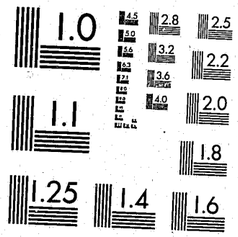

MIDWEST RESEARCH INSTITUTE

REPORT

SYSTEMS ANALYSIS OF CRIMINALISTICS OPERATIONS

FINAL REPORT
30 June 1969 - 28 June 1970

Grant NI-044

MRI Project No. 3333-D

For

U. S. Department of Justice
Law Enforcement Assistance Administration
Washington, D. C. 20530

RESEARCH INSTITUTE 425 VOLKER BOULEVARD, KANSAS CITY, MISSOURI 64110 • AREA 816 561-0202

SYSTEMS ANALYSIS OF CRIMINALISTICS OPERATIONS

by

Walter R. Benson
John E. Stacy, Jr.
Michael L. Worley

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PREFACE

This is the Final Report of the analyses, results, and conclusions developed in a year-long study of criminalistics operations conducted by Midwest Research Institute.

The study was funded by the U. S. Department of Justice, Law Enforcement Assistance Administration, under Grant NI-044, for the National Institute of Law Enforcement and Criminal Justice. The goal of the study was to perform a comprehensive systems analysis of the crime laboratory in law enforcement and criminal justice. Emphasis was placed on quantifying the knowledge of present experts in criminalistics so as to allow a structured approach to both enhance and multiply this expertise to the benefit of all areas of the country. The primary aim of the study was to recommend systems of criminalistics operations that would meet cost/benefit criteria while serving the needs of local communities, regional areas, and the nation.

The Midwest Research Institute staff performing the study were Walter R. Benson, John E. Stacy, Jr., and Michael L. Worley. Gaylord Atkinson, Duane Dieckman, and Robert Fleisher made special contributions in their particular fields. Joseph D. Nicol, Professor of Criminal Justice Administration, University of Illinois, was a special consultant in the field of criminalistics and actively participated in all phases of the study.

We wish to express our sincere appreciation for the cooperation and support we received from many agencies from across the nation. Many chiefs of police and state planning agencies responded to our initial inquiries concerning crime laboratories in their cities and states.

In particular, we are indebted to the criminalists of our working group for their counsel, their attendance at our conference in Chicago, and other activities as reflected in this report. The results of this study and the conclusions drawn from these results, although influenced by our associations with these experts, do not necessarily represent either the opinion of an individual member or the group consensus.

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Dr. Charles Kingston, Professor of Criminalistics, John Jay College of Criminal Justice, The City University of New York, was particularly helpful, both by his participation in our working group meeting in Chicago and conferences in Kansas City.

In addition to the crime laboratories associated with our working group members, we visited a number of other crime laboratories and wish to express appreciation to the following hosts:

Capt. Fred McDaniel, Commander
Police Crime Laboratory
Kansas City, Missouri

Gary D. McAlvey, Superintendent
Bureau of Identification
State of Illinois
Joliet, Illinois

James Conlisk, Superintendent
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Special recognition and appreciation is also due to the following individuals who conducted special substudies or made data available in support of this project: Gary McAlvey; James E. Halligan, Jr.; D. M. Lucas; Holly V. Holcomb, Superintendent of the Department of State Police, Salem, Oregon; and Inspector Garland Waters of the Metropolitan Police Department, Washington, D. C.

Approved for:

MIDWEST RESEARCH INSTITUTE

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1 July 1970

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I. INTRODUCTION

The role of science and technology in criminal justice has been addressed in some detail in the Task Force Report of the President's Commission on Law Enforcement and Administration of Justice, published in 1967.[17] The introductory paragraph of that report lucidly sets the stage for the important work of the Commission:

ROLE OF SCIENCE AND TECHNOLOGY IN CRIMINAL JUSTICE

> "The natural sciences and technology have long helped the police to solve specific crimes. Scientists and engineers have had very little impact, however, on the overall operations of the criminal justice system and its principal components: police, courts, and corrections. More than 200,000 scientists and engineers have applied themselves to solving military problems and hundreds of thousands more to innovation in other areas of modern life, but only a handful are working to control the crimes that injure or frighten millions of Americans each year. Yet, the two communities have much to offer each other: science and technology is a valuable source of knowledge and techniques for combating crime; the criminal justice system represents a vast area of challenging problems."

Approximitely one-half page of the 228 pages of the Commission's Report is devoted to the subject of criminalistics operations as a paragraph in the section entitled, "Improving Apprehension Capabilities." It is quoted in part below:

ANALYSIS OF PHYSICAL EVIDENCE IN CRIME LABORATORIES

> "The crime laboratory has been the oldest and strongest link between science and technology and criminal justice. Because of this tradition, and because the best laboratories, such as the FBI's, are well advanced, the Science and Technology Task Force did not devote major attention to criminalistics. There are some excellent laboratories in key locations around the country. However, the great majority of police department laboratories have only minimal equipment and lack highly skilled personnel."

This viewpoint is not surprising and sums up the general impression of crime laboratories. However, there are fewer than ten laboratories in the United States that can be called "full-service crime laboratories" (see Appendix 7) although the number of laboratories which engage in some aspect of forensic science is slightly more than 100. The effect of criminalistics on the criminal justice system was estimated by Borkenstein[2] as no more than 2 percent of reported cases finding their way to the crime laboratory. The impact of the laboratory on crime seems to be somewhat limited.

The crime laboratory concept enjoys a fine reputation, if not awe, by both the public in general and law enforcement officials in particular. Few persons are unable to recall reading of at least one heinous crime in which the crime laboratory provided the "absolute proof" of the guilt of the accused. Most crime laboratories have a display case or pictoral presentation of their past successes. Some conduct guided tours for visitors. The scientific techniques employed in the solution of these cases testify to the high degree of scientific competence, ingenuity, and dedication of the criminalists involved. Their skills in many instances parallel those of universities, research organizations, and industry. However, in too many others there is evidence of a failure to keep pace with modern analytical developments and the demands of modern criminal justice. The Director of the Federal Bureau of Investigation, Mr. J. Edgar Hoover, in response to a query from a research organization in conducting a study to determine the feasibility of establishing a local crime laboratory, commented in part:

> ". . . . it is noted that the modern crime detection laboratory requires a substantial variety of sophisticated scientific equipment and a diverse staff of highly trained scientific specialists in order to derive the maximum benefit from the scientific examination of evidentiary materials. The establishment of such facilities and the maintenance of the necessary diverse professional staff obviously are economically feasible only where a substantial, continuing volume of evidence is involved, a condition which may not exist in many communities or local law enforcement agencies. Because of this limitation faced by such local agencies, the FBI for many years has made available to all duly authorized law enforcement agencies in the United States its own extensive laboratory facilities on a cost-free cooperative basis. Moreover, if subsequent testimony at the local trial is needed, such testimony also is provided by our laboratory staff, again without cost to the requesting agency. As indicated, this program is one of long standing and local

> law enforcement agencies in every state are currently availing themselves of this service."[15]

In 1968, the FBI crime laboratory conducted 83,875 examinations of physical evidence[25] for state and local law enforcement agencies. Assuming a conservative estimate of three examinations per case this would equal FBI crime laboratory involvement in a total of 27,965 cases for the year. Estimating total national crime from the FBI's Uniform Crime Report[6] (reported crimes for index crimes and modified arrest data for others) as 25 million, it would appear that law enforcement officers are availing themselves of the nation's largest crime laboratory in fewer than 0.1 percent of their cases, the FBI's offer of free laboratory service notwithstanding.

While the fact that the crime laboratory can help solve crime is well known, the application of that knowledge varies considerably. In a 1966 study of crime laboratories,[25] 21 laboratories were listed as being active in the State of California, while 13 other states had none. A detailed study of an action plan to reduce crime in a metropolitan city of a southern state failed to mention a crime laboratory in its 60-page report. The small number of examinations requested by the state of the FBI laboratory (189 for 1968) is a further indication of the relatively neglected role of the crime laboratory in law enforcement efforts in the state.

Other states and municipalities ignore the crime laboratory by benign neglect. A book on crime laboratory techniques, written in 1949,[24] contains illustrations of a "modern crime laboratory." That same equipment and surroundings are virtually unchanged in that same laboratory today which now has fewer criminalists, is involved in a smaller percentage of reported cases, and whose budget is, in large part, devoted to photography and finger printing for identification purposes. A study of crime laboratory expenditures in 1961 and 1965 was reported by Parker[14] to show that despite inflation, the laboratory costs per 100,000 population decreased from $3,650 to $3,100 in that period. The median value of the dollar expenditure per case dropped from $45 in 1961 to $12 in 1965. Thus, while crime and inflation have been increasing at rates greater than the population growth, the relative amounts made available for crime laboratory operations have been decreasing.

The 1968 Study of Needs and the Development of Curricula in the Field of Forensic Science[26] surveyed almost all of the crime laboratories in the United States, and documented the vast differences in equipment, capabilities, and budgetary support among the laboratories surveyed. Operating budgets for the laboratories were reported as varying from $1,000 to $987,000. Eleven of the 92 laboratories surveyed had annual budgets exceeding $200,000 but 13 were provided less than $10,000. The median budget for the

laboratories surveyed was $116,000. The reported average annual caseload per full-time examiner varied from a high of 3,000 to a low of 22 cases. These wide differences reflect the degree of interest and support which the crime laboratory receives from the department or community it serves. The figures can also be construed as one measure of the capabilities of the laboratories surveyed. It is also interesting to note that over half of the crime laboratories surveyed have been in existence more than 20 years, with two having been established at the turn of the century, and only five have been in existence less than 10 years.

The mystique that surrounds the crime laboratory can be attributed in part to the publicity given to the outstanding successes of criminalists in cases attracting public concern and interest and also to the efforts of novelists specializing in crime mystery stories, such as Sir Arthur Conan Doyle's Sherlock Holmes series, the Earl Stanley Gardner novels, and a host of others. Criminalistics has often had attributed to it a number of roles that are difficult to identify and quantify with available data. It has been said that the crime laboratory aids in the detection of crime and the identification of the perpetrator, that it serves as a valuable aid to the prosecutor in the reconstruction of a case in court, and in the development of proof satisfactory to positive findings by a jury. It has been further suggested that the technical facilities serve as a leaven for the elevation of the entire departmental performance. These attributes, plus others that might be considered, are difficult to support on the basis of current statistics.

It was against the backdrop of the apparent contradictions among the many viewpoints evidenced that this study was conducted. Contradictions not so much by outspoken supporters or critics of the crime laboratory, but more importantly by the benign neglect in the form of meager budgetary support or insignificant use of the established crime laboratory facilities which implicitly contradicts the image of the laboratory's fight against crime and indicates that the "oldest and strongest link between law enforcement and science and technology" is indeed weak.

The study was conceived and the study plan was based on the premise that criminalistics is an important sub-system of the overall criminal justice system and that little was known quantitatively about criminalistics operations. The goal was to perform a systems analysis of the role that criminalistics plays in the criminal justice system and to define factors that influence size and location of criminalistics operations. The scope was limited by the assumption that criminalistics plays a valuable role in the justice system. Therefore, no attempt is made to measure its effectiveness.

A basic hypothesis of the study was that each type of crime yielded a distribution of specific evidence items and that a specific range of tests were performed on each category of evidence. It was further assumed that laboratory staffing and equipment could be determined by starting with the level and type of crime in the area to be served and using a laboratory planning model to define the approximate requirements.

Another goal of the study was to ascertain if reasonable estimates could be made of the national demand for criminalistics and to investigate the influence of laboratory location upon that demand.

The latter goal included the development of a laboratory location model to measure the relative effectiveness of alternatives for satisfying the nation's demand for criminalistics. One original concept was an echelon approach with many strategically placed lower level laboratories augmented by regional laboratories having sophisticated equipment and superior technical capability.

The plan of study is shown in Figure 1.

With this background in mind the following sections present the highlights of the study methodology.

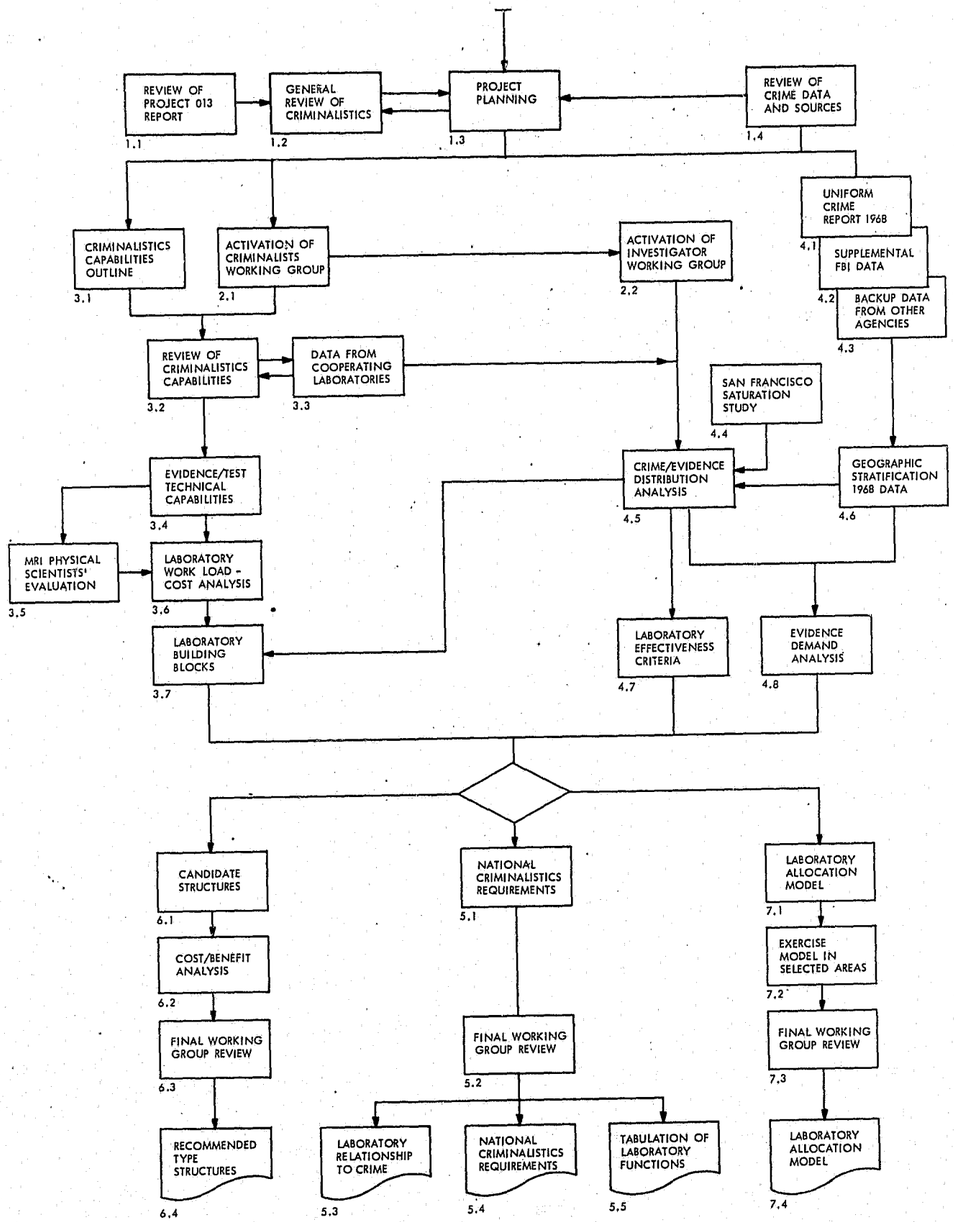


Figure 1 - Study Plan Flow Chart, "A Systems Analysis of Criminalistics Operations"

II. SUMMARY AND CONCLUSIONS

If nothing else, this study, a systems analysis of criminalistics operations, has revealed and documented that a "system" of crime laboratories does not exist. While many criminalists exchange technical information concerning laboratory procedures, either through professional societies or by personal contact, the relationship of each laboratory with the jurisdiction it serves has been so unique so as to preclude the common basis for exchange of management-type information. Some crime laboratories operating in a favorable environment of strong support by law enforcement agencies and ready acceptance of expert testimony by the judiciary have elevated their laboratories to a place of prominence and importance within that particular segment of the law enforcement system. Others have changed little since their inception decades ago perhaps due to lack of recognition of their capability or lack of support on the part of the jurisdiction served, or perhaps due to the criminalist who concentrated on perfecting laboratory techniques rather than promoting the application of his available skills.

The contribution that crime laboratories have made in protecting the innocent and apprehending and convicting the guilty in specific cases has been significant, and these notable accomplishments alone justify their existence. However, the involvement of the crime laboratory in the total body of crime has been so miniscule as to preclude a judgment as to the impact of criminalistics on the criminal justice system.

If a single characteristic has pervaded this study, it has been the anomaly. For each hypothesis or concept proposed, one could find support or contradiction from the meager data available. It is this lack of data on a uniform basis which established substantial barriers to a systematic analysis of crime laboratory operations. The wide variations in examiner caseload, distribution of type cases reaching the laboratory, laboratory services offered, cases per sworn officer served, and expert witness testimony leads one to the conclusion that despite complaints of overwork and lack of equipment, a vast potential exists in the crime laboratories currently in existence to provide significantly increased aid to law enforcement.

1. Improved Crime Scene Search Needed

Clearly, if the crime laboratory is to assume its proper role of increasing technical support capability for the law enforcement officer, there must be an attendant increase in physical clue material input from the scenes of crimes. While all law enforcement officers should receive training in the preservation of the crime scene, and the identification

and collection of significant physical clue material, skilled and supervised personnel attached to a laboratory with a primary responsibility for the collection and preservation of evidence appear to offer the greatest potential.

Use of laboratory examiners as regular crime scene units seems to represent a waste of resources especially due to the shortage of such examiners.

Few places in the United States have effective mobile units or evidence technician systems. Even where evidence technicians exist, the management of crime scenes is far from adequate due to a lack of attention to physical evidence by street supervision. In the final analysis, the laboratory is only as effective as the quality of its input material.

2. Laboratory Response Must Match Demand

The laboratory has a hand in influencing the amount of material that it receives. A negative attitude on the part of an examiner, frequent inconclusive results or slow response to need will reduce or halt input to the laboratory. Since the laboratory does not normally control its size or budget, the managing agency must share responsibility for the level of service that can be offered.

3. More Trained Criminalists Are Needed

Even the modest goal of three laboratory cases/year/sworn officer would only represent the crime laboratory's involvement in between 3 percent and 4 percent of the nation's crime. At an average caseload of 250 cases/year, this would require almost 4,000 criminalists or a fourfold increase over the current number of practitioners. If improved crime scene search measures are set in motion, and administrators and command staff reinforce and support the effort, existing crime laboratories would soon be inundated by physical clue material and faced with critical shortages of trained laboratory personnel. Improved crime scene search must be coupled with attendant increases in laboratory capability. Both academic and on-the-job training programs are needed.

4. Quality of Service Must be Maintained

There are few sources for training in criminalistics, and thus people with no preprofessional training are entering this field with the potential of endangering the credibility and accuracy of the results of laboratory examinations. Quality control measures of both intralaboratory and interlaboratory operations are required. Due to staff shortages, too

little attention has been given to individual, professional development. Short courses, seminars, and formal academic programs at graduate level should be encouraged.

5. Existing Crime Laboratory Resources Are Largely Devoted to Non-index Crime

Statutory tests (drugs, blood alcohol) reach the laboratory in both high percentage and quantity, pushing other evidence examination into the background. Many laboratories today become deeply involved in "platter cases" to the point that their heavy workload becomes so well known that it serves as a subtle deterrent to the search for physical evidence in more serious cases. Again, the whole justice system must accept some responsibility for allowing such items to saturate existing capabilities. Drugs should no more be allowed to dominate the laboratory than all police devoted to traffic.

One solution can be the development and adoption of automated analyses for commonly recurring materials. The second might be to further encourage the acceptance of laboratory reports at lower level courts and hearings without live testimony.

6. The Crime Laboratory Should be in the Main Stream of Law Enforcement Activity

Instead of merely being a captive service group, the crime laboratory should have a position in and a rapport with the agencies it supports.

The laboratory should be situated in the organization where it has some voice in its budget, personnel policies, and other management decisions. In organizational structures where the laboratory reports to a nontechnical supervisor, there is often a complete breakdown in ability to translate to the budget-making body the exact needs of the laboratory. Laboratory budgets are generally inadequate and in some instances earmarked funds are siphoned off for other concurrent departmental needs.

In addition to involvement in funding decisions, the laboratory needs to have a strong voice in assessing the amount, type, and quality of evidence that it receives. To have any meaning, this critical review must be listened to and acted upon by all levels of command and supervisory staff.

7. Crime Laboratories Must be Planned and Integrated into the Criminal Justice System

The development of crime laboratory capabilities must proceed hand in hand with crime scene search and user awareness of the resource. The law enforcement investigator, the prosecutor and other members of the legal community must be brought into any planning process to assure that the capabilities provided will, in fact, be used. This awareness and use cannot occur overnight nor should one expect a crime laboratory to develop other than through an orderly phased planning process which integrates the laboratory into the total law enforcement system. The laboratory planning model developed in this study can provide significant assistance in these areas.

8. Crime Laboratories Should Be Where the Crime Is

Every law enforcement officer in the nation should be provided with readily available crime laboratory service to the degree that it is economically feasible.

Under present operational concepts, a laboratory has a very limited zone of influence; its share of potential cases drops drastically with distance (as documented in this report) and is further limited by geopolitical boundaries and the degree of rapport between the laboratory and the users.

All high population density, high crime areas need a crime laboratory. New concepts to increase the radius of effectiveness of each laboratory must be sought. These concepts could include actual changes in operational methods such as: the establishment of a secure evidence transit system to bring physical clue material to a laboratory on a scheduled basis, use of closed-circuit TV or facsimile transmission devices to improve the communications between the laboratory and law enforcement agencies or use of satellite laboratory operations. Another approach to increase the sphere of influence can be to minimize the effect of geopolitical boundaries by increasing the number of agencies designated to be served by the laboratory.

9. A Crime Laboratory Should Serve an Entire Standard Metropolitan Statistical Area

The physical, economic, and social interdependence of the cities and counties which comprise an SMSA also influences the pattern of crime in that same area. Transportation systems and communications media transcend political boundaries, but with few exceptions, law enforcement agencies

accomplish this only on an ad hoc basis. This is particularly true of crime laboratories whose first loyalty and responsibility is to the political subdivision which provides the basis for its existence--the budget. A crime laboratory with a specific charter to serve an entire SMSA and multiple source funding can be responsive to the needs of all of the law enforcement departments. Priorities for augmenting existing laboratories or establishing new crime laboratories should be based on the SMSA crime laboratory concept, with consideration given to the size of the SMSA, crime rate, and number of law enforcement officers.

10. Crime Laboratories Should Maintain and Exchange Management Information

The scientific crime laboratory has been a part of the criminal justice system for the greater part of this century, and a significant exchange of technical information occurs between the practitioners of forensic science. However, this year-long study of crime laboratory operations, coupled with extensive literature search and conferences with outstanding men in the field, revealed a paucity of management information concerning what crime laboratories do, or more properly, what crime laboratories should do. There are few or no data on which to evaluate the performance of a crime laboratory. The answer to the question, what is the laboratory's contribution to law enforcement, or has it had any effect on the crime index, must remain speculative and subjective for the present. The crime laboratory is a valuable resource, and almost universally, every crime laboratory director complains of overwork, insufficient staff, inadequate facilities, lack of equipment, severe budgetary limitations, and a large backlog of cases. Few, if any, laboratories have operational policies which direct the efforts of this resource toward a specific category of crime. Except for those cases where the "heat is on" the laboratory largely reacts to the demands placed on it as a result of the ease of obtaining certain types of physical evidence. Narcotics analyses account for almost half of the numbers of cases handled by some laboratories, and the general category of "Illegal Acts" (fraudulent documents, driving while intoxicated, possession or use of narcotics, carrying concealed weapons, etc.) make up over three-fourths of the caseload in most laboratories. Laboratory cases involving Index Crimes are in the minority with some laboratories as low as 10 percent of their annual case volume.

Many laboratories are supervised by technicians who have advanced through some sort of laboratory system. While this is desirable in the sense that a laboratory supervisor should have extensive technical knowledge, it would also seem advisable to provide supplementary training in management techniques in order that the greatest utilization of personnel and materials can be achieved.

III. CRIMINALISTICS DEMAND PLANNING CONCEPTS

A. Crime/Evidence/Test Concept

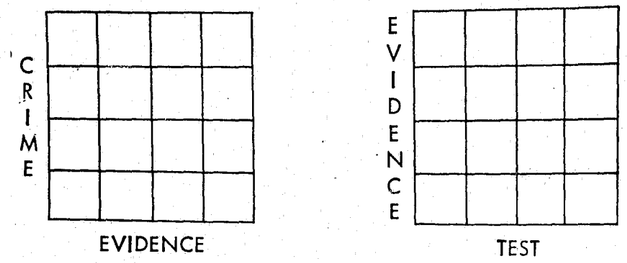
One of the primary goals of this study has been to develop quantitative planning tools with which to structure crime laboratories in accordance with need. One approach is to determine the relationship between crime and laboratory functions by using a three-dimensional matrix developed in two stages. The first stage in the development of this matrix is to determine the distribution of the occurrence of physical evidence by type crime (see Figure 2). For example, an analysis of the physical evidence yielded by the crime of murder will determine the frequency of occurrence of all of the types of physical evidence which can be produced by this type of crime. The number of times that blood, hair, fiber, paint, weapons, etc., are sent to the laboratory in connection with this crime is the basis for the frequency distribution. Similar distributions can be determined for other type crimes. An analysis of these data will reveal the potential of physical evidence available for examination by crime laboratories.

The second stage in the development of the crime/evidence/test three-dimensional matrix is the determination of what laboratory functions are required for the analysis of specific types of physical evidence. Again, frequency distributions for the number of times a particular laboratory test or function is called into play can be developed for all significant types of physical evidence.

These distributions can then be combined with the distribution of physical evidence by type crime to yield the three-dimensional matrix to correlate type crime with the probable requirement for crime laboratory functions or examinations.

Given the expected frequency of occurrence of a type crime for any selected area, the probable requirements for a specified crime laboratory function can be determined. Thus, the entire crime laboratory can be structured to meet the expected demand including the relative priorities for the various laboratory functions and associated equipment.

To be of any value in a national demand analysis, data available on a national basis were essential. The most obvious source of such data, under the assumption that crime laboratories are needed in some proportion to the amount of crime, is the Uniform Crime Report (UCR) published by the FBI.



CRIME CATEGORIES AND EXAMPLES

Crimes Against Persons
- Murder
- Other assaults
- Hit and run
- ⋮

Crimes Against Property and Commerce
- Burglary
- Arson
- Fraud
- ⋮

Illegal Acts
- Weapons
- Narcotics
- Abortion
- ⋮

Other

EVIDENCE CATEGORIES AND EXAMPLES

Physiological
- Blood
- Semen
- Other fluids
- Hair
- Other

Firearms

Trace Evidence
- Paint
- Fibers
- Building materials
- Misc. environmental
- Misc. personal

Marks and Impressions

Fragments

Clothing and Textiles

Chemical Products

Explosives

Documents

Narcotics and Drugs

All Other

TEST CATEGORIES AND EXAMPLES

I. Spatial Properties
- A. Configuration, Macro
- B. Configuration, Micro
- C. 2D and 3D impressions

II. Physical Properties
- A. Weight, volume, size
- B. Optical properties
  - 1. Color comparison, visual
  - 2. Color determination, instrumental
  - 3. Refractive index
  - 4. Fluorescence
- C. Thermal properties
- D. Misc. physical

III. Molecular Properties
- A. Chemical reactivity
- B. Biological activity
  - 1. Spot tests: Enzyme activity
  - 2. Spot tests: Antibody-Antigen reactions
- C. Molecular spectra
- D. Fractionation
- E. Molecular mass
- F. Molecular spacing

IV. Atomic Properties
- A. Atomic spectra
- B. Nuclear properties
- C. Elemental composition

V. Survey and Misc. Services

Figure 2 - Crime/Evidence-Evidence/Test Relationships

Although the UCR is valuable to determine the amount and distribution of the seven index crimes, it contains no data concerning actual levels of the remaining offenses. As the majority of laboratory workload is generated by non-index crime, other sources of such data were sought.

It was first determined that the monthly reports from each local police department to the FBI for purposes of making the UCR do not contain the necessary information on other offenses. Further analysis indicated that many of the nation's police departments do not publish data on all crimes beyond the level of that reported to the FBI. Certain cities publish summaries of levels of all crime and the arrests for those crimes. An attempt was made to correlate the amount of index crime with other crime and offenses with arrests, but the results were inconclusive. Attempts to solicit crime data from those states cooperating in Project SEARCH or from other states failed to yield any useful results. We are forced to conclude that the number of offenses of laboratory interest is not available at national, regional, or state levels and is only available for a limited number of cities. Figure 3 presents the levels of detail available for all offense categories.

Limited data on the amount and type of evidence yielded by each crime (or other event of laboratory interest) was obtained from several sources. The first was a study by Professor Brian Parker[14] on the amount and category of evidence that could be obtained from various offenses if sufficient resources were employed to adequately cover the crime scene.

The Metropolitan Police Department of the District of Columbia was a second source producing results from a one-month survey on the distribution of physical evidence by type of offense and the distribution of offenses that reached a laboratory (see Appendix 2).

The 1969 caseload of the Illinois State Laboratory at Joliet was analyzed using a computer program developed by MRI. The results of this analysis are presented in Appendix 3.

A similar analysis was performed on detailed records kept by the Oregon State Laboratory in Portland for an 11-month period. The results of this analysis are presented in Appendix 4.

These data, however, were insufficient for the complete development of the necessary frequency distributions for physical evidence by type crime, or the frequency distributions for laboratory tests by category of physical evidence. The hypothesis was further plagued by another factor. Parker[14] concludes that 9 out of every 10 criminal activities results in potential physical objects as a likely laboratory input. In this same study, Parker found an average of three items of physical clue material at

Crime or Event of Interest	Offense Data: Lowest Level of Geographic Stratification	Offense Data: Highest Level of Geographic Stratification	Arrest Data: Lowest Level of Geographic Stratification	Arrest Data: Highest Level of Geographic Stratification
Murder & Non-negligent Manslaughter Forcible Rape Robbery Aggravated Assault Burglary (breaking or entering) Larceny--Theft (greater than $50) Auto Theft	Specific Cities by Pop. Group	National	Population Groups	National
Manslaughter by Negligence	Specific Cities by Pop. Group	National	Population Groups	National
Larceny--Theft (Under $50)			Population Groups	National
Non-Aggravated Assault			Population Groups	National
Arson Forgery & Counterfeiting Fraud Embezzlement Stolen Property Vandalism Weapons (carrying-possessing) Other Sex Offenses Narcotic Drug Laws Gambling Driving Under the Influence Beverage Alcohol Violations	Limited City Data		Population Groups	National
Kidnapping Abortion Extortion & Threats Bombing Hit and Run Animal Poisoning Obscene Literature Adulterated Food Suicide Other Deaths of Suspicious Nature Conservation Law Violations	Limited City Data			

Figure 3 - Analysis of Crime Data Availability

each crime scene visited on a saturation basis. Ignoring the distribution of type physical evidence, and considering only the aggregate, the implication of these numbers, when one considers the gross estimate of 25,000,000 reported crimes per year in the U. S., is that there is vastly more physical evidence available to be brought to the laboratory than there are criminalists in the entire U. S. trained to examine it. Clearly then, the crime/evidence/test concept is more sensitive to the ability of law enforcement officers to collect physical evidence than it is to the level of crime. The lack of detailed data to establish distributions and correlations between crime and laboratory tests becomes more academic than real for the present.

The study of crime/evidence relationships was not terminated even when its use as a national demand strategy was eliminated. These relationships were still needed to understand the flow of evidence to a laboratory, to determine the questions that are normally asked of the laboratory, to investigate priorities and the methods used. The crime/evidence and evidence/test method is also a valid planning concept if the levels of all crime in the area to be served are known. While the hypothesis appears to remain valid, its implementation and testing must await the establishment of suitable data collection systems.

These problems notwithstanding, the planners of criminalistics operations remain in need of a simple algorithm whereby readily available data could be applied to yield meaningful guidelines for structuring a crime laboratory. In the course of these investigations, a concept evolved which meets these requirements and overcomes the weaknesses described above.

B. Cases per Officer (CPO) Concept

The basis for the cases per officer (CPO) concept is that the number of cases that actually reach the crime laboratory is in direct proportion to the number of patrolmen and special investigators available for crime scene search and related investigations. The hypothesis is that the crime laboratory is a technical support resource available to the sworn officer who is in contact with crime. In this regard, the crime laboratory can be considered technical support in the same manner as the police computer, communication system, detention facility, radar equipment, etc. All are available "tools" to aid and support law enforcement officers. Thus, a fraction of the crime laboratory and the other technical support capabilities can be considered as part of the patrolman's or detective's "equipment" as is his revolver, night stick, or patrol car.

Since only sworn officers are empowered to arrest, it was not considered that the crime laboratory served civilian employees of police departments. The number of sworn officers in a jurisdiction or community also provided an implied measure of the total amount of crime in the community, since it represents in a very practical sense what the community views as its needs for law enforcement. At the least it represents how much of the available budget the community is willing to spend for police services. While there are differences in organizations of police departments (sworn/civilian ratios, use of evidence technicians, etc.), it was considered that the number of sworn officers available has more significance as a gross planning factor than possible differences in organizational structure.

It should be noted at this point, however, that the purpose of the CPO concept is to provide a basis for crime laboratory planning. It should not be construed as being a measure of effectiveness of a crime laboratory or, for that matter, of the whole criminalistics operation which would include not only the crime laboratory but the law enforcement departments served and the prosecutors and courts making use of the expert testimony.

Comparison of crime volumes and caseloads indicates that only a fractional part of the physical evidence potential actually reaches any crime laboratory.

The level of crime in the U. S. can be considered as an infinite source of evidence that could be analyzed by a crime laboratory. The limiting factor appears to be the crime scene investigator who does not bring the evidence to the laboratory. The reasons for the tremendous disparity between potential and actual yields, however, go beyond the obvious and can be traced to shortages of officers, nonavailability of convenient laboratory service, lack of training and supervision in handling of physical evidence, or to attitudes or practices of prosecutors or courts.

The concept of a relationship between laboratory caseload and the number of sworn officers in the jurisdiction which the laboratory serves evolved after extensive review of the literature, analysis of crime laboratory records, and interaction with the criminalist working group. Figure 4 shows the Laboratory Cases per Officer ratio determined from caseload data reported in the John Jay Study for laboratories in these cities.[25] Even though there is a wide range of values shown (from 0.7 to 8.2) the frequency of CPO values between 1.0 and 4.0 warranted further investigation of this concept.

