0-25	94
0-30	96
.	.
.	.
.	.
0-100	100

SOURCE: Results of July 1974 test obtained from New York City Police Department.

NOTE: The test consisted of a comparison of 50 latent prints against a file of 2500 sets of inked prints that included a match for each of the 50 latent prints. Masks were sometimes used.

Under the assumptions that the optical component would perform as well in an operational as in a test environment and that the digital component check would be roughly independent of the optical comparison,

the Department specifies that about the top 25 percent of cards passing the digital check should be examined, and expects about 94 percent of existing matches to be found.

CURRENT EFFECTIVENESS OF THE NEW YORK SYSTEM

Because the innovative element of the New York McDonnell Douglas system is its optical component, we focus on its performance. About 25 percent of the cards passing the digital component check will be manually examined in conformance with Department policy. Thus, the optical component should serve to divert 75 percent of those that passed the digital component check. To assess the capability of the current system to do this, it is helpful to consider an alternative system identical to the current one except in two important respects: (1) it has no optical component and (2) the digital component is modified slightly so as to be able to handle two-character fingerprint classification schemes.

Suppose, for simplicity of argument, that we have a two-character fingerprint classification scheme that augments the one-character scheme of the current system with a second character that subdivides each of the categories in the one-character scheme into four equally frequent subcategories. Patterns categorized simply as radial loops in the one-character scheme might, for example, be subcategorized according to ridge count. Let us use this two-character scheme in our hypothetical digital system to classify both inked and latent prints.

Visualize a search with this system of a latent print for which the specific finger producing the print is known. (In at least 75 percent of our sampled cases, the specific finger producing the print was known.) The two-character code for the latent can then be compared to the code for the appropriate finger on each master file card. Because the second character divides the class represented by the first character into four equally sized subcategories, on the average only 25 percent of the master file cards passing the digital check of the single-character code under the current system would pass the digital check of the two-character code under our alternative system. The additional character of the classification code should thus be able to screen out

as many cards as the optical component of the current system is expected to eliminate.

In most cases where the finger producing the print is known, the prints of <u>other</u> fingers are typically available and are usually checked with the digital component. (The average number of fingers coded in the sampled cases using the <u>AND</u> mode was 1.9.) By making a digital check on two-character codes for these as well, the benefit from the additional character is much greater. On the other hand, in cases where the finger producing the latent is unknown, the benefit from the additional character is not so great.

We infer that the all-digital system with its hypothetical two-character classification scheme would eliminate about as many master file cards as the current system, while achieving about the same rate of identification. By eliminating the optical comparison, we would gain three major advantages. First, the system could be used to check many additional latent prints, such as those from printed surfaces, that can now be searched only manually. Secondly, it would be much less expensive, since the bulk of the cost of the current system is due to the optical hardware. (The incremental cost for the hypothetical all-digital system would be for the coding of the additional character for each inked print. For New York City, which adds about 25,000 cards per year, the incremental time required to code the additional character would probably be only about a one-half man-year.)* Finally, it would be much faster, since it is the optical component which consumes most of the processing time in the existing system.

While the all-digital system is based on a <u>hypothetical</u> classification scheme, schemes do currently exist that are thought to have about the same screening capability and others exist that certainly have a much greater capability. The first and second, or first and third character of the Three-Digit Miracode Classification System,** for example,

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*Based on classification time estimates for the NCIC, Single Fingerprint Classification Code, Numerical Classification Format System, and Three-Digit Miracode Classification System as given in Ref. 5, Appendix A.

**See Ref. 5, Appendix B, for a description of each of the classification schemes discussed in this paragraph.

would likely have very roughly the same screening capability as our hypothetical system. The complete Three-Digit Miracode System, the Numerical Classification Format System, and the Battley System provide much greater screening capabilities though some additional time would be required to accomplish the more detailed coding.

Recapitulating, the all-digital system with its hypothetical classification scheme, compared with the McDonnell-Douglas New York system as currently operated and equipped, could screen out as many master file cards, could be used to search prints now processed manually, would cost substantially less, and would be much faster. Against this standard, the current New York system must be regarded as deficient.

IMPROVEMENT OF NEW YORK SYSTEM EFFECTIVENESS

We have discerned two means by which the effectiveness of the system can be markedly improved. One involves the development of an additional hardware component; the other, a change in policy used in conjunction with the additional component.

An Additional Hardware Component

With the current system, all prints from fingers potentially producing the latent print must be examined on the high-ranked cards, for there is no means of perceiving the individual prints on the cards that are closely matched to the latent. The original system contained a component to perform this function; it displayed images of the closely matched prints for examination by fingerprint technicians. The images were, however, of inadequate optical quality so the component was abandoned. Presumably, this component could be improved or another developed that would be suitable for use by the technicians. If so, only the individual highly ranked prints would need to be examined.

Policy Change

Under current policy, the prints on 25 percent of the cards passing the digital component check are examined. The 25 percent level is applied regardless of the number of prints on each card that are optically compared, that is, independently of the use of masks. Not taking

the use of masks into account causes manual searches to be inefficient. This inefficiency could be eliminated if the additional component described above is developed.

Given the operation of the additional component, so that only the closely matched prints on each card need be examined, then under current policy the percent of highest-ranking cards to be examined would remain fixed at 25 percent. This would imply the examination of a varying percentage of the most closely matched prints, the percent varying as a function of the number of optically compared prints per card. For example, examination of 25 percent of the highest-ranked cards might result in an examination of as little as 3 percent* of the most closely matched prints when no mask is used and all ten prints are optically compared, or an examination of 25 percent when a one-finger mask is used and only one finger compared.

Efficient utilization of resources requires, however, that the marginal utilities of the last print searched in each case be equal, or, equivalently, that the degrees of match of these prints with the corresponding latent prints be equal.** This can be accomplished by a policy that specifies a varying percentage of cards to be examined, where the percentage varies, according to the size of the mask used in the search, in such a way as to equalize the percentage of most closely matched prints that are examined.*** The specific percentages could be determined by a series of tests, similar to the one described earlier (p. 28), but in which a specific size mask is used in each test.† By selecting percentages of cards across the tests that equalize the identification rate of existing matches, one could also equalize the percentage of most closely matched prints that are examined.

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*Based on an assumption of independence of prints on a card.

**We disregard differences in importance of cases.

***Alternatively, it may be possible to accomplish this by means of a control setting on the additional component corresponding to a certain degree of match so that all inked prints matching the latent to at least this degree would be manually examined.

†It is probably only necessary to do three tests, one for one-finger masks, another for five-finger masks, and a third for no mask at all, as the percentages for intermediate size masks could likely be estimated.

The tests would, in addition, reveal the extent of improvement obtainable. We believe that use of this policy, in conjunction with the additional component, would substantially enhance the effectiveness of the system. It is possible that about the same identification rate that is now obtained could be achieved with about one-sixth of the current manual examinations.* Freed manpower could potentially be used to search correspondingly larger portions of the master file with the possibility of substantially increasing the identification rate.

COST OF SYSTEM

Both initial and operational costs for the New York fingerprint identification system are displayed in Table 10.** The bulk of the initial cost is, of course, for the hardware itself. The latter includes the filter maker, the comparator, the aperture card camera processer, and the diazo copier, but excludes the viewers. The total cost of this hardware is about $290,000.*** New York has leased it for two years at a cost of $228,600 with an option to purchase at the end of that period for an additional $61,000. Additionally, about $3,000 was spent on the purchase of four aperture card viewers, and $15,000 on general support equipment such as file cabinets for the aperture card master file and a refrigerator for storing supplies for filter development. The production of the recidivist master file of some 135,000 silver aperture cards and corresponding diazo copies cost $38,000. The total initial cost for the New York system was just under $350,000.

*Based on an assumption of independence among the fingerprints of an individual.

**In New York the system is supported by $285,740 in funds from the Law Enforcement Assistance Administration (basically for lease of the hardware components, conversion of the recidivist file to aperture cards, and purchase of support equipment and supplies) and $176,000 in funds from New York City (primarily for manpower to operate the system).

***McDonnell Douglas Electronics has indicated that the cost of the components to other jurisdictions would be approximately the same.

Table 10

NEW YORK SYSTEM COSTS

Item	Cost
Initial Costs	
Hardware components[a]	$290,000
Aperture card viewers (4)	3,000
General support equipment	15,000
Master file aperture cards[b]	38,000
Total	$346,000
Annual Operational Costs	
Manpower (5 fingerprint technicians)[c]	$ 95,000
Supplies	10,000
Total	$105,000

[a]Excludes viewers.