	City	Sworn Police Officers	Cases to Laboratory	CPO
1.	New Orleans*	1,460	3,516	2.4
2.	Oakland	651	3,976	6.1
3.	Dayton	427	2,314	5.4
4.	San Francisco	1,745	6,372	3.6
5.	Fort Worth	580	1,877	3.2
6.	Chicago	12,000	34,400	2.86
7.	Houston	1,577	4,414	2.8
8.	Columbus	807	2,067	2.56
9.	Cleveland	2,161	5,006	2.3
10.	Kansas City	970	1,458	1.5
11.	Buffalo*	1,400	1,600	1.1
12.	St. Louis*	2,170	4,500	2.1
13.	Newark	1,379	1,300	0.95
14.	Philadelphia	7,319	5,223	0.71
15.	New York City	29,900	20,978	0.7

* Updated.
Source: Ref. 25, except as updated in this study.

Figure 4 - Laboratory Cases per Officer, Selected Cities

Additional research indicated that some of the cities showing a high CPO were including in their reported caseload such services as polygraph examinations, I. D. Bureau Activities, latent print cases, etc., each of which distorts the CPO index.

Another contributing factor to a high CPO was found to be an abnormally high percentage of drug cases. It was determined during the course of the study that the typical city laboratory has approximately 30 percent of its total caseload made up of drug cases. If a particular jurisdiction has an inordinately large number of such cases then this factor must be recognized in advance in planning for their particular operations. Parker[14] reported that 489 cases were received by the crime laboratory during the 3-month study period. Projected out to a 1-year period of time, this would imply that 1956 cases were being sent to the laboratory. This figure when coupled with the 166 police officers in the survey area would yield a CPO index of 11.8 which is extraordinarily high in comparison with the other CPO values shown in Figure 3. Further analysis revealed that 452 of the 489 cases received by the laboratory were drug cases so that if these are extracted from the total caseload the revised CPO index is calculated to be 0.9 which is more in line with other city CPO's.

It is not recommended that the laboratory planner ignore the number of drug cases that he will likely receive. Quite to the contrary, he should recognize in advance that a large number of "platter" cases (i.e., spot tests on drugs) may well inflate his total caseload figure but that the actual workload imposed on the criminalist may be substantially less than with clue material from a major case.

It is intended that this analysis provide guidelines to assist in interpreting the CPO for a particular jurisdiction and in so doing provide a basis for equipping and staffing a laboratory commensurate with the criminalistics needs of that jurisdiction. Figure 5 shows a distribution of type cases to the laboratory for selected cities. These cities were selected because of the availability of caseload data and the variations in size and caseload distribution represented. The extremes in the proportion of drug cases to the laboratory vary from 16 percent to 92 percent with the average being 54 percent.

Drugs have been identified out of the total caseload primarily because of the faster turn-around time which is normally associated with this type of case. Even though the complexity of certain of the synthetic drugs has increased in recent years and as a result more extensive laboratory procedures are now employed to analyze these drug samples, by-and-large, the crime laboratory can still process drug cases faster than many other kinds of clue materials.

The planner of a crime laboratory may utilize the CPO concept to approximate his need for criminalists by utilizing available data from his local jurisdiction to the extent that it is available. If local data are not available, then approximations may be made based on guidelines established in this report and elsewhere in the literature. Figure 2 indicates that the expected yield of cases to the laboratory per sworn officer in a typical city is in the neighborhood of 3.0 cases per officer per year. A crime laboratory which is to serve a jurisdiction with 1,000 police officers would then expect to receive 3,000 cases per year.

The average number of cases that an examiner can handle varies with the type of analysis that he is performing. The 1967 survey of crime laboratories[25] indicated typical examiner caseloads for a number of city laboratories ranging from 150 to 1,000. Based on this information and a survey of caseload data from laboratories around the country, it was concluded that caseload per examiner values should be assigned reflecting the particular distribution of expected cases in a given jurisdiction. Applying this philosophy, numerical values of 125 (one-half case per day), 250 (one case per day), and 500 (two cases per day) were chosen to represent low, medium and high percentages, respectively, of drugs in the caseload distributions. If the jurisdiction in the example just cited had the normal

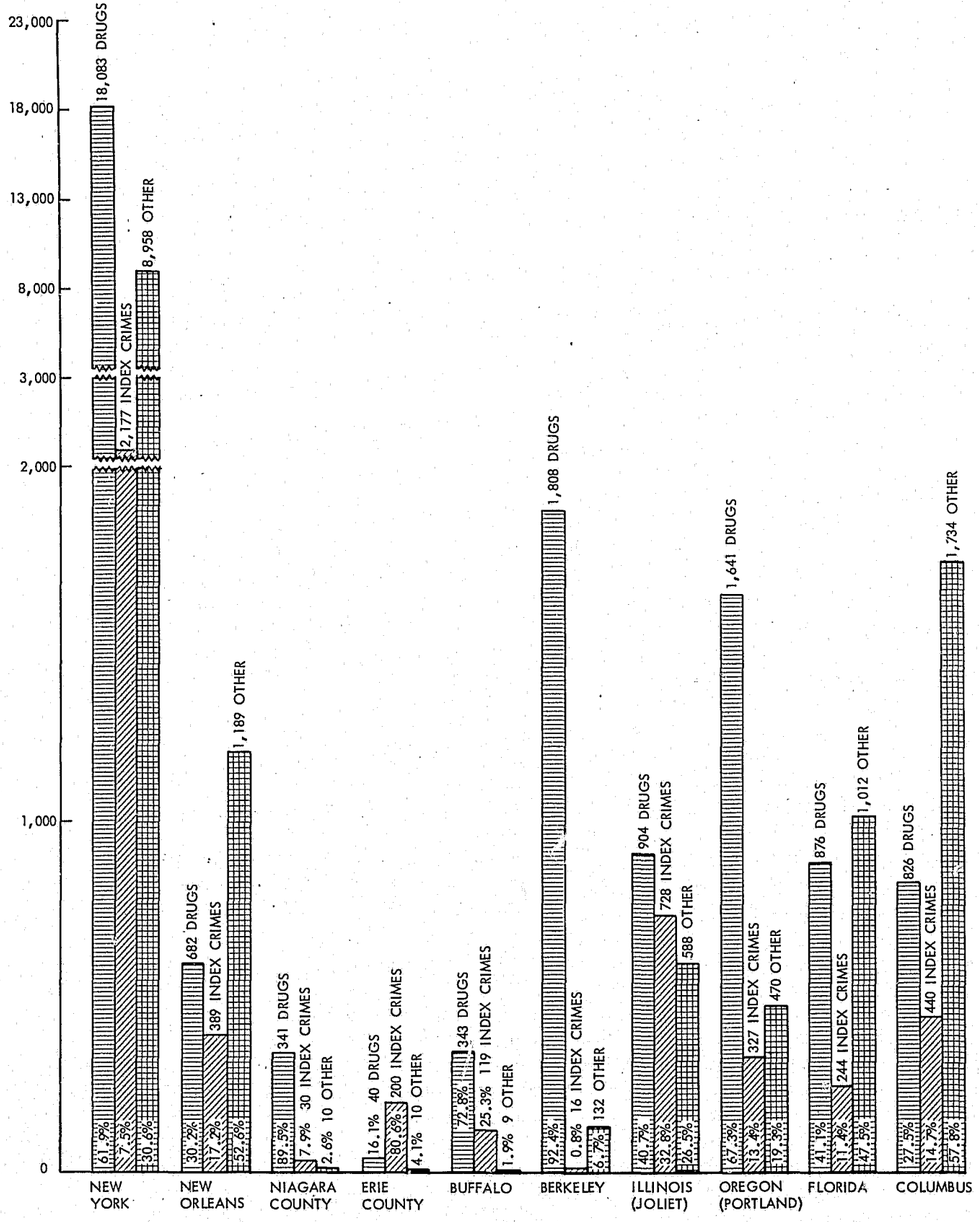


Figure 5 - Distribution of Type Cases to Crime Laboratories

percentage of drug cases the planner would select the 250 cases/examiner as the expected annual workload of an examiner in his laboratory and determine that he should plan on staffing approximately 12 examiners. (3,000 cases ÷ 250 cases per examiner). Note that if he anticipated a high percentage of drug cases he would select the 500 cases per examiner and plan on staffing only six examiners in his laboratory. More definitive staffing and equipment priorities are given in Section V and Appendices 7, 8 and 9.

The case-per-officer concept provides a simple consistent means of determining the approximate demand for criminalistics. It recognizes that the crime laboratory is not an entity unto itself, but that it exists solely to serve the needs of law enforcement and criminal justice, and must be considered as an integral part of the entire system. For planning purposes, data on police population to be served are more readily available than details on crime itself.

IV. CANDIDATE STRUCTURES TO SATISFY THE DEMAND FOR CRIMINALISTICS

The number of crime laboratories required to serve the needs of law enforcement in the United States has not been clearly defined in the past. According to a recent survey,[25] there were, at the time of that study in 1967, 105 activities which were called crime laboratories. One might say that the existence of these laboratories represents satisfaction of the demand. Some investigators into the subject state that any city or county with a population of 100,000 or more can support a criminalistics operation. Others indicate that the criterion for a model regional crime laboratory is the capacity to serve a minimum of 500,000 to 1,000,000 people with an average of 5,000 Part I offenses per year, but that it should be within 2 hours' driving time from the crime scene.[25] Borkenstein raises the other question of centralization versus decentralization. "The great dilemma in the application of the forensic sciences to the administration of justice and law enforcement is: to centralize or not to centralize. Centralization tends to promote scientific specialization, perfection of equipment, and efficiency in operation. However, there are many real and practical pressures in the opposite direction."[2] Using the 2-hour driving time criterion, over 400 laboratories would be required to meet this demand for crime laboratory services. Implicit in this concept is the assumption that crime is uniformly distributed across all areas of the United States. Obviously, this is not so. Using crimes of violence as a measurement, five states--New York, California, Illinois, Michigan, and Texas--account for half of the violent crime reported in 1968. Eight other states account for the next 25 percent, and so on. The density of violent crime by state is shown in Figure 6.

It is a truism that people commit crimes, and the volume of crimes is high where populations are dense (or large as in the case of Texas). Figure 7 shows the rank order of the 21 states which account for 87 percent of the nation's violent crime. (Rank order of other states is shown in Appendix 6.)

The impact of the cities on violent crime is well known. The suburbs surrounding these cities are part of that crime pattern. The same factors which define relationships between a municipality and its surrounding counties as a Standard Metropolitan Statistical Area (SMSA) apply to crime as well (see Figure 8). Eleven SMSA's account for half of the violent crime in the U.S., but have less than one-fourth of the nation's population (see Figure 9).

The crime laboratories that exist today are where they are for a variety of reasons. The attitudes of law enforcement officials in the area,

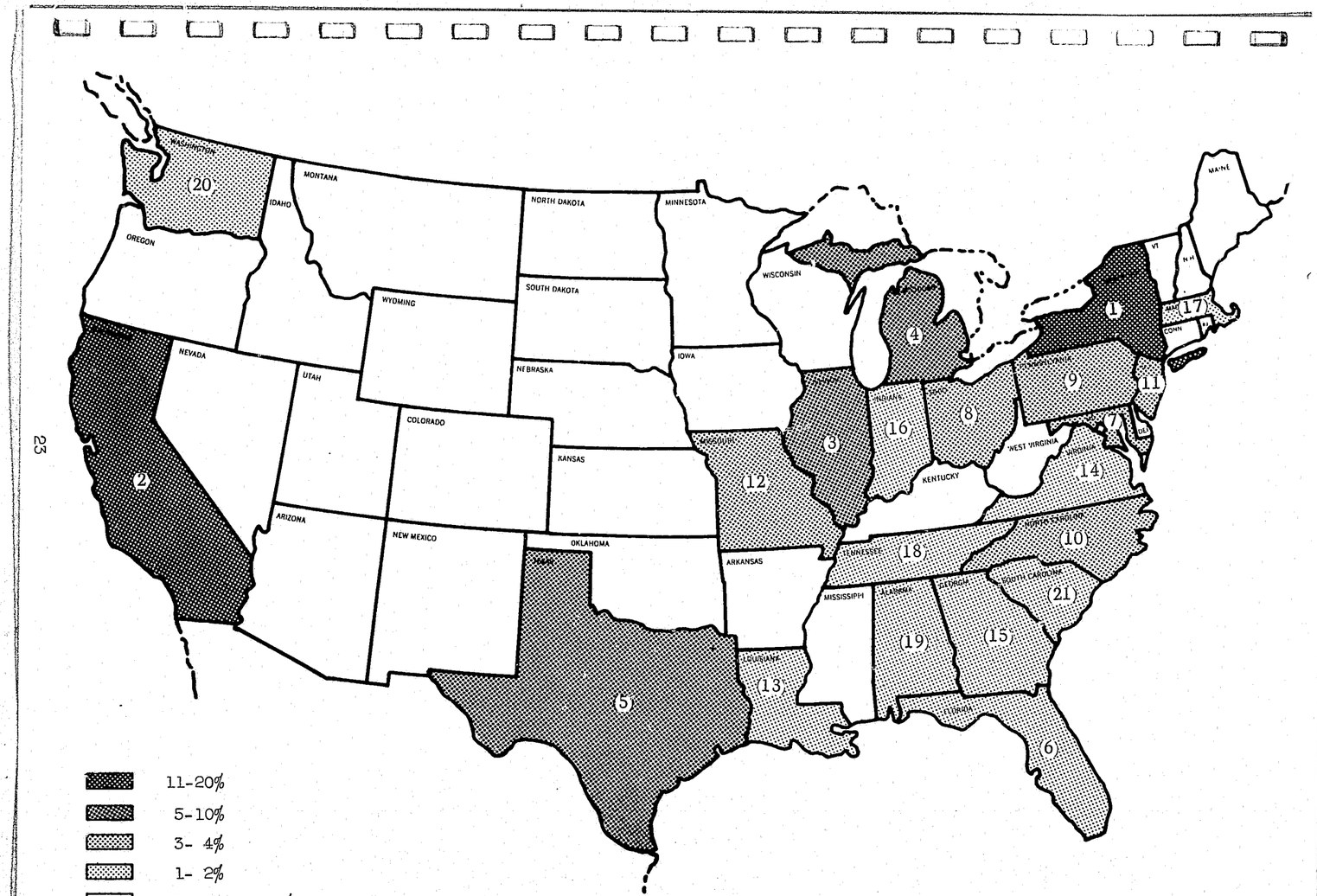


Figure 6 - Distribution of Violent Crime in U. S. by State
(Source of Data, Uniform Crime Report, FBI, 1968)

STATE	RANK	PERCENTAGE OF NATIONAL CRIMES OF VIOLENCE		PERCENTAGE OF STATES VIOLENT CRIMES OCCURRING IN SMSA	PERCENTAGE OF STATES VIOLENT CRIMES OCCURRING IN OTHER CITIES	PERCENTAGE OF STATES VIOLENT CRIMES OCCURRING IN RURAL AREAS
		EACH	CUM			
NEW YORK	1	16.5	16.5	98.2	1.1	0.8
CALIFORNIA	2	13.3	30.3	96.7	1.8	1.5
ILLINOIS	3	7.6	37.9	96.1	2.0	1.9
MICHIGAN	4	6.1	44.0	92.6	3.4	4.0
TEXAS	5	5.0	49.0	87.0	5.6	7.4
FLORIDA	6	4.7	53.8	81.1	8.9	10.0
MARYLAND	7	4.0	57.7	96.9	1.3	1.9
OHIO	8	3.6	61.3	92.8	4.0	3.2
PENNSYLVANIA	9	3.4	64.7	94.5	2.5	2.9
NORTH CAROLINA	10	3.0	67.7	46.8	19.8	33.4
NEW JERSEY	11	2.8	70.6	88.1	11.0	0.8
MISSOURI	12	2.6	73.2	90.2	2.9	7.0
LOUISIANA	13	2.0	75.2	75.2	9.1	15.7
VIRGINIA	14	1.8	77.0	69.8	10.4	19.9
GEORGIA	15	1.7	78.7	51.0	17.0	32.0
INDIANA	16	1.7	80.3	87.2	8.3	4.4
MASSACHUSETTS	17	1.5	81.9	98.0	1.5	0.5
TENNESSEE	18	1.5	83.3	66.9	9.5	23.7
ALABAMA	19	1.4	84.8	65.3	13.2	21.5

Figure 7 - Crime Laboratory Demand Analysis States Ranked by Violent Crime with Intra-State Distribution Based on Uniform Crime Report - 1968

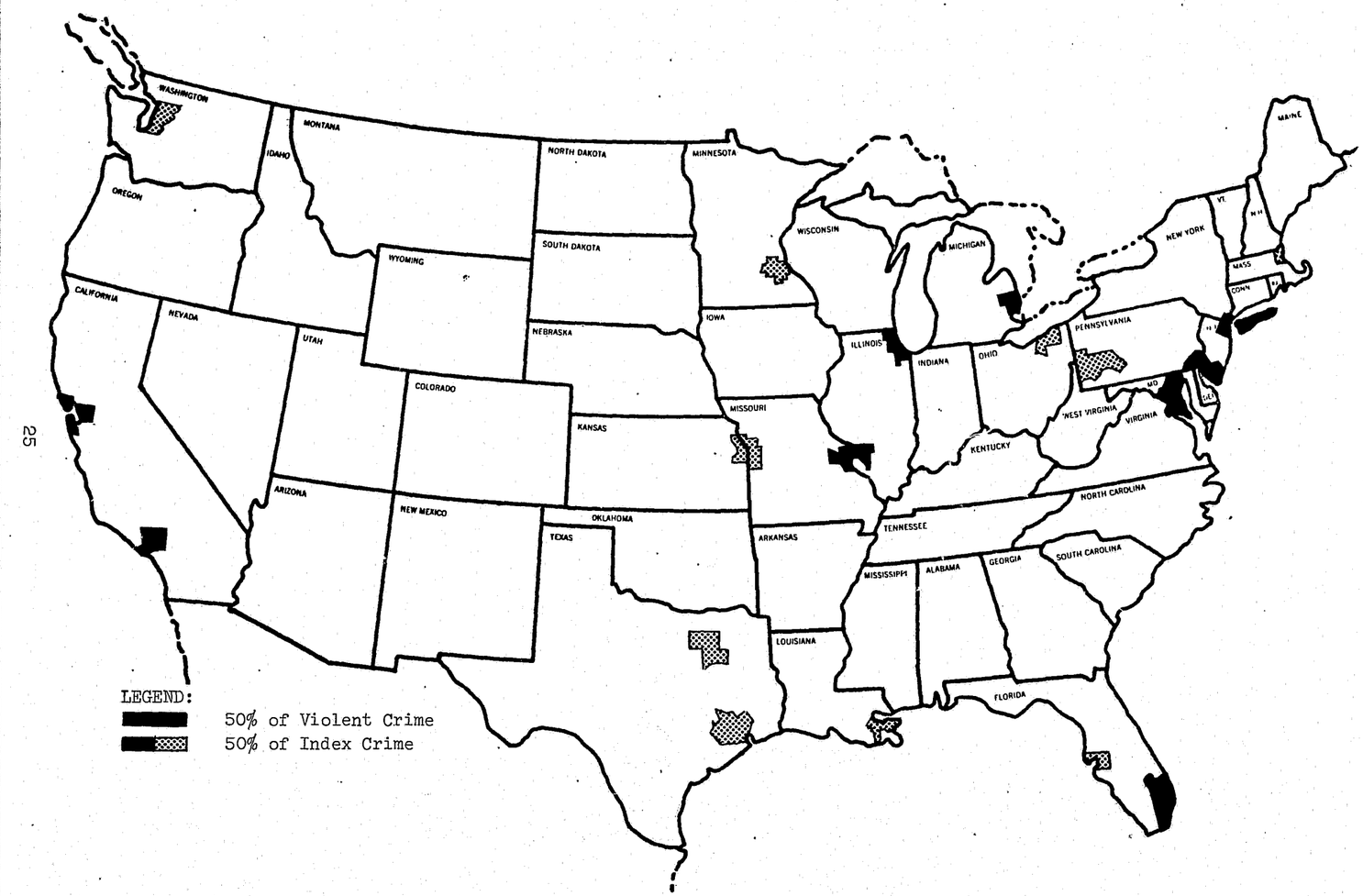


Figure 8 - Concentration of Index Crime in U. S.

SMSA	RANK	POPULATION	CUM PERCENT NATIONAL POPULATION	CRIMES OF VIOLENCE	CUM PERCENT OF NATIONAL CRIMES OF VIOLENCE	TOTAL INDEX CRIMES	CUM PERCNT OF TOTAL NATIONAL CRIMES
NEW YORK, N.Y.	1	11587000.	5.8	89090.	15.1	548511.	12.3
LOS ANGELES-LONG BEACH, CALIF	2	6900000.	9.2	44562.	22.7	324673.	19.5
CHICAGO, ILL	3	6871000.	12.7	38806.	29.3	168856.	23.3
DETROIT, MICH	4	4225000.	14.8	26023.	33.7	152581.	26.7
BALTIMORE, MD	5	2021000.	15.8	20456.	37.2	89926.	28.8
SAN FRANCISCO-OAKLAND, CALIF	6	3029000.	17.3	18440.	40.3	141352.	31.9
WASHINGTON, D.C.-MD-VA	7	2755000.	18.7	16455.	43.1	94123.	34.0
PHILADELPHIA, PA.-N.J.	8	4847000.	21.1	12113.	45.2	76057.	35.7
ST. LOUIS, MO.-ILL	9	2395000.	22.3	10442.	46.9	69457.	37.3
MIAMI, FLA	10	1219000.	22.9	9489.	48.5	48998.	38.4
NEWARK, N.J	11	1870000.	23.9	8800.	50.0	65818.	39.9
HOUSTON, TEX	12	1854000.	24.8	8727.	51.5	56032.	41.1
BOSTON-LOWELL-LAWRENCE, MASS	13	3253000.	26.4	6328.	52.6	82447.	43.0
CLEVELAND, OHIO	14	2076000.	27.5	6142.	53.6	46728.	44.0
PITTSBURGH, PA	15	2366000.	28.7	5999.	54.7	49830.	45.1
KANSAS CITY, MO.-KANS	16	1300000.	29.3	5921.	55.7	38873.	46.0
NEW ORLEANS, LA	17	1033000.	29.8	5642.	56.6	35093.	46.8
DALLAS, TEX	18	1457000.	30.6	4857.	57.5	33680.	47.5
MINNEAPOLIS-ST.PAUL, MINN	19	1691000.	31.4	4602.	58.2	51302.	48.7
SEATTLE-EVERETT, WASH	20	1311000.	32.1	4439.	59.0	43645.	49.7
TAMPA-ST. PETERSBURG, FLA	21	898000.	32.5	3941.	59.7	30912.	50.3

Figure 9 - Crime Laboratory Demand Analysis Standard Metropolitan Statistical Areas
Ranked by Violent Crime Based on Uniform Crime Reports - 1968

budgetary considerations, and the availability of qualified criminalists and examiners, all have had bearing on the decision to establish a crime laboratory. The policies and service attitudes of state crime laboratories, where they exist, also influence the decision on local laboratories. With the possible exception of one or two state crime laboratory systems, crime laboratories have not been established as parts of an overall system designed to provide services in accordance with the demand for laboratory support. Laboratories have not been established based on a quantitative analysis of need.

Theoretically, it would be possible to serve the needs of the nation from one single crime laboratory, centrally located, and at the same time achieve significant economies in professional manpower, equipment, and processing efficiency. On the other end of the spectrum, using the 50-mile radius criterion, more than 400 crime laboratories would be required to serve all areas with local laboratories. The total cost of these laboratories would be quite high, but the service level achieved would also be high. It is easy to visualize the reluctance of an investigator to wrap up a car bumper and mail it to the central laboratory for analysis as compared with the convenience of taking that same item to the local laboratory in a patrol car. This also suggests that there would be decay in the amount of evidence which reached the laboratory as a function of the distance of the enforcement agency to the crime laboratory facility. It is also apparent that the effect of distance to reduce the amount of physical evidence which would be submitted to a crime laboratory is not the same for all crimes. Decay coefficients must be established for each type crime as a function of distance.

Parker's conclusions[14] that 9 out of 10 crimes result in potential physical objects as a likely laboratory input has the implication of over 20,000,000 cases to the laboratory each year. At a medium level workload of 250 cases per year, it would require almost 100,000 criminalists to process this evidence. Even considering a more realistic approach of the limitation of the number of cases each sworn officer could be expected to bring into the laboratory to three cases per sworn officer per year, the number of cases to the laboratory would be almost 1,000,000. Again, using the 250 cases per examiner per year basis, 4,000 criminalists would be required to examine that volume of clue material. It is difficult to visualize a single 4,000-man national crime laboratory which could meet this requirement. It is almost as difficult to visualize a fourfold increase in the number of qualified criminalists operating in multiple laboratories. Fortunately, or unfortunately as the case may be, the real world is quite different than the theoretical. The prospect of 20 million laboratory cases per year is interesting only to establish the fact that a very large body of physical clue material is available for collection to be sent to the crime laboratory. Similarly, there is little expectation that the 307,000* sworn police officers

* Compiled from UCR data.

in the United States will each collect physical clue material in three cases during the next year. The Federal Bureau of Investigation Crime Laboratory received less than one-tenth case per officer from non-FBI sources during 1968.

Considering the crime laboratory as a technical support for the sworn police officer, the influence or availability of that support appears to vary as a function of the distance of the laboratory from the jurisdiction or police officer served. The relationship is not clearly defined, nor are data available from which to develop a model to analyze quantitatively all of the factors involved in this phenomenon. There is sufficient evidence, however, to support the hypothesis of convenience which suggests that law enforcement officers are more apt to request technical support from a nearby local crime laboratory where they have frequent contact with the personnel, than they are to prepare physical clue material for transmission to a distant lab which may or may not have a charter to serve their particular jurisdiction.

The factors influencing this diminution or decay of the influence of the laboratory as a function of remoteness or distance are probably quite complex. The laws of the state, and the attitude of the courts and prosecutors toward the use of physical evidence or expert testimony in court, can have a significant effect on whether or not evidence is sent to the laboratory.

Political boundaries can serve as barriers to sending physical clue material to the laboratory. Jurisdictions outside the city are often served by the laboratory on a second priority basis, if at all, when the workload is high. While crime laboratories are generally cooperative in providing services to other agencies, their first loyalty is to the jurisdiction which provides funding and support.

The distance of the laboratory from the crime scene is a significant factor in determining whether or not physical clue material is sent to the laboratory.

The law enforcement department exercises great influence on the amount of physical clue material that is sent to a laboratory, regardless of the proximity or jurisdiction of the laboratory. Command emphasis on the collection of physical evidence certainly plays a role, as does the level of training of investigators in collection of physical evidence, equipment available, existence of crime scene search teams or evidence technicians, the amount of time an investigator can spend on each case, among others.

The crime laboratory itself influences its own volume of work. If the laboratory is able to satisfy investigators' requests for laboratory examinations, then that investigator and others will continue to make

similar requests. Conversely, if requests for service are denied, response time is inordinately long, or consistently inconclusive results are provided, the tendency will be to reduce the number of requests for service that the investigators make to the laboratory.

The discussion of the factors which influence the amount of physical clue materials that are sent to crime laboratories could probably be extended for several pages; however, the continuation would be of no real value, since the point already has been made that many factors are involved, and the relative importance of any one factor will vary with each laboratory, and there are no quantitative measures available to determine relative importance.

The phenomenon does appear to have a characteristic decay curve when cases per officer submitted to the laboratory are plotted against distance from the laboratory. Available data from Florida as reported in Appendix 5 are shown in Figure 10, Evidence Submission Decay as a Function of Distance. The multitudinous factors which effect decay notwithstanding, it appears that those law enforcement jurisdictions within a 50-mile radius of a laboratory will use the laboratory with much greater frequency than those which are beyond the approximate 50-mile radius. The frequency of use drops off sharply as this distance is exceeded to approach zero beyond the limits of influence of the laboratory.

Using data for the average number of cases per officer for city laboratories and several state laboratories, one can construct a hypothetical decay curve from which to approximate a CPO value for a regional laboratory concept (see Figure 11). From this decay curve then, hypothetical or planning CPO values can be determined which can be used for the analysis of several candidate structures for meeting the criminalistics demand. For the purpose of this analysis, a relatively conservative value for city laboratories of three cases per officer per year was selected. Since the counties which comprise an SMSA are largely within a 50-mile radius of the principal city,[26] the CPO value for the SMSA should be nearly the same as for the city. A CPO value of 1.0 is used as planning value for state laboratories, while a regional laboratory could be expected to draw on the basis of 0.5 cases per officer per year for the regions served. A value of 0.1 CPO is used for the national laboratory.

Several assumptions are used for the analysis. It is assumed that the minimum size for a full-service laboratory would consist of five qualified examiners. Such a laboratory would also include technical and administrative support such as photographic technicians, fingerprint technicians, clerical, and administrative personnel.

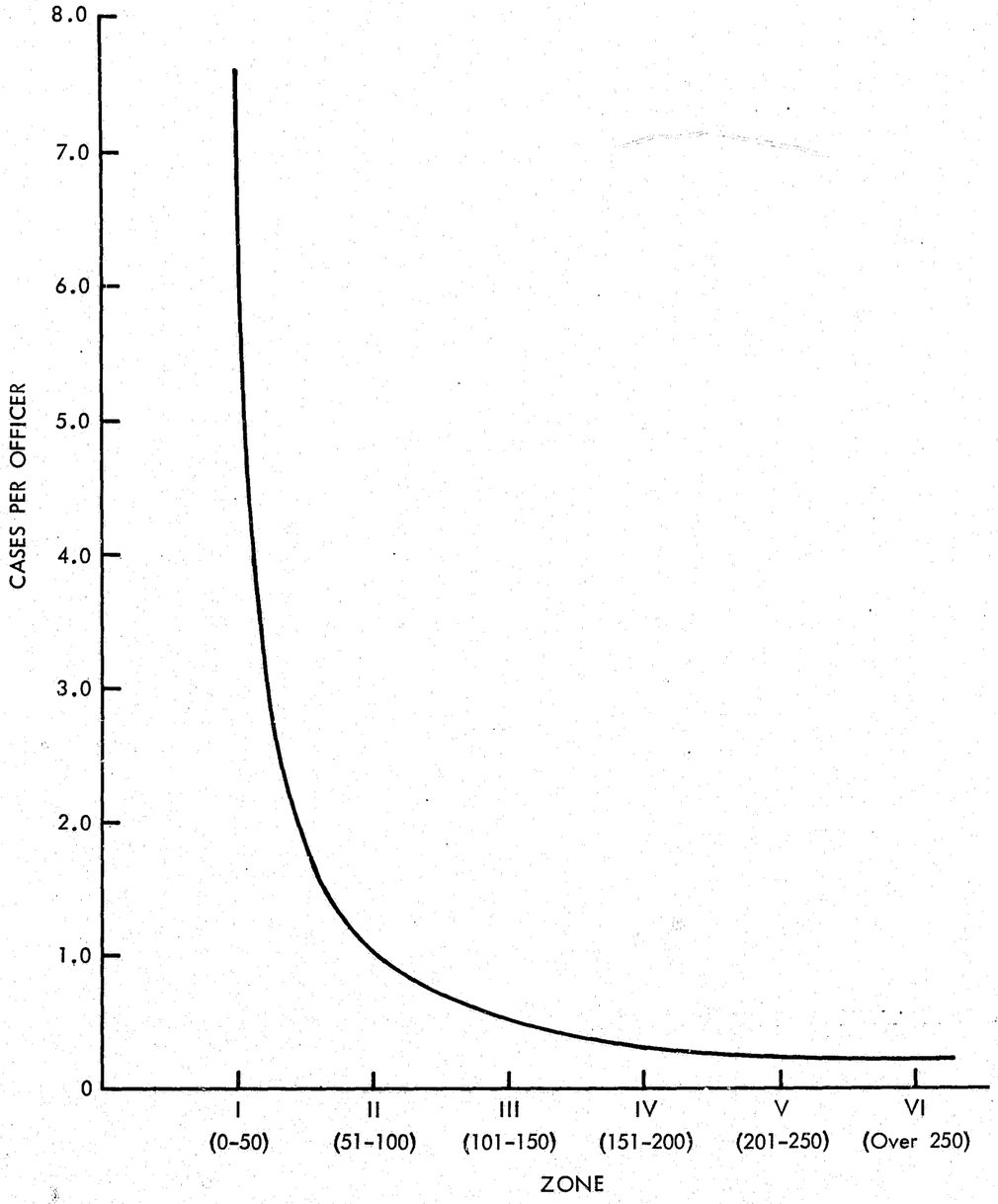


Figure 10 - Evidence Submission Decay as a Function of Distance

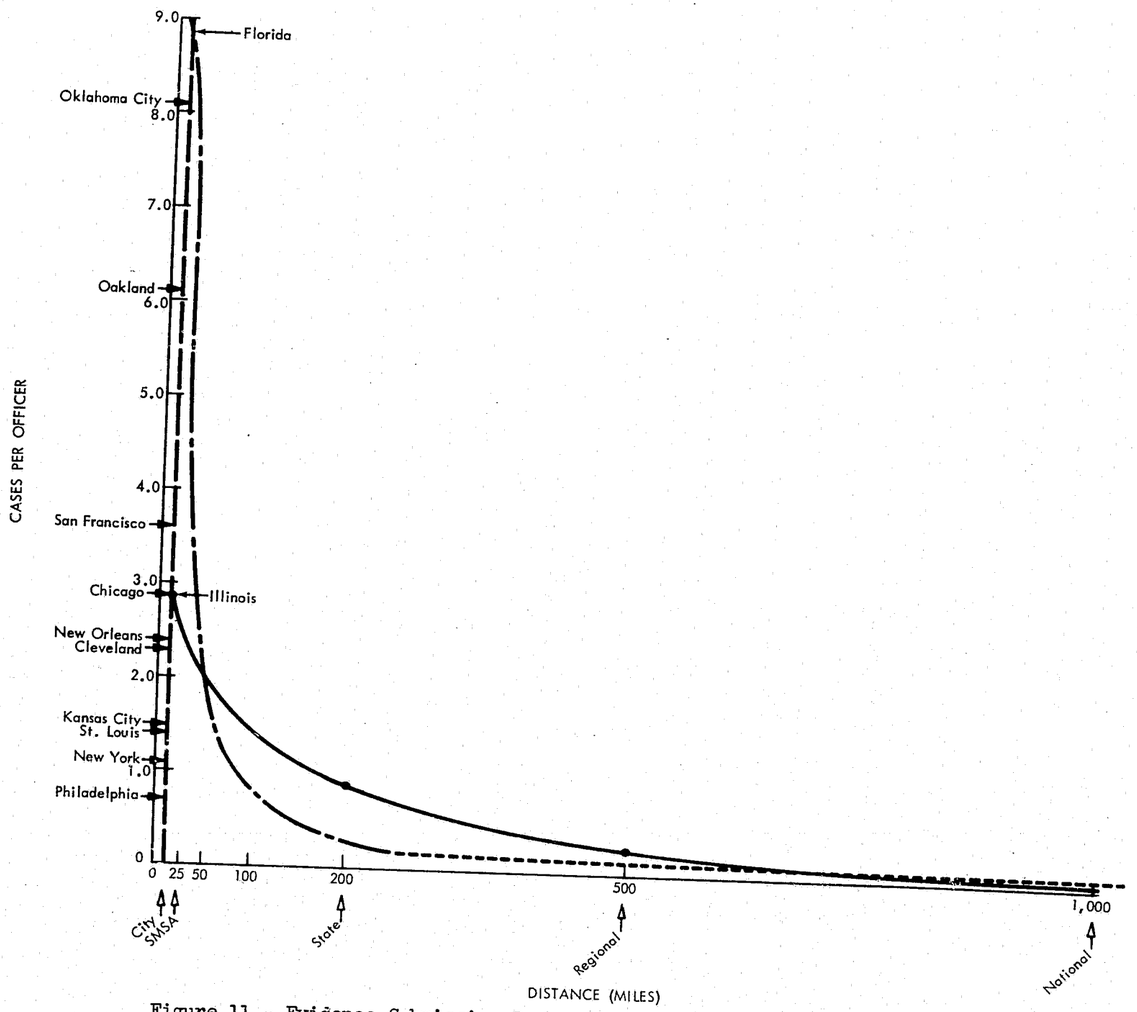


Figure 11 - Evidence Submission Decay as a Function of Type Laboratory

Laboratories are classified as small (5 to 15 examiners), medium (16 to 40 examiners), large (41 to 100 examiners), and very large (over 100 examiners). This latter category could include both a single laboratory or a laboratory system with satellites nearby. Under one concept, a standard cost per examiner, including equipment and technical and administrative support, is assumed for all categories of crime laboratories. While there are certain efficiencies to be gained within the large laboratory, such as lower equipment costs per examiner or multiple use of the same equipment by more than one examiner, in some large jurisdictions or areas to be served the increased travel time which would be added to court testimony time demands would negate the advantage. Under this concept, a planning figure of $20,000 per year per examiner was used as the basis for determining crime laboratory costs (see Appendix 1).