[b]Includes both silver and diazo copies for a file of 135,000 records.

[c]Includes the technicians who run the comparator, maintain the master file, and produce the filters. It excludes the technician provided under the lease of the system to the New York Police Department. It also excludes technicians who evaluate incoming prints and technicians who manually examine the potential matches for a latent print.

Most of the costs to operate the system are personnel costs. The choice of the personnel costs to be ascribed to the system is to some extent arbitrary. We have included the $95,000 in annual salaries to support the two fingerprint technicians who run the comparator, the one who makes filters and keeps records, and two who maintain the aperture card master file.* We have excluded the two senior fingerprint technicians

*One-and-one-half persons were required to maintain the master file for the previous manual system.

who evaluate all incoming latent prints and assign cases, as well as the 13 technicians who do all of the manual comparisons of latent with inked prints, including those first searched on the comparator. The only other operational cost is for supplies such as aperture cards and filters. The total annual operating cost for the system is just over $100,000.

FINDINGS AND SUGGESTIONS

1. FINDING: The New York/McDonnell-Douglas system, as it is currently equipped and operated, is ineffectual for latent fingerprint identification relative to a hypothetical but realizable all-digital system.

2. FINDING: The effectiveness of the current system might be substantially improved by the development of an additional component and a change in policy.

   The improvement, in theory, could enable the current identification rate to be achieved with only one-sixth of the current manual examinations. Or, the same level of manpower could then search much larger subsets of the master file, and thereby increase the identification rate.

SUGGESTION: An assessment should be made of the feasibility of developing this additional component to indicate the individual highly matched prints on each master-file card.

SUGGESTION: Tests, as described in the body of this study, should be conducted to determine the actual extent to which the effectiveness of the system could be improved.

SUGGESTION: An assessment should be made as to whether further development of the system would likely result in substantial improvement of the system's effectiveness, specifically including a determination of whether its search capability can be extended to prints not now searchable.

This system is the first operational one of its type. It has demonstrated a capability to discriminate, to a degree, between matching and nonmatching prints. Conceivably, further refinements to the system might produce an effective latent fingerprint system.

SUGGESTION: Given the results of the above suggestions, the potential effectiveness of the system should be compared with that of alternatives for the development of latent fingerprint processing, including, in particular, the FBI FINDER (inked fingerprint) system modified for latent print processing.

3. FINDING: The effectiveness of the New York system or any latent fingerprint system depends upon the choice of master file fingerprint records against which latent prints are searched. Presently, the selection of records for inclusion in the master file and the choice of those to be searched against a particular latent print is unduly subjective.

SUGGESTION: A study should be conducted to develop guidelines for the construction and organization of master fingerprint files and for the choice of subfiles to be searched for match of latent prints.

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III. CASE STUDY: THE INDIANAPOLIS STOLEN AND PAWNED PROPERTY SYSTEM

In 1972, the stolen and pawned property system currently used by the Indianapolis Police Department became operational. This information system was developed by System Sciences Development Corporation with the assistance of the Department.

PURPOSES OF THE INDIANAPOLIS SYSTEM

The Indianapolis system has two principal purposes: (1) to aid in the identification and recovery of stolen property and (2) to provide investigative leads to the apprehension of the responsible thieves. To pursue these ends, it provides an automated comparison of pawned articles with articles reported as stolen and a query capability to ascertain whether described articles have been reported stolen. Pawned or queried articles found to be stolen can then be restored to owners. Investigative leads contained in information on the pawners of articles identified as stolen can then be traced.

Unlike most property information systems, the Indianapolis system is designed to process information on articles of any value not only with known serial numbers, but also with unknown serial numbers or non-serialized. (It does not, however, handle licensed vehicles.) Thus, this system is more powerful than the Indiana State and the Federal stolen property systems since the latter two do not handle articles that are pawned, without serial numbers, or low-valued.*

DESIGN OF THE INDIANAPOLIS SYSTEM

The basic element of the Indianapolis system is the individual property file into which a record for each pawned or reported-stolen article is entered. The record is intended to hold descriptive information about the article including its type, serial number, brand name,

*The State and Federal systems process information only on articles of greater than $500 value, except for color television and office equipment which can be entered regardless of value.

model number, and a series of detailed characteristic codes developed specifically to describe nonserialized articles (but which may also be used for other classes of articles).

Comparison of pawned and reported-stolen article descriptions are automatically performed when an article is first entered via video-terminals into the property file. That is, with each entry of a pawned-article description, the system searches for possible matches with stolen property; and, with each reported-stolen article description entry, a search is made for matches with pawned articles. Potential matches are immediately displayed on the terminal, and a hard-copy report listing all potential matches is produced daily.

An article need not be pawned, of course, to be checked against stolen property entries. Descriptors for any article can be entered via terminal to be compared with the corresponding descriptors of all articles held in the file. Potential matches are displayed on the terminal screen and documented in the daily report.

The design of the system incorporates an automatic interface with the property subsystems of the Indiana Data and Communications System (IDACS) and the National Crime Information Center (NCIC) System.

STATUTORY SUPPORT OF THE INDIANAPOLIS SYSTEM

To be viable, a stolen and pawned property system such as the Indianapolis system requires a full and timely reporting of articles received by pawnshop dealers and the holding of such articles until they can be compared with stolen-property descriptions. An Indianapolis ordinance* compels pawnbrokers

- o to complete a card record on each pawned article and daily to deliver cards from the previous day to the chief of police, and
- o to retain a pawned article for at least seven days after the corresponding card has been delivered to the chief of police.

*Code of Indianapolis and Marion County, 1970, Title 7, Chap. 11, "Pawnbrokers," as amended.

CHARACTERISTICS OF THE PROPERTY FILE IN THE INDIANAPOLIS SYSTEM

Data Sources for the Property File

Two source documents provide the article information for the file:

- o The stolen article reports are completed by police detectives in making theft investigations. The report form specifically provides for recording the type, serial number, brand name, model number, engravings, value, and age of each reported-stolen article. Additional descriptive information can be included.
- o The pawned article cards, mandated by municipal ordinance, are completed by pawnbrokers on all pawned articles. The ordinance specifies that the following items of information be recorded:
  - article type
  - article description (including serial number, if any)
  - article purchase price
  - amount loaned
  - time and date article received
  - broker's name and address
  - broker's ticket number
  - date reported
  - pawner's signature and address
  - pawner's description* (sex, age, height, weight, race and complexion, and clothing)
  - pawner's right thumb print.

The Indianapolis ordinance specifies that four different cards be used according to the type of article pawned (namely, watches, other jewelry, clothing, and other article types), the information entered on the cards differs only in the article description.

*A February 1975 amendment to the Indianapolis ordinance adds the requirement that a photograph be taken of each pawner.

Data Entry into the Property File

Information recorded on the above documents is entered directly into the property file via terminal. The entries must include the article type, brand name, and whether the article was pawned or reported stolen.* Serial number, model number, and value are entered, whenever available. Characteristic codes must be entered for nonserialized property and may be entered for serialized property with unknown or known serial numbers. For nonserialized property, engravings or monograms can also be entered.**

The characteristic codes entail a detailed classification of nearly 150 types of articles, for which as many as 12 characteristics are recognized. The coding of a coat, for example, would indicate whether it was a man's or a woman's, the type of coat, the size, the size class (small, regular, or large), material, primary color, secondary color, type of pattern, style, number of buttons, color of buttons, and presence of lining.

Also entered for pawned articles are the date on which the article was pawned and the pawnshop in which it was pawned, as well as the pawner's name and address as indicated on the pawned article card.*** For stolen articles, the date of theft and the corresponding case number are entered.

All stolen articles entered are automatically checked against criteria for entry into the Indiana State IDACS and Federal NCIC property systems. Descriptions meeting the criteria are routed to these systems for entry.

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*Though the system has a provision for handling recovered property not tied to any case, only one such article was found in the property file of June 1975. We have consequently disregarded such articles in this report.

**The system also permits a social security number to be entered for each article. The Department encourages residents to mark their property with their social security number as identification in event of theft. Only 44 articles in the entire file were found by us to have a social security number identification at the time of our examination (June 1975).

***In actuality, the pawner's name and address are not stored on the property file but are recorded with other information on a second file used to produce the pawner name and address reports described on p. 48.

Periodic Purge of the Property File

Most records of pawned or reported-stolen articles are not retained in the property file indefinitely. About once a year the property file is purged. Under current purge criteria, all records of pawned articles more than $1\frac{1}{2}$ months old and records of serialized stolen articles, aside from guns, more than 16 months old, are deleted. (Stolen gun records are retained indefinitely.) Records of reported-stolen articles with unknown serial numbers or nonserialized are deleted if more than 1 to 3 months old, depending on the type of article. However, a record of stolen jewelry may be retained up to 16 months if the article is sufficiently valuable.

Contents of the Property File

To ascertain the character of its contents, we examined the property file in June 1975, when it contained records for almost 13,000 articles, 82 percent of which were stolen articles and 18 percent pawned.

The distribution of file records by class of article is shown in Table 1. About 95 percent of both reported-stolen and pawned articles contained in the file were serialized items for which the serial number is known. Very few articles in the file were either serialized items with unknown serial numbers or items that were not serialized. Thus, the effort to design the system to process property without serial numbers does not appear to have been rewarded.

The distribution of file records by type of article is given in Table 2. Almost 50 percent of the reported-stolen articles and 30 percent of the pawned articles were firearms--pistols, rifles, and shotguns. Home entertainment equipment, such as televisions, radios, and stereo equipment, constituted roughly 30 percent of both stolen and pawned articles. Office equipment and photographic equipment were the next most common types.

Most types involved only serialized articles. Nonserialized articles were almost entirely of two types: about 69 percent were garments, principally expensive fur or leather coats, and about 31 percent were expensive jewelry items. The coding scheme capable of processing 150 different types of nonserialized articles was largely dormant, there being only five types present in June 1975, with three of them rare.

Table 1

NUMBER OF STOLEN AND PAWNED ARTICLES IN PROPERTY FILE BY CLASS OF ARTICLE, JUNE 1975

Class	Reported Stolen		Pawned	
	No.	%	No.	%
Serialized: known serial number	10,162	96	2,165	95
Serialized: unknown serial number	105	1	89	4
Nonserialized	323	3	27	1
Total	10,590	100	2,281	100

Table 2

NUMBER OF STOLEN AND PAWNED ARTICLES IN PROPERTY FILE BY TYPE OF ARTICLE, JUNE 1975

Type	Reported Stolen		Pawned	
	No.	%	No.	%
Firearms	5,190	49.0	688	30.2
Home entertainment equipment	3,065	28.9	784	34.4
Office equipment	717	6.8	156	6.8
Photographic equipment	346	3.3	298	13.1
Tools	325	3.1	34	1.5
Garments	249	2.3	2	0.1
Bicycles	183	1.7	1	--
Household appliances	159	1.5	8	0.4
Jewelry	143	1.4	30	1.3
Musical instruments	83	0.8	270	11.8
Other	130	1.2	10	0.4
Total	10,590	100.0	2,281	100.0

The frequency with which various items of descriptive information were given for the three classes of articles is exhibited in Table 3. Article type and brand name, required by the system for data entry for all three classes of articles, are of course always present. Serial number was found to occur for all serialized articles with known serial numbers, but never for either of the other two classes. "Model" was entered for 90 percent of articles with known serial numbers, for just under 80 percent of articles with unknown serial numbers, and for somewhat under 70 percent of nonserialized articles. Sometimes, however, a description rather than the actual model number was given. For example, the "model" of a television with unknown model number may be indicated as "portable" or "color." At least one of the characteristic codes was present for each nonserialized article, for this is required for entry of such an article into the property file. For serialized articles, the characteristic codes are almost never entered. The system permits engravings or monograms to be recorded only for nonserialized articles. Such identifiers were found in the records of only 10 percent of the nonserialized articles, a total of 34. Almost all were monograms on coats.

Table 3

FREQUENCY OF OCCURRENCE OF DESCRIPTIVE DATUM (IN PERCENT) BY CLASS OF ARTICLE IN MASTER FILE, JUNE 1975

Descriptive Datum	Class of Article			
	Serialized: Known Serial Number	Serialized: Unknown Serial Number	Non-serialized	Classes Combined
Article type	100	100	100	100
Serial number	100	0	0	95.8
Brand name	100	100	100	100
Model[a]	90.4	78.9	67.1	89.6
Characteristic codes[b]	0	1.0	100	2.8
Engravings/ monograms	0	0	9.7	0.3

[a]Often this was not the actual model number, but some descriptive information.

[b]Typically, only some of the codes were indicated. The percentage of articles with at least one code indicated is shown here.

The composition of the records in the property file would depend on the length of time since the most recent purge. The June 1975 file that we examined had last been purged in March 1975. It consequently contained about four months' recording of pawned articles, 19 months' recording of stolen articles with serial numbers (aside from guns kept since entry), and from 4 to 19 months' recording of stolen articles without serial numbers. Because so few of the records are of stolen articles without serial numbers, purging, besides reducing the overall size of the file, mainly alters the mix of stolen and pawned articles. Immediately after the March purge, for example, the property file contained about 9500 stolen articles, but only 700 pawned articles.* Regardless of the length of time since purge, the relative frequency of records for articles without serial numbers would remain very small since so few are entered. The mix of article types within the stolen and pawned categories, as shown in Table 2, should also be largely unaffected, except for firearms, the relative frequency of which should decrease with time elapsed from most-recent purging. The relative frequencies with which the various descriptive data shown in Table 3 occur should be unaffected by the time elapsed since the most-recent purge.

OPERATIONS OF THE INDIANAPOLIS SYSTEM

Matching Stolen and Pawned Property: The Entry-Query

The primary function of the system is to determine potential matches between articles reported stolen and articles pawned. This is accomplished automatically in conjunction with data entry in what we term an entry-query. With each stolen article input, the system checks for records of pawned articles in the property file possibly matching the stolen entry. With each pawned article input, the system performs a check for records of stolen articles possibly matching the pawned entry.** The system also automatically checks, with the entry of each

*This was determined by use of the entry date of articles in the June 1975 file.

**In actuality, with both stolen and pawned entries, the system checks all records in the master file, both stolen and pawned, for potential matches. We think it would be preferable to check pawned articles only against stolen and stolen articles only against pawned.

pawned article of a type meeting IDACS and NCIC criteria, for matches with stolen property in those systems.

The determination of potential matches is accomplished by means of a scoring algorithm based on the descriptive information captured on each article record. To each article in the property file, the system assigns a score of from 0 to 50 depending on the degree of match with the article being entered, a higher score indicating a closer match. The system displays on a video terminal screen those articles in the file with positive matching scores, up to a maximum of 20 articles ranked in descending order by score.

The algorithm incorporates two scoring systems: one for articles with serial numbers, known or unknown, and another for nonserialized articles. In both systems, only articles in the file of the same type can receive nonzero scores. For serialized articles a score of 50 is assigned only to an article with an identical serial number. A match on brand name of serialized articles contributes 10 points to a score. A match on model also adds 10 points to a score.* If the sum of the serial numbers of an article in the file equals the sum of the serial numbers of the article being entered, 10 points are contributed. (Thus, articles entered with transposed digits in the serial number increase a score.) Nonserialized articles are scored by assigning 20 points for a brand-name match, 10 points for a match on model, and 10 points for a match on all the characteristic codes indicated for the entered article.

Ascertaining Whether an Article is Stolen: The Simple Query

The Indianapolis system, as mentioned earlier, provides an on-line inquiry capability to determine whether or not a described article has been stolen. An article description can be entered into any of the 15 terminals, whereupon the system searches for matches with reported-stolen records, using the algorithm described above. We term such inquiries simple queries to distinguish them from the entry-queries.

*An additional point is added for each matching character of the characteristic code, among the first eight characters.

Generating Reports to Aid Investigations

The Indianapolis system routinely generates two weekly reports useful to investigators. One is the pawner name report which lists, alphabetically by the last name of the pawner, pawned article records entered into the property file.* The report includes the name and address of the pawner, the article type, the date on which the article was entered into the system, the date on which it was pawned, the pawnshop where the article was pawned, and the pawnshop dealer's ticket number. The report enables an investigator to observe easily the frequency with which an individual has been pawning, the types of articles he has pawned, and the pawnshops he has used. It is typically used to check out a specific suspect.