To show the effect of improved efficiencies with larger consolidated laboratory operations, an analysis was conducted using variable cost per examiner for each laboratory category. The $20,000 per annum figure was retained for the small laboratory, $19,000 per examiner for the medium, $18,000 per annum for the large, and $17,000 per examiner per year for the very large laboratory.

A laboratory caseload capability of 250 cases per year per examiner is used as an average planning figure for the analysis. For city and SMSA laboratories, the effect of higher or lower caseload capabilities is shown, using values of 125 cases per year and 500 cases per year in addition to the medium value. The number of sworn law enforcement officers in the United States is assumed to be 307,000.[6]

For regional crime laboratory concepts, the nine law enforcement regions of the Uniform Crime Report[6] are used. They are: the New England States, Middle Atlantic States, East North Central States, West North Central States, South Atlantic States, East South Central States, West South Central States, Mountain States, and Pacific States.

Seven candidate structures or systems of crime laboratories are examined in the analysis as follows:

1. A single national crime laboratory (CPO 0.1).

2. Nine regional crime laboratories (CPO 0.5) + one national laboratory (CPO 0.1).

3. Fifty state laboratories (CPO 1.0) + one national laboratory (CPO 0.1).

4. Sixty city laboratories (CPO 3.0) + nine regional laboratories (CPO 0.5) + one national laboratory (CPO 0.1).

5. Sixty city laboratories (CPO 3.0) + 50 state laboratories (CPO 1.0) + one national laboratory (CPO 0.1).

6. One hundred and four SMSA laboratories (CPO 3.0) + nine regional laboratories (CPO 0.5) + one national laboratory (CPO 0.1).

7. One hundred and four SMSA laboratories (CPO 3.0) + 50 state laboratories (CPO 1.0) + one national laboratory (CPO 0.1).

The difference in those concepts embodying city crime laboratories vs. the SMSA crime laboratory is one of including the specific charter of the crime laboratory beyond the city limits of the jurisdiction in which it is established. It is difficult, if not impossible, to separate the city from its surrounding suburbs and dependent counties. The criminal does not recognize these political boundaries and works at his "trade" freely crossing from one end to another. Most communities have cooperative arrangements to meet this problem, but the provision of crime laboratory services is on a convenience rather than authorized basis. The SMSA crime laboratory visualized in this analysis is one which has a specific charter to serve the entire SMSA, is supported financially from all local agencies, and perhaps supplemented by Federal support for this purpose. The advantage of a single open bullet file for the entire SMSA is obvious. The SMSA laboratory would utilize personnel drawn from the many participating departments. Similarly, a regional laboratory would be established to provide services to all of the law enforcement agencies within the states of its region.

Appendix 1, Cost Effectiveness Analysis, Candidate Structures, provides the details of the analysis. For cities and SMSA's, respectively, a rank order analysis shows a priority of establishing or augmenting existing crime laboratories by city or SMSA under the assumptions contained in the analysis (see Figure 12). (Additional cities and SMSA's are shown in Appendix 1.) For example, to provide a local crime laboratory to be available to 50 percent of the police of the nation would require 41 full-service laboratories which would need 1,845 qualified examiners.

A tabular summary sheet from Appendix 1 appears as Figure 13, showing the comparison of the seven selected locational strategies. Each strategy is examined under three conditions.

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JUNE 1970

DEMAND FOR CRIME LAB EXAMINERS IN STANDARD METROPOLITAN STATISTICAL AREAS BASED ON A YIELD OF THREE CASES PER OFFICER

MSA	EST NO. POLICE	EST. LAB CASES	NO. EXAMINERS BY CASELOAD LOW	MED	HIGH	CUM NO. POLICE	CUM LAB CASES	CUM. EXAMINERS BY CASELOAD LOW	MED	HIGH	CUM. PERCENT INDEX POP.	CRIME	POL.	RNK
NEW YORK, N.Y.	34119.	102357.	819.	409.	205.	34119.	102357.	819.	409.	205.	5.8	12.3	11.1	1
CHICAGO, ILL	15666.	46998.	376.	188.	94.	49785.	149355.	1195.	597.	299.	9.2	16.1	16.2	2
PHILADELPHIA, PA.-N.J.	10541.	31623.	253.	126.	63.	60326.	180978.	1448.	724.	362.	11.7	17.8	19.7	3
LOS ANGELES-LONG BEACH, CALIF	9971.	29913.	239.	120.	60.	70297.	210891.	1687.	844.	422.	15.1	25.0	22.9	4
DETROIT, MICH	7580.	22740.	182.	91.	45.	77877.	233631.	1869.	935.	467.	17.2	28.4	25.4	5
BOSTON-LOWELL-LAWRENCE, MASS	6089.	18267.	146.	73.	37.	83966.	251898.	2015.	1008.	504.	18.9	30.3	27.4	6
WASHINGTON, D.C.-MD-VA	4958.	14874.	119.	59.	30.	88924.	266772.	2134.	1067.	534.	20.2	32.4	29.0	7
SAN FRANCISCO-OAKLAND, CALIF	4278.	12834.	103.	51.	26.	93202.	279606.	2237.	1118.	559.	21.7	35.6	30.4	8
BALTIMORE, MD	4183.	12549.	100.	50.	25.	97385.	292155.	2337.	1169.	584.	22.8	37.6	31.7	9
ST. LOUIS, MO.-ILL	3739.	11217.	90.	45.	22.	101124.	303372.	2427.	1213.	607.	24.0	39.1	32.9	10
CLEVELAND, OHIO	3378.	10134.	81.	41.	20.	104502.	313506.	2508.	1254.	627.	25.0	40.2	34.0	11
NEWARK, N.J	2939.	8817.	71.	35.	18.	107441.	322323.	2579.	1289.	645.	25.9	41.7	35.0	12
PITTSBURGH, PA	2864.	8592.	69.	34.	17.	110305.	330915.	2647.	1324.	662.	27.1	42.8	35.9	13
MILWAUKEE, WIS	2593.	7779.	62.	31.	16.	112898.	338694.	2710.	1355.	677.	27.8	43.3	36.8	14
BUFFALO, N.Y.	2427.	7281.	58.	29.	15.	115325.	345975.	2768.	1384.	692.	28.5	43.9	37.6	15
HOUSTON, TEX	2141.	6423.	51.	26.	13.	117466.	352398.	2819.	1410.	705.	29.4	45.2	38.3	16
MINNEAPOLIS-ST.PAUL, MINN	2079.	6237.	50.	25.	12.	119545.	358635.	2869.	1435.	717.	30.3	46.3	38.9	17
DALLAS, TEX	2076.	6228.	50.	25.	12.	121621.	364863.	2919.	1459.	730.	31.0	47.1	39.6	18
PATERSON-CLIFTON-PASSAIC, N.J.	1858	5574.	45.	22.	11.	123479.	370437.	2963.	1482.	741.	31.7	47.6	40.2	19
KANSAS CITY, MO.-KANS	1829.	5487.	44.	22.	11.	125308.	375924.	3007.	1504.	752.	32.3	48.5	40.8	20
NEW ORLEANS, LA	1741.	5223.	42.	21.	10.	127049.	381147.	3049.	1525.	762.	32.8	49.3	41.4	21
MIAMI, FLA	1698.	5094.	41.	20.	10.	128747.	386241.	3090.	1545.	772.	33.4	50.4	41.9	22
SEATTLE-EVERETT, WASH	1675.	5025.	40.	20.	10.	130422.	391266.	3130.	1565.	783.	34.1	51.3	42.5	23
CINCINNATI,OHIO-KY.-IND	1586.	4758.	38.	19.	10.	132008.	396024.	3168.	1584.	792.	34.8	51.8	43.0	24
JERSEY CITY, N.J.	1583.	4749.	38.	19.	9.	133591.	400773.	3206.	1603.	802.	35.1	52.1	43.5	25
ATLANTA, GA	1536.	4608.	37.	18.	9.	135127.	405381.	3243.	1622.	811.	35.8	52.9	44.0	26
INDIANAPOLIS, IND	1532.	4596.	37.	18.	9.	136659.	409977.	3280.	1640.	820.	36.3	53.5	44.5	27
DENVER, COLO	1524.	4572.	37.	18.	9.	138183.	414549.	3316.	1658.	829.	36.9	54.3	45.0	28
SAN DIEGO, CALIF	1496.	4488.	36.	18.	9.	139679.	419037.	3352.	1676.	838.	37.5	54.9	45.5	29
PROV.-PAWT-WARWICK,R.I.	1441.	4323.	35.	17.	9.	141120.	423360.	3387.	1693.	847.	37.9	55.4	46.0	30
ANA.-ST. ANA-GARD. GR., CAL.	1271.	3813.	31.	15.	8.	142391.	427173.	3417.	1709.	854.	38.5	56.2	46.4	31
MEMPHIS, TENN.-ARK	1237.	3711.	30.	15.	7.	143628.	430884.	3447.	1724.	862.	38.9	56.7	46.8	32
TAMPA-ST. PETERSBURG, FLA	1237.	3711.	30.	15.	7.	144865.	434595.	3477.	1738.	869.	39.4	57.4	47.2	33
PORTLAND, OREG-WASH	1218.	3654.	29.	15.	7.	146083.	438249.	3506.	1753.	876.	39.8	58.0	47.6	34
COLUMBUS, OHIO	1170.	3510.	28.	14.	7.	147253.	441759.	3534.	1767.	884.	40.3	58.6	48.0	35
TOLEDO, OHIO-MICH	1115.	3345.	27.	13.	7.	148368.	445104.	3561.	1780.	890.	40.6	58.8	48.3	36
SAN. BERN.-RIV.-ONT., CAL.	1097.	3291.	26.	13.	7.	149465.	448395.	3587.	1794.	897.	41.2	59.6	48.7	37
PHOENIX, ARIZ	1079.	3237.	26.	13.	6.	150544.	451632.	3613.	1807.	903.	41.6	60.3	49.0	38
SAN JOSE, CALIF	1065.	3195.	26.	13.	6.	151609.	454827.	3639.	1819.	910.	42.1	60.8	49.4	39
HONOLULU, HAWAII	1054.	3162.	25.	13.	6.	152663.	457989.	3664.	1832.	916.	42.4	61.3	49.7	40
HUNTSVILLE, ALA	1051.	3153.	25.	13.	6.	153714.	461142.	3689.	1845.	922.	42.6	61.4	50.1	41
LOUISVILLE, KY-IND	1032.	3096.	25.	12.	6.	154746.	464238.	3714.	1857.	928.	43.0	62.0	50.4	42

Figure 12

		Strategy	CPO	Cases to Lab	Number Examiners	Analysis 1 Fixed Examiner Cost ($ x 10^6)	Analysis 2 Variable Examiner Cost ($ x 10^6)	Analysis 3 Number Examiners	Analysis 3 Variable Caseload ($ x 10^6)
I.	1	National Lab	0.1	30,700	123	2.46	2.09	246	4.18
II.	1	National Lab	0.1	30,700	123	2.46	2.09	123	2.09
	9	Regional Labs	0.5	153,500	614	12.28	11.05	1,228	20.88
				184,200	737	14.74	13.14	1,351	22.97
III.	1	National Lab	0.1	30,700	123	2.46	2.09	246	4.18
	50	State Labs	1.0	307,000	1,228	24.56	23.33	1,228	23.33
				337,700	1,351	27.02	25.42	1,474	27.51
IV.	1	National Lab	0.1	30,700	123	2.46	2.09	246	4.18
	9	Regional Labs	0.5	97,655	390	7.80	7.41	780	14.82
	60	City Labs	3.0	335,073	1,340	26.80	25.46	670	13.40
				463,428	1,853	37.06	34.96	1,696	32.40
V.	1	National Lab	0.1	30,700	123	2.46	2.09	246	4.18
	50	State Labs	1.0	195,309	781	15.62	14.84	781	14.84
	60	City Labs	3.0	335,073	1,340	26.80	25.46	670	13.40
				561,082	2,244	44.88	42.39	1,697	32.42
VI.	1	National Lab	0.1	30,700	123	2.46	2.09	246	4.18
	9	Regional Labs	0.5	56,991	228	4.56	4.56	456	8.21
	104	SMSA Labs	3.0	579,057	2,316	46.32	44.00	1,158	23.16
				666,748	2,667	53.34	50.65	1,860	35.55
VII.	1	National Lab	0.1	30,700	123	2.46	2.09	246	4.18
	50	State Labs	1.0	113,981	456	9.12	9.12	456	9.12
	104	SMSA Labs	3.0	579,057	2,316	46.32	44.00	1,158	23.16
				723,738	2,895	57.90	55.21	1,860	36.46

Figure 13 - Summary Table, Cost/Effectiveness Analysis

In one case, the cost per examiner is held constant for all size laboratories regardless of location.

In another, the cost per examiner per year is varied with the size of the laboratory, assuming efficiencies resulting from larger laboratory operations.

A third analysis is shown using the variable cost per examiner and adding the assumption that city and SMSA laboratories receive a high proportion of "routine" examination requests such that the caseload per examiner could be considered to be 500 cases per year, while the examiners in state laboratories would average 250 cases per year, and regional and Federal laboratory examiners would only receive 125 cases per year. The reduced figure for state, regional, and Federal laboratories reflects the assumption that these laboratories receive the more serious or more complex cases and thus the time demands are greater for each case.

Throughout this analysis, it is assumed that the cases per officer sent to the laboratory are characteristic of the CPO decay curve, and law enforcement departments within the city or the SMSA submit 3.0 cases per officer per year, other departments outside of the city or SMSA would average one case per year to the appropriate state laboratory, one-half a case per year to the appropriate regional laboratory, and one-tenth of a case per year to a national crime laboratory.

The number of examiners required under all but strategies I and II exceeds the total number reported in the 1967 survey of crime laboratories.[25] The dollar value shown for costs is valid for comparison purposes only. However, the assumed costs of $20,000 per examiner per year reflect a salary figure of $12,500 with the remainder consisting of equipment, support, fringe benefits, and travel. Other average annual costs could be assumed, and the total cost of a given strategy would be proportionately more or less.

Another approach was also used in the cost/effectiveness analysis. Each location strategy was measured against a constant goal of three cases per officer to the laboratory for the entire nation's police force. Thus, if a given group of laboratories constituting a location strategy could produce an average of 1.5 cases per officer for the nation's police, it could be said that the performance index of that strategy would be 0.5. Similarly, if the total cost to establish sufficient crime laboratories to provide 50-mile radius coverage over the entire United States is assumed, then this cost could be taken as an upper bound of the costs which would be required to provide the 3.0 CPO performance level. Therefore, the total cost for a given set of laboratories constituting a strategy could be measured as that fraction of the maximum cost. A location strategy which provided laboratories at one-third of the assumed maximum cost would have a cost index of 0.33.

The effect of varying the number of laboratories within a given strategy, i.e., examining the entire range of 10 to 82 city laboratories when considered in terms of performance index and cost index, can produce a curve which is characteristic of that strategy. The results of such an analysis are shown in Figure 14. Strategies I, II, and III are considered static and are shown as single points. Others are varied throughout a feasible range to develop characteristic curves. In establishing cost indices, both annual operating costs and initial start-up costs are considered for each laboratory.

The ideal locational strategy would be one which approached a performance index of 1.0 with cost approaching zero. This slope of the curve at any given point represents the order of magnitude of additional fund expenditure which would be required to achieve an incremental improvement in performance. Thus, a steep portion of the curve shows that increasing the number of laboratories under that strategy will yield significant performance improvement per dollar expended. Conversely, a flat portion indicates that the marginal return or improvement is becoming less for each laboratory added. The optimum point is shown where the slope of the curve is 45 degrees.

Figure 14 demonstrates the application of the location model using certain assumed values. The results should be useful for gross planning purposes and with refined data could eventually become a more precise planning tool.

The purpose of this analysis was to develop the structure for an analysis model, and to exercise the model with available data. Refinement of the model and more comprehensive analysis of structures must await the availability of more precise data from which to develop the decay coefficients and laboratory workload capabilities.

There is little question that the model is sensitive to the rate of input from law enforcement agencies, that is, the cases per officer per year provided to the crime laboratory. Implicit in this conclusion is that improved awareness of the value of physical clue material on the part of law enforcement officers offers a significant opportunity for increasing the involvement and contribution of the crime laboratory to the criminal justice system.

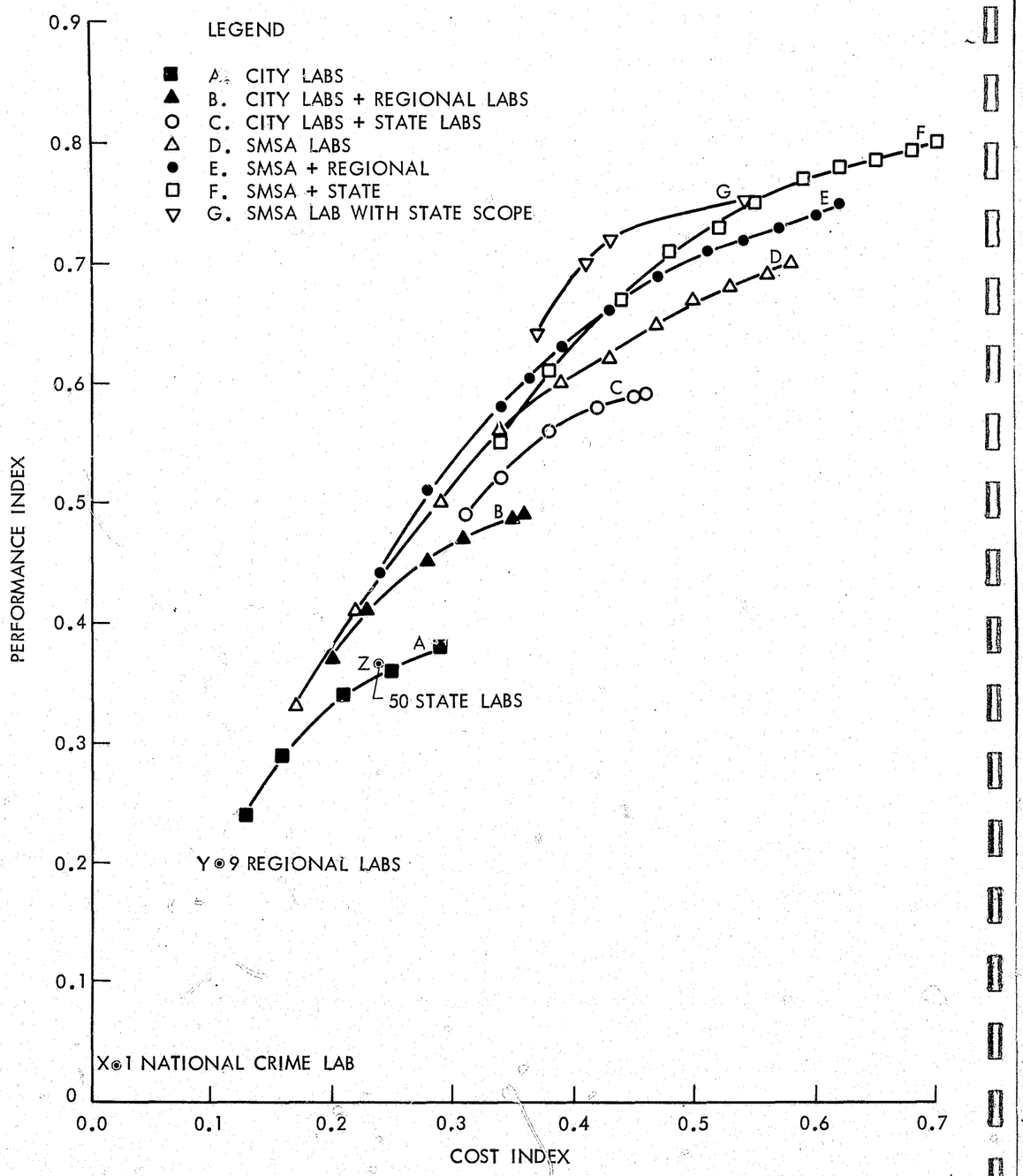

Figure 14 - Cost/Effectiveness of Crime Laboratory Location Strategies

V. LABORATORY PLANNING

This section summarizes the Laboratory Analysis and Budgeting System developed during this study and presents certain ancillary discussions of laboratory planning factors.

From the outset, it was apparent that planning of a crime laboratory could not be accomplished with a "cookbook." Characteristics of the area to be served; the training and background of available staff; attitudes of law enforcement, prosecutors and courts; existing capabilities; different priorities, and limitations in budget all combine to make each laboratory unique.

In recognition of this uniqueness, a planning model was developed that would accommodate all of the diverse factors needed to plan for a laboratory. The model uses a planning compiler previously developed by Midwest Research Institute.

The model consists of a series of input lines that first itemize equipment, staff and cost elements for a laboratory. Ten time increments in the model (months, quarters, or years) allow phasing the acquisition of staff and equipment and permit use of incremental cost increase factors.

Relationships between input lines, as established by the planner, and arithmetic capability of the compiler allow sums, differences, and ratios to be calculated. Users of the model may exercise complete control over the content and sequence of the resultant reports.

This Laboratory Analysis and Budgeting System (LABS), the designation given to the model, operates as illustrated in the flow chart of Figure 15.

In an actual laboratory planning operation, the planner would start to determine the criminalistics needs of his jurisdiction or region by a study of the environment to be served and a review of sources of planning guidelines.

Previous sections of this report have described methods for determining the relative merit of alternatives for the location and service area of a criminalistics operation. The cases-per-officer concept when applied to the area to be served, properly accounting for the decay factors, yields a total caseload expected to the laboratory. Use of the caseload-per-examiner averages, properly weighted for factors such as amount of travel and relative degree of the drug problem, will yield a target level of examiners for the laboratory. The skills of laboratory staff and the equipment

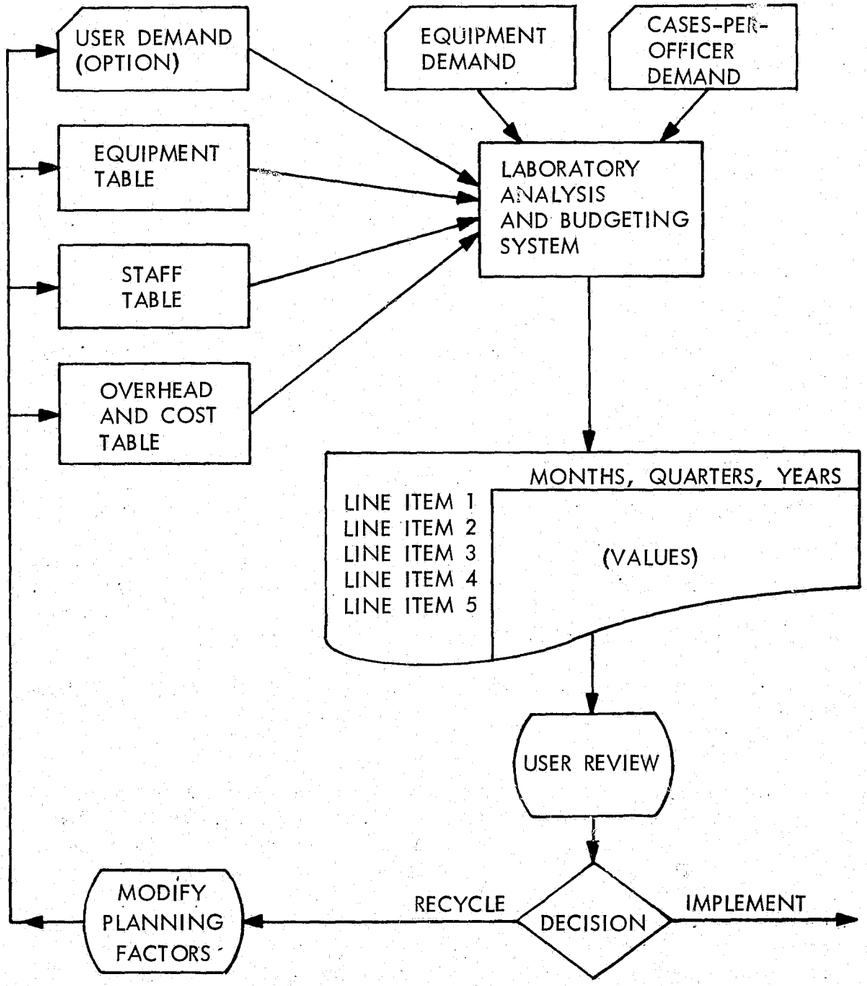

Figure 15 - Flow Chart of Laboratory Analysis and Budgeting System (LABS)

required to activate the proposed laboratory can then be determined using the factors described herein as a guide.

Forms such as the one entitled Equipment Table in Figure 16 are used by the planner as input to LABS. The form provides one line for each item of equipment and requires data on the quantity required, the unit cost, the priority and the time period in which each should be acquired. An overall allowance for installation is included which would add this percentage to the total cost of all the specified equipment. The summary section allows the planner to specify cost summaries that are desired such as "Total Equipment Cost--Microanalysis Laboratory." The cost of each equipment item coded with that summary code would accumulate into that summary line.

Forms that deal with staff, overhead and cost, funds source and caseload are presented in Appendix 9. These are prepared by the planner in a similar manner to the equipment form above.

These forms, after coding and conversion to machine readable data, are processed on the planning compiler.

The resultant computer program edits the input data and performs all calculations that are required. Representative calculations include incorporating a specified annual increase factor into each salary, summarizing the number of total professional and support staff and calculating the ratio between them, accumulating the cost of all laboratory equipment, determining the total cost of the laboratory for each time increment and itemizing the cost share for each supporting agency.

Reports are then generated in accordance with standard or user specified sequence of lines. One report generated during the planning of a Regional Crime Laboratory for Greater Kansas City is presented in Figure 17 with the complete report contained in Appendix 9.

As previously illustrated in the LABS flow chart (Figure 15), the model is intended to be a dynamic planning tool. A plan that does not meet the expectations of the planner or the needs of the agency can be easily regenerated by making only those changes desired in the input. "What if" questions can also be asked and the effect of alternatives can be simulated.

The Laboratory Analysis and Budgeting System can be used by laboratory planners at several levels of sophistication. First, the forms can serve as a check list of factors and the reports serve as a format to guide a manual planning operation. Planners with access to a computer and computer programs could have their own version of the model programmed for their use.

EQUIPMENT TABLE

DATE: _____

AGENCY _____ LABORATORY _____ LOCATION _____

EQUIPMENT TYPE: CENTRAL SERVICE ☐ FUNCTIONAL LAB ☐ _____ Function

INDIVIDUAL ☐ _____ Name or Function

LINE NO.	ITEM DESCRIPTION	QTY.	COST* (EACH)	PRIORITY (H,M,L)	TIME PERIOD(S) ACQUISITION	ADD INTO SUMMARY

*Include Required Accessories

ALLOWANCE FOR INSTALLATION _____%

SUMMARIES DESIRED

LINE NO.	SUMMARY DESCRIPTION	ADD INTO NEXT LEVEL

Sheet _____ of _____

Figure 16 - LABS Equipment Table

SUMMARY REPORT — REGIONAL CRIME LAB

	PLANNING ITEM	0	1	2	3	4
76	TOTAL NUMBER OF EMPLOYEES	-0.0	12.0	19.0	25.0	25.0
26	TOTAL NUMBER PROFESSIONALS	-0.0	10.0	15.0	18.0	18.0
42	TOTAL NUMBER SUPPORT	-0.0	2.0	4.0	7.0	7.0
94	TOTAL MONTHLY SALARY + FRING	0	11330	19430	25298	25298
50	TOTAL SALARY-PROF/MONTH	0	8300	13250	16550	16550
66	TOTAL SALARY-SUPPT/MONTH	0	1000	2350	4075	4075
296	TOTAL POLICE SALARY	0	6350	8000	8900	8900
280	TOTAL CIVILIAN SALARY	0	2950	8200	12325	12325
93	POLICE MONTHLY FRINGE	0	1587	2000	2225	2225
92	CIVILIAN MONTHLY FRINGE	0	442	1230	1848	1848
75	TOTAL QRTLY SALARY + FRINGE	0	33990	58290	75896	75896
261	1ST YEAR CUM	0	33990	92280	168177	244074
262	2ND YEAR CUM	0	0	0	0	0
259	TOTAL EQUIPMENT PURCHASE CST	0	56152	3897	14082	6472
152	TOTAL CHEM. ANALYSIS EQUIP	0	37980	1080	9480	5940
181	TOTAL BIO. ANALYSIS EQUIP	0	7172	352	1562	242
218	TOTAL PHYSICAL EXAMINATION	0	11000	165	2915	165
221	TOTAL DOCUMENT ANALYSIS	0	0	2300	125	125
108	TOTAL CRIME SCENE SERVICE	0	7450	6550	6650	450
117	TOTAL PHOTOGRAPHIC EQUIP.	0	3600	100	100	100
251	TOTAL EQUIP + STAFF COST	0	90142	62187	89978	82368
268	EQUIP AND STAFF COST YEAR 1	0	0	0	0	324677
272	EQUIP AND STAFF COST YEAR 2	0	0	0	0	0

Figure 17 - Sample LABS Report

Arrangements can also be made on a cost basis to use the proprietary planning compiler at MRI. In the near future, this compiler may also be available on a national time-sharing computer network so that any planner with access to a terminal can plan a laboratory or other justice system operation from his own office.

A. Equipment Planning

There are many opinions as to the equipment that is essential for a crime laboratory--almost as many as there are laboratories. The variations in these opinions involve both the proper mix of equipment as well as selection of specific models. Recommendations of equipment in this report are based on the judgment of the study team and the working group members. The planner is cautioned, however, to use these for budgetary and preliminary planning purposes only and to leave the final equipment selection to the criminalist director or other experts hired by the laboratory.

The tables of equipment for a full-service laboratory are contained in Appendix 8. Figure 18 shows a portion of the table. Items are grouped by the functional laboratory area that they primarily support; priorities are based on the combined recommendations of the study team and the working group members; cost estimates are based on the average cost of an item with suitable capability including the cost of essential accessories. An allowance of 20 percent should be added to all instruments to cover the cost of installation and other initial activation costs.

A concept developed in this study would define all laboratory equipment in three categories based on the scope of their use in the laboratory:

(1) Central Service (CS) equipment needed to support the laboratory as a whole.

(2) Functional Laboratory (FL) equipment required to support all staff in a particular function (i.e., Chemistry).

(3) Individual (I) equipment issued to each examiner according to his range of duties.

Ultimately, each item of equipment would be coded as CS, FL, or I; the specific functional area in the case of FL or I would add a suffix FL_1 or I_3. The number of professionals that could be supported by each CS or $FL_{(n)}$ item would also be coded. For example, a particular device of general value that will support 12 professionals would be coded CS 12. A less general item used in the chemistry laboratory capable of supporting four professionals would be coded $FL_1 4$.

EQUIPMENT SUMMARY

Chemical Analysis Function

Equipment

General Purpose

High Priority	Purchase Price
Balances, general purpose and analytical	$ 900
Glassware	800
Centrifuge	300
Paper and thin layer chromatography	250
Miscellaneous hardware	100
Hot plates	200
Ultraviolet lamp	100
Drying oven	200
Hot water (steam bath)	100
Medium Priority	
Clocks and timers	50
PH and specific ion meter	500
Vacuum pump	100
Low Priority	
Muffle furnace	200

Figure 18

This method would provide laboratory planners and managers a more specific means to account for existing equipment and to support requirements for additional items. It would also refine the laboratory planning model to give it a more precise "building block" capability. The approach gives recognition to the fact that a laboratory needs certain essential equipment to even be a laboratory and that it requires other items in order to support any given capability. It further relates staff growth to incremental equipment acquisitions.

A pictorial representation of this concept is contained in Figure 19. Each item of central service equipment would be listed in the inner circle along with the level of staff it would support. A similar entry would be made in each sector of the next circle representing a given functional area offered by the laboratory. The outer circle would list all professionals and contain the equipment procured for their own use.

B. Staff Planning

Staffing is by far the most important factor in a crime laboratory. Even beyond the fact that over 80 percent of a laboratory's budget is for staff, the acquisition of the right personnel in the proper sequence can insure the value and growth of the criminalistics operation. The shortage of qualified practitioners also dictates that the most effective use be made of all talent available in the nation.

Although ultimately the staff problem comes down to one man and one job, there are guidelines that can help the laboratory planner.

C. Professional Staff

Generally speaking, the smaller a laboratory operation the more versatile its staff must be. Although a one-man operation is possible, it would require a professional with the talent and range of skills that may be better employed in directing a larger laboratory. The small laboratory also runs into problems of continuity and ability to perpetuate itself. It is difficult to maintain a truly scientific atmosphere of professional exchange and there is the tendency to require the staff to extend themselves beyond their primary specialities. Also, the low caseload with wide variety of analyses prevents the development of specialties and increases the time required to regain skills to perform complex tests. These latter factors can also be a problem if a specialist from a large laboratory is recruited to start a new operation.