The second report is the pawner address report. The information contained in this report is identical to that contained in the pawner name report; it differs only in that the entries are sorted by pawner's address rather than his name. This presentation reveals individuals who pawn under different names but use the same address.**

Generating Administrative Reports

The system also generates two administrative reports on a daily basis. The entry report lists the complete records of all articles, both stolen and pawned, entered into the property file each day. The records are listed chronologically by time of entry. The hit report lists matches made with the system as the result of either entry-queries or simple queries. Each match is listed under the article being entered or queried.

Maintaining a Manual Card File

In addition to the machine-readable property file discussed above, the Indianapolis system maintains a manual card file of article records.

*The records are actually listed by the last name as coded in a specialized name coding system called soundex.

**Both the pawner name and address reports are produced from a file (auxiliary to the property file) which contains pawned-article information.

The file consists of pawned-article cards obtained from pawnbrokers and stolen-article cards prepared from theft reports.

USE OF THE INDIANAPOLIS SYSTEM

The Police Pawn Detail

The principal user of the system is the Pawn Detail under the Investigative Division. This Detail is responsible for entering and matching all stolen and pawned items except firearms. Daily visits to pawnshops are made to collect pawned-article cards and check them against corresponding articles. The items on the cards and on the stolen article reports received by the unit are screened for entry; those not eliminated are entered via the Pawn Detail's video-terminal. Under current procedures, primarily articles with serial numbers or other unique identifiers are entered. About 12,000 articles are entered annually.* Potential matches displayed by the terminal are immediately inspected. When a match with a score of 50 indicating an identical serial number is obtained, the appropriate pawnshop is notified to hold the pawned article and the detective assigned to the case is provided information concerning the match. When lower scoring matches are obtained, each is reviewed to assess the likelihood of a true match. Articles considered to be probable matches are acted on by the appropriate detective. When an actual match is made between a stolen and a pawned article, a copy of the pawned-article card is sent to the Identification Branch for identification of the thumbprint.

The Pawn Detail also makes inquiries of suspected stolen articles, mostly at the request of investigators. Approximately 18,000 such inquiries are made annually.**

The Police Crime Laboratory

The Crime Laboratory uses the property system to process stolen

*Based on the number of articles with entry dated between 1 March and 31 May 1975 on June 1975 property file.

**Based on the number of inquiries made between 23 July and 18 August 1975.

and pawned firearms. Descriptions of stolen and pawned guns are entered into the system via a Crime Laboratory terminal from the same source documents used by the Pawn Detail. About 2,000 stolen guns and 3,000 pawned guns are entered annually.* Guns received by the Laboratory are routinely checked with the system to determine if they have been stolen. Case-related guns obtained from arrestees, guns tested for registration, and guns sold and reported to the Police Department are all checked. Approximately 12,000 firearm inquiries are made annually in the Crime Laboratory.**

Other Units

Besides the Pawn Detail and Crime Laboratory terminals, 13 additional terminals located throughout the Department, as well as in the Marion County Sheriff's Office, can be used by officers to ascertain whether an article has been reported as stolen. The vast majority of these inquiries are made on the terminal in the Dispatcher's Office. For example, a patrolman stops a car and observes three televisions in the back; he then requests by radio that the dispatcher check the set descriptions. Approximately 21,000 such inquiries are made annually.***

HARDWARE COMPONENTS OF THE INDIANAPOLIS SYSTEM

All of the computer support and associated manpower for the property system is provided by the Department's Data Processing Division. The system is operated on an IBM 370/145 which services the entire Indianapolis Police Department. A direct interface exists with the State IDACS System and, through it, with the Federal NCIC System. An on-line mode is used to make entries and queries and a batch mode to generate standard reports. A total of 15 IBM 3277 Model 2 video-terminals support the on-line functions.

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*Based on the number of entries made between 1 January and 31 August 1975.

**Based on the number of inquiries made between 1 January and 31 August 1975.

***Based on the number of inquiries made between 23 July and 18 August 1975.

SYSTEM EFFECTIVENESS

We have described the two principal objectives of the Indianapolis system to be to aiding the identification and recovery of stolen property and providing investigative leads to the apprehension of the responsible thieves. Thus, appropriate measures of the effectiveness of the system would be the amount of property recovered and the number of, and results from, the investigative leads obtained. These are most conveniently discussed in terms of individual operations of the system.

Entry-Query Effectiveness

The matching of pawned and stolen (nonfirearm) articles by the Pawn Detail relates to both system objectives. To determine the amount of pawned stolen property (excluding guns) recovered by means of the system's matching operations function, we examined the list of articles recovered by the Pawn Detail given in the Department's monthly memoranda of recovered property for 1974. The head of the Pawn Detail estimates that at least 90 percent of the listed articles were recovered by means of the system's automatic matching function. The remainder were said to be recovered by some type of manual matching. Sometimes, for example, a pawned article suspected of being stolen, but not matched to a stolen article, will be checked and found to be stolen, though not reported. In any case, the recovery of all of the pawned articles is attributable to the system, if not specifically to its automatic matching function. The number of guns recovered by means of matching stolen and pawned firearms was obtained from Crime Laboratory personnel.

In 1974, the system led to the recovery of 268 pawned articles valued at about $80,000. The number and estimated value by type of the recovered articles are shown in Table 4. Home entertainment equipment accounted for 80 articles worth about $17,000, and 39 pieces of photographic equipment accounted for another $12,000. Recovered jewelry was valued at about $17,000. Office equipment and musical instruments each accounted for 36 articles worth a total of about $18,000.

Table 4

NUMBER AND TOTAL DOLLAR VALUE OF PAWNED ARTICLES RECOVERED IN 1974 BY ARTICLE TYPE

Type	Number of Articles[a]	Total Value
Firearms	10	$ 500[b]
Home entertainment equipment	80	17,176
Office equipment	36	8,573
Photographic equipment	39	11,876
Tools	13	3,935
Garments	0	0
Bicycles	5	658
Household appliances	3	3,179
Jewelry	15	17,440
Musical instruments	36	9,214
Other[c]	31	6,770
Total	268	$79,321

SOURCE: Indianapolis Police Department monthly internal memoranda of recovered property for 1974.

[a]The numbers shown are minimums. When more than one, but an unspecified number, of articles were jointly reported as recovered, the number of articles was counted as only two. Collective articles such as "tool box with tools" were counted as one article.

[b]Estimate based on a value of $50 for each firearm.

[c]Value estimate reflects recovered articles of various types for which a common value was reported.

As shown in Table 5, 73 percent of the cases involving the recovered articles were within the City of Indianapolis jurisdiction and 13 percent in surrounding Marion County. Most of the remaining cases belonged to other local jurisdictions in Indiana State. The distribution in percent of dollar value rather than percent of cases is quite similar.

Table 5

DISTRIBUTION OF NUMBER OF CASES INVOLVING RECOVERED PAWNED ARTICLES AND DOLLAR VALUL OF RECOVERIES (EXCLUDING FIREARMS) IN 1974 BY JURISDICTION

Jurisdiction	Percent of Cases	Percent of Total Dollar Value of Recovered Articles
Indianapolis	73.2	77.8
Marion County	13.2	7.9
Other Indiana local	10.1	9.9
Indiana State	0.4	0.6
Out-of-state	1.9	2.6
Federal	1.2	1.2
Total	100.0	100.0

SOURCE: Indianapolis Police Department monthly internal memoranda of recovered property for 1974.

Consider next the leads obtained with the system. The 268 recovered articles were associated with about 183 separate cases. For each of the 183 cases, the pawned article cards for the recovered articles provided investigative leads, including the thumbprint and a physical description of the pawner, with a usually erroneous signature and address. We were able to ascertain the results of leads only for a portion of the 138 cases falling within Indianapolis's jurisdiction. Of the 100 pawned-article cards received in 1974 by the Department's Identification Branch, 78 pawners were positively identified, typically on the basis of the thumbprint. We did not discover what the leads produced

in the other 38 cases within Indianapolis's jurisdiction and in the 45 outside cases.

Single-Query Effectiveness

The capability provided by the system to query whether or not described articles have been reported stolen relates to the first objective of the system--to aid in the identification and recovery of stolen property. To the extent that stolen articles are included in the State and Federal property systems, the Indianapolis system duplicates the query capability provided by these systems.

The total single-query effectiveness can be measured as the amount of property recovered by this means. The incremental effectiveness can be measured as the amount of recovered property that would not have been recovered by use of the other systems. Unfortunately, data for this purpose are largely unavailable, with the exception of gun recovery data in the Crime Laboratory. Queries on firearms in 1974 resulted in the recovery of about 160 stolen guns* worth on the order of $8000.** Since all stolen guns are eligible for entry in the State and Federal systems, these presumably could have been recovered solely by use of the latter systems.

Investigative Report Effectiveness

The pawner name and address reports contribute to system effectiveness by providing additional leads to thief identity and possibly to the recovery of more property. While we learned that these reports are used by investigators, data on the frequency with which fruitful leads were obtained or articles recovered was unavailable.

SYSTEM COSTS

The Indianapolis system was developed with about $40,000 in LEAA funds plus a lesser amount of local funds. Federal funds primarily

*Based on figures obtained from Crime Laboratory personnel. It excludes 35 guns in unfounded cases and 25 guns recovered by other jurisdictions.

**Estimated value of $50 per gun.

supported the development of the system by System Sciences Development Corporation; the remainder supported the conversion of the existing manual system's master file to a machine-readable file. Local funds supported Indianapolis Police Department personnel who assisted in the development of the system.

Approximate costs to operate the system are shown in Table 6. Costs are expressed either in dollars or in hours of computer processing time on an IBM 370/145. Four full-time people are required, two comprising the Pawn Detail and two in the Crime Laboratory. The Pawn Detail consists of a sergeant who visits pawnshops to check cards written by brokers against corresponding articles and a police officer who enters descriptions of stolen and pawned articles into the system. The annual salaries to support these two positions total about $23,000. In the Crime Laboratory, the system is supported by a police officer and a civilian clerk-typist. Both enter descriptions of stolen and pawned firearms into the system and enter queries about case-related guns, guns being registered, and guns that are sold. About $16,000 annually supports these two positions.

The video-display terminals in the Pawn Detail and Crime Laboratory on which all entries and some queries are made involve leasing costs of about $3,000 annually. The cost of the other 13 terminals from which only queries can be made is not included since these primarily support other functions.

The computer processing time required to support the system is substantial. About 70 hours of central processing unit time is needed annually to support entry-queries and updates, and approximately another 60 hours for simple queries. The daily data entry and hit reports take about 70 hours of processing, and the pawner's name and address reports require another 60 hours. The processing time required to purge the master file is negligible.

In total, the operational costs for the system consist of about $42,000 and 260 hours of computer processing annually.

The marginal costs to operate the system are substantially lower, since the manpower required to enter many of the stolen articles and to query numerous other articles is needed, even without the Indianapolis system, to support and utilize the State and Federal systems.

Table 6

ANNUAL OPERATIONAL COSTS

Item	Cost	CPU Time[a] (hours)
Manpower		
Pawn room (one sergeant, one police officer)	$23,000	--
Crime laboratory (one police officer, one clerk-typist)	16,000	--
Computer video-terminals (two IBM 3277 Model 2's)	3,000	--
Computer processing (IBM 370/145)		
Entry-queries and updates	--	70
Simple queries	--	60
Data entry and hit reports (daily)	--	70
Pawner name and address reports (weekly)	--	60
File purge	--	1
Total	$42,000	261

SOURCE: Estimates made by author based on data supplied by Indianapolis Department.

[a]Central Processing Unit time. Rough estimates.

UNRESOLVED PROBLEMS

A Privacy Issue

As far as we could determine, the Indianapolis property system appears to produce results that are commensurate with its resource costs. But an important nonresource cost of the system remains to be considered. Part of the latter cost is a loss of freedom and privacy for a noncriminal pawner. The act of pawning in Indianapolis requires that his name, address, physical description, and thumbprint be recorded and transmitted to police. Pawners may find it demeaning to have their thumbprint (and picture) taken and may well prefer not to have records of their transaction maintained in police files. Also, the ordinance supporting the system imposes on pawnbrokers the inconvenience of collecting the required information and the possible loss

of legitimate customers who prefer to avoid pawning under these conditions. In deciding whether or not to enact such an ordinance, officials must weigh the net gains to law enforcement against the penalties to pawners and pawnbrokers.

Variants of the Indianapolis ordinance could be used to strike different balances of gains and losses. One variant would require the same information be obtained by pawnbrokers, but initially only the article information would be transmitted to police. Only when an article is identified as stolen would the pawnbroker transmit pawner information to the police. Thus, only information on people pawning stolen articles would be obtained by the police.

A more extreme variant would require only article information to be recorded. This would eliminate most disbenefits to pawners and pawnbrokers, but would aid only the recovery of stolen property and not the identification of offenders unless, fortuitously, fingerprints could be lifted from the recovered article.

Articles Lacking Serial Numbers

Despite substantial design efforts to make the Indianapolis system capable of processing articles without serial numbers, few such articles are currently entered into the system. Why is this so? Perhaps the main reason is that unequivocal identification is necessary before an article can be taken from a pawnbroker. This legal consideration deters the entry of any articles for which no such identification can be made. Nonserialized, mass-produced articles are of this nature. A second reason is the failure to record the detailed information demanded by the system. In Indianapolis, the stolen article report form does not spell out the information required to process articles without serial numbers, so oversights by detectives are commonplace. Sometimes, of course, victims will not have the information even when asked.

FINDINGS AND SUGGESTIONS

Our examination of the Indianapolis system leads us to set forth conclusions and suggestions to other communities regarding possible implementation of similar systems.

1. FINDING: The contribution of the Indianapolis stolen and pawned property system to law enforcement appears to outweigh its resource costs.

The recovery of $79,000 in pawned property and the identification of at least 78 offenders were attributable to the system in 1974. The annual operating cost for the system was about $42,000 plus about 260 hours of computer processing. The marginal costs to operate the system were substantially less.

SUGGESTION: Law enforcement agencies receiving pawned property reports in other jurisdictions should test the utility of this type of information system by using the existing NCIC property system.* This test could be performed by first entering serialized articles of values as low as, say, $50. (In Indianapolis, about 98 percent of the recovered articles had values of at least $50.) Serialized pawned articles of similar values could then be queried on the NCIC system, after a short delay, so that the article, if stolen, will likely have been reported and entered prior to the pawned-article query. In this manner, the amount of serialized property that could be recovered can be estimated.

SUGGESTION: The National Crime Information Center should itself consider modifying its current stolen property system so that pawned articles, as well as stolen articles, can be entered and the two can be automatically matched.

2. FINDING: The Indianapolis stolen and pawned property system relies upon an ordinance that mandates pawnbrokers to report articles received and to hold these articles for a specified period of time. The ability of the Indianapolis system to identify offenders derives mainly from the requirement that a thumbprint of the pawner be obtained.

*With NCIC approval.

SUGGESTION: An agency planning a stolen and pawned property system should weigh alternative versions of the pawnbroker control ordinance and recommend enactment of one that strikes a defensible balance of the law enforcement gains and the burdens on citizens.

3. FINDING: Articles without serial numbers (or other unique identifiers) pose special difficulties to a property information system. With the exception of jewelry, designing this system to process such property may not be justified.

Despite the substantial pains taken to give the Indianapolis system a capability to handle articles without serial numbers, we found only about 4 percent of the articles in the Indianapolis property file were of this kind. The system is able to handle 150 different article types, but only two were entered with any frequency. Jewelry was the only type of nonserialized property for which any recoveries were made in 1974 in Indianapolis.

SUGGESTION: An agency planning a stolen and pawned property system should be wary of including articles without serial numbers in the system unless it can avoid the shortcomings in the Indianapolis experience.

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IV. CASE STUDY: THE LOS ANGELES AUTOMATED FIELD INTERVIEW SYSTEM

In the late 1940s, the Los Angeles Police Department introduced a manual card system for field interviews which was decentralized into 17 geographic areas. Because the retrieval of information was so cumbersome and a city-wide search of field interviews virtually impossible, in 1967 the Department tested the feasibility of an automated system. The following year implementation of a centralized batch-process system called simply the Automated Field Interview System (AFIS) was completed. This system is now being converted to an on-line system.

This case-study concerns the batch-process version of AFIS. We would have preferred to analyze the on-line system, but since it did not become operational until April of this year, no information on its performance was available.

THE PURPOSE OF THE LOS ANGELES SYSTEM

As for all field interview systems, the primary purpose of AFIS is to produce investigative leads from field interview information. To this end, it must enable investigators to search suspect and vehicle characteristics recorded in field interviews for matches to corresponding characteristics in cases under investigation.