Figure 20 presents a family tree based on the increasing specialization principle. In practice, the criminalist is augmented initially by

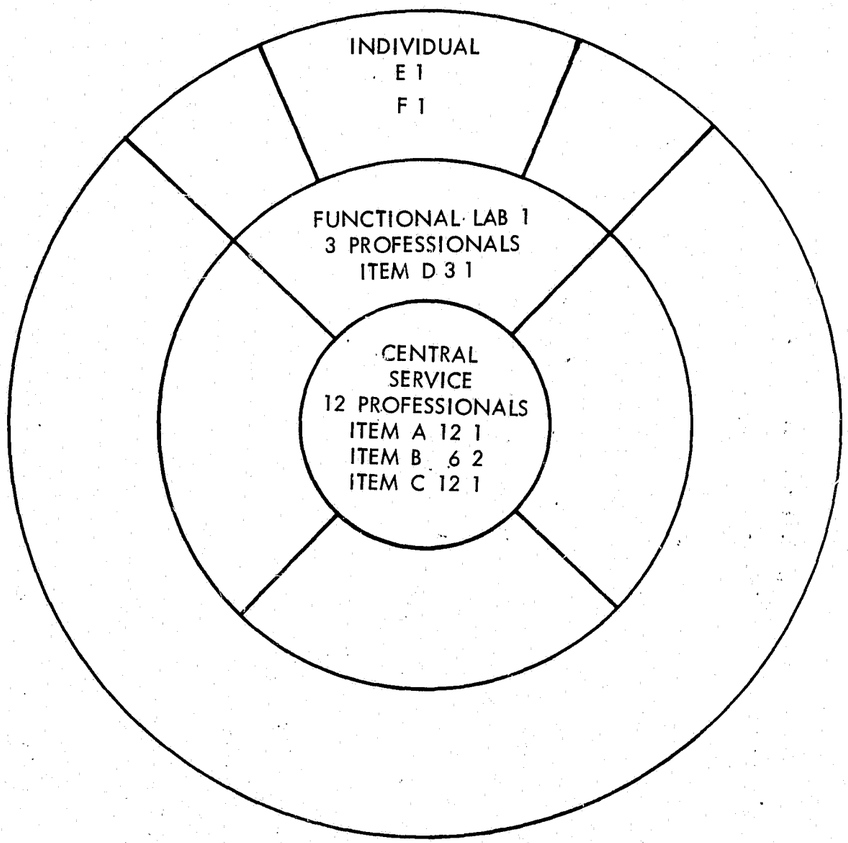

Figure 19 - Coding of Laboratory Equipment by Scope and Allocation

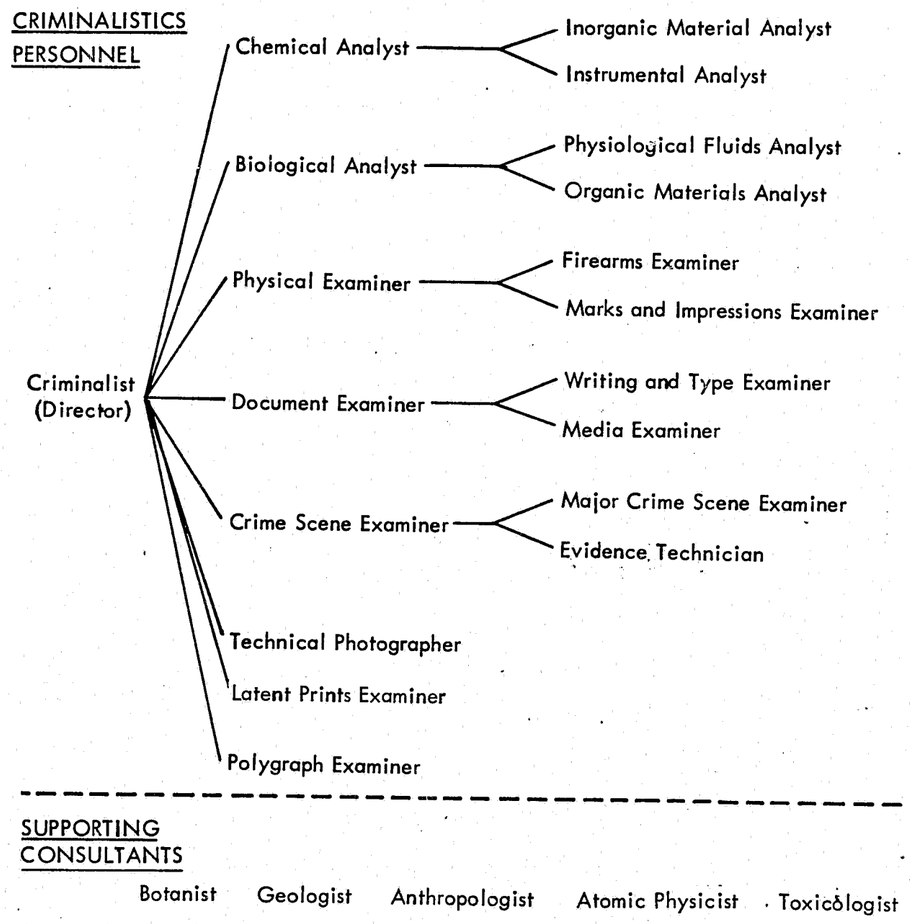

Figure 20 - A Family Tree of Crime Lab Skills

as many of the second level specialties as the agency can support. As workload and financial support increase, additional specialists are recruited, or hired and trained by the laboratory. The chart also illustrates that consultants may be required to supplement even the most versatile staff on some occasions, (i.e., identification of soils, bones, seeds, or use of Neutron Activation Analysis). Technicians and laboratory aides are also employed by larger laboratories to help reduce the menial tasks for the higher skilled professionals and increase their effective caseload.

D. Support Staff

Crime laboratories generally complain of inadequate administrative support. This lack of support manifests itself in two ways. First, lack of an administrative assistant for the director of a laboratory drastically limits the time the director can spend in the analysis of his laboratory's operation or in direct support of operational research in the field of administration.

Second, this lack of administrative assistance (both in the form of an "assistant" and/or by additional clerical help) drastically reduces the amount of data kept by laboratories.

Studies of laboratories are hampered by the lack of such data. Conclusions about the characteristics of criminalistics operations can also be biased by the problem that extremely busy laboratories whose data would have most value do not have time to keep anything more than broad summaries. There is a tendency therefore to base general recommendations on available, though not necessarily representative, data or upon subjective judgment in lieu of data.

E. Allocation of Working Time by Function

The time spent by laboratory personnel is often thought of as being devoted to either examinations or court appearances. These activities, though inherently the primary areas, do not constitute all of the time spent by professionals in a laboratory. Categories of work which can be used to allocate staff working time are outlined and explained below:

Case Work

Bench Work - All "in-lab" work involved with actual cases including unpacking, marking, survey, set-up, examinations, and reporting.

Witness Services - Time spent out of the laboratory for appearances in court, including preliminary hearings and grand juries. Also includes travel and waiting time in addition to actual appearance time.

Case Consultation - Time spent either in or out of the laboratory discussing cases with investigators or prosecutors. Consultation with other examiners (including supervision) or technical consultants would be counted as "Bench Work."

Those categories above and beyond case work but necessary to a laboratory operation are:

Professional Development - Covers activities by staff to improve their own capabilities. Include library hours, attendance at seminars, workshops, professional meetings, and formal training programs. Mandatory in-service training for sworn officers would also be included.

Training of Others - Effort devoted specifically to the training of other examiners or laboratory users including conducting services and academy programs.

Test Development - This category covers research development, adaptation or implementation of new technical capability in the laboratory.

Liaison - Contacts with other agencies not specifically related to the normal processing of a case is the intent of this category.

Public Information - Contacts of a non-agency nature including speeches for civic groups, school assemblies, conducting tours, etc.

Administration - Activities of a business or management nature are included here. Supervision including staff appraisal, management reporting, budgeting, purchasing, maintenance are appropriate.

Additional data are needed to ascertain the proportions of time spent by staff at various levels in each of these categories. At this point

it will suffice to advise the planner to consider the depreciation of effective bench time due to administrative and "contact" obligations on senior staff and the professional development required by juniors.

F. Crime/Evidence Relationships and Laboratory Planning

As discussed earlier, a major initial concept was based on each category of crime generating a distribution of types of evidence and these evidence types being subjected to a distribution of tests. It was assumed that such relationships would be of value to the laboratory planner.

Although lack of sufficient data on these relationships precludes their use at this time in the planning model, the concept and available data are presented for future use.

Categories for both crime and evidence were developed and a matrix form prepared as illustrated in Figure 21. Limited data concerning the yield of physical evidence by type crime are contained in Appendices 2, 3, and 4.

The use of crime/evidence relationships by the laboratory planner is encouraged where adequate crime data are maintained for the region to be served and when more data on the yield of evidence by type crime are available. Until that time, the planner is advised to review the profile of crime in the area to be served for comparison with the crime profile in an area already served by a crime laboratory that he may desire to use as a model. The profile of "crime" that influences the types of evidence the laboratory should receive is better viewed as "crime and other events of laboratory interest" to include those activities that may not be included in crime statistics. Death investigations in support of medical examiner, or extensive blood alcohol and urine narcotics tests may not be reflected from "crime" reports. Finally, Professor Parker's data[14] is yet another source of evidence yield by type crime representing more the ultimate potential rather than what can actually be expected to reach the laboratory.

G. Evidence/Test Relationships and Laboratory Planning

The second basic concept in this study was that there is a relationship between evidence and tests that could be documented and used to aid in determining equipment and workload requirements.

Each evidence item is normally subjected to a specific test or series of tests depending on the information desired from the item. The questions to be answered on a blood sample, for example, can range from "is it human blood?" to "what is its alcohol content?" The question can normally be answered by a limited number of specific tests, although under

VOLUME OF EVIDENCE AND CRIME SOURCE

CRIME CATEGORIES

Estimate Percent of Evidence Volume From Each Category

TOTAL 1969 CASELOAD

Actual or Estimated Volume of Evidence Processed in 1969 Based on Number of Items or Number of Exams. (Specify) EVIDENCE CATEGORIES	Persons											Property and Commerce															Illegal Acts														
	Index				I & II				Other			Index		I & II										Other				I & II								Other					
	Murder	Rape	Robbery	Agg. Assault	Neg. Mans.	Other Assaults	Other Sex	Family	Kidnapping	Hit & Run	Death Invest.	Other Persons	Burglary	Larceny 50+	Auto Theft	Larceny 50-	Arson	Forg. & Count.	Fraud	Embezzle	Stolen Prop.	Vandalism	Bombing	Pets, Livestock	Food & Drug	Other Prop.	Weapons	Comm. Vice	Narcotics	Gambling	DWI	Liquor	Drunkenness	Suicide	Abortion	Obscene Lit.	Conservation	Other Acts
Physiological																																						
Blood																																						
Semen																																						
Fluids																																						
Blood Content																																						
Hair																																						
Misc.																																						
Firearms																																						
Guns																																						
Bullet & Cart.																																						
Powder																																						
Misc.																																						
Trace																																						
Paint																																						
Fibers																																						
Bldg. Mtl.																																						
Environ.																																						
Personal																																						
Marks/Imp.																																						
Tools																																						
Tire/Shoe																																						
Misc.																																						
Fragments																																						
Glass																																						
Misc.																																						
Clothing																																						
Chemicals																																						
Petro																																						
Alcohol																																						
Poisons																																						
Misc.																																						
Explosives																																						
Devices																																						
Residue																																						
Documents																																						
Narc. & D.D.																																						
M.J.																																						
Other																																						
Misc.																																						
All Other																																						
Food																																						
Property																																						
Misc.																																						
Survey																																						

Figure 21 - Crime/Evidence Matrix

certain circumstances, additional tests are required to insure a result. Flow charts were developed to define the family of techniques applicable to each evidence/question set. (See Figure 22). Coding method based on the fundamental properties of the evidence which the test seeks to analyze illustrates the availability of options for obtaining similar results. The selection of these options by different laboratories is based on availability of certain instruments, amount and condition of evidence or examiner preference.

A further discussion of this method, the coding system and the flow charts, is contained in Appendix 8. At this stage of development, these charts are but one step in defining the tests used in criminalistics. The applicability of certain instruments to certain classes of evidence and the preliminary workload data will provide some guidelines to laboratory planners.

Another approach toward the definition of criminalistics methods and the applicability of equipment, skills, and tests to the analysis of certain classes of evidence is contained in Appendix 7. An example of this approach is shown in Figure 23.

The reasons for developing a Laboratory Planning Model were threefold:

(1) To describe the operation of crime laboratories in a more definitive manner than has previously been available;

(2) To form the basis for the collection of data which will ultimately carry this definition to a fairly precise level; and

(3) To provide an interim tool to help guide planners faced with immediate decisions on the creation, augmentation, or restructuring of criminalistics operations.

The model and other planning factors presented in this report move in the direction of each of these goals.

The precision of the output from the LABS model is dependent upon the detail and reliability of input data. The search for input data as the initial step in the planning process, often reveals new insights into the problem. The LABS planning model provides a structured method for the collection and evaluation of such data.

Evidence Item: Powders, capsules, tablets.
Request: Is material a drug or narcotic?

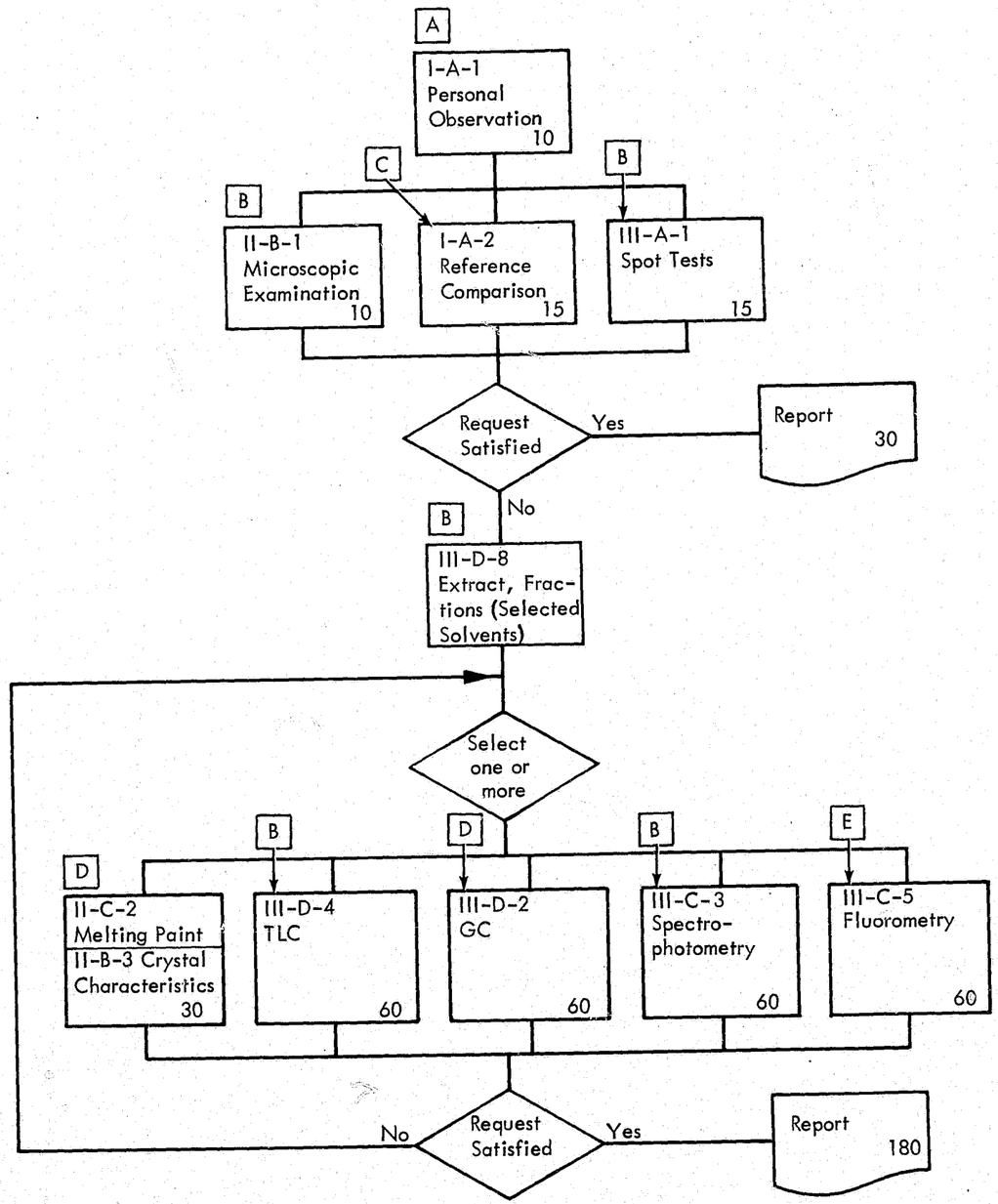

Figure 22 - Laboratory Test Flow Chart

TABULATION OF LABORATORY SERVICES

Service Category Firearms Identification

EVIDENCE INPUT	TESTS	TIME REQUIRED	EQUIPMENT/ COST	REFERENCE STANDARDS	TECHNICIAN SKILLS-DEGREE	DEGREE OF IDENTITY vs IDENTIFICATION	CRIMES
Weapons; revolvers, pistols, rifles, shotguns machine guns, zip guns, etc.	Determine possible owner from fingerprints and debris in mechanism. Usually performed by other associates in lab.	20-30 min.	stereomicroscope	standards of suspects' fingerprints and pocket debris	Specialty in fingerprint development and comparison Specialty in fiber and trace analysis	possible to positive	Homicide Agg. Assault Armed Robbery
	Recency of firing by debris in barrel or decay of NO_2 vs. time	20 min.- 24 hr.	stereomicroscope $700 spectrophotometer $500-$5000	Lit. or slide collection	Skill in microanalysis and instrumental analysis BS +	May be used to refute alibi	Homicide Agg. Assault Armed Robbery
	Operating condition of weapon; trigger pull, effective operation of safeties and other parts. If parts are broken, assess recency of break and restore to working order -- Fire tests	20-60 min.	Hand tools, set of weights.	collection of guns or parts	Intimate knowledge of operation of guns -- 6 mos. -1 yr. HS +	Investigative aid	Homicide Agg. Assault Armed Robbery
	Comparison with bullets and cartridges in case See: Cartridge and bullet sheets						
Bullets; fired and unfired	Evidence of ricochet ; adhering debris	10-20 min.	stereomicroscope $700	literature and standards from scene	If present, work shared with microanalyst HS +	Aid in reconstruction of event	Homicide; Agg. Assault; Armed Robbery
	Blood and tissue adhering (usual blood tests employed)	10 min.- 8 hr.	stereomicroscope $700	usual blood standards	BS +	Aid in reconstruction of event.	
	Class characteristics; type of weapon	10 min.- 30 min.	stereomicroscope $700	collection of fired bullets	2-3 weeks training H.S.	Determines possible guns as invest. aid.	Homicide Agg. Assault; Armed Robbery
	Comparison between two or more bullets in case to establish one or more guns. Also, comparison with open case file. Identification of weapon by comparison of tests vs. evidence bullet.	20 min. - 3 hr. per bullet. Greater than for ctgs due to possible mutilation	Comp. microscope; $1200 - $5000	case tests Open file	Skill developed by comparing several hundred pairs of fired bullets matched and mismatched, under supervision; 3-4 months; HS ⟶ BS	can be positive if sufficient rifling impression is available	Homicide Agg. Assault; Armed Robbery
Cartridges, Fired and unfired	Manufacture, caliber and type, type of weapon	10 min.- 30 min.	stereomicroscope $700	cartridge collection	2-3 weeks H.S.	Investigative Aid	Homicide Armed Robbery
	Comparison; fired in same or different weapons	30-60 min.	comp. microscope -- $1200 $5000	case specimen	2-3 months H.S. +	positive identification	Assault
	Recency of fire; accumulated debris	15 min.	stereomicroscope $700	Lit	1-2 weeks	Investigative Aid	
	Gain or loss of weight vs. time	1-3 days	Balance analyt. $300 - $500	Lit.	BS	Investigative Aid	
	Decay of NO_2	1-2 days	spectrophotometer $500 - $5000	Lit.	BS	Investigative Aid	
	Identification of weapon by comparison with tests from suspect gun. Also comparison with open case file.	20-60 min. per ctg.	Comp.micro- $1200 - $5000	case tests open file	Skill developed by comparing several hundred pairs of fired ctgs., matched and mismatched 2-3 months concentration under supervision HS ⟶ BS	can be positive identification if sufficient marks are available	Homicide Armed robbery Assault

Data Source

Figure 23

TABULATION OF LABORATORY SERVICES

Service Category Firearms Identification (including powder residue)

EVIDENCE INPUT	TESTS	TIME REQUIRED	EQUIPMENT/ COST	REFERENCE STANDARDS	TECHNICIAN SKILLS-DEGREE	DEGREE OF IDENTITY vs IDENTIFICATION	CRIMES
Powder patterns; shot pattern	Detection of powder particles by infra red photography, visual examination, chemical detection (Walker test), spectroscopic identification of lead, barium and antimony, soft x-ray detection of lead. All of the above tests are used to determine distance of shooting; some are sensitive 0-9 ft., other 0-24 in. Determination of distance requires preparation of a series of test patterns using gun and ammo of same make and lot.	2-6 hr. depending on test used and problems offered by support material	stereomicroscope $700 spectrograph $6,000 + Soft x-ray $1000-$3000 Camera, etc. $200 - $400	case patterns; case weapon case ammo	skill varies from 1-2 wks for easily visual patterns to 2-3 mo. for complex instrumentation HS BS +	Distance may be determined to ½" - ¼" for powder patterns to 1' to 6' for shot patterns	Homicide Agg. Assault Armed Robbery
Primer residue; Harrison test or NAA	Harrison test - 0.1NHCl swabs of hands in 5-7 regions. Swabs tested for Pb, Sb and Ba. controls of gun tests and fired cartridges.	2-4 hr/test	expendables	case ctgs. and weapon	considereble practice in performance of test. 2-3 weeks BS +	Fairly good presumption of firing of gun. Investigative Aid	Homicide Agg. Assault Armed Robbery
	NAA - irradiation of wax gloves of suspects hands	2-6 days	contract testing $150/test		Ph.D	Fairly good presumption of firing of gun Investigative Aid	Homicide; Agg. Assault; Armed robbery

Data Source

Figure 23 (Concluded)

APPENDIX 1

COST/EFFECTIVENESS ANALYSIS

Introduction

This appendix contains the details of a cost/effectiveness analysis of the various candidate strategies proposed for a national criminalistics system. Figure 1-1 provides the summary results comparing seven locational strategies under three conditions. Figure 1-2 and Figure 1-3 provide the bases upon which these and the subsequent analyses were structured.

Candidate Strategies

The candidate strategies considered in this cost/effectiveness analysis are those which were described in Section IV, along with supporting rationale. The simplest of these systems is that containing the single national laboratory with increasing complexity of structure through the "pure" systems (i.e., national plus 50 state laboratories) and finally to the "hybrid" mixes (i.e., national, state, and SMSA). It will be noted that in each of the strategies shown in Figure 1-1 a national laboratory has been included while allowing the other components of a mix to vary. The rationale behind the plan recognizes that a national laboratory exists today and that whatever strategy is ultimately adopted to improve our nation's criminalistics system it will, of necessity, include this capability. One other point regarding the role of the national laboratory in each of the strategies should be noted. Even though in the logic about to be described the total caseload in a given strategy is based on assignment of cases to specific laboratories covered in that strategy, the caseload to the national laboratory remains constant. This allotment of cases to the national laboratory under each strategy is in keeping with the practice of the present-day criminalistics system whereby any agency may submit clue material for analyses to a national crime laboratory such as the FBI regardless of the availability of a more local laboratory.

Additionally, it should be noted that the cases per officer (CPO) concept discussed in Section II was applied consistently throughout the analysis so that the yield to a particular type of laboratory (regional, city, etc.) is consistent.

The discussion in Section IV and this introduction then provide the background upon which the cost/effectiveness analysis was determined.

Analysis, Phase I

Figure 1-1 compares the seven locational strategies as to the number of examiners required at the national level and as to the relative costs of each strategy.

	Strategy		CPO	Cases to Lab	Number Examiners	Analysis 1 Fixed Examiner Cost ($ x 10^6)	Analysis 2 Variable Examiner Cost ($ x 10^6)	Analysis 3 Number Examiners	Analysis 3 Variable Caseload ($ x 10^6)
I.	1	National Lab	0.1	30,700	123	2.46	2.09	246	4.18
II.	1	National Lab	0.1	30,700	123	2.46	2.09	123	2.09
	9	Regional Labs	0.5	153,500	614	12.28	11.05	1,228	20.88
				184,200	737	14.74	13.14	1,351	22.97
III.	1	National Lab	0.1	30,700	123	2.46	2.09	246	4.18
	50	State Labs	1.0	307,000	1,228	24.56	23.33	1,228	23.33
				337,700	1,351	27.02	25.42	1,474	27.51
IV.	1	National Lab	0.1	30,700	123	2.46	2.09	246	4.18
	9	Regional Labs	0.5	97,655	390	7.80	7.41	780	14.82
	60	City Labs	3.0	335,073	1,340	26.80	25.46	670	13.40
				463,428	1,853	37.06	34.96	1,696	32.40
V.	1	National Lab	0.1	30,700	123	2.46	2.09	246	4.18
	50	State Labs	1.0	195,309	781	15.62	14.84	781	14.84
	60	City Labs	3.0	335,073	1,340	26.80	25.46	670	13.40
				561,082	2,244	44.88	42.39	1,697	32.42
VI.	1	National Lab	0.1	30,700	123	2.46	2.09	246	4.18
	9	Regional Labs	0.5	56,991	228	4.56	4.56	456	8.21
	104	SMSA Labs	3.0	579,057	2,316	46.32	44.00	1,158	23.16
				666,748	2,667	53.34	50.65	1,860	35.55
VII.	1	National Lab	0.1	30,700	123	2.46	2.09	246	4.18
	50	State Labs	1.0	113,981	456	9.12	9.12	456	9.12
	104	SMSA Labs	3.0	579,057	2,316	46.32	44.00	1,158	23.16
				723,738	2,895	57.90	55.21	1,860	36.46

Figure 1-1 - Summary Table, Cost/Effectiveness Analysis

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JUNE 1970

DEMAND FOR CRIME LAB EXAMINERS
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BASED ON A YIELD OF THREE CASES PER OFFICER

CITY	INDEX CRIME	NUMBER POLICE	EST. LAB CASES	NO. EXAMINERS BY CASELOAD LOW	MED	HIGH	CUM. NUMBER POLICE	CUM. LAB CASES	CUM. EXAMINERS BY CASELOAD LOW	MED	HIGH	CUM PERCENT INDEX CRIME POP.	CRIME	POL.	RANK
NEW YORK,N.Y.	482990.	29939.	89817.	719.	359.	180.	29939.	89817.	719.	359.	180.	3.9	10.8	9.8	1
CHICAGO,ILL.	119723.	12006.	36018.	288.	144.	72.	41945.	125835.	1007.	503.	252.	5.7	13.5	13.7	2
PHILADELPHIA,PA.	73439.	7319.	21957.	176.	88.	44.	49264.	147792.	1182.	591.	296.	6.7	14.2	16.0	3
LOS ANGELES,CALIF.	163162.	5937.	17811.	142.	71.	36.	55201.	165603.	1325.	662.	331.	7.9	17.9	18.0	4
DETROIT,MICH.	94590.	4647.	13941.	112.	56.	28.	59848.	179544.	1436.	718.	359.	8.7	20.0	19.5	5
BALTIMORE,MD.	67157.	3259.	9777.	78.	39.	20.	63107.	189321.	1515.	757.	379.	9.2	21.5	20.6	6
WASHINGTON,D.C.	49360.	3220.	9660.	77.	39.	19.	66327.	198981.	1592.	796.	398.	9.6	22.6	21.6	7
BOSTON,MASS.	32887.	2612.	7836.	63.	31.	16.	68939.	206817.	1655.	827.	414.	9.9	23.4	22.5	8
CLEVELAND,OHIO.	34028.	2161.	6483.	52.	26.	13.	71100.	213300.	1706.	853.	427.	10.4	24.1	23.2	9
ST. LOUIS,MO.	39054.	2016.	6048.	48.	24.	12.	73116.	219348.	1755.	877.	439.	10.8	25.0	23.8	10
MILWAUKEE,WIS.	17362.	1911.	5733.	46.	23.	11.	75027.	225081.	1801.	900.	450.	11.1	25.4	24.4	11
SAN FRANCISCO,CALIF.	47108.	1745.	5235.	42.	21.	10.	76772.	230316.	1843.	921.	461.	11.5	26.4	25.0	12
PITTSBURGH,PA.	32230.	1621.	4863.	39.	19.	10.	78393.	235179.	1881.	941.	470.	11.8	27.2	25.5	13
HOUSTON,TEX.	47955.	1577.	4731.	38.	19.	9.	79970.	239910.	1919.	960.	480.	12.3	28.2	26.0	14
DALLAS,TEX.	24170.	1504.	4512.	36.	18.	9.	81474.	244422.	1955.	978.	489.	12.6	28.8	26.5	15
BUFFALO,N.Y.	15891.	1425.	4275.	34.	17.	9.	82899.	248697.	1990.	995.	497.	12.9	29.1	27.0	16
NEWARK,N.J.	34660.	1379.	4137.	33.	17.	8.	84278.	252834.	2023.	1011.	506.	13.1	29.9	27.5	17
NEW ORLEANS,LA.	26607.	1377.	4131.	33.	17.	8.	85655.	256965.	2056.	1028.	514.	13.4	30.5	27.9	18
SEATTLE,WASH.	25242.	1025.	3075.	25.	12.	6.	86680.	260040.	2080.	1040.	520.	13.7	31.1	28.2	19
INDIANAPOLIS,IND.	20687.	1023.	3069.	25.	12.	6.	87703.	263109.	2105.	1052.	526.	13.9	31.5	28.6	20
MEMPHIS,TENN.	17783.	1007.	3021.	24.	12.	6.	88710.	266130.	2129.	1065.	532.	14.2	31.9	28.9	21
KANSAS CITY,MO.	25282.	970.	2910.	23.	12.	6.	89680.	269040.	2152.	1076.	538.	14.4	32.5	29.2	22
CINCINNATI,OHIO.	11609.	942.	2826.	23.	11.	6.	90622.	271866.	2175.	1087.	544.	14.7	32.8	29.5	23
DENVER,COLO.	24072.	936.	2808.	22.	11.	6.	91558.	274674.	2197.	1099.	549.	14.9	33.3	29.8	24
ATLANTA,GA.	18018.	876.	2628.	21.	11.	5.	92434.	277302.	2218.	1109.	555.	15.1	33.7	30.1	25
SAN DIEGO,CALIF.	16320.	875.	2625.	21.	10.	5.	93309.	279927.	2239.	1120.	560.	15.4	34.1	30.4	26
JERSEY CITY,N.J.	6391.	859.	2577.	21.	10.	5.	94168.	282504.	2260.	1130.	565.	15.6	34.2	30.7	27
HONOLULU,HAWAII.	13985.	786.	2358.	19.	9.	5.	94954.	284862.	2279.	1139.	570.	15.7	34.5	30.9	28
MINNEAPOLIS,MINN.	21236.	775.	2325.	19.	9.	5.	95729.	287187.	2297.	1149.	574.	16.0	35.0	31.2	29
PHOENIX,ARIZ.	22217.	774.	2322.	19.	9.	5.	96503.	289509.	2316.	1158.	579.	16.2	35.5	31.4	30
SAN ANTONIO,TEX.	26903.	743.	2229.	18.	9.	4.	97246.	291738.	2334.	1167.	583.	16.5	36.1	31.7	31
PORTLAND,OREG.	17044.	722.	2166.	17.	9.	4.	97968.	293904.	2351.	1176.	588.	16.7	36.5	31.9	32
TOLEDO,OHIO.	9372.	709.	2127.	17.	9.	4.	98677.	296031.	2368.	1184.	592.	16.8	36.7	32.1	33
MIAMI,FLA.	19370.	670.	2010.	16.	8.	4.	99347.	298041.	2384.	1192.	596.	17.0	37.1	32.4	34
LONG BEACH,CALIF.	14699.	660.	1980.	16.	8.	4.	100007.	300021.	2400.	1200.	600.	17.1	37.4	32.6	35
OAKLAND,CALIF.	28333.	651.	1953.	16.	8.	4.	100658.	301974.	2416.	1208.	604.	17.3	38.1	32.8	36
LOUISVILLE,KY.	17940.	603.	1809.	14.	7.	4.	101261.	303783.	2430.	1215.	608.	17.5	38.5	33.0	37
FORT WORTH,TEX.	11646.	580.	1740.	14.	7.	3.	101841.	305523.	2444.	1222.	611.	17.7	38.7	33.2	38
ROCHESTER,N.Y.	9789.	573.	1719.	14.	7.	3.	102414.	307242.	2458.	1229.	614.	17.9	39.0	33.4	39
TAMPA,FLA.	13202.	572.	1716.	14.	7.	3.	102986.	308958.	2472.	1236.	618.	18.0	39.3	33.5	40
BIRMINGHAM,ALA.	11557.	520.	1560.	12.	6.	3.	103506.	310518.	2484.	1242.	621.	18.2	39.5	33.7	41
NORFOLK,VA.	11736.	492.	1476.	12.	6.	3.	103998.	311994.	2496.	1248.	624.	18.3	39.8	33.9	42