OVERVIEW OF THE LOS ANGELES SYSTEM

AFIS was designed as an automated batch-process system to be operated, aside from computer support, out of a centralized organizational unit. The data base for the system is composed of two files of field interviews, one a name file containing records of all field interviews, the other a vehicle file containing records of only those field interviews that involve a vehicle. A capability to query field interview data is provided by four search routines, differing according to the types of information to be queried. One routine, for example,

is used to search license plate numbers. Batch processing is used for both data entry and inquiries.

The organizational unit has the responsibility of processing field interview data for entry and of receiving and processing requests for searches from investigators throughout the Department or from other law enforcement agencies. Inquiries are made in this system by specialized civilian clerks, rather than investigators.

LAPD FIELD INTERVIEWS

LAPD Policy on Field Interview Reports

Los Angeles Police Department policy* specifies that in order to complete a field interview report for entry into the system, "there must exist a situation where the officer can factually articulate a reasonable cause to believe the person interviewed is involved in criminal activity or will become so in the near future." Though the Department recognizes noncriminal situations in which reports should also be completed, it directs that these should not be entered into AFIS. An example of the latter would be a report filled out on a lost adult. While such a report might be useful to another officer who located this person, it is unlikely to be the source of a useful investigative lead.

The Department policy specifies circumstances under which reports must always be prepared for entry into the system:

- When a person is detained for investigation of a felony, but cannot be booked because of present insufficiency of evidence.
- When a person is booked for an offense other than a traffic violation or plain drunkenness.**

The policy of completing field interviews on arrested persons is unusual, if not unique. The inclusion of records of these interviews

*Los Angeles Police Department Training Bulletin, Vol. V, Issue 15, June 29, 1973.

**Arrests for begging are also now excluded.

into the system makes the AFIS equivalent, in terms of the classification types we defined in Part I, to a field interview system (containing only records of suspicious persons that were not arrested) combined with a physical characteristics system and a vehicle characteristics system.

The policy of the Department also specifies circumstances under which the preparation of field interview reports for entry into the system is not mandatory:

- When a person is in the company of an arrestee and his criminal history or the circumstances indicate a probable involvement in criminal activity.
- When a person is a member of a gang whose activities have chronically necessitated police actions.
- When a person cited for a traffic violation has a criminal history that indicates he is continually involved in criminal activity.
- When a person is in an inappropriate place at an unusual hour.
- When a person is loitering near schools with no logical reason for being there.
- When a person is loitering near a location notorious for vice or narcotics activity with no lawful reason for being there.

Contents of Field Interview Reports

The information obtained in field interviews is recorded on field interview reports. Though several different report forms have been used since the inception of the system, the information captured has changed little. Each of the forms has provided for the recording of the name, alias, address, business, phone number, driver's license number, social security number, and physical description of the subject being interviewed; a description of any vehicle involved; and the date, time, location, and reporting district of the interview.

Data Base of the Los Angeles System

The AFIS data base is created and maintained from the field interview reports. It is composed of two files: a name file and a vehicle file. The name file includes a record for all field interviews, capturing from each interview report the name, sex, descent, date of birth, hair color, eye color, height and weight of the interviewed subject; the date, time, and reporting district of the interview; and, if a vehicle was involved, the make, model, year, type, colors, number and state of license, and an indication of whether the subject was the driver or a passenger. The vehicle file contains a records only for interviews in which a vehicle was involved, the elements captured being the same as those in the name file.

The number of reports completed and entered into AFIS is shown in Table 1. On the average, about 200,000 reports are entered annually. About half are pedestrian reports; the other half involve vehicles. Roughly 38 percent of the pedestrian reports and 30 percent of the vehicle reports are estimated to be completed in conjunction with an arrest.* The wide variation in the number of reports completed each year is thought to stem from differing officer reactions to successive report forms introduced by the Department.

It can be inferred from Table 1 that field interview reports are, in practice, not completed as frequently as specified by policy. In 1974, about 162,000 arrests were made in Los Angeles for which reports should, according to policy, have been completed.** However, the total number of field interviews completed was only 137,000, and 60 or 70 percent of these were not completed in conjunction with an arrest.

*Based on samples of 101 pedestrian reports and 98 vehicle reports from February and March 1975.

**Estimate was provided by Los Angeles Police Department, based on 1974 Statistical Digest of the Los Angeles Police Department.

Table 1

FIELD INTERVIEW REPORTS PROCESSED:
1971 TO 1974

Year	Pedestrian Reports	Vehicle Reports	Total
1971	66,103[a]	94,211	160,314
1972	166,973	144,218	311,191
1973	115,525	95,278	210,803
1974	76,250	60,839	137,089
Average	106,213	98,636	204,849

SOURCE: Table titled "Summary of Automated Field Interview System: Yearly Reports" produced by the Los Angeles Police Department Automated Field Interview Unit.

[a]Pedestrian reports were not entered into the system prior to July 1971.

Under current policy, records in the data base are purged on a daily basis when they are 15 months old. The size of the data base at any time is consequently somewhat larger than the number of reports processed annually. In May 1975, it contained a total of about 210,000 field interview records.

THE FUNCTIONS OF THE LOS ANGELES SYSTEM

The Los Angeles field interview system's primary function is, of course, to provide an inquiry capability to search completed field interviews for suspect and vehicle characteristics matching those of a case under investigation. As a by-product, two weekly administrative reports are prepared.

Inquiry Capability

The capability to query field interviews is provided by four different search routines. Name searches can be used to query the last name, first name, sex, descent, and/or age range of a suspect.

With a license search a complete or partial license plate number and/or the state of a license can be queried. The capability to search partial license plate numbers is particularly useful as the California Law Enforcement Telecommunications Systems (CLETS), which accesses the State's Department of Motor Vehicle files, can be used only to search complete licenses.

Vehicle characteristics can be searched alone or in conjunction with suspect characteristics in vehicle searches. The vehicle characteristics that can be queried are the make, model, type, top and bottom colors, year range, complete or partial license, and state of license; the suspect characteristics that can be searched are identical to those in the name search.

The fourth routine, called a date-time search, can be used to query the date and time (each within some range) and the geographic area of the completion of field interviews. These can be searched in conjunction with vehicle make and/or any of the various suspect characteristics of the name search.

It is worth noting that much of the inquiry capability provided by this system would be virtually impossible to obtain with a manual system. The best example is the vehicle search in which various combinations of as many as 13 different characteristics can be queried.

Administrative Reports

AFIS produces two weekly administrative reports. Both chronologically list the field interviews completed by geographic area; one by the Department's 17 major geographic divisions called Areas, the other by the much smaller Basic Car Areas.

THE OPERATIONS OF THE LOS ANGELES SYSTEM

The organizational unit that operates the system is called the Automated Field Interview Unit (AFIU). Besides processing field interview data for input to the system, the Unit receives requests for searches from investigators, determines and prepares the specific searches to be made, and screens the output from the searches for return to the investigators. To see how the system operates in practice, we examined 104 search-requests received by the Unit in the first week of March 1975, and the searches made in response to those requests.

The types of offenses for which requests were made is shown in Table 2. Burglary, hit-and-run, robbery, and theft together account for 60 percent of the requests. About 20 percent were not for any specific case, but for investigation only. Most of these were made by the Recruitment Division, presumably to check out potential employees.

Table 3 shows the numbers of suspects and vehicles described in the search-requests. Half of the requests included a description of precisely one suspect; multiple suspects were described in about 40 percent of the requests. More than 80 percent of the requests included a description of one vehicle, most of the remainder containing only suspect descriptions.

Table 2

DISTRIBUTION OF OFFENSE TYPE IN SEARCH-REQUESTS[a]

Type of Offense	Percent of Requests
Burglary	23
Hit and run	14
Homicide	1
Rape	5
Robbery	15
Theft[b]	8
Investigation only	19
Other[c]	15
Total	100

[a]104 search-requests made in the first week of March 1975.

[b]Includes grand theft and petty theft; excludes grand theft auto and theft from vehicle.

[c]Includes four percent of the requests for which no offense was indicated.

Table 3

DISTRIBUTION OF THE NUMBER OF SUSPECT AND VEHICLE DESCRIPTIONS IN SEARCH-REQUESTS[a]

Number of Descriptions	Percent of Requests Suspects	Percent of Requests Vehicles
0	10	16
1	49	81
2	25	1
At least 3	16	2
Average number	1.5[b]	0.9[c]

[a]104 search-requests made in the first week of March 1975.

[b]Includes requests with information on *no* suspects.

[c]Includes requests with information on *no* vehicles.