Figure 1-2

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NASHVILLE,TENN.	15537.	477.	1431.	11.	6.	3.	104475.	313425.	2507.	1254.	627.	18.4	40.1	34.0	43
YONKERS,N.Y.	5173.	469.	1407.	11.	6.	3.	104944.	314832.	2519.	1259.	630.	18.5	40.2	34.2	44
OMAHA,NEBR.	10523.	467.	1401.	11.	6.	3.	105411.	316233.	2530.	1265.	632.	18.6	40.5	34.3	45
OKLAHOMA CITY,OKLA.	10138.	462.	1386.	11.	6.	3.	105873.	317619.	2541.	1270.	635.	18.8	40.7	34.5	46
ST. PAUL,MINN.	15300.	460.	1380.	11.	6.	3.	106333.	318999.	2552.	1276.	638.	19.0	41.0	34.6	47
SAN JOSE,CALIF.	10125.	456.	1368.	11.	5.	3.	106789.	320367.	2563.	1281.	641.	19.1	41.3	34.8	48
SACRAMENTO,CALIF.	9940.	449.	1347.	11.	5.	3.	107238.	321714.	2574.	1287.	643.	19.2	41.5	34.9	49
TULSA,OKLA.	10011.	434.	1302.	10.	5.	3.	107672.	323016.	2584.	1292.	646.	19.3	41.7	35.1	50
DAYTON,OHIO.	10408.	427.	1281.	10.	5.	3.	108099.	324297.	2594.	1297.	649.	19.4	42.0	35.2	51
RICHMOND,VA.	8491.	424.	1272.	10.	5.	3.	108523.	325569.	2605.	1302.	651.	19.5	42.1	35.3	52
PROVIDENCE,R.I.	10721.	410.	1230.	10.	5.	2.	108933.	326799.	2614.	1307.	654.	19.6	42.4	35.5	53
SYRACUSE,N.Y.	7517.	406.	1218.	10.	5.	2.	109339.	328017.	2624.	1312.	656.	19.7	42.6	35.6	54
HARTFORD,CONN.	8941.	401.	1203.	10.	5.	2.	109740.	329220.	2634.	1317.	658.	19.8	42.8	35.7	55
BRIDGEPORT,CONN.	5767.	397.	1191.	10.	5.	2.	110137.	330411.	2643.	1322.	661.	19.9	42.9	35.9	56
CHARLOTTE,N.C.	9466.	394.	1182.	9.	5.	2.	110531.	331593.	2653.	1326.	663.	20.0	43.1	36.0	57
AKRON,OHIO	10958.	393.	1179.	9.	5.	2.	110924.	332772.	2662.	1331.	666.	20.2	43.3	36.1	58
NEW HAVEN,CONN.	7401.	387.	1161.	9.	5.	2.	111311.	333933.	2671.	1336.	668.	20.2	43.5	36.3	59
WORCESTER,MASS.	7873.	380.	1140.	9.	5.	2.	111691.	335073.	2681.	1340.	670.	20.3	43.7	36.4	60
SPRINGFIELD,MASS.	5596.	372.	1116.	9.	4.	2.	112063.	336189.	2690.	1345.	672.	20.4	43.8	36.5	61
EL PASO,TEX.	7708.	366.	1098.	9.	4.	2.	112429.	337287.	2698.	1349.	675.	20.5	44.0	36.6	62
PATERSON,N.J.	3421.	346.	1038.	8.	4.	2.	112775.	338325.	2707.	1353.	677.	20.6	44.1	36.7	63
FLINT,MICH.	8431.	338.	1014.	8.	4.	2.	113113.	339339.	2715.	1357.	679.	20.7	44.2	36.8	64
WICHITA,KANS.	7103.	333.	999.	8.	4.	2.	113446.	340338.	2723.	1361.	681.	20.8	44.4	37.0	65
ALBUQUERQUE,N.MEX.	11186.	309.	927.	7.	4.	2.	113755.	341265.	2730.	1365.	683.	20.9	44.7	37.1	66
LAS VEGAS,NEV.	3285.	307.	921.	7.	4.	2.	114062.	342186.	2737.	1369.	684.	21.0	44.7	37.2	67
CAMDEN,N.J.	4250.	307.	921.	7.	4.	2.	114369.	343107.	2745.	1372.	686.	21.0	44.8	37.3	68
BATON ROUGE,LA.	6408.	305.	915.	7.	4.	2.	114674.	344022.	2752.	1376.	688.	21.1	45.0	37.4	69
GARY,IND.	9858.	299.	897.	7.	4.	2.	114973.	344919.	2759.	1380.	690.	21.2	45.2	37.5	70
FORT LAUDERDALE,FLA.	5363.	295.	885.	7.	4.	2.	115268.	345804.	2766.	1383.	692.	21.2	45.3	37.5	71
YOUNGSTOWN,OHIO.	4006.	291.	873.	7.	3.	2.	115559.	346677.	2773.	1387.	693.	21.3	45.4	37.6	72
SHREVEPORT,LA.	3843.	290.	870.	7.	3.	2.	115849.	347547.	2780.	1390.	695.	21.4	45.5	37.7	73
TRENTON,N.J.	5500.	290.	870.	7.	3.	2.	116139.	348417.	2787.	1394.	697.	21.5	45.6	37.8	74
TUCSON,ARIZ.	6837.	289.	867.	7.	3.	2.	116428.	349284.	2794.	1397.	699.	21.6	45.8	37.9	75
JACKSON,MISS.	2498.	277.	831.	7.	3.	2.	116705.	350115.	2801.	1400.	700.	21.6	45.8	38.0	76
ST. PETERSBURG,FLA.	7514.	274.	822.	7.	3.	2.	116979.	350937.	2807.	1404.	702.	21.7	46.0	38.1	77
ELIZABETH,N.J.	4195.	270.	810.	6.	3.	2.	117249.	351747.	2814.	1407.	703.	21.8	46.1	38.2	78
GRAND RAPIDS,MICH.	5675.	266.	798.	6.	3.	2.	117515.	352545.	2820.	1410.	705.	21.9	46.2	38.3	79
FRESNO,CALIF.	9796.	263.	789.	6.	3.	2.	117778.	353334.	2827.	1413.	707.	21.9	46.4	38.4	80
SALT LAKE CITY,UTAH.	7633.	263.	789.	6.	3.	2.	118041.	354123.	2833.	1416.	708.	22.0	46.6	38.4	81
KNOXVILLE,TENN.	4492.	261.	783.	6.	3.	2.	118302.	354906.	2839.	1420.	710.	22.1	46.7	38.5	82
SPOKANE,WASH.	3966.	260.	780.	6.	3.	2.	118562.	355686.	2845.	1423.	711.	22.2	46.8	38.6	83
DES MOINES,IOWA.	4838.	256.	768.	6.	3.	2.	118818.	356454.	2852.	1426.	713.	22.3	46.9	38.7	84

Figure 1-2 (Continued)

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JUNE 1970

DEMAND FOR CRIME LAB EXAMINERS
IN CITIES HAVING A POLICE FORCE OF AT LEAST 250 OFFICERS
BASED ON A YIELD OF THREE CASES PER OFFICER

CITY	INDEX CRIME	NUMBER POLICE	EST. LAB CASES	NO. EXAMINERS BY CASELOAD LOW	MED	HIGH	CUM. NUMBER POLICE	CUM. LAB CASES	CUM. EXAMINERS BY CASELOAD LOW	MED	HIGH	CUM PERCENT INDEX CRIME POP.	CRIME POL	RANK
MOBILE, ALA.	6831.	251.	753.	6.	3.	2.	119069.	357207.	2858.	1429.	714.	22.4	47.0 38.8	85
WATERBURY, CONN.	2492.	250.	750.	6.	3.	2.	119319.	357957.	2864.	1432.	716.	22.4	47.1 38.9	86

Figure 1-2 (Concluded)

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JUNE 1970

DEMAND FOR CRIME LAB EXAMINERS
IN STANDARD METROPOLITAN STATISTICAL AREAS
BASED ON A YIELD OF THREE CASES PER OFFICER

SMSA	EST NO. POLICE	EST. LAB CASES	NO. EXAMINERS BY CASELOAD LOW	MED	HIGH	CUM NO. POLICE	CUM LAB CASES	CUM. EXAMINERS BY CASELOAD LOW	MED	HIGH	CUM. PERCENT INDEX CRIME POP.	CRIME POL.	RNK
NEW YORK, N.Y.	34119.	102357.	819.	409.	205.	34119.	102357.	819.	409.	205.	5.8	12.3 11.1	1
CHICAGO, ILL	15666.	46998.	376.	188.	94.	49785.	149355.	1195.	597.	299.	9.2	16.1 16.2	2
PHILADELPHIA, PA.-N.J.	10541.	31623.	253.	126.	63.	60326.	180978.	1448.	724.	362.	11.7	17.8 19.7	3
LOS ANGELES-LONG BEACH, CALIF	9971.	29913.	239.	120.	60.	70297.	210891.	1687.	844.	422.	15.1	25.0 22.9	4
DETROIT, MICH	7580.	22740.	182.	91.	45.	77877.	233631.	1869.	935.	467.	17.2	28.4 25.4	5
BOSTON-LOWELL-LAWRENCE, MASS	6089.	18267.	146.	73.	37.	83966.	251898.	2015.	1008.	504.	18.9	30.3 27.4	6
WASHINGTON, D.C.-MD-VA	4958.	14874.	119.	59.	30.	88923.	266772.	2134.	1067.	534.	20.2	32.4 29.0	7
SAN FRANCISCO-OAKLAND, CALIF	4278.	12834.	103.	51.	26.	93202.	279606.	2237.	1118.	559.	21.7	35.6 30.4	8
BALTIMORE, MD	4183.	12549.	100.	50.	25.	97385.	292155.	2337.	1169.	584.	22.8	37.6 31.7	9
ST. LOUIS, MO.-ILL	3739.	11217.	90.	45.	22.	101124.	303372.	2427.	1213.	607.	24.0	39.1 32.9	10
CLEVELAND, OHIO	3378.	10134.	81.	41.	20.	104502.	313506.	2508.	1254.	627.	25.0	40.2 34.0	11
NEWARK, N.J	2939.	8817.	71.	35.	18.	107441.	322323.	2579.	1289.	645.	25.9	41.7 35.0	12
PITTSBURGH, PA	2864.	8592.	69.	34.	17.	110305.	330915.	2647.	1324.	662.	27.1	42.8 35.9	13
MILWAUKEE, WIS	2593.	7779.	62.	31.	16.	112898.	338694.	2710.	1355.	677.	27.8	43.3 36.8	14
BUFFALO, N.Y.	2427.	7281.	58.	29.	15.	115325.	345975.	2768.	1384.	692.	28.5	43.9 37.6	15
HOUSTON, TEX	2141.	6423.	51.	26.	13.	117466.	352398.	2819.	1410.	705.	29.4	45.2 38.3	16
MINNEAPOLIS-ST.PAUL, MINN	2079.	6237.	50.	25.	12.	119545.	358635.	2869.	1435.	717.	30.3	46.3 38.9	17
DALLAS, TEX	2076.	6228.	50.	25.	12.	121621.	364863.	2919.	1459.	730.	31.0	47.1 39.6	18
PATERSON-CLIFTON-PASSAIC, N.J.	1858.	5574.	45.	22.	11.	123479.	370437.	2963.	1482.	741.	31.7	47.6 40.2	19
KANSAS CITY, MO.-KANS	1829.	5487.	44.	22.	11.	125308.	375924.	3007.	1504.	752.	32.3	48.5 40.8	20
NEW ORLEANS, LA	1741.	5223.	42.	21.	10.	127049.	381147.	3049.	1525.	762.	32.8	49.3 41.4	21
MIAMI, FLA	1698.	5094.	41.	20.	10.	128747.	386241.	3090.	1545.	772.	33.4	50.4 41.9	22
SEATTLE-EVERETT, WASH	1675.	5025.	40.	20.	10.	130422.	391266.	3130.	1565.	783.	34.1	51.3 42.5	23
CINCINNATI-OHIO-KY.-IND	1586.	4758.	38.	19.	10.	132008.	396024.	3166.	1584.	792.	34.8	51.8 43.0	24
JERSEY CITY, N.J.	1583.	4749.	38.	19.	9.	133591.	400773.	3206.	1603.	802.	35.1	52.1 43.5	25
ATLANTA, GA	1536.	4608.	37.	18.	9.	135127.	405381.	3243.	1622.	811.	35.8	52.9 44.0	26
INDIANAPOLIS, IND	1532.	4596.	37.	18.	9.	136659.	409977.	3280.	1640.	820.	36.3	53.5 44.5	27
DENVER, COLO	1524.	4572.	37.	18.	9.	138183.	414549.	3316.	1658.	829.	36.9	54.3 45.0	28
SAN DIEGO, CALIF	1496.	4488.	36.	18.	9.	139679.	419037.	3352.	1676.	838.	37.5	54.9 45.5	29
PROV.-PAWT-WARWICK, R.I.	1441.	4323.	35.	17.	9.	141120.	423360.	3387.	1693.	847.	37.9	55.4 46.0	30
ANA.-ST. ANA-GARD. GR., CAL.	1271.	3813.	31.	15.	8.	142391.	427173.	3417.	1709.	854.	38.5	56.2 46.4	31
MEMPHIS, TENN.-ARK	1237.	3711.	30.	15.	7.	143628.	430884.	3447.	1724.	862.	38.9	56.7 46.8	32
TAMPA-ST. PETERSBURG, FLA	1237.	3711.	30.	15.	7.	144865.	434595.	3477.	1738.	869.	39.4	57.4 47.2	33
PORTLAND, OREG-WASH	1218.	3654.	29.	15.	7.	146083.	438249.	3506.	1753.	876.	39.8	58.0 47.6	34
COLUMBUS, OHIO	1170.	3510.	28.	14.	7.	147253.	441759.	3534.	1767.	884.	40.3	58.6 48.0	35
TOLEDO, OHIO-MICH	1115.	3345.	27.	13.	7.	148368.	445104.	3561.	1780.	890.	40.6	58.8 48.3	36
SAN. BERN.-RIV.-ONT., CAL.	1097.	3291.	26.	13.	7.	149465.	448395.	3587.	1794.	897.	41.2	59.6 48.7	37
PHOENIX, ARIZ	1079.	3237.	26.	13.	6.	150544.	451632.	3613.	1807.	903.	41.6	60.3 49.0	38
SAN JOSE, CALIF	1065.	3195.	26.	13.	6.	151609.	454827.	3639.	1819.	910.	42.1	60.8 49.4	39
HONOLULU, HAWAII	1054.	3162.	25.	13.	6.	152663.	457989.	3664.	1832.	916.	42.4	61.3 49.7	40
HUNTSVILLE, ALA	1051.	3153.	25.	13.	6.	153714.	461142.	3689.	1845.	922.	42.6	61.4 50.1	41
LOUISVILLE, KY-IND	1032.	3096.	25.	12.	6.	154746.	464238.	3714.	1857.	928.	43.0	62.0 50.4	42

Figure 1-3

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JUNE 1970

DEMAND FOR CRIME LAB EXAMINERS
IN STANDARD METROPOLITAN STATISTICAL AREAS
BASED ON A YIELD OF THREE CASES PER OFFICER

SMSA	EST NO. POLICE	EST. LAB CASES	NO. EXAMINERS BY CASELOAD LOW	MED	HIGH	CUM NO. POLICE	CUM LAB CASES	CUM. EXAMINERS BY CASELOAD LOW	MED	HIGH	CUM. PERCENT INDEX POP.	CRIME	POL.	RNK
BIRMINGHAM, ALA	1025.	3075.	25.	12.	6.	155771.	467313.	3739.	1869.	935.	43.3	62.4	50.7	43
ROCHESTER, N.Y.	1011.	3033.	24.	12.	6.	156782.	470346.	3763.	1881.	941.	43.8	62.7	51.1	44
WORCESTER, MASS	1005.	3015.	24.	12.	6.	157787.	473361.	3787.	1893.	947.	44.1	63.0	51.4	45
HART.-NEW BRIT.-BRIS., CONN.	980.	2940.	24.	12.	6.	158767.	476301.	3810.	1905.	953.	44.5	63.4	51.7	46
ALBANY-SCHENECTADY-TROY, N.Y.	977.	2931.	23.	12.	6.	159744.	479232.	3834.	1917.	958.	44.8	63.6	52.0	47
NORFOLK-PORTSMOUTH, VA	961.	2883.	23.	12.	6.	160705.	482115.	3857.	1928.	964.	45.2	64.1	52.3	48
FORT WORTH, TEX	920.	2760.	22.	11.	6.	161625.	484875.	3879.	1939.	970.	45.5	64.5	52.6	49
SACRAMENTO, CALIF	913.	2739.	22.	11.	5.	162538.	487614.	3901.	1950.	975.	45.9	65.0	52.9	50
DAYTON, OHIO	912.	2736.	22.	11.	5.	163450.	490350.	3923.	1961.	981.	46.3	65.4	53.2	51
SAN ANTONIO, TEX	910.	2730.	22.	11.	5.	164360.	493080.	3945.	1972.	986.	46.7	66.1	53.5	52
SPRING.-CHIC.-HOLY., MASS.	902.	2727.	22.	11.	5.	165269.	495807.	3966.	1983.	992.	46.8	66.3	53.8	53
GREENSBORO-HIGH POINT, N.C.	878.	2634.	21.	11.	5.	166147.	498441.	3988.	1994.	997.	47.1	66.6	54.1	54
NASHVILLE, TENN	858.	2574.	21.	10.	5.	167005.	501015.	4008.	2004.	1002.	47.3	66.9	54.4	55
SYRACUSE, N.Y	858.	2574.	21.	10.	5.	167863.	503589.	4029.	2014.	1007.	47.7	67.2	54.7	56
AKRON, OHIO	792.	2376.	19.	10.	5.	168655.	505965.	4048.	2024.	1012.	48.0	67.6	54.9	57
GARY-HAMMOND-EAST CHICAGO, IND	769.	2307.	18.	9.	5.	169424.	508272.	4066.	2033.	1017.	48.3	68.0	55.2	58
BRIDGE.-STAN.-NOR, CONN	754.	2262.	18.	9.	5.	170178.	510534.	4084.	2042.	1021.	48.7	68.4	55.4	59
YOUNGSTO.-WARREN, OHIO	751.	2253.	18.	9.	5.	170929.	512787.	4102.	2051.	1026.	49.0	68.6	55.7	60
FORT LAUDERDAL.-HOLLYWOOD, FLA	731.	2193.	18.	9.	4.	171660.	514980.	4120.	2060.	1030.	49.3	69.0	55.9	61
OKLAHOMA CITY, OKLA	721.	2163.	17.	9.	4.	172381.	517143.	4137.	2069.	1034.	49.6	69.3	56.2	62
ALLEN.-BETH.-EAST. PA.-N.J.	711.	2133.	17.	9.	4.	173092.	519276.	4154.	2077.	1039.	49.8	69.4	56.4	63
NEW HAVEN-WATERBURY, CONN	709.	2127.	17.	9.	4.	173801.	521403.	4171.	2086.	1043.	50.2	69.8	56.6	64
RICHMOND, VA	705.	2115.	17.	8.	4.	174506.	523518.	4188.	2094.	1047.	50.4	70.1	56.8	65
OMAHA, NEBR-IOWA	668.	2004.	16.	8.	4.	175174.	525522.	4204.	2102.	1051.	50.7	70.4	57.1	66
WILMINGTON, DEL.-N.J.-MD	658.	1974.	16.	8.	4.	175832.	527496.	4220.	2110.	1055.	51.0	70.6	57.3	67
TULSA, OKLA	643.	1929.	15.	8.	4.	176475.	529425.	4235.	2118.	1059.	51.2	70.9	57.5	68
GRAND RAPIDS, MICH	629.	1887.	15.	8.	4.	177104.	531312.	4250.	2125.	1063.	51.4	71.1	57.7	69
FLINT, MICH	627.	1869.	15.	7.	4.	177727.	533181.	4265.	2133.	1066.	51.7	71.4	57.9	70
KNOXVILLE, TENN	600.	1800.	14.	7.	4.	178327.	534981.	4280.	2140.	1070.	51.9	71.5	58.1	71
SALT LAKE CITY, UTAH	599.	1797.	14.	7.	4.	178926.	536778.	4294.	2147.	1074.	52.2	71.8	58.3	72
AUSTIN, TEX	581.	1743.	14.	7.	3.	179507.	538521.	4308.	2154.	1077.	52.3	72.0	58.5	73
FRESNO, CALIF	565.	1695.	14.	7.	3.	180072.	540216.	4322.	2161.	1080.	52.5	72.4	58.7	74
CHARLOTTE, N.C.	544.	1632.	13.	7.	3.	180616.	541848.	4335.	2167.	1084.	52.7	72.6	58.8	75
HARRISBURG, PA	539.	1617.	13.	6.	3.	181155.	543465.	4348.	2174.	1087.	52.9	72.7	59.0	76
ORLANDO, FLA	505.	1515.	12.	6.	3.	181660.	544980.	4360.	2180.	1090.	53.1	72.9	59.2	77
WICHITA, KANS	498.	1494.	12.	6.	3.	182158.	546474.	4372.	2186.	1093.	53.3	73.1	59.3	78
TRENTON, N.J	488.	1464.	12.	6.	3.	182646.	547938.	4384.	2192.	1096.	53.5	73.3	59.5	79
TACOMA, WASH	474.	1422.	11.	6.	3.	183120.	549360.	4395.	2197.	1099.	53.6	73.5	59.6	80
UTICA-ROME, N.Y.	471.	1413.	11.	6.	3.	183591.	550773.	4406.	2203.	1102.	53.8	73.5	59.8	81
WILKES-BARRE-HAZELTON, PA	461.	1383.	11.	6.	3.	184052.	552156.	4417.	2209.	1104.	54.0	73.6	60.0	82
PEORIA, ILL	460.	1380.	11.	6.	3.	184512.	553536.	4428.	2214.	1107.	54.2	73.7	60.1	83
SHREVEPORT, LA	454.	1362.	11.	5.	3.	184966.	554898.	4439.	2220.	1110.	54.3	73.9	60.2	84

Figure 1-3 (Continued)

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KANSAS CITY, MISSOURI 64110

JUNE 1970

DEMAND FOR CRIME LAB EXAMINERS
IN STANDARD METROPOLITAN STATISTICAL AREAS
BASED ON A YIELD OF THREE CASES PER OFFICER

SMSA	EST NO. POLICE	EST. LAB CASES	NO. EXAMINERS BY CASELOAD LOW	MED	HIGH	CUM NO. POLICE	CUM LAB CASES	CUM. EXAMINERS BY CASELOAD LOW	MED	HIGH	CUM. PERCENT INDEX POP.	CRIME	POL.	RNK
LANSING, MICH	445.	1335.	11.	5.	3.	185411.	556233.	4450.	2225.	1112.	54.5	74.1	60.4	85
BAKERSFIELD, CALIF	443.	1329.	11.	5.	3.	185854.	557562.	4460.	2230.	1115.	54.7	74.3	60.5	86
CHATTANOOGA, TENN.-GA	434.	1302.	10.	5.	3.	186288.	558864.	4471.	2235.	1118.	54.8	74.5	60.7	87
DAVENPORT-ROCK ISLAND-MOLINE, I	419.	1257.	10.	5.	3.	186707.	560121.	4481.	2240.	1120.	55.0	74.6	60.8	88
EL PASO, TEX	415.	1245.	10.	5.	2.	187122.	561366.	4491.	2245.	1123.	55.2	74.8	61.0	89
MOBILE, ALA	409.	1227.	10.	5.	2.	187531.	562593.	4501.	2250.	1125.	55.4	75.0	61.1	90
LITTLE ROCK-NORTH LITTLE RK, AR	407.	1221.	10.	5.	2.	187938.	563814.	4511.	2255.	1128.	55.6	75.2	61.2	91
YORK, PA	404.	1212.	10.	5.	2.	188344.	565032.	4520.	2260.	1130.	55.7	75.2	61.3	92
STOCKTON, CALIF	401.	1203.	10.	5.	2.	188745.	566235.	4530.	2265.	1132.	55.9	75.5	61.5	93
SOUTH BEND, IND	400.	1200.	10.	5.	2.	189145.	567435.	4539.	2270.	1135.	56.0	75.6	61.6	94
BINGHAMTON, N.Y.-PA	397.	1191.	10.	5.	2.	189542.	568626.	4549.	2275.	1137.	56.1	75.6	61.7	95
BEAUMONT-PORT ARTHUR, TEX	394.	1182.	9.	5.	2.	189936.	569808.	4558.	2279.	1140.	56.3	75.8	61.9	96
READING, PA	391.	1173.	9.	5.	2.	190327.	570981.	4568.	2284.	1142.	56.5	75.2	62.0	97
COLUMBIA, S.C.	390.	1170.	9.	5.	2.	190717.	572151.	4577.	2289.	1144.	56.6	76.0	62.1	98
LAS VEGAS, NEV	388.	1164.	9.	5.	2.	191105.	573315.	4587.	2293.	1147.	56.7	76.2	62.2	99
GREENVILLE, S.C.	387.	1161.	9.	5.	2.	191492.	574476.	4596.	2298.	1149.	56.4	76.3	62.4	100
LANCASTER, PA	384.	1158.	9.	5.	2.	191878.	575634.	4605.	2303.	1151.	57.0	76.4	62.5	101
SPOKANE, WASH	384.	1158.	9.	5.	2.	192264.	576792.	4614.	2307.	1154.	57.2	76.5	62.6	102
CHARLESTON, S.C.	378.	1134.	9.	5.	2.	192642.	577926.	4623.	2312.	1156.	57.3	76.6	62.7	103
JACKSON, MISS	377.	1131.	9.	5.	2.	193019.	579057.	4632.	2316.	1158.	57.5	76.7	62.9	104
CORPUS CHRISTI, TEX	373.	1119.	9.	4.	2.	193392.	580176.	4641.	2321.	1160.	57.6	76.9	63.0	105
JOHNSTOWN, PA	360.	1107.	9.	4.	2.	193761.	581283.	4650.	2325.	1163.	57.8	76.9	63.1	106
JACKSONVILLE, FLA	364.	1092.	9.	4.	2.	194125.	582375.	4659.	2329.	1165.	58.0	77.3	63.2	107
MADISON, WIS	361.	1083.	9.	4.	2.	194486.	583458.	4668.	2334.	1167.	58.2	77.4	63.4	108
DULUTH-SUPERIOR, MINN.-WIS	358.	1074.	9.	4.	2.	194844.	584532.	4676.	2338.	1169.	58.3	77.5	63.5	109
TUCSON, ARIZ	358.	1074.	9.	4.	2.	195202.	585606.	4685.	2342.	1171.	58.5	77.7	63.6	110
CHARLESTON, W.VA.	353.	1059.	8.	4.	2.	195555.	586665.	4693.	2347.	1173.	58.6	77.8	63.7	111
WEST PALM BEACH, FLA	351.	1053.	8.	4.	2.	195906.	587718.	4702.	2351.	1175.	58.7	78.0	63.8	112
COLUMBUS, GA-ALA	349.	1047.	8.	4.	2.	196255.	588765.	4710.	2355.	1178.	58.9	78.1	63.9	113
ERIE, PA	344.	1032.	8.	4.	2.	196599.	589797.	4718.	2359.	1180.	59.0	78.1	64.0	114
HUNT.-ASH. W. VA.-KY-OHIO	340.	1020.	8.	4.	2.	196939.	590817.	4727.	2363.	1182.	59.1	78.2	64.1	115
ATLANTIC CITY, N.J.	338.	1014.	8.	4.	2.	197277.	591831.	4735.	2367.	1184.	59.2	78.4	64.3	116
EVANSVILLE, IND.-KY	338.	1014.	8.	4.	2.	197615.	592845.	4743.	2371.	1186.	59.3	78.5	64.4	117
SCRANTON, PA	337.	1011.	8.	4.	2.	197952.	593856.	4751.	2375.	1188.	59.5	78.5	64.5	118
FORT WAYNE, IND	336.	1008.	8.	4.	2.	198288.	594864.	4759.	2379.	1190.	59.6	78.7	64.6	119
ROCKFORD, ILL	333.	999.	8.	4.	2.	198621.	595863.	4767.	2383.	1192.	59.7	78.7	64.7	120
DES MOINES, IOWA	331.	993.	8.	4.	2.	198952.	596856.	4775.	2387.	1194.	59.9	78.9	64.8	121
AUGUSTA, GA.-S.C.	329.	987.	8.	4.	2.	199281.	597843.	4783.	2391.	1196.	60.0	78.9	64.9	122
NEWPORT NEWS-HAMPTON, VA	306.	918.	7.	4.	2.	199587.	598761.	4790.	2395.	1198.	60.1	79.1	65.0	123
STEUB.-WEIR.-OHIO-W. VA.	299.	897.	7.	4.	2.	199886.	599658.	4797.	2399.	1199.	60.2	79.1	65.1	124
PENSACOLA, FLA	298.	894.	7.	4.	2.	200184.	600552.	4804.	2402.	1201.	60.3	79.2	65.2	125
BROCKTON, MASS	295.	885.	7.	4.	2.	200479.	601437.	4811.	2406.	1203.	60.5	79.4	65.3	126

Figure 1-3 (Continued)

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DEMAND FOR CRIME LAB EXAMINERS
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BASED ON A YIELD OF THREE CASES PER OFFICER

SMSA	EST NO. POLICE	EST. LAB CASES	NO. EXAMINERS BY CASELOAD LOW	MED	HIGH	CUM NO. POLICE	CUM LAB CASES	CUM. EXAMINERS BY CASELOAD LOW	MED	HIGH	CUM. PERCENT INDEX POP.	CRIME POL.	RNK
RALEIGH, N.C.	293.	879.	7.	4.	2.	200772.	602316.	4819.	2409.	1205.	60.6	79.4 65.4	127
LEXINGTON, KY	282.	846.	7.	3.	2.	201054.	603162.	4825.	2413.	1206.	60.7	79.6 65.5	128
SALINAS-MONTEREY, CALIF	279.	837.	7.	3.	2.	201333.	603999.	4832.	2416.	1208.	60.9	79.7 65.6	129
VALLEJO-NAPA, CALIF	277.	831.	7.	3.	2.	201610.	604830.	4839.	2419.	1210.	60.9	79.9 65.7	130
FALL RIVER-NEW BEDFORD, MASS	275.	825.	7.	3.	2.	201885.	605655.	4845.	2423.	1211.	61.1	80.1 65.8	131
SAGINAW, MICH	272.	816.	7.	3.	2.	202157.	606471.	4852.	2426.	1213.	61.2	80.2 65.8	132
WHEELING, W.VA.-OHIO	269.	807.	6.	3.	2.	202426.	607278.	4858.	2429.	1215.	61.3	80.2 65.9	133
OXNARD-VENTURA, CALIF	267.	801.	6.	3.	2.	202693.	608079.	4865.	2432.	1216.	61.5	80.4 66.0	134
COLORADO SPRINGS, COLO	260.	780.	6.	3.	2.	202953.	608859.	4871.	2435.	1218.	61.6	80.5 66.1	135
ANN ARBOR, MICH.	254.	762.	6.	3.	2.	203207.	609621.	4877.	2438.	1219.	61.7	80.6 66.2	136
LORAIN-ELYRIA, OHIO	254.	762.	6.	3.	2.	203461.	610383.	4883.	2442.	1221.	61.8	80.7 66.3	137
DURHAM, N.C.	249.	747.	6.	3.	1.	203710.	611130.	4889.	2445.	1222.	61.9	80.8 66.4	138
KALAMAZOO, MICH	249.	747.	6.	3.	1.	203959.	611877.	4895.	2448.	1224.	62.0	80.9 66.4	139
EUGENE, OREG	241.	723.	6.	3.	1.	204200.	612600.	4901.	2450.	1225.	62.1	81.0 66.5	140
LUBBOCK, TEX	240.	720.	6.	3.	1.	204440.	613320.	4907.	2453.	1227.	62.2	81.1 66.6	141
RACINE, WIS	239.	717.	6.	3.	1.	204679.	614037.	4912.	2456.	1228.	62.3	81.1 66.7	142
TERRE HAUTE, IND	239.	717.	6.	3.	1.	204918.	614754.	4918.	2459.	1230.	62.4	81.2 66.7	143
SAVANNAH, GA	238.	714.	6.	3.	1.	205156.	615468.	4924.	2462.	1231.	62.5	81.3 66.8	144
NEW LONDON-GROTON-NORWICH, CONN	235.	705.	6.	3.	1.	205391.	616173.	4929.	2465.	1232.	62.6	81.4 66.9	145
AMARILLO, TEX	229.	687.	5.	3.	1.	205620.	616860.	4935.	2467.	1234.	62.7	81.5 67.0	146
MUSKEGON-MUSKEGON HEIGHTS, MICH	222.	666.	5.	3.	1.	205842.	617526.	4940.	2470.	1235.	62.8	81.6 67.0	147
ROANOKE, VA	220.	660.	5.	3.	1.	206062.	618186.	4945.	2473.	1236.	62.9	81.7 67.1	148
SALEM, OREG	218.	654.	5.	3.	1.	206280.	618840.	4951.	2475.	1238.	63.0	81.7 67.2	149
FAYETTEVILLE, N.C.	217.	651.	5.	3.	1.	206497.	619491.	4956.	2478.	1239.	63.1	81.8 67.3	150
LIMA, OHIO	215.	645.	5.	3.	1.	206712.	620136.	4961.	2481.	1240.	63.2	81.9 67.3	151
SANTA BARBARA, CALIF	215.	645.	5.	3.	1.	206927.	620781.	4966.	2483.	1242.	63.3	82.0 67.4	152
MCALLEN-PHARR-EDINBURG, TEX	212.	636.	5.	3.	1.	207139.	621417.	4971.	2486.	1243.	63.4	82.0 67.5	153
GREEN BAY, WIS	210.	630.	5.	3.	1.	207349.	622047.	4976.	2488.	1244.	63.5	82.1 67.5	154
PORTLAND, MAINE	204.	618.	5.	2.	1.	207555.	622665.	4981.	2491.	1245.	63.6	82.1 67.6	155
ASHEVILLE, N.C.	205.	615.	5.	2.	1.	207760.	623280.	4986.	2493.	1247.	63.6	82.2 67.7	156
LINCOLN, NEBR	202.	606.	5.	2.	1.	207962.	623886.	4991.	2496.	1248.	63.7	82.2 67.7	157
JACKSON, MICH	200.	600.	5.	2.	1.	208162.	624486.	4996.	2498.	1249.	63.8	82.3 67.8	158
SPRINGFIELD, ILL	196.	588.	5.	2.	1.	208358.	625074.	5001.	2500.	1250.	63.9	82.4 67.9	159
WACO, TEX	196.	582.	5.	2.	1.	208552.	625656.	5005.	2503.	1251.	63.9	82.4 67.9	160
FORT SMITH, ARK-OKLA	193.	579.	5.	2.	1.	208745.	626235.	5010.	2505.	1252.	64.0	82.5 68.0	161
ANDERSON, IND.	189.	564.	5.	2.	1.	208933.	626799.	5014.	2507.	1254.	64.1	82.5 68.1	162
CEDAR RAPIDS, IOWA	181.	543.	4.	2.	1.	209114.	627342.	5019.	2509.	1255.	64.2	82.5 68.1	163
TOPEKA, KANS	179.	537.	4.	2.	1.	209293.	627879.	5023.	2512.	1256.	64.2	82.6 68.2	164
PUEBLO, COLO	178.	534.	4.	2.	1.	209471.	628413.	5027.	2514.	1257.	64.3	82.7 68.2	165
ALTOONA, PA.	177.	531.	4.	2.	1.	209648.	628944.	5032.	2516.	1258.	64.4	82.7 68.3	166
GALVESTON-TEXAS CITY, TEX	176.	528.	4.	2.	1.	209824.	629472.	5036.	2518.	1259.	64.5	82.8 68.3	167
SPRINGFIELD, MO	175.	525.	4.	2.	1.	209999.	629997.	5040.	2520.	1260.	64.5	82.8 68.4	168

Figure 1-3 (Continued)

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WATERLOO, IOWA	174.	522.	4.	2.	1.	210173.	630519.	5044.	2522.	1261.	64.6	82.9 68.5	169
BROWN.-HARL-SAN. BEN. TEX.	171.	513.	4.	2.	1.	210344.	631032.	5048.	2524.	1262.	64.7	82.9 68.5	170
MUNCIE, IND	170.	510.	4.	2.	1.	210514.	631542.	5052.	2526.	1263.	64.7	83.0 68.6	171
LYNCHBURG, VA	169.	507.	4.	2.	1.	210683.	632049.	5056.	2528.	1264.	64.8	83.0 68.6	172
MANSFIELD, OHIO	169.	507.	4.	2.	1.	210852.	632556.	5060.	2530.	1265.	64.9	83.1 68.7	173
LAKE CHARLES, LA	168.	504.	4.	2.	1.	211020.	633060.	5064.	2532.	1266.	64.9	83.1 68.7	174
KENOSHA, WIS	166.	498.	4.	2.	1.	211186.	633558.	5068.	2534.	1267.	65.0	83.2 68.8	175
CHAMPAIGN-URBANA, ILL	165.	495.	4.	2.	1.	211351.	634053.	5072.	2536.	1268.	65.1	83.2 68.8	176
FARGO-MOORHEAD, N. DAK-MINN	152.	456.	4.	2.	1.	211503.	634509.	5076.	2538.	1269.	65.1	83.2 68.9	177
BAY CITY, MICH	150.	450.	4.	2.	1.	211653.	634959.	5080.	2540.	1270.	65.2	83.3 68.9	178
MANCHESTER, N.H.	148.	444.	4.	2.	1.	211801.	635403.	5083.	2542.	1271.	65.3	83.3 69.0	179
ABILENE, TEX	147.	441.	4.	2.	1.	211948.	635844.	5087.	2543.	1272.	65.4	83.4 69.0	180
OGDEN, UTAH	146.	438.	4.	2.	1.	212094.	636282.	5090.	2545.	1273.	65.4	83.4 69.1	181
SIOUX CITY, IOWA-NEBR	144.	432.	3.	2.	1.	212238.	636714.	5094.	2547.	1273.	65.5	83.5 69.1	182
WICHITA FALLS, TEX	143.	429.	3.	2.	1.	212381.	637143.	5097.	2549.	1274.	65.5	83.5 69.2	183
DECATUR, ILL	142.	426.	3.	2.	1.	212523.	637569.	5101.	2550.	1275.	65.6	83.6 69.2	184
MONROE, LA	136.	408.	3.	2.	1.	212659.	637977.	5104.	2552.	1276.	65.7	83.6 69.3	185
PROVO-OREM, UTAH	136.	408.	3.	2.	1.	212795.	638385.	5107.	2554.	1277.	65.7	83.6 69.3	186
BOISE, IDAHO	135.	405.	3.	2.	1.	212930.	638790.	5110.	2555.	1278.	65.8	83.6 69.4	187
LAWTON, OKLA	132.	396.	3.	2.	1.	213062.	639186.	5113.	2557.	1278.	65.8	83.7 69.4	188
TEXARKANS. TEX-ARK	120.	360.	3.	1.	1.	213182.	639546.	5116.	2558.	1279.	65.9	83.7 69.4	189
WILMINGTON, N.C.	115.	345.	3.	1.	1.	213297.	639891.	5119.	2560.	1280.	66.0	83.8 69.5	190
PITTSFIELD, MASS	100.	300.	2.	1.	1.	213397.	640191.	5122.	2561.	1280.	66.0	83.8 69.5	191
LAFAYETTE, LA	94.	282.	2.	1.	1.	213491.	640473.	5124.	2562.	1281.	66.1	83.9 69.5	192

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Figure 1-3 (Concluded)

For any given strategy, the CPO value shown reflects the probable yield to that particular type laboratory based on the discussion in Section II. The cases to the laboratory are determined to be the product of the number of sworn police officers in jurisdiction of the laboratory under that strategy times the CPO value. The third column depicts the number of examiners required for all laboratories of a given type based on an average of 250 cases per examiner a year. The cost figures shown in the fourth column are based on a fixed cost at $20,000 per examiner per year and were determined as follows:

$12,500	Salary
2,500	Salary related expenses (retirement, medical, vacation, sick leave, FICA, etc.)
5,000	Other (equipment replacement and maintenance, travel for court testimony and professional meetings, technical and administrative support share)
$20,000	

The fifth column of Figure 1-1 reflects a variable cost per examiner assuming certain efficiencies of the larger laboratory operations. (Due to more efficient use of equipment and personnel time as in batch processing; lower technical and administrative cost shares; etc.) Assuming a maximum of 5 percent greater efficiency in overall operating costs in any echelon of laboratory size, the following plan for recognizing economies of operation was adopted.