The specific suspect and vehicle characteristics contained in the search-requests are shown in Tables 4 and 5.* About half of the requests included at least a first or last name, with 44 percent of the requests specifying both the first and last names and 4 percent only one or the other. Monikers or aliases were rarely given. Age, sex, and descent were usually provided; hair color, eye color, height and weight frequently specified. As to the vehicle characteristics, at least a partial license plate number was contained in 60 percent of the search-requests, the complete license plate number being specified in 51 percent and a partial license number in only 9 percent. The state issuing the license plate was given in only 23 percent of the requests, the rest presumably being in-state. In only 2 percent of the requests was the license said to be out-of-state. The year or year-range of the vehicle, the make, and the (solid or top) color were usually provided. Model and type were often, though less frequently, stated.

The types of searches made on AFIS in response to search-requests are shown in Table 6. About half of the requests resulted in at least one name search, with an average of more than three names being queried in each such search. Many of these are simply combinations of, or variations on, others. Half of the requests resulted in a license search, an average of more than four license plate numbers or their variants being queried in each search. Almost 40 percent of the requests resulted in at least one vehicle search; most involved the search of only a single vehicle. Only one date-time search was prompted by the 104 sampled search-requests.

The characteristics actually employed in name searches are shown in Table 7. The first column gives the relative frequency with which the characteristic was used among all name searches; and the second column gives the frequency among those name searches for which the characteristic was specified in the search request. At

*Requests with no suspect characteristics or no vehicle characteristics are included. When more than one suspect or vehicle was described, we have based the indication of characteristics on those listed first.

Table 4

SUSPECT CHARACTERISTICS INDICATED IN SEARCH-REQUESTS[a]

Characteristic	Percent of Requests with Specified Characteristic Included
Name	48[b]
Moniker or alias	10
Age or age range	74
Sex	86
Descent	83
Hair color	58
Eye color	46
Height	62
Weight	59
Oddities	12
Other	14

[a]104 search-requests made in first week of March 1975.

[b]Includes cases with either first, last, or both first and last names indicated.

NOTE: Requests with no suspect characteristics indicated are included. For requests with more than one suspect description, the indication of the characteristics is based on that listed first.

Table 5

VEHICLE CHARACTERISTICS INDICATED IN SEARCH-REQUESTS[a]

Characteristic	Percent of Requests with Specified Characteristic Included
License (complete or partial)	60
State of license	23
Year or year range	75
Make	81
Model	34
Type	53
Solid or top color	72
Bottom color	9
Other	15

[a]104 search-requests made in first week of March 1975.

NOTE: Requests with no vehicle characteristics are included. For requests with more than one vehicle description, the indication of characteristics is based on that listed first.

Table 6

RELATIVE FREQUENCY AND AVERAGE NUMBER OF SEARCHES BY TYPE[a]

Type of Search	Percent of Requests Resulting in At Least One Search	Average Number of Searches[b]
Name	48	3.5[c]
Vehicle	38	1.2
License	50	4.4[d]
Date-time	1	2.0[e]

[a]104 search-requests made in first week of March 1975.

[b]Includes only requests for which *at least one* search of the indicated type was made.

[c]Indicates actual number of names queried, though up to three names may be queried in a "single" search.

[d]Indicates actual number of licenses or partial licenses queried, though up to five such licenses may be queried in a "single" search.

[e]This entry represents a single date-time search.

Table 7

USE OF CHARACTERISTICS IN NAME SEARCHES[a]

Characteristics	Percent, with Characteristic Used, of All Name Searches	Percent, with Characteristic Used, of Name Searches with Characteristic Indicated in Request
Name	100	100
Sex	3	4
Descent	3	4
Age or age range	3	5

[a]Based on 104 search-requests from the first week of March 1975.

[b]Includes search-requests with either first, last, or both first and last names indicated.

NOTE: The entries in this table are based on the *first* listed name search in each of the 29 sampled search-requests that had only a single suspect indicated in the request and involved at least one name search.

least a first or last name is always specified, as required by the system. In fact, both names are given in about 70 percent of the searches. Sex, descent, and age are rarely used, even though, as shown in Table 4, they are included in most requests.

In license searches, complete or partial plate numbers and/or the state of the license can be specified. At least a partial plate number was always indicated in the searches resulting from our sample of requests, and the plate was described as out-of-state in 4 percent of the searches. The use of characteristics in vehicle searches is shown in Table 8. Make is almost always indicated; color (solid or top) and year usually specified. Suspect characteristics are indicated in a high percentage of the searches, though no portion of the name was ever indicated.

THE HARDWARE OF THE LOS ANGELES SYSTEM

Computer support for AFIS is provided by an IBM 370-155 which services most Departments of the City of Los Angeles. Approximately seven IBM 822's (or their equivalent) are needed to keypunch both field interview data and search specification.*

THE EFFECTIVENESS OF THE LOS ANGELES SYSTEM

The purpose of AFIS is to produce investigative leads. It is appropriate, therefore, to measure its effectiveness by the number of leads obtained and the results of those leads. Table 9 shows, for 1971 through 1974, the number of searches made on AFIS, the number of leads obtained, and the number of arrests and clearances resulting, at

*The use of the keypunch machines is indicated here, not as the means by which the L.A.P.D. has accomplished input to the system, but rather or perhaps the simplest means of accomplishing it. The L.A.P.D. has had to use more complex equipment because it has been inputting field interview data based on a 500-column record to support the new on-line system, rather than the 80-column record for the batch system.

Table 8

USE OF CHARACTERISTICS IN VEHICLE SEARCHES[a]

Characteristics	Percent, with Characteristic Used, of All Vehicle Searches	Percent, with Characteristic Used, of Vehicle Searches with Characteristic Indicated in Request
Year or year range	75	86
Make	98	100
Model	42	80
Type	55	83
Solid or top color	80	84
Bottom color	30	(b)
License	20	53
State of license	5	(b)
Sex	62	66
Descent	62	67
Age or age range	62	74
Suspect name	0	0

[a]Based on 104 search-requests from the first week of March 1975.

[b]Too few vehicle searches with the indicated characteristic to justify an entry.

NOTE: The entries in this table are based on the *first* listed vehicle search in each of the 40 sampled search-requests that had only a single vehicle indicated in the request and involved at least one vehicle search.

Table 9

PERFORMANCE OF AFIS, 1971 TO 1974

Year	Number of Searches	Leads	Arrests	Clear-ances
1971	5891	1103	207	871
1972	6974	1795	463	1845
1973	6789	1493	298	968
1974	7074	1076	266	819
Average	6682	1367	308	1126

SOURCE: Table titled "Summary of Automated Field Interview System: Yearly Reports" produced by the Los Angeles Police Department Automated Field Interview Unit.

NOTE: The number of leads indicates the frequency with which at least one lead was produced by a search, whereas the number of arrests and clearances are total counts including multiple arrests or clearances from a single search.

least in part, from the leads.* Six or seven thousand searches were made annually. About 1400 of these produced at least one lead. These leads in turn contributed to an average annual total of about 300 arrests and 1100 clearances. These results should be assessed in light of the number of offenses reported in Los Angeles. In 1973, for example, a total of about 212,000 of the offenses indexed by the Federal Bureau of Investigation were reported.** (The indexed offenses are murder, forcible rape, robbery, aggravated assault, burglary, larceny-theft, and auto theft.)

The types of offenses for which arrests were made as a result of AFIS leads are revealed by Table 10. The entries are based on the 199 arrests resulting from searches made between April 29, 1974, and April 13, 1975. Burglary, hit and run, and robbery each account for almost 20 percent of the arrests. Two percent of the AFIS-assisted arrests were in homicide cases; one percent were in rape cases.

What we unfortunately do not know is the frequency with which AFIS leads were instrumental to the arrests. Also unknown is the extent to which vital leads were producible only by means of the field interview system. It is possible, for example, that some leads obtained by searching complete license plate numbers could also have been obtained with CLETS, the California State system that accesses Department of Motor Vehicle records. The advantage claimed for AFIS over CLETS when the complete license is known is that it can also help to identify the driver of an unregistered vehicle or a vehicle sold but not reregistered. Also the fact of providing the name of the driver rather than the registered owner is claimed sometimes to be advantageous. How frequently these advantages result in arrest-or clearance-producing leads obtainable from AFIS is speculative.

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*This information is compiled by the AFIU from evaluations performed by investigators. Specifically, the investigators are asked "Did ... information furnish any new leads to your investigation?," "Did information assist in arrest of suspects? How many?," and "Did information assist in clearing case(s)? How many?"