Laboratory Size	Cost Per Examiner
5-15 examiners	$20,000
16-40 examiners	19,000
41-100 examiners	18,000
100+ examiners	17,000

The 5 percent level of improved efficiency could not be substantiated on the basis of available data. This figure is, however, consistent with that observed in similar industrial operations in which increased size promotes greater efficiency. The inclusion of the cost figures in this column is intended to increase the basis of comparison of each of the location strategies and should be considered for their relative order of magnitude only.

Column 7 in Figure 1-1 again reflects the number of examiners required in each type laboratory under a given strategy but this time the caseload per examiner is allowed to vary. (Costs are again variable as described in the preceding paragraph.) The rationale underlying this third type of analysis is that cities and SMSA laboratories are likely to receive a proportionately higher share of routine examination requests so as to enable an examiner in such a local laboratory to surpass the 250 cases per year level and reach 500 cases per year. (Some laboratories around the country are actually reporting even higher caseloads.)

Continuing with this analysis plan the complexity of the cases reaching the state, regional, and national laboratories would increase so as to reduce the expected caseload per examiner proportionately. The figures used in computing the required number of examiners for these larger jurisdiction laboratories are 250, 250, and 125, respectively.

The following paragraphs describe the unique characteristics of each of the location strategies shown in Figure 1-1.

Strategy I. The yield of cases to the national laboratory is based on the discussion of crime laboratory demand presented in Section IV. In this and subsequent strategies, the number of sworn police personnel in the United States is taken to be 307,000 including city police officers, county sheriffs, state marshals, police, and state highway patrol. A CPO value of 0.1 is used to yield 30,700 cases per year to the national laboratory.

Strategy II. The cases to the nine regional laboratories were determined by applying the 0.5 CPO to the entire police force of the nation since the nine regions as defined in the UCR partitioned the United States into nine distinct and exhaustive areas. Again, with a 0.1 CPO, 30,700 cases are sent to the national laboratory.

Strategy III. The 50 state laboratories, again, cover all the police force in the U. S. but the CPO value has increased to 1.0 so that twice as many cases reach the 50 state laboratories as did the nine regional laboratories under Strategy II. The national laboratory CPO remains 0.1.

Strategy IV. This is the first of the "hybrid" locational strategies (e.g., the first to consider the effects of splitting the allocation of "cases to laboratory" to three echelons of laboratory service). In this strategy, the cases to the 60 city laboratories were determined from the Figure 1-2 ranking report. Sixty was chosen as the cutoff point for city laboratories since under the medium caseload concept of 250 cases per examiner, Figure 1-2 indicates that below this level the required number of examiners drops below the recommended minimum as discussed in Section III. The cumulative number of police served by the 60 city laboratories is determined from Figure 1-2.

to be 111,691 so that a 3.0 CPO would yield 335,073 cases to these laboratories. The police in the nation not served by these city laboratories are then assigned to the nine regional laboratories at a reduced (0.5) CPO. In addition, all of the nation's police are assigned to the national laboratory at a CPO of 0.1. The total yeild of cases to any crime laboratory is then the sum of the allocation to one national, nine regional, and 60 city laboratories.

Strategy V. This strategy is similar to the preceding one in that cases are first allocated to the 60 cities using the 3.0 CPO but the remaining police officers are assigned to 50 state laboratories and the national laboratory. The resulting difference in "cases to laboratory" may be noted by comparing the yield under Strategy IV as compared to Strategy V.

Strategy VI. The ranking of SMSA's shown in Figure 1-3 was used to establish a cut-off point in the number of SMSA's to be assigned a crime laboratory. This ranking report shows that 104 SMSA's is the maximum number of laboratories that can be strucuured without violating the five examiners per laboratory requirement for a full-service laboratory. This report further shows that 193,019 of the nation's police are served by these 104 SMSA's using the 3.0 CPO. The yield of cases to laboratory is calculated to be 579,057 cases. Under this strategy, the remaining portion of the nation's police are assigned to regional laboratories at the 0.5 CPO rate. The national laboratory again is considered at the 0.1 CPO value.

Strategy VII. This strategy is identical to that just described except that the police not covered by the 104 SMSA laboratories are assigned to 50 state laboratories. The result is, again, that a greater percentage of the nation's crimes receive the attention of a crime laboratory under the "balance to regional laboratory" strategies.

Results

The results of the calculations highlighted in the seven strategies described above are summarized in Figure 1-1. Certain general observations can be made from the data shown in this figure.

(1) As the complexity of the location strategy increases so does the number of cases to the laboratories with resulting increase in cost.

(2) The number of examiners required in any but the simplest of strategies exceeds the resource currently available.

(3) The variable cost per laboratory examiner analysis does not appreciably affect the overall cost to the nation for any given strategy.

(4) The cost for a given strategy is most sensitive to the number of cases an examiner in a laboratory can be expected to handle (third analysis). Due to a variance in the number of examiners required to analyze the fixed caseload under this hypothesis the resulting cost comparison for a given strategy may vary by an average of 22 percent in the hybrid mixes (Strategies IV through VII). The most severely affected are, of course, those strategies having a preponderance of national and regional laboratories with the caseload per examiner reduced (Strategies I and II in particular).

While the analysis summary presented in Figure 1-1 provides some interesting insights into both manpower and dollar resource requirements under several analysis plans, it falls short of providing a meaningful basis of comparison of system effectiveness of a given strategy with that of another. With this objective in mind, a Phase II of the cost/effectiveness analysis of proposed location strategies was conducted.

Analysis, Phase II

This phase of the cost/effectiveness analysis measures each location strategy against a goal of three cases per officer to the laboratory for the entire nation's police force. This goal was determined to be feasible after considering the number of crime laboratories in the country that are already close to the 3.0 level. (Note the cluster of laboratories near the 3.0 mark in Figure 1-4). A performance index was developed which compares the average CPO of a particular strategy with the 3.0 goal. The ratio thus obtained may be considered as a comparative measure of the effectiveness of the strategy relative to national requirements.

A similar index was defined for comparing strategy costs with the costs associated with some upper bound figure or maximum expenditure for criminalistics services to the entire nation. To arrive at this figure, it was determined that if the nation were saturated with crime laboratories so as to provide a 50-mile radius coverage (roughly equivalent to 2-hour driving turn-around time), then approximately 400 laboratories would be required. Assuming a $200,000 start-up cost per laboratory, some $80 million would be needed for start-up costs only. In addition, if the 307,000 police officers generated 921,000 cases to the laboratory (3.0 CPO), then 3,690 examiners would be required at the medium caseload level. Each of these examiners costs $20,000 per year so that another $73.8 million is needed to staff and maintain these laboratories. The total cost to the nation for this maximum coverage would then be approximately $154 million which is taken to be the upper bound figure for criminalistics services. The total cost for a given location strategy is measured as a fraction of this maximum cost, thus providing a cost comparison basis for each strategy.

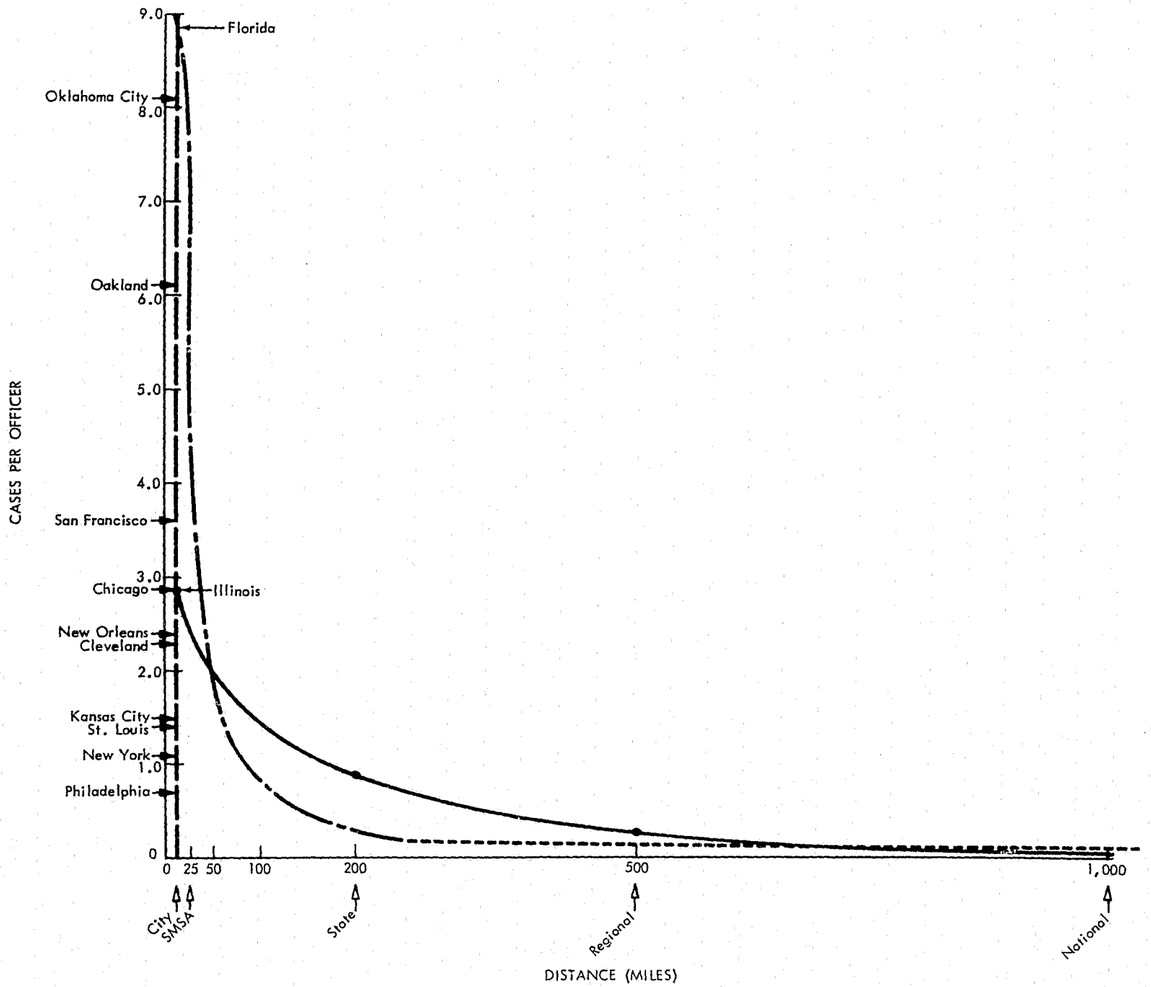

Figure 1-4 - Evidence Submission Decay as a Function of Type Laboratory

CONTINUED

1 OF 3

Cost/Effectiveness Model

A cost/effectiveness model was developed which discriminates between location strategies relative to the performance and cost indices just described. The model accommodates mixes of city, SMSA, state, regional, and national laboratories according to predefined parameters. By varying the number of laboratories to be considered in a given strategy, a curve characteristic of that strategy results. The strategies considered in this second phase of the cost/effectiveness analysis include those shown in Figure 1-1 as well as certain additional ones to be discussed later. Before examining each of these strategies in detail, the generalized model will be presented with accompanying documentation.

Cost Index Calculation

The basis for the cost index calculation of a strategy of j laboratories of type i jurisdiction and ℓ type k laboratories is given by the expression:

$$I_c = \left\{ 2.0 \times 10^4 \left[E_{ij} + R_k (3.07 \times 10^5 - P_{ij})/L \right] + 2.0 \times 10^5 \, (j + \ell) \right\} / 154 \times 10^6$$

where

I_c = Cost index

i = Strategy's primary laboratories' jurisdiction

j = Number of primary laboratories

k = Jurisdiction of secondary-type laboratory

ℓ = Number of laboratories of type k

E_{ij} = Cum number of examiners required for j of the i type (laboratories)

R_k = CPO yield to laboratories of type k

P_{ij} = Cum number of police in j jurisdiction of type i

L = Caseload per examiner in the secondary laboratory jurisdiction

Constants

2.0×10^4 = Cost of an examiner in a crime laboratory per year

2.0×10^5 = Initial start-up cost of a crime laboratory

3.07×10^5 = Number of police officers in the nation

154×10^6 = Upper bound expenditure for criminalistic operations

Performance Index Calculation

The basis for the performance index calculation of a strategy of j laboratories of type i jurisdiction plus ℓ laboratories of type k jurisdiction laboratories is given by the expression:

$$I_p = \left[C_{ij} + R_k(3.07 \times 10^5 - P_{ij})\right] / 9.21 \times 10^5$$

where the variable

I_p = Performance index

C_{ij} = Cumulative number of cases to j laboratories of type i

R_k = CPO yield to type k laboratories

P_{ij} = Cumulative number of police in j jurisdictions of type i

Constants

3.07×10^5 = Number of police officers in the nation

9.21×10^5 = Cases to laboratory at the 3.0 CPO goal

Example of Exercising the Cost/Effectiveness Model

Suppose for example that a planner wishes to apply the cost/effectiveness model just described to investigate the relative merits of a strategy which places crime laboratories in the top 60 SMSA's (ranked by police population) and wishes to assign the balance of the police force not served by the SMSA's to nine regional laboratories. The cost index, I_c, is then calculated to be:

$$I_c = \left\{2.0 \times 10^4 \left[2{,}051 + 0.5(3.07 \times 10^5 - 170{,}929)/250\right] + 2.0 \times 10^5(69)\right\} / 154 \times 10^6$$

$I_c = 0.39$

The value of E_{ij} in the general cost equation is determined from Figure 1-3, the SMSA ranking report. This report shows that placing laboratories in the top 60 SMSA's will require 2,051 examiners at the 250 (medium) caseload level. Hence

$E_{ij} = 2{,}051$

$R_k = 0.5$ since the secondary type of laboratory in the strategy is regional (SMSA being the primary analysis factor).

$P_{ij} = 170{,}929$ which is the cum number of police served by the 60 SMSA laboratories as determined again from the Figure 1-3 ranking report.

L = Caseload per examiner in the secondary laboratory jurisdiction and is also assumed to be 250 cases per year.

$j+\ell$ = Total number of laboratories in this strategy--60 SMSA plus 9 regional = 69 laboratories.

The performance index I_p is calculated in a similar manner:

$$I_p = \left[512{,}787 + 0.5(3.07 \times 10^5 - 170{,}660)\right] / 9.21 \times 10^5$$

$I_p = 0.63$

with the value of the variable C_{ij} being read directly from Figure 1-3.

The parameters associated with the strategy under consideration are then 0.39 and 0.63 for the cost and performance indices, respectively. In themselves, the indices relate that this particular strategy would cost 39 percent as much as the upper bound cost figure discussed earlier and would serve 63 percent of the police officers of the nation. The real significance of the indices, however, is their relative values in comparison with the same indices for other locational strategies.

Alternative Location Strategies

The cost and performance indices have been calculated for some 61 alternative strategies and the results are displayed graphically in Figure 1-5 with the exact combinations of laboratories in each strategy shown in Figure 1-6. The family of curves shown in this figure represent strategies of laboratory locations ranging from mixes of pure city and SMSA laboratories to combinations of local laboratories with state or regional laboratory supplements.

The results displayed in Figure 1-5 can be best interpreted by considering the family of curves represented in addition to interpreting individual points locations. As indicated in Section IV of the main report, the ideal locational strategy would be one which approached a performance index of 1.0 with cost approaching zero. Keeping the optimum goal in mind, a survey of the curves shown in this figure will indicate the family(ies) of curves which are most cost effective as well as reveal the optimum point within a given family.

Curve A in the figure was plotted from six data points and represents a strategy assigning crime laboratories to the top 10, 20, 50, 60, 80, and 86 cities in the city ranking report, Figure 1-2. It is noted from the sahpe of this curve that the most cost/effective allocation is reached in the lower range of number of laboratories (near the 30 laboratory level) since beyond this point the slope of the curve tends to diminish indicating a lower return on the investment of additional city laboratories.

Curve B represents an initial assignment of the same number of city laboratories as was shown in Curve A but this time the remaining police officers not served by the city laboratories are assigned to nine regional laboratories. Under this concept, the optimum mix seems to be around the 40 city laboratory allocation. Figure 1-5 shows that the total at this optimum level is 0.49 including the regional laboratories.

Curve C again represents the assignment of city laboratories at the same rate as in the previous strategy but with the balance of the nation's police force being assigned to 50 state laboratories. An interesting characteristic of this curve is that no well-defined optimum point exists but an interval between 60 and 80 total laboratories (Figure 1-5) appears to be about equally cost effective.

The strategy represented by Curve D is that of only assigning crime laboratories to SMSA's. Eleven data points comprise this curve so that the effects of extending a given strategy over a wide range of laboratories is well illustrated in this particular example. The optimum point in this strategy seems to have been reached at about the 60 to 70 SMSA level.

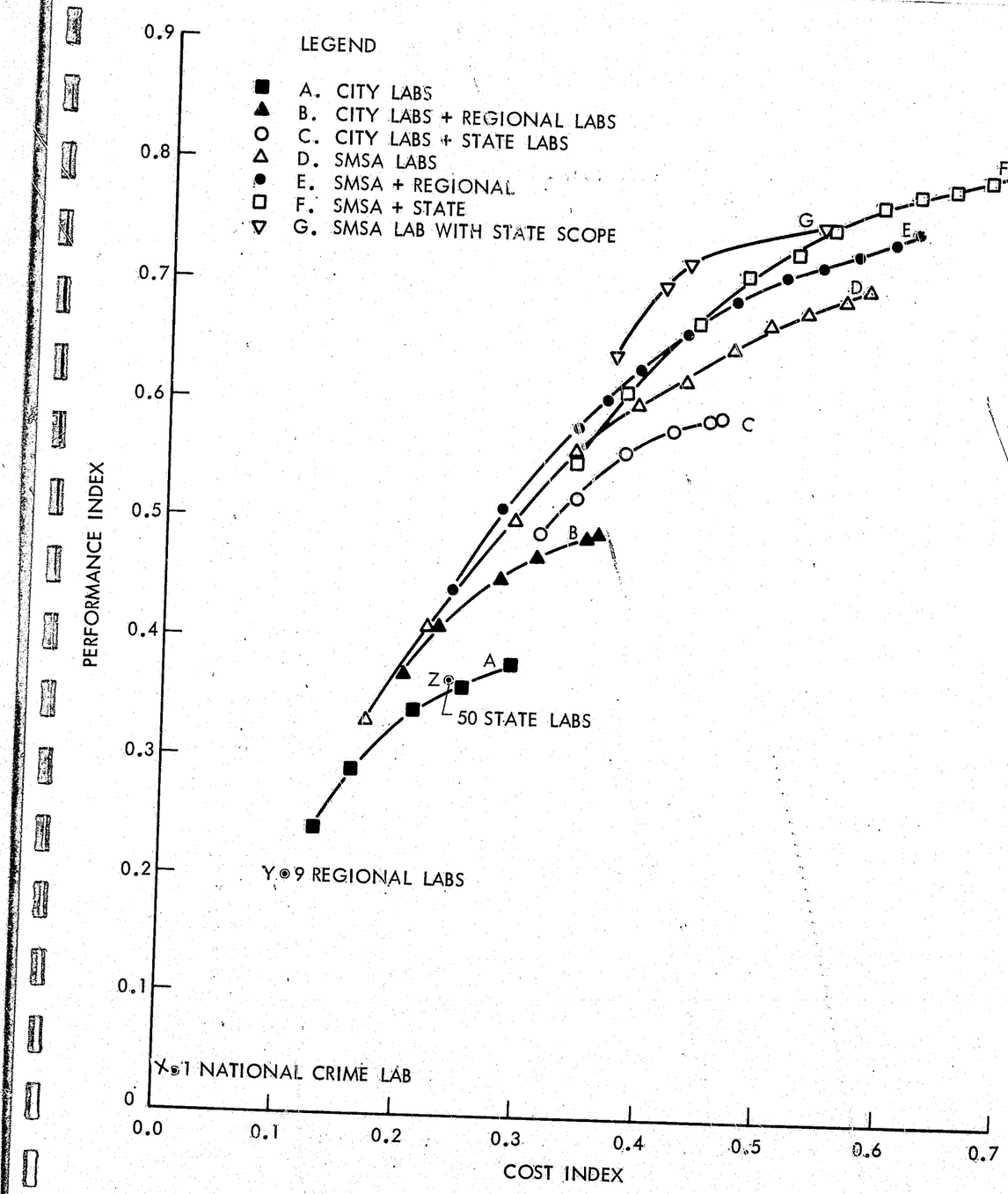

Figure 1-5 - Cost/Effectiveness of Crime Laboratory Location Strategies

Curve A	Number of Crime Laboratories: City	SMSA	State	Regional	Total	I_p	I_c
Point 1	10				10	0.24	0.13
2	20				20	0.29	0.16
3	40				40	0.34	0.21
4	60				60	0.36	0.25
5	80				80	0.38	0.29
6	86				86	0.39	0.30
Curve B							
1	10			9	19	0.37	0.20
2	20			9	29	0.41	0.23
3	40			9	49	0.45	0.28
4	60			9	69	0.47	0.31
5	80			9	89	0.49	0.35
6	86			9	95	0.49	0.36
Curve C							
1	10		50		60	0.49	0.31
2	20		50		70	0.52	0.34
3	40		50		90	0.56	0.38
4	60		50		110	0.58	0.42
5	80		50		130	0.59	0.45
6	86		50		136	0.59	0.46
Curve D							
1		10			10	0.33	0.17
2		20			20	0.41	0.22
3		40			40	0.50	0.29
4		60			60	0.56	0.34
5		80			80	0.60	0.39
6		100			100	0.62	0.43
7		120			120	0.65	0.47
8		140			140	0.67	0.50
9		160			160	0.68	0.53
10		180			180	0.69	0.56
11		192			192	0.70	0.58

Figure 1-6 - Candidate Crime Laboratory Systems, Alternative Location Strategies

Curve E	Number of Crime Laboratories: City	SMSA	State	Regional	Total	I_p	I_c
1		10		9	19	0.44	0.24
2		20		9	29	0.51	0.28
3		40		9	49	0.58	0.34
4		60		9	69	0.63	0.39
5		80		9	89	0.66	0.43
6		100		9	109	0.69	0.47
7		120		9	129	0.71	0.51
8		140		9	149	0.72	0.54
9		160		9	169	0.73	0.57
10		180		9	189	0.74	0.60
11		192		9	201	0.75	0.62
Curve F							
Point 1		10	50		60	0.55	0.34
2		20	50		70	0.61	0.38
3		40	50		90	0.67	0.44
4		60	50		110	0.71	0.48
5		80	50		130	0.73	0.52
6		100	50		150	0.75	0.55
7		120	50		170	0.77	0.59
8		140	50		190	0.78	0.62
9		160	50		210	0.79	0.65
10		180	50		230	0.79	0.68
11		192	50		242	0.80	0.70
Curve G							
Point 1		45	5		50	0.64	0.37
2		50	5		55	0.70	0.41
3		61	5		66	0.72	0.43
4		76	5		81	0.75	0.54

Figure 1-6 (Concluded)

Note that this level is in contrast to the optimum point in the pure city mix, Curve A, which occurred much earlier at approximately the 30 laboratory level.

Curve E represents a strategy of SMSA laboratories with the remaining officers being assigned to regional laboratories. The optimum point of cost/effectiveness appears to be reached between the 60-80 SMSA laboratory level (69-89) total number of laboratories, (Figure 1-5).

Curve F uses the same analysis base as the preceding strategy but this time the officers not covered by SMSA laboratories are assigned to state laboratories. The greatest cost/effectiveness point for this strategy is approximately at the 20 SMSA and 50 state laboratory level.

The six strategies discussed in the preceding paragraphs, were, in general, representative of increasing order in both cost and effectiveness. The strategies consisted of focusing on one of two primary recipients of laboratory caseload (city or SMSA) with a possible allocation of the remaining police officers not covered by the strategy to a larger jurisdictional laboratory. The general trend of the family of curves as can be seen from Figure 1-5 is upward and to the right indicating both increased effectiveness and additional costs. In an effort to generate a curve showing greater effectiveness but not having the additional costs that had been attendant with previous strategies a new plan was devised.

Under this analysis plan, 20, 40 and 60 SMSA laboratories were structured with the stipulation that any state not having a SMSA within the cut-off point would receive a laboratory in their largest SMSA (if they had any SMSA's) with the remaining caseload going to a state laboratory. One additional combination considered was only one laboratory per state located in the largest SMSA in the state (for 45 states), at the 3.0 CPO level and the remainder allocated to those 45 SMSA laboratories and five additional state laboratories, at the 1.0 CPO level. The result of this analysis is depicted in Curve G of Figure 1-5. This curve clearly exhibits greater performance of crime laboratories in the higher I_D values without the comparable cost increases shown in strategies C, D, E, and F.

While Strategy G appears to be the most cost effective, it is probably only of academic interest. The concept of only one laboratory per state, located in the largest city, would be difficult to accept for many states with large areas, populations or crime rates.

If the reality of CPO and decay are accepted, however, those strategies which establish crime laboratories to serve an entire SMSA are clearly superior to the city laboratory concept.

Similarly, the regional laboratory, even with a CPO of five times above that at which the FBI laboratory now operates, cannot compete with a full-service laboratory at the state level to serve those jurisdictions not having a city or SMSA laboratory.

APPENDIX 2

WASHINGTON, D. C., DATA

Washington, D. C., Evidence Survey

Through the cooperation of the Washington, D. C., Metropolitan Police Department, we were able to obtain a first sampling of physical evidence yield by type crime. Washington, D. C., was selected as one of the sites for an evidence survey because of the location of the FBI crime laboratory within the city. The close proximity of such a laboratory with an almost infinite capability affords to the D. C. Police Department a unique opportunity not shared by most other law enforcement agencies in the country.

The special evidence report survey was conducted for a period of 1 month with the complete activities of the mobile laboratory unit, homicide squad, and sex squad being recorded. Each crime that was covered by the Mobile Laboratory Unit was recorded on the MRI form shown in Figure 2-1. The MRI form was designed to be compatible with the standard MPD form and provide a summary of physical evidence yield per crime investigated.

The results of the study are presented in Figures 2-2, 2-3 and 2-4, which show the distribution of crimes by physical evidence item recovered, and the actual offenses which occurred in Washington, D. C., during the sample period. The sample size, of course, varies for each crime reported and is indicated at the top of each tabulation in Figure 2-3 and only those crimes with a sufficiently large sample size are included. The frequency of occurrence for each evidence item represents the number of cases in which the evidence appeared at least once.

MIDWEST RESEARCH INSTITUTE

MRI EVIDENCE REPORT SURVEY
METROPOLITAN POLICE DEPARTMENT
WASHINGTON, D. C.

11/4/69

DATE	MCL NO.	OFFENSE	EVIDENCE QTY.	EVIDENCE ITEM	EVIDENCE JUDGED NO VALUE	HELD FOR POSSIBLE LATER USE	TOTAL ANALYSIS BY MPD	REFERRED TO FBI LAB	REFERRED TO NARCOLAB
10/28	12-151	Robbery-Holdup		Latent Prints from a loaf of bread		X	X		
11/1	12-199	Robbery-Holdup		Latent Prints from dresser in bed-					
				room	X		X		
11/3	12-233	Arson	2	Rolls of Black and White Film		X	X		
			2	Beer Bottles containing gasoline	X			X	
			1	Handkerchief used for wicks	X		X		
11/3	12-238	Burglary II	2	Rolls of Black and White Film		X	X		
				Latent Prints from boxes	X		X		
11/3	12-239	Robbery-Holdup(Bank)	1	Roll of Black and White Film		X	X		
			1	Diagram of Scene		X	X		
				Latent Prints from the counter		X	X		

Figure 2-1 - Sample Data Collection Form

CRIME/FREQUENCY DISTRIBUTION

	Crime	Frequency
1.	Robbery	81
2.	Death investigations	23
3.	Homicide	19
4.	Rape	15
5.	Burglary	12
6.	ADW	7
7.	Bombing	4
8.	Larceny	3
9.	Arson	2
10.	Recovered stolen property	2
11.	Police investigation	2
12.	Kidnapping	1
13.	Destroying property	1
14.	Hit and run	1
15.	Simple assault	1
16.	National firearms act	1
17.	Carrying deadly weapon	1
18.	Photos of evidence	1
19.	Photographic assignment	1
		178

Cases in which evidence sent to FBI: 9
Percent of cases in which evidence sent to FBI: 5%

Figure 2-2 - Physical Evidence Collection Activity by Type Crime, Metropolitan Police Department, Washington, D. C., for the Month of November 1969.

CRIME: Robbery
NUMBER CASES: 81

Evidence Item	Frequency of Occurrence	Percentage
Latent prints	73	90
Gun	3	4
Other weapon		
Bullet	1	1
Slug	1	1
Shell casing		
Powder residue		
Blood stains		
Fingerprints		
Explosive fragments		
Charred specimens		
Clothing		
Soil sample		
Paper products	2	2
Tissue samples		
Marks and impressions		
Petroleum products		

CRIME: Death Investigation
NUMBER CASES: 23

Evidence Item	Frequency of Occurrence	Percentage
Latent prints	3	13
Gun	1	4
Other weapon	2	9
Bullet		
Slug		
Shell casing		
Powder residue		
Blood stains		
Fingerprints	14	60
Explosive fragments		
Charred specimens		
Clothing		
Soil sample		
Paper products		
Tissue samples	1	4
Marks and impressions		
Petroleum products		

Figure 2-3 - Frequency Distributions of Type Physical Evidence by Type Crime. (One month sample, MPD, Washington, D. C.)