**Clarence Kelley, Crime in the United States: 1973, U.S. Government, 1974.

Table 10

DISTRIBUTION OF OFFENSE TYPE IN AFIS-ASSISTED ARRESTS[a]

Type of Offense	Percent of Arrests
Burglary	18
Hit and run	19
Homicide	2
Rape	1
Robbery	18
Theft[b]	12
Other	30
Total	100

[a]199 arrests resulting from search-requests from April 1974 to April 1975.

[b]Includes grand theft and petty theft. Excludes grand theft auto and theft from vehicle.

NOTE: Multiple arrests in individual cases from a single lead are included.

The Los Angeles field interview system can be thought of as containing records of four types of field contacts, categorized according to whether or not a vehicle was involved and whether or not an arrest was made. Because each of the types can, as a matter of policy, be either included or excluded from a field interview system and, in particular, because most field interview systems do not include all four types, it is revealing to relate the contact types to the effectiveness of AFIS.

Based on searches made between April 1974 and April 1975, we have estimated the relative frequency with which AFIS-assisted arrests are related to each of the four record types. The results are shown in Table 11, in which they are compared with the relative frequency of occurrence of the four record types in the field interview data base. Records involving vehicles turned out to be most useful. Fully 54 percent of the AFIS-assisted arrests are related to vehicle-nonarrest records, though these records comprise only 31 percent of the data base. Similarly, vehicle-arrest records, which constitute only 13 percent of the data base, are related to 28 percent of the arrests. The contribution of pedestrian records was, at best, minor for they were related to only 18 percent of the arrests, though constituting more than half of the data base.

Our assessment of AFIS effectiveness reflects only the possible benefits resulting from searches of field interview data and not benefits obtained from the actual conduct of field interviews.* Presumably some arrests were made at the time of an interview, as a direct result of the interrogation. Field interviews also help prevent crime. Such benefits were ignored since field interviews would be conducted even without AFIS.

*We must here consider the term "field interview" to exclude those instances when an interview report is completed because an arrest was made, as distinguished from instances when an arrest was made as a result of an actual interrogation.

Table 11

DISTRIBUTION OF RECORD TYPE IN AFIS-ASSISTED ARRESTS COMPARED TO DISTRIBUTION OF RECORD TYPE IN DATA BASE

Type of Record	Percent of AFIS-Assisted Arrests[a]	Percent of Data Base Records[b]
Vehicle-nonarrest	54	31
Vehicle-arrest	28	13
Pedestrian-nonarrest	13	35
Pedestrian-arrest	5	21
Total	100	100

SOURCE: Estimated by author.

[a]Estimates based on arrests resulting from search-requests from April 1974 to April 1975.

[b]Estimates based on pedestrian and vehicle report data for 1974 and samples of 101 pedestrian reports and 98 vehicle reports from early 1975.

COSTS OF THE LOS ANGELES SYSTEM

An overall assessment of AFIS requires that its (marginal) effectiveness discussed above be balanced against the marginal cost.

The annual costs to operate AFIS are substantial.* As shown in Table 12, the manpower costs alone amount to about $274,000. This consists of the salaries and overhead to support two police officers who supervise the field-interview system operation on the day and night shifts, one senior clerk-typist and one clerk-typist who prepare most of the searches, and 12 other clerk-typists who code and key-punch field interview reports and maintain manual files of the reports.**

The computer processing to support the system costs about $60,000 annually. Another $7,000 is required for the lease of seven keypunch machines. In total, the annual operational costs (including overhead) for AFIS are about $340,000.

LEGAL AND ETHICAL ISSUES

We shall merely touch upon several legal and ethical issues that present themselves in the use of information on systems such as AFIS. Some are legal questions arising in actual conduct of field interviews; others concerning the automation, maintenance, and use of field interview records are both legal and ethical in nature.

Legality must be a concern of all police departments that conduct field interviews, regardless of whether or not the interviews are reported or the reports are automated. Legality issues were discussed in detail by the President's Commission on Law Enforcement and Administration of Justice.*** The Commission noted, first of all,

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*The development costs are unknown.

**For this case-study, in contrast to the others, overhead costs were obtainable and are included. To compare costs across systems, overhead costs must be added to the costs for the other systems or subtracted from the costs for this system.

***See the President's Commission on Law Enforcement and Administration of Justice, Task Force Report: The Police, 1967, pp. 183-185, from which the material presented herein was drawn.

Table 12

ANNUAL OPERATIONAL COSTS

Item	Cost
Manpower[a]	$274,000
Computer processing (IBM 370/155)	
File maintenance	24,000[b]
Searches and administrative reports	37,000[b]
Keypunch equipment (7 IBM 822's)	7,000
Total	$342,000

SOURCE: Computations based on information provided by Los Angeles Police Department.

[a]Includes salaries and overhead to support 2 police officers, 1 senior clerk-typist, and 13 clerk-typists.

[b]These entries are undoubtedly low since they are based on data for 1974, a year in which fewer than usual interview reports were processed.

that the limits of police authority to conduct field interviews are unclear in most jurisdictions. Though some states have specific statutory authority for officers to stop suspicious persons, most states do not. The Commission also pointed out that in many communities field interviews are a major source of friction between the police and minority groups. It found that field interviews are

- often conducted with little or no basis for suspicion.
- sometimes used in a way which discriminates against minority groups, the poor, and the juvenile.
- frequently conducted in a discourteous or otherwise offensive manner.

The Commission stated that it "believes there is a definite need to authorize the police to stop suspects and possible witnesses of major crimes, to detain them for brief questioning if they will not voluntarily cooperate, and to search such suspects for dangerous weapons when such a precaution is necessary." It recommended that "in order to balance the need for field interviews against the harmful effect on police-community relations which may result from their indiscriminate use, state legislatures should define the extent of police authority to stop and question persons and police departments should adopt detailed policies governing this authority whether or not legislation exists."

In connection with the automation, maintenance, and use of field interview records, there is a serious question of whether or not the mere inclusion of noncriminals in an automated police file containing a relatively high proportion of criminals is a violation of the constitutional right to privacy of those individuals. Though few legal guidelines to assist in making such a determination currently exist, they appear to be forthcoming, perhaps as a result of the work of the Privacy Protection Study Commission set up under the Privacy Act of 1974.* A second issue concerns the penalty to noncriminals (included in the file) of being questioned in connection with cases

*Public Law 93-579, 93rd Congress, S. 3418, December 31, 1974.

under investigation. When a physical description of one of these innocent individuals (and/or a description of his vehicle) resembles a corresponding description in a case under investigation, the report of the field interview of which he was the subject will be outputted by the system. As a result, this individual may be unnecessarily and unjustifiably interrogated by an investigator.

FINDINGS AND SUGGESTIONS

1. FINDING: The Los Angeles Automated Field Interview System has produced leads contributing, on the average, to about 300 arrests and 1100 clearances annually at a cost (including overhead) of about $340,000.

   How many of these leads were instrumental to the arrests and clearances and how often the vital information in the leads could have been obtained from other sources were not ascertainable.

SUGGESTION: Police agencies should critically appraise whether the incremental arrests and clearances obtainable with an automated field interview system justify its cost.

SUGGESTION: The effectiveness of AFIS will remain incompletely understood until detailed analyses of AFIS-assisted arrests and clearances are conducted. These analyses should identify the AFIS-provided information in the leads that was useful, assess the relative contribution of that information to the arrests or clearances, and ascertain the likelihood of obtaining it from other sources.

SUGGESTION: A study should be made of the extent to which state systems that access motor vehicle records could be modified to provide additional investigative leads. In particular, the inclusion of information on the geographic area of the residence of the owner of the car and the colors of the car, combined with an inquiry capability to search on these characteristics and/or partial license plate numbers, should be investigated.

2. FINDING: Field interview reports involving vehicles have been substantially more useful (in AFIS experience) than pedestrian reports in producing investigative leads that result in arrests. Vehicle reports completed for simple interrogations and for arrests each have produced more fruitful leads than either type of pedestrian report.

SUGGESTION: Police agencies with field interview information systems should carefully review whether or not the inclusion of pedestrian reports justifies its costs. Agencies should also consider whether the modification or development of a system for the retrieval of information from reports of arrests involving vehicles would be desirable. (Such a system could be handled separately or combined with an arrestee physical characteristics system or a field interview system.)

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