CRIME: Homicide
NUMBER CASES: 19

Evidence Item	Frequency of Occurrence	Percentage
Latent prints	4	21
Gun	3	16
Other weapon	2	11
Bullet	1	5
Slug	2	11
Shell casing	3	16
Powder residue	1	5
Blood stains	2	11
Fingerprints	2	11
Explosive fragments		
Charred specimens		
Clothing	1	5
Soil sample		
Paper products		
Tissue samples	1	5
Marks and impressions	1	5
Petroleum products		

CRIME: Rape
NUMBER CASES: 14

Evidence Item	Frequency of Occurrence	Percentage
Latent prints	11	79
Gun		
Other weapon		
Bullet		
Slug		
Shell casing		
Powder residue		
Blood stains		
Fingerprints		
Explosive fragments		
Charred specimens		
Clothing	3	21
Soil sample	1	7
Paper products		
Tissue samples		
Marks and impressions		
Petroleum products		
Cosmetic articles	1	7

Figure 2-3 (Continued)

CRIME: Burglary (Occupied Premise)
NUMBER CASES: 11

Evidence Item	Frequency of Occurrence	Percentage
Latent prints	7	64
Gun		
Other weapon		
Bullet		
Slug		
Shell casing		
Powder residue		
Blood stains		
Fingerprints		
Explosive fragments		
Charred specimens		
Clothing		
Soil sample		
Paper products	1	9
Tissue samples		
Marks and impressions	3	27
Petroleum products		

CRIME: ADW
NUMBER CASES: 9

Evidence Item	Frequency of Occurrence	Percentage
Latent prints	2	22
Gun	2	22
Other weapon	1	11
Bullet		
Slug	2	22
Shell casing		
Powder residue		
Blood stains		
Fingerprints		
Explosive fragments		
Charred specimens		
Clothing		
Soil sample		
Paper products	1	11
Tissue samples		
Marks and impressions		
Petroleum products		

Figure 2-3 (Concluded)

WASHINGTON, D. C., METROPOLITAN POLICE DEPARTMENT

Actual Offenses Reported Oct.-Nov. 1969

Part 1 Classes	Oct.	Nov.
1. Criminal Homicide		
A. Murder	29	27
B. Manslaughter	-	-
*C. Negligent homicide	2	2
2. Rape	28	21
A. Attempt rape	7	4
3. Robbery	1,214	1,102
A. Attempt robbery	135	154
4. Aggravated Assault	338	271
5. Housebreaking	1,992	2,008
*A. Attempt housebreaking	154	131
6. Larceny--Theft	2,618	2,491
*A. $100 and over	377	415
*B. Under $100	2,241	2,076
7. Auto Theft	1,046	1,231
Total Part 1 Classes	8,055	7,885

Part 2 Classes	Oct.	Nov.
8. Other Assaults	16	19
*A. Other	188	132
9. Arson	25	29
10. Forgery and Counterfeiting	28	37
11. Fraud	16	10
*A. Fraud	19	35
12. Embezzlement	4	5
*A. Embezzlement	6	3
13. Stolen Property (Rec. etc.)	7	5
*A. Stolen property	8	9
14. Vandalism	32	35
*A. Vandalism	377	475
15. Weapons (carrying and poss.)	1	-
*A. Weapons	105	84
16. Prostitution	-	-
*A. Prostitution	84	62
17. Sex Offenses (ex. 2 and 16)	3	6
*A. Sex offenses	27	21
18. Drug Laws	60	42
*A. Drug Laws	73	73
19. Gambling	50	13
*A. Gambling	58	18
20. *Offenses Against Family	3	-
22. Liquor Laws	-	-
*A. Laws	74	192
25. *Vagrancy	1	-
26. All Other Offenses	36	35
*A. All other offenses	1,540	1,254
27. *Fugitive From Justice	32	37
Total Part 2 Classes	2,873	2,631

* Misdemeanors.

Figure 2-4 - Reported Offenses MPD, Washington, D. C., for Months of October and November 1969

APPENDIX 3

ILLINOIS STATE LABORATORY AT JOLIET ANALYSIS

The program described in Section V has been used with success to analyze data from the Illinois State Crime Laboratory at Joliet and the State Police Crime Laboratory in Portland, Oregon. Output from the Joliet laboratory is shown in Figure 3-1, this Appendix, and the Portland data analysis is shown in Appendix 4, Figures 4-1 through 4-3.

The significance of the results displayed in these appendices does not lie in the magnitude of the numbers shown here but rather in the workload factors which these numbers suggest. Before any firm conclusions can be drawn about parameters describing the operation of a crime laboratory, a much larger data base is needed. The presentation of the program output in this report is intended to be indicative of the kinds of analyses that would be possible should adequate data be made available.

LINE	CATEGORY	NUMBER	PERCENT
1	CASELOAD BY TYPE OFFENSE	2220	100.0
2	MURDER	77	3.5
3	RAPE	61	2.7
4	ROBBERY	64	2.9
5	AGG ASSAULT	9	.4
6	NEG MANSLAUGHTER	7	.3
7	OTHER ASSAULTS	24	1.1
8	OTHER SEX	21	.9
9	FAMILY	1	.0
10	KIDNAPPING	2	.1
11	HIT + RUN	35	1.6
12	DEATH INVESTIGATION	7	.3
13	OTHER PERSONS	1	.0
14	BURGLARY	363	16.4
15	LARCENY 50+	153	6.9
16	AUTO THEFT	1	.0
17	LARCENY 50-	0	0.0
18	ARSON	75	3.4
19	FORGERY + COUNTERFEIT	10	.5
20	FRAUD	5	.2
21	EMBEZZLEMENT	0	0.0
22	STOLEN PROPERTY	1	.0
23	VANDALISM	37	1.7
24	BOMBING	11	.5
25	PETS + LIVESTOCK	0	0.0
26	FOOD + DRUG	0	0.0
27	OTHER PROPERTY	5	.2
28	WEAPONS	56	2.5
29	COMM VICE	1	.0
30	NARCOTIC + DD	904	40.7
31	GAMBLING	1	.0
32	DWI	18	.8
33	LIQUOR	21	.9
34	DRUNKNESS	0	0.0
35	SUICIDE	19	.9
36	ABORTION	0	0.0
37	OBSCENE LITERATURE	2	.1
38	CONSERVATION	0	0.0
39	OTHER ACTS	4	.2
40	PERSONS INDEX	211	9.5
41	PERSONS I + II	53	2.4
42	PERSONS OTHER	45	2.0
43	PROPERTY + COM INDEX	517	23.3
44	PROPERTY + COM I + II	128	5.8
45	PROPERTY + COM OTHER	16	.7
46	ILLEGAL ACTS I + II	1001	45.1
47	ILLEGAL ACTS OTHER	25	1.1
48	LAB SERVICE CASES ONLY	1949	100.0
49	FIREARMS	232	11.9
50	BLOOD ALCOHOL	31	1.6

Figure 3-1 - Complete Illinois Data Analysis

LINE	CATEGORY	NUMBER	PERCENT
51	NARCOTICS	692	35.5
52	PAINT	111	5.7
53	GLASS	21	1.1
54	LATENT PRINTS	425	21.8
55	DANGEROUS DRUGS	350	18.0
56	TOOLMARK	148	7.6
57	DOCUMENT	2	.1
58	SEROLOGY	156	8.0
59	HAIR AND FIBRE	49	2.5
60	BOMB(EXPLOSIVES)	18	.9
61	FOOTWEAR ID.(PRINTS)	20	1.0
62	SOIL	11	.6
63	ARSON DEBRIS	21	1.1
64	ALCOHOL CONTENT (LIQ)	23	1.2
65	INTOXICATING CMPD	5	.3
66	BLOOD EXAM	1	.1
67	OTHER EXAM	90	4.6
68	LAB CASES BY TYPE INSTR	231	100.0
69	UV	2	.9
70	IR	81	35.1
71	ES	15	6.5
72	GC	55	23.8
73	EMP	80	34.6
74	XRD	27	11.7
75	LAB CASES BY TYPE RESULT		
76	POSITIVE LAB RESULTS	1031	
77	NEGATIVE LAB RESULTS	526	
78	INCONCLUSIVE RESULTS	199	
79	FINGERPRINT CASES ONLY		
80	POSITIVE	180	
81	NEGATIVE	278	
82	INCONCLUSIVE	13	
83	OFFENSE NOT SPECIFIED	221	
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Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
1	INSTRUMENT BY TYPE EXAM		
2	FIREARMS	232	
3	U.V.	0	0.0
4	I.R.	4	1.7
5	E.S.	0	0.0
6	G.C.	0	0.0
7	EMP	4	1.7
8	XRD	1	.4
9	BLOOD ALCOHOL	31	
10	U.V.	0	0.0
11	I.R.	0	0.0
12	E.S.	0	0.0
13	G.C.	0	0.0
14	EMP	1	3.2
15	XRD	0	0.0
16	NARCOTICS	692	
17	U.V.	0	0.0
18	I.R.	26	3.8
19	E.S.	1	.1
20	G.C.	1	.1
21	EMP	2	0.0
22	XRD	4	0.0
23	PAINT	111	
24	U.V.	0	0.0
25	I.R.	1	.9
26	E.S.	7	6.3
27	G.C.	1	.9
28	EMP	66	59.5
29	XRD	3	2.7
30	GLASS	21	
31	U.V.	0	0.0
32	I.R.	0	0.0
33	E.S.	4	19.0
34	G.C.	0	0.0
35	EMP	5	23.8
36	XRD	0	0.0
37	LATENT PRINT	425	
38	U.V.	0	0.0
39	I.R.	1	.2
40	E.S.	0	0.0
41	G.C.	4	.9
42	EMP	6	1.4
43	XRD	1	.2
44	DANGEROUS DRUG	350	
45	U.V.	0	0.0
46	I.R.	38	10.9
47	E.S.	0	0.0
48	G.C.	1	.3
49	EMP	0	0.0
50	XRD	6	1.7

Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
51	TOOL MARK	148	
52	U.V.	0	0.0
53	I.R.	0	0.0
54	E.S.	2	1.4
55	G.C.	0	0.0
56	EMP	9	6.1
57	XRD	3	2.0
58	SEROLOGY	156	
59	U.V.	0	0.0
60	I.R.	2	1.3
61	E.S.	0	0.0
62	G.C.	2	1.3
63	EMP	7	4.5
64	XRD	0	0.0
65	HAIR + FIBRE	49	
66	U.V.	0	0.0
67	I.R.	1	2.0
68	E.S.	0	0.0
69	G.C.	0	0.0
70	EMP	3	6.1
71	XRD	0	0.0
72	BOMB (EXPLOSIVE)	18	
73	U.V.	1	5.6
74	I.R.	2	11.1
75	E.S.	0	0.0
76	G.C.	1	5.6
77	EMP	4	22.2
78	XRD	13	72.2
79	FOOTWEAR I.D.	20	
80	U.V.	0	0.0
81	I.R.	0	0.0
82	E.S.	1	5.0
83	G.C.	0	0.0
84	EMP	2	10.0
85	XRD	0	0.0
86	SOIL	11	
87	U.V.	0	0.0
88	I.R.	0	0.0
89	E.S.	1	9.1
90	G.C.	0	0.0
91	EMP	0	0.0
92	XRD	0	0.0
93	ARSON DEBRIS	21	
94	U.V.	0	0.0
95	I.R.	1	4.8
96	E.S.	0	0.0
97	G.C.	17	81.0
98	EMP	0	0.0
99	XRD	1	4.8
100	ALCOHOL CONTENT	23	

Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
101	U.V.	0	0.0
102	I.R.	0	0.0
103	E.S.	0	0.0
104	G.C.	0	0.0
105	EMP	0	0.0
106	XRD	0	0.0
107	INTOXICATING CMPD.	5	
108	U.V.	0	0.0
109	I.R.	4	80.0
110	E.S.	0	0.0
111	G.C.	4	80.0
112	EMP	0	0.0
113	XRD	0	0.0
114	OTHER	90	
115	U.V.	1	1.1
116	I.R.	17	18.9
117	E.S.	4	4.4
118	G.C.	31	34.4
119	EMP	3	3.3
120	XRD	4	4.4
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Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
1	TYPE OF EXAMINATION	232	10.5
2	FIREARMS	31	1.4
3	BLOOD ALCOHOL	692	31.3
4	NARCOTICS	111	5.0
5	PAINT	21	.9
6	GLASS	425	19.2
7	LATENT PRINTS	350	15.8
8	DANGEROUS DRUGS	148	6.7
9	TOOLMARK	2	.1
10	DOCUMENT	156	7.0
11	SEROLOGY	49	2.2
12	HAIR AND FIBRE	18	.8
13	BOMB(EXPLOSIVES)	20	.9
14	FOOTWEAR ID.(PRINTS)	11	.5
15	SOIL	21	.9
16	ARSON DEBRIS	23	1.0
17	ALCOHOL CONTENT (LIQ)	5	.2
18	INTOXICATING CMPD	1	.0
19	BLOOD EXAM	90	4.1
20	OTHER EXAM	2213	100.0
21	TOTAL CASE LOAD BY MONTH	150	6.8
22	JANUARY	232	10.5
23	FEBRUARY	128	5.8
24	MARCH	190	8.6
25	APRIL	149	6.7
26	MAY	181	8.2
27	JUNE	187	8.5
28	JULY	250	11.3
29	AUGUST	248	11.2
30	SEPTEMBER	228	10.3
31	OCTOBER	158	7.1
32	NOVEMBER	111	5.0
33	DECEMBER	2214	100.0
34	CASELOAD BY SERVICE TYPE	1488	67.2
35	LABORATORY	10	.5
36	CRIME SCENE	273	12.3
37	FINGERPRINT	242	10.9
38	POLYGRAPH	1	.0
39	PHOT	76	3.4
40	LAB + FINGER PRINT	43	1.9
41	LAB + CRIME SCENE	6	.3
42	LAB SCENE FINGER PHOTO	38	1.7
43	LAB SCENE FINGER	27	1.2
44	CRIME SCENE FINGER	1	.0
45	CRIME SCENE PHOTO	3	.1
46	LAB SCENE PHOTO	1	.0
47	FINGER PHOTO	1	.0
48	LAB PHOTO	1	.0
49	LAB POLYGRAPH	2176	100.0
50	CASE LOAD BY LENGTH		

Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
51	ONE DAY	289	13.3
52	TWO TO THREE DAYS	156	7.2
53	FOUR TO SEVEN DAYS	370	17.0
54	ONE TO TWO WEEKS	324	14.9
55	TWO TO THREE WEEKS	200	9.2
56	THREE TO FOUR WEEKS	158	7.3
57	FOUR PLUS WEEKS	679	31.2
58	CASE LOAD BY COUNTY	2199	100.0
59	ADAMS	1	.0
60	ALEXANDER	2	.1
61	BOND	0	0.0
62	BOONE	10	.5
63	BROWN	0	0.0
64	BUREAU	5	.2
65	CALHOUN	0	0.0
66	CARROLL	2	.1
67	CASS	1	.0
68	CHAMPAIGN	16	.7
69	CHRISTIAN	1	.0
70	CLARK	0	0.0
71	CLAY	0	0.0
72	CLINTON	0	0.0
73	COLES	7	.3
74	COOK	423	19.2
75	CRAWFORD	0	0.0
76	CUMBERLAND	1	.0
77	DEKALB	26	1.2
78	DEWITT	0	0.0
79	DOUGLAS	1	.0
80	DUPAGE	310	14.1
81	EDGAR	0	0.0
82	EDWARDS	0	0.0
83	EFFINGHAM	7	.3
84	FAYETTE	7	.3
85	FORD	0	0.0
86	FRANKLIN	1	.0
87	FULTON	0	0.0
88	GALLATIN	0	0.0
89	GREENE	0	0.0
90	GRUNDY	11	.5
91	HAMILTON	0	0.0
92	HANCOCK	0	0.0
93	HARDIN	0	0.0
94	HENDERSON	3	.1
95	HENRY	12	.5
96	IROQUOIS	11	.5
97	JACKSON	2	.1
98	JASPER	1	.0
99	JEFFERSON	0	0.0
100	JERSEY	0	0.0

Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
101	JO DAVIESS	34	1.5
102	JOHNSON	1	.0
103	KANE	149	6.8
104	KANKAKEE	88	4.0
105	KENDALL	16	.7
106	KNOX	8	.4
107	LAKE	84	3.8
108	LASALLE	62	2.8
109	LAWRENCE	0	0.0
110	LEE	11	.5
111	LIVINGSTON	20	.9
112	LOGAN	1	.0
113	MACON	0	0.0
114	MACOUPIN	0	0.0
115	MADISON	6	.3
116	MARION	1	.0
117	MARSHALL	1	.0
118	MASON	0	0.0
119	MASSAC	0	0.0
120	MCDONOUGH	4	.2
121	MCHENRY	35	1.6
122	MCLEAN	7	.3
123	MENARD	0	0.0
124	MERCER	2	.1
125	MONROE	1	.0
126	MONTGOMERY	0	0.0
127	MORGAN	0	0.0
128	MOULTRIE	0	0.0
129	OGLE	32	1.5
130	PEORIA	5	.2
131	PERRY	1	.0
132	PIATT	1	.0
133	PIKE	0	0.0
134	POPE	0	0.0
135	PULASKI	0	0.0
136	PUTNAM	0	0.0
137	RANDOLP	0	0.0
138	RICHLAND	1	.0
139	ROCK ISLAND	211	9.6
140	SALINE	0	0.0
141	SANGAMON	10	.5
142	SCHUYLER	0	0.0
143	SCOTT	0	0.0
144	SHELBY	0	0.0
145	STARK	1	.0
146	ST. CLAIR	0	0.0
147	STEPHENSON	28	1.3
148	TAZEWELL	5	.2
149	UNION	0	0.0
150	VERMILION	16	.7

Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
151	WABASH	0	0.0
152	WARREN	16	.7
153	WASHINGTON	0	0.0
154	WAYNE	1	.0
155	WHITE	0	0.0
156	WHITESIDE	55	2.5
157	WILL	305	13.9
158	WILLIAMSON	1	.0
159	WINNEBAGO	110	5.0
160	WOODFORD	7	.3
161	CASELOAD BY TYPE AGENCY	2214	100.0
162	POLICE	1315	59.4
163	SHERIFF	526	23.8
164	STATE POLICE	195	8.8
165	NARCOTIC CONTROL	81	3.7
166	STATES ATTORNEY OFFICE	40	1.8
167	CORONER	4	.2
168	STATE FIRE MARSHALL	19	.9
169	ST.ANTHONY HOSPITAL	1	.0
170	STATEVILLE PENT.	1	.0
171	POLICE + STATE POLICE	3	.1
172	GULF MOBILE + OHIO RR	2	.1
173	JOLIET STATE PEN	2	.1
174	FIRE DEPT	10	.5
175	TINLEY PARK	1	.0
176	MIU SECURITY POLICE	1	.0
177	RACE TRACK POLICE LAB	1	.0
178	STATE REFORM FOR WOMEN	1	.0
179	UNIROYAL SECURITY	1	.0
180	POLICE + SHERIFF	3	.1
181	ILLINOIS YOUTH COMMISS	4	.2
182	ADDITIONAL AGENCIES		
183	ST POL + ST ATT OFF	0	0.0
184	DEPT OF AGRICULTURE	1	.0
185	AT+F DIV OF US TRE DEP	1	.0
186	DIXON STATE SCHOOL	1	.0
187	CASELOAD BY TECHNICIAN		
188	MCALVEY	61	2.8
189	CARDOSI	291	13.1
190	TURCOTTE	137	6.2
191	CALLAGHAN	37	1.7
192	KOMAR	157	7.1
193	KREISER	268	12.1
194	CERVEN	120	5.4
195	DILLON	159	7.2
196	MURPHY	2	.1
197	RITTER	343	15.5
198	KRAATZ	414	18.7
199	AUBEY	12	.5
200	VANDER KOLK	139	6.3

Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
201	MATTEWS	154	7.0
202	BELLEAU	49	2.2
203	SANDAHL	0	0.0
204	DALLUGE	68	3.1
205	AUSTIN	262	11.8
206	MEYN	245	11.1
207	CASES 2 OR MORE TECH	555	25.1
208	CASES 3 OR MORE TECH	130	5.9
209	CASES 4 OR MORE TECH	33	1.5
210	CASES 5 OR MORE TECH	10	.5
211	CASES 6 TECH	3	.1
212	POLYGRAPH CASES ONLY	243	100.0
213	INNOCENT	166	68.3
214	GUILTY	79	32.5
215	INCONCLUSIVE	12	4.9
216	ADMISSION	18	7.4
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Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
1	CASES-ALL AGENCIES	2199	
2	POLICE	1315	59.8
3	SHERIFF	526	23.9
4	STATE POLICE	195	8.9
5	COUNTY CASELOAD		
6	ALEXANDER	2	
7	POLICE	1	50.0
8	SHERIFF	0	0.0
9	STATE POLICE	0	0.0
10	BOONE	10	
11	POLICE	5	50.0
12	SHERIFF	4	40.0
13	STATE POLICE	1	10.0
14	BUREAU	5	
15	POLICE	2	40.0
16	SHERIFF	2	40.0
17	STATE POLICE	0	0.0
18	CARROLL	2	
19	POLICE	1	50.0
20	SHERIFF	1	50.0
21	STATE POLICE	0	0.0
22	CHAMPAIGN	16	
23	POLICE	10	62.5
24	SHERIFF	2	12.5
25	STATE POLICE	4	25.0
26	COLES	7	
27	POLICE	7	100.0
28	SHERIFF	0	0.0
29	STATE POLICE	0	0.0
30	COOK	423	
31	POLICE	316	74.7
32	SHERIFF	7	1.7
33	STATE POLICE	33	7.8
34	DEKALB	26	
35	POLICE	19	73.1
36	SHERIFF	4	15.4
37	STATE POLICE	0	0.0
38	DUPAGE	310	
39	POLICE	187	60.3
40	SHERIFF	104	33.5
41	STATE POLICE	15	4.8
42	EFFINGHAM	7	
43	POLICE	1	14.3
44	SHERIFF	0	0.0
45	STATE POLICE	5	71.4
46	FAYETTE	7	
47	POLICE	2	28.6
48	SHERIFF	5	71.4
49	STATE POLICE	0	0.0
50	GRUNDY	11	

Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
51	POLICE	9	81.8
52	SHERIFF	2	18.2
53	STATE POLICE	0	0.0
54	HENDERSON	3	
55	POLICE	0	0.0
56	SHERIFF	3	100.0
57	STATE POLICE	0	0.0
58	HENRY	12	
59	POLICE	5	41.7
60	SHERIFF	7	58.3
61	STATE POLICE	0	0.0
62	IROQUOIS	11	
63	POLICE	0	0.0
64	SHERIFF	4	36.4
65	STATE POLICE	6	54.5
66	JACKSON	2	
67	POLICE	1	50.0
68	SHERIFF	0	0.0
69	STATE POLICE	0	0.0
70	JO DAVIESS	34	
71	POLICE	3	8.8
72	SHERIFF	25	73.5
73	STATE POLICE	1	2.9
74	KANE	149	
75	POLICE	117	78.5
76	SHERIFF	10	6.7
77	STATE POLICE	9	6.0
78	KANKAKEE	88	
79	POLICE	50	56.8
80	SHERIFF	33	37.5
81	STATE POLICE	2	2.3
82	KENDALL	16	
83	POLICE	5	31.3
84	SHERIFF	11	68.8
85	STATE POLICE	0	0.0
86	KNOX	8	
87	POLICE	6	75.0
88	SHERIFF	1	12.5
89	STATE POLICE	0	0.0
90	LAKE	84	
91	POLICE	80	95.2
92	SHERIFF	0	0.0
93	STATE POLICE	3	3.6
94	LASALLE	62	
95	POLICE	20	32.3
96	SHERIFF	25	40.3
97	STATE POLICE	3	4.8
98	LEE	11	
99	POLICE	2	18.2
100	SHERIFF	5	45.5

Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
101	STATE POLICE	2	18.2
102	LIVINGSTON	20	
103	POLICE	1	5.0
104	SHERIFF	1	5.0
105	STATE POLICE	16	80.0
106	MADISON	6	
107	POLICE	6	100.0
108	SHERIFF	0	0.0
109	STATE POLICE	0	0.0
110	MCDONOUGH	4	
111	POLICE	2	50.0
112	SHERIFF	2	50.0
113	STATE POLICE	0	0.0
114	MCHENRY	35	
115	POLICE	9	25.7
116	SHERIFF	25	71.4
117	STATE POLICE	1	2.9
118	MCLEAN	7	
119	POLICE	0	0.0
120	SHERIFF	6	85.7
121	STATE POLICE	1	14.3
122	MERCER	2	
123	POLICE	0	0.0
124	SHERIFF	2	100.0
125	STATE POLICE	0	0.0
126	OGLE	32	
127	POLICE	12	37.5
128	SHERIFF	19	59.4
129	STATE POLICE	1	3.1
130	PEORIA	5	
131	POLICE	2	40.0
132	SHERIFF	0	0.0
133	STATE POLICE	3	60.0
134	ROCK ISLAND	211	
135	POLICE	123	58.3
136	SHERIFF	73	34.6
137	STATE POLICE	6	2.8
138	SANGAMON	10	
139	POLICE	0	0.0
140	SHERIFF	0	0.0
141	STATE POLICE	9	90.0
142	STEPHENSON	28	
143	POLICE	11	39.3
144	SHERIFF	17	60.7
145	STATE POLICE	0	0.0
146	TAZEWELL	5	
147	POLICE	2	40.0
148	SHERIFF	2	40.0
149	STATE POLICE	1	20.0
150	VERMILION	16	

Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
151	POLICE	13	81.3
152	SHERIFF	2	12.5
153	STATE POLICE	0	0.0
154	WARREN	16	
155	POLICE	8	50.0
156	SHERIFF	0	0.0
157	STATE POLICE	0	0.0
158	WHITESIDE	55	
159	POLICE	11	20.0
160	SHERIFF	4	7.3
161	STATE POLICE	31	56.4
162	WILL	305	
163	POLICE	198	64.9
164	SHERIFF	63	20.7
165	STATE POLICE	26	8.5
166	WINNEBAGO	110	
167	POLICE	56	50.9
168	SHERIFF	45	40.9
169	STATE POLICE	3	2.7
170	WOODFORD	7	
171	POLICE	1	14.3
172	SHERIFF	5	71.4
173	STATE POLICE	1	14.3
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Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
1	EXAM BY TYPE OFFENSE		
2	MURDER	77	
3	FIREARMS	47	61.0
4	BLOOD ALCOHOL	8	10.4
5	NARCOTICS	1	1.3
6	PAINT	2	2.6
7	GLASS	0	0.0
8	LATENT PRINT	17	22.1
9	DANGEROUS DRUG	1	1.3
10	TOOL MARK	0	0.0
11	DOCUMENT	0	0.0
12	SEROLOGY	31	40.3
13	HAIR + FIBRE	8	10.4
14	BOMB (EXPLOSIVE)	0	0.0
15	FOOTWEAR I.D.	1	1.3
16	SOIL	1	1.3
17	ARSON DEBRIS	1	1.3
18	ALCOHOL CONTENT	0	0.0
19	INTOXICATINE CMPD.	0	0.0
20	BLOOD	1	1.3
21	OTHER	4	5.2
22	RAPE	61	
23	FIREARMS	1	1.6
24	BLOOD ALCOHOL	0	0.0
25	NARCOTICS	0	0.0
26	PAINT	0	0.0
27	GLASS	0	0.0
28	LATENT PRINT	6	9.8
29	DANGEROUS DRUG	0	0.0
30	TOOL MARK	0	0.0
31	DOCUMENT	0	0.0
32	SEROLOGY	30	49.2
33	HAIR + FIBRE	14	23.0
34	BOMB (EXPLOSIVE)	0	0.0
35	FOOTWEAR I.D.	1	1.6
36	SOIL	0	0.0
37	ARSON DEBRIS	0	0.0
38	ALCOHOL CONTENT	0	0.0
39	INTOXICATING CMPD.	0	0.0
40	BLOOD	0	0.0
41	OTHER	1	1.6
42	ROBBERY	64	
43	FIREARMS	15	23.4
44	BLOOD ALCOHOL	1	1.6
45	NARCOTICS	0	0.0
46	PAINT	0	0.0
47	GLASS	1	1.6
48	LATENT PRINT	28	43.8
49	DANGEROUS DRUG	1	1.6
50	TOOL MARK	2	3.1

Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
51	DOCUMENT	0	0.0
52	SEROLOGY	5	7.8
53	HAIR + FIBRE	4	6.3
54	BOMB (EXPLOSIVE)	0	0.0
55	FOOTWEAR I.D.	1	1.6
56	SOIL	1	1.6
57	ARSON DEBRIS	0	0.0
58	ALCOHOL CONTENT	0	0.0
59	INTOXICATING CMPD.	0	0.0
60	BLOOD	0	0.0
61	OTHER	2	3.1
62	AGG. ASSAULT	9	
63	FIREARMS	7	77.8
64	BLOOD ALCOHOL	0	0.0
65	NARCOTICS	0	0.0
66	PAINT	0	0.0
67	GLASS	0	0.0
68	LATENT PRINT	3	33.3
69	DANGEROUS DRUG	0	0.0
70	TOOLMARK	0	0.0
71	DOCUMENT	0	0.0
72	SEROLOGY	2	22.2
73	HAIR + FIBRE	1	11.1
74	BOMB (EXPLOSIVE)	0	0.0
75	FOOTWEAR I.D.	0	0.0
76	SOIL	1	11.1
77	ARSON DEBRIS	0	0.0
78	ALCOHOL CONTENT	0	0.0
79	INTOXICATING CMPD.	0	0.0
80	BLOOD	0	0.0
81	OTHER	0	0.0
82	NEG. MANS.	7	
83	FIREARMS	3	42.9
84	BLOOD ALCOHOL	0	0.0
85	NARCOTICS	1	14.3
86	PAINT	3	42.9
87	GLASS	0	0.0
88	LATENT PRINT	3	42.9
89	DANGEROUS DRUG	0	0.0
90	TOOLMARK	0	0.0
91	DOCUMENT	0	0.0
92	SEROLOGY	2	28.6
93	HAIR + FIBRE	0	0.0
94	BOMB (EXPLOSIVE)	0	0.0
95	FOOTWEAR I.D.	1	14.3
96	SOIL	0	0.0
97	ARSON DEBRIS	0	0.0
98	ALCOHOL CONTENT	0	0.0
99	INTOXICATING CMPD.	0	0.0
100	BLOOD	0	0.0

Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
101	OTHER	0	0.0
102	OTHER ASSAULT	24	
103	FIREARMS	8	33.3
104	BLOOD ALCOHOL	0	0.0
105	NARCOTICS	0	0.0
106	PAINT	0	0.0
107	GLASS	0	0.0
108	LATENT PRINT	5	20.8
109	DANGEROUS DRUG	0	0.0
110	TOOLMARK	0	0.0
111	DOCUMENT	0	0.0
112	SEROLOGY	7	29.2
113	HAIR + FIBRE	0	0.0
114	BOMB (EXPLOSIVE)	0	0.0
115	FOOTWEAR I.D.	0	0.0
116	SOIL	0	0.0
117	ARSON DEBRIS	0	0.0
118	ALCOHOL CONTENT	0	0.0
119	INTOXICATING CMPD.	0	0.0
120	BLOOD	0	0.0
121	OTHER	0	0.0
122	OTHER SEX	21	
123	FIREARMS	0	0.0
124	BLOOD ALCOHOL	0	0.0
125	NARCOTICS	0	0.0
126	PAINT	1	4.8
127	GLASS	0	0.0
128	LATENT PRINT	2	9.5
129	DANGEROUS DRUG	1	4.8
130	TOOLMARK	0	0.0
131	DOCUMENT	0	0.0
132	SEROLOGY	2	9.5
133	HAIR + FIBRE	1	4.8
134	BOMB (EXPLOSIVE)	0	0.0
135	FOOTWEAR I.D.	0	0.0
136	SOIL	0	0.0
137	ARSON DEBRIS	0	0.0
138	ALCOHOL CONTENT	0	0.0
139	INTOXICATING CMPD.	0	0.0
140	BLOOD	0	0.0
141	OTHER	1	4.8
142	FAMILY	1	
143	FIREARMS	0	0.0
144	BLOOD ALCOHOL	0	0.0
145	NARCOTICS	0	0.0
146	PAINT	0	0.0
147	GLASS	0	0.0
148	LATENT PRINT	0	0.0
149	DANGEROUS DRUG	0	0.0
150	TOOLMARK	0	0.0

Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
151	DOCUMENT	0	0.0
152	SEROLOGY	0	0.0
153	HAIR + FIBRE	0	0.0
154	BOMB (EXPLOSIVE)	0	0.0
155	FOOTWEAR I.D.	0	0.0
156	SOIL	0	0.0
157	ARSON DEBRIS	0	0.0
158	ALCOHOL CONTENT	0	0.0
159	INTOXICATING CMPD.	0	0.0
160	BLOOD	0	0.0
161	OTHER	0	0.0
162	KIDNAPPING	2	
163	FIREARMS	0	0.0
164	BLOOD ALCOHOL	0	0.0
165	NARCOTICS	0	0.0
166	PAINT	0	0.0
167	GLASS	0	0.0
168	LATENT PRINT	0	0.0
169	DANGEROUS DRUG	0	0.0
170	TOOLMARK	0	0.0
171	DOCUMENT	0	0.0
172	SEROLOGY	2	100.0
173	HAIR + FIBRE	1	50.0
174	BOMB (EXPLOSIVE)	0	0.0
175	FOOTWEAR I.D.	0	0.0
176	SOIL	0	0.0
177	ARSON DEBRIS	0	0.0
178	ALCOHOL CONTENT	0	0.0
179	INTOXICATING CMPD.	0	0.0
180	BLOOD	0	0.0
181	OTHER	1	50.0
182	HIT AND RUN	35	
183	FIREARMS	0	0.0
184	BLOOD ALCOHOL	0	0.0
185	NARCOTICS	0	0.0
186	PAINT	32	91.4
187	GLASS	3	8.6
188	LATENT PRINT	0	0.0
189	DANGEROUS DRUG	0	0.0
190	TOOLMARK	2	5.7
191	DOCUMENT	0	0.0
192	SEROLOGY	3	8.6
193	HAIR + FIBRE	2	5.7
194	BOMB (EXPLOSIVE)	0	0.0
195	FOOTWEAR I.D.	0	0.0
196	SOIL	1	2.9
197	ARSON DEBRIS	0	0.0
198	ALCOHOL CONTENT	0	0.0
199	INTOXICATING CMPD.	0	0.0
200	BLOOD	0	0.0

Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
201	OTHER	1	2.9
202	DEATH INVESTIGATION	7	
203	FIREARMS	2	28.6
204	BLOOD ALCOHOL	0	0.0
205	NARCOTICS	0	0.0
206	PAINT	0	0.0
207	GLASS	0	0.0
208	LATENT PRINT	2	28.6
209	DANGEROUS DRUG	0	0.0
210	TOOL MARK	0	0.0
211	DOCUMENT	0	0.0
212	SEROLOGY	2	28.6
213	HAIR + FIBRE	0	0.0
214	BOMB (EXPLOSIVE)	0	0.0
215	FOOTWEAR I.D.	0	0.0
216	SOIL	0	0.0
217	ARSON DEBRIS	0	0.0
218	ALCOHOL CONTENT	0	0.0
219	INTOXICATING CMPD.	0	0.0
220	BLOOD	0	0.0
221	OTHER	2	28.6
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Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
		18	
1	D.W.I.	0	0.0
2	FIREARMS	12	66.7
3	BLOOD ALCOHOL	1	5.6
4	NARCOTICS	0	0.0
5	PAINT	0	0.0
6	GLASS	1	5.6
7	LATENT PRINT	0	0.0
8	DANGEROUS DRUG	0	0.0
9	TOOL MARK	0	0.0
10	DOCUMENT	0	0.0
11	SEROLOGY	0	0.0
12	HAIR + FIBRE	0	0.0
13	BOMB (EXPLOSIVE)	0	0.0
14	FOOTWEAR I.D.	0	0.0
15	SOIL	0	0.0
16	ARSON DEBRIS	0	0.0
17	ALCOHOL CONTENT	0	0.0
18	INTOXICATING CMPD.	0	0.0
19	BLOOD	1	5.6
20	OTHER	21	
21	LIQUOR	1	4.8
22	FIREARMS	5	23.8
23	BLOOD ALCOHOL	0	0.0
24	NARCOTICS	0	0.0
25	PAINT	0	0.0
26	GLASS	1	4.8
27	LATENT PRINT	0	0.0
28	DANGEROUS DRUG	0	0.0
29	TOOL MARK	0	0.0
30	DOCUMENT	1	4.8
31	SEROLOGY	0	0.0
32	HAIR + FIBRE	0	0.0
33	BOMB (EXPLOSIVE)	0	0.0
34	FOOTWEAR I.D.	0	0.0
35	SOIL	0	0.0
36	ARSON DEBRIS	12	57.1
37	ALCOHOL CONTENT	0	0.0
38	INTOXICATING CMPD.	0	0.0
39	BLOOD	0	0.0
40	OTHER	19	
41	SUICIDE	17	89.5
42	FIREARMS	1	5.3
43	BLOOD ALCOHOL	0	0.0
44	NARCOTICS	0	0.0
45	PAINT	0	0.0
46	GLASS	4	21.1
47	LATENT PRINT	0	0.0
48	DANGEROUS DRUG	0	0.0
49	TOOL MARK	0	0.0
50	DOCUMENT		

Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
51	SEROLOGY	7	36.8
52	HAIR + FIBRE	0	0.0
53	BOMB (EXPLOSIVE)	0	0.0
54	FOOTWEAR	0	0.0
55	SOIL	0	0.0
56	ARSON DEBRIS	0	0.0
57	ALCOHOL CONTENT	0	0.0
58	INTOXICATING CMPD.	0	0.0
59	BLOOD	0	0.0
60	OTHER	2	10.5
61	OBSCENE LITERATURE	2	
62	FIREARMS	0	0.0
63	BLOOD ALCOHOL	0	0.0
64	NARCOTICS	0	0.0
65	PAINT	0	0.0
66	GLASS	0	0.0
67	LATENT PRINT	2	100.0
68	DANGEROUS DRUG	0	0.0
69	TOOL MARK	0	0.0
70	DOCUMENT	0	0.0
71	SEROLOGY	0	0.0
72	HAIR + FIBRE	0	0.0
73	BOMB (FXPLOSIVE)	0	0.0
74	FOOTWEAR	0	0.0
75	SOIL	0	0.0
76	ARSON DEBRIS	0	0.0
77	ALCOHOL CONTENT	0	0.0
78	INTOXICATING CMPD.	0	0.0
79	BLOOD	0	0.0
80	OTHER	0	0.0
81	OTHER ACTS	4	
82	FIREARMS	0	0.0
83	BLOOD ALCOHOL	0	0.0
84	NARCOTIS	0	0.0
85	PAINT	0	0.0
86	GLASS	0	0.0
87	LATENT PRINT	0	0.0
88	DANGEROUS DRUG	0	0.0
89	TOOLMARK	0	0.0
90	DOCUMENT	0	0.0
91	SEROLOGY	0	0.0
92	HAIR + FIBRE	0	0.0
93	BOMB (FXPLOSIVE)	0	0.0
94	FOOTWEAR	0	0.0
95	SOIL	0	0.0
96	ARSON DEBRIS	0	0.0
97	ALCOHOL CONTENT	0	0.0
98	INTOXICATING CMPD.	0	0.0
99	BLOOD	0	0.0
100	OTHER	0	0.0

Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
101	FRAUD	5	
102	FIREARMS	0	0.0
103	BLOOD ALCOHOL	0	0.0
104	NARCOTICS	0	0.0
105	PAINT	0	0.0
106	GLASS	0	0.0
107	LATENT PRINT	1	20.0
108	DANGEROUS DRUG	0	0.0
109	TOOL MARK	0	0.0
110	DOCUMENT	0	0.0
111	SEROLOGY	0	0.0
112	HAIR + FIBRE	0	0.0
113	BOMB (EXPLOSIVE)	0	0.0
114	FOOTWEAR I.D.	0	0.0
115	SOIL	0	0.0
116	ARSON DEBRIS	0	0.0
117	ALCOHOL CONTENT	0	0.0
118	INTOXICATING CMPD.	0	0.0
119	BLOOD	0	0.0
120	OTHER	1	20.0
121	EMBEZZLE	0	
122	FIREARMS	0	0.0
123	BLOOD ALCOHOL	0	0.0
124	NARCOTICS	0	0.0
125	PAINT	0	0.0
126	GLASS	0	0.0
127	LATENT PRINT	0	0.0
128	DANGEROUS DRUG	0	0.0
129	TOOL MARK	0	0.0
130	DOCUMENT	0	0.0
131	SEROLOGY	0	0.0
132	HAIR + FIBRE	0	0.0
133	BOMB (EXPLOSIVE)	0	0.0
134	FOOTWEAR I.D.	0	0.0
135	SOIL	0	0.0
136	ARSON DEBRIS	0	0.0
137	ALCOHOL CONTENT	0	0.0
138	INTOXICATING CMPD.	0	0.0
139	BLOOD	0	0.0
140	OTHER	0	0.0
141	VANDALISM	37	
142	FIREARMS	11	29.7
143	BLOOD ALCOHOL	0	0.0
144	NARCOTICS	1	2.7
145	PAINT	0	0.0
146	GLASS	0	0.0
147	LATENT PRINT	9	24.3
148	DANGEROUS DRUG	0	0.0
149	TOOL MARK	1	2.7
150	DOCUMENT	0	0.0

Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
151	SEROLOGY	0	0.0
152	HAIR + FIBRE	0	0.0
153	BOMB (EXPLOSIVE)	2	5.4
154	FOOTWEAR I.D.	0	0.0
155	SOIL	1	2.7
156	ARSON DEBRIS	0	0.0
157	ALCOHOL CONTENT	0	0.0
158	INTOXICATING CMPD.	0	0.0
159	BLOOD	0	0.0
160	OTHER	1	2.7
161	BOMBING	11	
162	FIREARMS	0	0.0
163	BLOOD ALCOHOL	0	0.0
164	NARCOTICS	0	0.0
165	PAINT	0	0.0
166	GLASS	0	0.0
167	LATENT PRINT	0	0.0
168	DANGEROUS DRUG	0	0.0
169	TOOL MARK	0	0.0
170	DOCUMENT	0	0.0
171	SEROLOGY	0	0.0
172	HAIR + FIBRE	0	0.0
173	BOMB (EXPLOSIVE)	10	90.9
174	FOOTWEAR I.D.	0	0.0
175	SOIL	0	0.0
176	ARSON DEBRIS	0	0.0
177	ALCOHOL CONTENT	0	0.0
178	INTOXICATING CMPD.	0	0.0
179	BLOOD	0	0.0
180	OTHER	0	0.0
181	OTHER PROPERTY	5	100.0
182	FIREARMS	0	0.0
183	BLOOD ALCOHOL	0	0.0
184	NARCOTICS	0	0.0
185	PAINT	0	0.0
186	GLASS	0	0.0
187	LATENT PRINT	1	20.0
188	DANGEROUS DRUG	0	0.0
189	TOOL MARK	0	0.0
190	DOCUMENT	0	0.0
191	SEROLOGY	1	20.0
192	HAIR + FIBRE	0	0.0
193	BOMB (EXPLOSIVE)	0	0.0
194	FOOTWEAR I.D.	0	0.0
195	SOIL	0	0.0
196	ARSON DEBRIS	0	0.0
197	ALCOHOL CONTENT	0	0.0
198	INTOXICATING CMPD.	0	0.0
199	BLOOD	0	0.0
200	OTHER	2	40.0

Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
201	WEAPONS	56	
202	FIREARMS	54	96.4
203	BLOOD ALCOHOL	0	0.0
204	NARCOTICS	0	0.0
205	PAINT	1	1.8
206	GLASS	0	0.0
207	LATENT PRINT	2	3.6
208	DANGEROUS DRUG	0	0.0
209	TOOL MARK	0	0.0
210	DOCUMENT	0	0.0
211	SEROLOGY	0	0.0
212	HAIR + FIBRE	0	0.0
213	BOMB (EXPLOSIVE)	1	1.8
214	FOOTWEAR I.D.	0	0.0
215	SOIL	0	0.0
216	ARSON DEBRIS	0	0.0
217	ALCOHOL CONTENT	0	0.0
218	INTOXICATING CMPD.	0	0.0
219	BLOOD	0	0.0
220	OTHER	2	3.6
221	NARCOTICS AND D.D.	904	
222	FIREARMS	5	.6
223	BLOOD ALCOHOL	0	0.0
224	NARCOTICS	687	76.0
225	PAINT	4	.4
226	GLASS	0	0.0
227	LATENT PRINT	9	1.0
228	DANGEROUS DRUG	343	37.9
229	TOOL MARK	1	.1
230	DOCUMENT	0	0.0
231	SEROLOGY	2	.2
232	HAIR + FIBRE	1	.1
233	BOMB (EXPLOSIVE)	0	0.0
234	FOOTWEAR I.D.	0	0.0
235	SOIL	0	0.0
236	ARSON DEBRIS	0	0.0
237	ALCOHOL CONTENT	1	.1
238	INTOXICATING CMPD.	1	.1
239	BLOOD	0	0.0
230	OTHER	5	.6
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Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
1	OTHER PERSONS	1	
2	FIREARMS	0	0.0
3	BLOOD ALCOHOL	0	0.0
4	NARCOTICS	0	0.0
5	PAINT	0	0.0
6	GLASS	0	0.0
7	LATENT PRINT	0	0.0
8	DANGEROUS DRUG	0	0.0
9	TOOL MARK	0	0.0
10	DOCUMENT	0	0.0
11	SEROLOGY	0	0.0
12	HAIR + FIBRE	0	0.0
13	BOMB (EXPLOSIVE)	0	0.0
14	FOOTWEAR I.D.	0	0.0
15	SOIL	0	0.0
16	ARSON DEBRIS	0	0.0
17	ALCOHOL CONTENT	0	0.0
18	INTOXICATING CMPD.	0	0.0
19	BLOOD	0	0.0
20	OTHER	0	0.0
21	BURGLARY	363	
22	FIREARMS	3	.8
23	BLOOD ALCOHOL	0	0.0
24	NARCOTICS	1	.3
25	PAINT	12	3.3
26	GLASS	7	1.9
27	LATENT PRINT	211	58.1
28	DANGEROUS DRUG	1	.3
29	TOOL MARK	118	32.5
30	DOCUMENT	1	.3
31	SEROLOGY	16	4.4
32	HAIR + FIBRE	9	2.5
33	BOMB (EXPLOSIVE)	1	.3
34	FOOTWEAR I.D.	13	3.6
35	SOIL	3	.8
36	ARSON DEBRIS	0	0.0
37	ALCOHOL CONTENT	0	0.0
38	INTOXICATING CMPD.	0	0.0
39	BLOOD	0	0.0
40	OTHER	5	1.4
41	LARCENY 50+	153	
42	FIREARMS	1	.7
43	BLOOD ALCOHOL	0	0.0
44	NARCOTICS	0	0.0
45	PAINT	3	2.0
46	GLASS	3	2.0
47	LATENT PRINT	76	49.7
48	DANGEROUS DRUG	1	.7
49	TOOL MARK	11	7.2
50	DOCUMENT	0	0.0

Figure 3-1 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
51	SEROLOGY	0	0.0
52	HAIR + FIBRE	0	0.0
53	BOMB (EXPLOSIVE)	0	0.0
54	FOOTWEAR I.D.	0	0.0
55	SOIL	2	1.3
56	ARSON DEBRIS	0	0.0
57	ALCOHOL CONTENT	0	0.0
58	INTOXICATING CMPD.	0	0.0
59	BLOOD	0	0.0
60	OTHER	2	1.3
61	ARSON	75	
62	FIREARMS	0	0.0
63	BLOOD ALCOHOL	0	0.0
64	NARCOTICS	0	0.0
65	PAINT	1	1.3
66	GLASS	0	0.0
67	LATENT PRINT	9	12.0
68	DANGEROUS DRUG	0	0.0
69	TOOL MARK	0	0.0
70	DOCUMENT	0	0.0
71	SEROLOGY	3	4.0
72	HAIR + FIBRE	0	0.0
73	BOMB (EXPLOSIVE)	3	4.0
74	FOOTWEAR I.D.	0	0.0
75	SOIL	0	0.0
76	ARSON DEBRIS	20	26.7
77	ALCOHOL CONTENT	0	0.0
78	INTOXICATING CMPD.	0	0.0
79	BLOOD	0	0.0
80	OTHER	33	44.0
81	FORGERY + COUNTERFEIT	0	
82	FIREARMS	0	0.0
83	BLOOD ALCOHOL	0	0.0
84	NARCOTICS	0	0.0
85	PAINT	0	0.0
86	GLASS	0	0.0
87	LATENT PRINT	0	0.0
88	DANGEROUS DRUG	0	0.0
89	TOOL MARK	0	0.0
90	DOCUMENT	0	0.0
91	SEROLOGY	0	0.0
92	HAIR + FIBRE	0	0.0
93	BOMB (EXPLOSIVE)	0	0.0
94	FOOTWEAR I.D.	0	0.0
95	SOIL	0	0.0
96	ARSON DEBRIS	0	0.0
97	ALCOHOL CONTENT	0	0.0
98	INTOXICATING CMPD.	0	0.0
99	BLOOD	0	0.0
100	OTHER	0	0.0

Figure 3-1 (Concluded)

APPENDIX 4

STATE POLICE CRIME LABORATORY DATA--PORTLAND, OREGON

The following report is based on data obtained from the State Police Crime Laboratory in Portland, Oregon. The generalized computer program described in Appendix 3 was again used for this analysis.

Figure 4-1 provides a distribution of the cases to the Portland laboratory during an 11-month survey period ending in July 1969. Evidence yield per type offense is depicted in Figure 4-2 for those crimes whose frequency of occurrence warranted such an analysis.

As was indicated in the discussion of the Joliet laboratory data, the data base established during this study is insufficient to define exact relationships between many of the complex facets of criminalistics' operations. The distributions shown in Figure 4-2, however, strongly suggest that probability factors might well be established between evidence yield and type crime if a uniform recording and reporting system of laboratory data is established in the future.

Since blood alcohol, marijuana, and drug examinations were excluded from the data shown in Figure 4-2, a separate analysis of these caseload generators was made. Figure 4-3 displays the distribution by month of the year for cases received by the laboratory resulting in examination of these types. The fourth column, showing number of cases of drug identification, permits the calculation of the average number of examinations per case for drug offenses. While this single statistic is not meaningful in itself, if combined with similar drug caseload data from other laboratories, it could form the bases upon which a laboratory planner could determine the need for drug analyses in his own jurisdiction.

LINE	CATEGORY	NUMBER	PERCENT
1	CASELOAD BY TYPE OFFENSE		
2	TOTAL CASES REPORTED	797	
3	MURDER	44	
4	RAPE	72	
5	ROBBERY	6	
6	AGG ASSAULT	44	
7	NEG MANSLAUGHTER	2	
8	OTHER ASSAULT	13	
9	OTHER SEX	7	
10	FAMILY OFFENSES	5	
11	KIDNAPPING	0	
12	HIT AND RUN	90	
13	DEATH INVESTIGATION	146	
14	BURGLARY	133	
15	LARCENY 50+	26	
16	AUTO THEFT	2	
17	LARCENY 50-	10	
18	ARSON	8	
19	FORG AND COUNTERFEIT	0	
20	FRAUD	0	
21	EMBEZZLEMENT	0	
22	STOLEN PROPERTY	4	
23	VANDALISM	37	
24	BOMBING	4	
25	PETS•LIVESTOCK	19	
26	FOOD AND DRUG	0	
27	OTHER PROPERTY	51	
28	WEAPONS	14	
29	COMM. VICE	0	
30	NARCOTICS AND D.D.	0	
31	GAMBLING	0	
32	D.W.I.	0	
33	LIQUOR	23	
34	DRUNKENNESS	0	
35	SUICIDE	2	
36	ABORTION	1	
37	OBSCENE LITERATURE	0	
38	CONSERVATION	17	
39	OTHER ILLEGAL ACTS	14	
40			
41			
42			
43			
44			
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46			
47			
48			
49			
50			

Figure 4-1 - A Distribution of Cases to State Police Crime Laboratory--Portland, Oregon

LINE	CATEGORY	NUMBER	PERCENT
1	EVIDENCE YIELD/OFFENSE		
2	MURDER	44	
3	PHYSIOLOGICAL EVID	29	65.9
4	NARCOTICS	6	13.6
5	FIREARMS	25	56.8
6	DOCUMENTS	0	0.0
7	CLOTHING AND FABRICS	13	29.5
8	FRAGMENTS	1	2.3
9	TRACE EVIDENCE	4	9.1
10	MARKS + IMPRESSIONS	0	0.0
11	EXPLOSIVES	0	0.0
12	CHEMICAL PRODUCTS	5	11.4
13	MISCELLANEOUS	1	2.3
14	CRIME SCENE	23	52.3
15	RAPE	72	
16	PHYSIOLOGICAL EVID	70	97.2
17	NARCOTICS	2	2.8
18	FIREARMS	0	0.0
19	DOCUMENTS	0	0.0
20	CLOTHING AND FABRICS	16	22.2
21	FRAGMENTS	0	0.0
22	TRACE EVIDENCE	2	2.8
23	MARKS + IMPRESSIONS	0	0.0
24	EXPLOSIVES	0	0.0
25	CHEMICAL PRODUCTS	1	1.4
26	MISCELLANEOUS	1	1.4
27	CRIME SCENE	28	38.9
28	AGGRAVATED ASSAULT	44	
29	PHYSIOLOGICAL EVID	21	47.7
30	NARCOTICS	1	2.3
31	FIREARMS	26	59.1
32	DOCUMENTS	0	0.0
33	CLOTHING AND FABRICS	3	6.8
34	FRAGMENTS	3	6.8
35	TRACE EVIDENCE	3	6.8
36	MARKS + IMPRESSIONS	0	0.0
37	EXPLOSIVES	0	0.0
38	CHEMICAL PRODUCTS	2	4.5
39	MISCELLANEOUS	0	0.0
40	CRIME SCENE	22	50.0
41	HIT AND RUN	90	
42	PHYSIOLOGICAL EVID	5	5.6
43	NARCOTICS	2	2.2
44	FIREARMS	0	0.0
45	DOCUMENTS	0	0.0
46	CLOTHING AND FABRICS	4	4.4
47	FRAGMENTS	11	12.2
48	TRACE EVIDENCE	83	92.2
49	MARKS + IMPRESSIONS	0	0.0
50	EXPLOSIVES	0	0.0

Figure 4-2 - Evidence Yield by Type Offense, State Police Crime Laboratory--Portland, Oregon

LINE	CATEGORY	NUMBER	PERCENT
51	CHEMICAL PRODUCTS	1	1.1
52	MISCELLANEOUS	0	0.0
53	CRIME SCENE	9	10.0
54	DEATH INVESTIGATION	146	
55	PHYSIOLOGICAL EVID	107	73.3
56	NARCOTICS	50	34.2
57	FIREARMS	8	5.5
58	DOCUMENTS	0	0.0
59	CLOTHING AND FABRICS	3	2.1
60	FRAGMENTS	0	0.0
61	TRACE EVIDENCE	4	2.7
62	MARKS + IMPRESSIONS	0	0.0
63	EXPLOSIVES	1	.7
64	CHEMICAL PRODUCTS	21	14.4
65	MISCELLANEOUS	2	1.4
66	CRIME SCENE	13	8.9
67	BURGLARY	133	
68	PHYSIOLOGICAL EVID	34	25.6
69	NARCOTICS	1	.8
70	FIREARMS	1	.8
71	DOCUMENTS	0	0.0
72	CLOTHING AND FABRICS	8	6.0
73	FRAGMENTS	7	5.3
74	TRACE EVIDENCE	70	52.6
75	MARKS + IMPRESSIONS	46	34.6
76	EXPLOSIVES	0	0.0
77	CHEMICAL PRODUCTS	2	1.5
78	MISCELLANEOUS	2	1.5
79	CRIME SCENE	73	54.9
80	LARCENY 50+	26	
81	PHYSIOLOGICAL EVID	3	11.5
82	NARCOTICS	1	3.8
83	FIREARMS	7	26.9
84	DOCUMENTS	0	0.0
85	CLOTHING AND FABRICS	1	3.8
86	FRAGMENTS	1	3.8
87	TRACE EVIDENCE	6	23.1
88	MARKS + IMPRESSIONS	8	30.8
89	EXPLOSIVES	0	0.0
90	CHEMICAL PRODUCTS	1	3.8
91	MISCELLANEOUS	1	3.8
92	CRIME SCENE	5	19.2
93	VANDALISM	37	
94	PHYSIOLOGICAL EVID	1	2.7
95	NARCOTICS	0	0.0
96	FIREARMS	11	29.7
97	DOCUMENTS	0	0.0
98	CLOTHING AND FABRICS	0	0.0
99	FRAGMENTS	0	0.0
100	TRACE EVIDENCE	9	24.3

Figure 4-2 (Continued)

LINE	CATEGORY	NUMBER	PERCENT
101	MARKS + IMPRESSIONS	0	0.0
102	EXPLOSIVES	3	8.1
103	CHEMICAL PRODUCTS	4	10.8
104	MISCELLANEOUS	2	5.4
105	CRIME SCENE	12	32.4
106	OTHER PROPERTY	51	
107	PHYSIOLOGICAL EVID	3	5.9
108	NARCOTICS	0	0.0
109	FIREARMS	1	2.0
110	DOCUMENTS	1	2.0
111	CLOTHING AND FABRICS	1	2.0
112	FRAGMENTS	1	2.0
113	TRACE EVIDENCE	6	11.8
114	MARKS + IMPRESSIONS	2	3.9
115	EXPLOSIVES	0	0.0
116	CHEMICAL PRODUCTS	32	62.7
117	MISCELLANEOUS	1	2.0
118	CRIME SCENE	11	21.6
119	LIQUOR	23	
120	PHYSIOLOGICAL EVID	0	0.0
121	NARCOTICS	0	0.0
122	FIREARMS	0	0.0
123	DOCUMENTS	0	0.0
124	CLOTHING AND FABRICS	0	0.0
125	FRAGMENTS	0	0.0
126	TRACE EVIDENCE	0	0.0
127	MARKS + IMPRESSIONS	0	0.0
128	EXPLOSIVES	0	0.0
129	CHEMICAL PRODUCTS	23	100.0
130	MISCELLANEOUS	0	0.0
131	CRIME SCENE	0	0.0
132			
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Figure 4-2 (Concluded)

Month	Examinations: Blood Alcohol	Examinations: Drugs, Etc.	Examinations: Marijuana	Number Cases Drugs Identified	Examinations Per Case (Drug)
January	73	292	281	74	3.9
February	71	186	196	58	3.2
March	83	194	246	65	3.0
April	79	367	498	75	4.9
May	78	259	246	66	3.9
June	88	194	218	57	3.4
July	100	320	137	85	3.8
August	69	221	224	76	2.9
September	108	411	196	81	5.1
October	85	499	279	112	4.5
November	69	384	271	92	4.2
	903	3,327	2,792	841	Average = 3.9

Figure 4-3 - Blood Alcohol, Marijuana, and Drug Caseload to the State Police Crime Laboratory--Portland, Oregon

APPENDIX 5

FLORIDA STATE CASELOAD DISTRIBUTION
AS RELATED TO NUMBER OF FULL-TIME SWORN PERSONNEL
AND DISTANCE FROM LABORATORY

For reporting purposes the Florida State Laboratory is divided into Criminalistics, Documents and Latent Prints. Therefore, in this type of presentation, in some instances, one case may be worked by another section and be counted twice in the totals. It is estimated that this would occur in approximately 5 to 10 percent of the total. It should be further noted that in addition to the Dade County Laboratory servicing its own county and Broward County, the State Board of Health laboratories provide a narcotics and dangerous drugs analysis service, particularly in the Central Florida area.

The sworn personnel data were obtained from a census by the Florida Highway Patrol which was disseminated by the Florida Police Standards Council in a report dated January 1969.

The caseload data shown in Figures 5-1 through 5-4 represent the period from 1 July 1968 to 30 June 1969.

County	Full-Time Sworn Officers	Cases Submitted to Laboratory	Zone	Rate
Dade (Miami)	2,436	Dade County Crime Laboratory		
Broward (Ft. Lauderdale)	935			
Palm Beach (West Palm Beach)	809	88	VI	0.11
Hillsborough (Tampa)	772	43	V	0.05
Duval (Jacksonville)	753	92	IV	0.12
Pinellas (St. Petersburg)	697	58	IV	0.08
Brevard (Titusville)	395	160	V	0.40
Orange (Orlando)	392	95	V	0.24
Polk (Bartow)	252	71	V	0.28
Volusia (Daytona Beach)	245	44	V	0.18
Alachua (Gainesville)	216	55	III	0.25
Escambia (Pensacola)	188	115	IV	0.61
Sarasota (Sarasota)	128	20	V	0.15
Bay (Panama City)	111	76	II	0.68
Leon (Tallahassee)	61	679	I	11.13
	5,019	1,596		0.32
All Others	1,252	1,038		0.83
	6,271	2,634		0.42

Figure 5-1 - Summary Caseload to Florida State Laboratory Distribution Analysis

Zone	Miles	Full-Time Sworn Officers	Cases Submitted to Laboratory	Rate
I	0-50	122	836	6.8
II	51-100	181	157	0.87
III	101-150	504	313	0.62
IV	151-200	1,773	393	0.22
V	201-250	2,445	495	0.20
VI	Over 250	1,246	440	0.35
		6,271	2,634	0.42

Figure 5-2 - Case Submissions by Zone

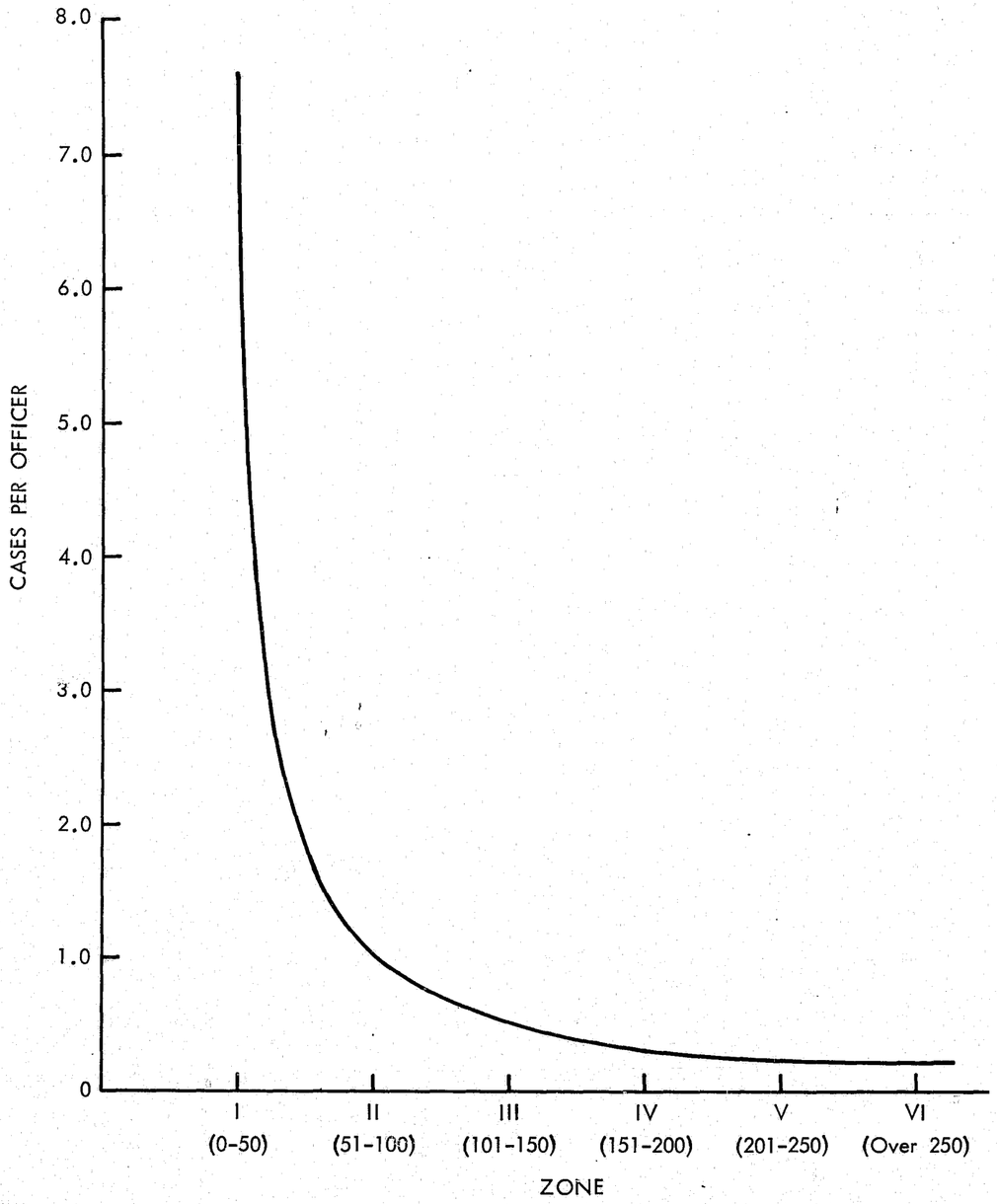

Figure 5-3 - Evidence Submission Decay as a Function of Distance

County	Full-Time Sworn Officers	Cases Submitted to Laboratory	Zone	Rate
Calhoun	5	19	I	3.8
Franklin	4	26	I	6.5
Gadsden	6	32	I	5.3
Jefferson	9	39	I	4.3
Leon	61	679	I	11.1
Liberty	2	4	I	2.0
Madison	9	6	I	0.6
Taylor	22	24	I	1.1
Wakulla	4	7	I	1.7
Bay	111	76	II	0.6
Dixie	5	8	II	1.6
Gulf	6	10	II	1.6
Hamilton	4	4	II	1.0
Holmes	10	10	II	1.0
Jackson	17	25	II	1.4
Lafayette	2	0	II	0.0
Suwannee	17	16	II	0.9
Washington	9	8	II	0.8
Alachua	216	55	III	0.2
Baker	8	14	III	1.7
Bradford	14	0	III	0.0
Clay	22	8	III	0.3
Columbia	27	12	III	0.4
Gilchrist	7	0	III	0.0
Levy	14	7	III	0.5
Marion	45	163	III	3.6
Okaloosa	53	37	III	0.6
Union	4	5	III	1.2
Walton	11	7	III	0.6
Citrus	13	5	III	0.3
Escambia	188	115	IV	0.6
Duval	753	92	IV	0.1
Flagler	7	11	IV	1.5
Nassau	28	9	IV	0.3
Putnam	25	14	IV	0.5
St. Johns	60	19	IV	0.3
Hernando	12	20	IV	1.6
Pasco	40	33	IV	0.8
Pinellas	697	58	IV	0.08
Santa Rosa	20	18	IV	0.6
Sumter	13	4	IV	0.3
Brevard	395	160	V	0.4

Figure 5-4 - Detailed Caseload Distribution Analysis

County	Full-Time Sworn Officers	Cases Submitted to Laboratory	Zone	Rate
Hillsborough	772	43	V	0.1
Lake	64	20	V	0.3
Manatee	85	7	V	0.1
Orange	392	95	V	0.2
Osceola	37	21	V	0.6
Polk	252	71	V	0.3
Sarasota	128	20	V	0.2
Seminole	75	14	V	0.2
Volusia	245	44	V	0.2
Charlotte	48	20	VI	0.4
Collier	65	11	VI	0.2
DeSoto	14	2	VI	0.1
Glades	6	4	VI	0.7
Hardee	12	26	VI	2.2
Hendry	8	8	VI	1.0
Highlands	23	22	VI	0.9
Indian River	36	43	VI	1.2
Lee	43	45	VI	1.1
Martin	26	70	VI	2.7
Monroe	67	7	VI	0.1
Okeechobee	8	9	VI	1.1
Palm Beach	809	88	VI	0.1
St. Lucie	81	85	VI	1.1

Figure 5-4 - Concluded

APPENDIX 6

CRIME DISTRIBUTION BY SMSA AND STATE

As previously reported, the analysis of criminalistics demand began by focusing attention on the Uniform Crime Report - 1968, published by the FBI. The information contained in this report pertains primarily to Part I crimes and provides a distribution of crime categories by region, state, and Standard Metropolitan Statistical Area (SMSA). A computer program was written to analyze the crime data which ranks the SMSA's or states by population or crime index. Outputs from this program are shown in Figures 6-1 and 6-2. These reports reflect the concentration of Part I crimes in the nation at a glance.

Figure 6-1, "Ranking Report - SMSA" illustrates that if criminalistics operations were strengthened to obtain optimum effectiveness in only the 11 largest SMSA's, this influence would be brought to bear on 50 percent of the nation's violent crime. This table further shows that these SMSA's have a disproportionate share of the nation's violent crime but that 40 percent of the total index crimes and all of the attendant nonindex criminal activity would come under the influence of these same criminalistics operations. The report also indicates that doubling the number of SMSA's in which criminalistics activities were substantially enhanced would bring only an additional 10 percent of the nation's violent and total index crimes under close survey.

SMSA	RANK	POPULATION	CUM PERCENT NATIONAL POPULATION	CRIMES OF VIOLENCE	CUM PERCENT OF NATIONAL CRIMES OF VIOLENCE	TOTAL INDEX CRIMES	CUM PERCNT OF TOTAL NATIONAL CRIMES
NEW YORK, N.Y.	1	11587000.	5.8	89090.	15.1	548511.	12.3
LOS ANGELES-LONG BEACH, CALIF	2	6900000.	9.2	44562.	22.7	324673.	19.5
CHICAGO, ILL	3	6871000.	12.7	38806.	29.3	168856.	23.3
DETROIT, MICH	4	4225000.	14.8	26023.	33.7	152581.	26.7
BALTIMORE, MD	5	2021000.	15.8	20456.	37.2	89926.	28.8
SAN FRANCISCO-OAKLAND, CALIF	6	3029000.	17.3	18440.	40.3	141352.	31.9
WASHINGTON, D.C.-MD-VA	7	2755000.	18.7	16455.	43.1	94123.	34.0
PHILADELPHIA, PA.-N.J.	8	4847000.	21.1	12113.	45.2	76057.	35.7
ST. LOUIS, MO.-ILL	9	2395000.	22.3	10442.	46.9	69457.	37.3
MIAMI, FLA	10	1219000.	22.9	9489.	48.5	48998.	38.4
NEWARK, N.J	11	1870000.	23.9	8800.	50.0	65818.	39.9
HOUSTON, TEX	12	1854000.	24.8	8727.	51.5	56032.	41.1
BOSTON-LOWELL-LAWRENCE, MASS	13	3253000.	26.4	6328.	52.6	82447.	43.0
CLEVELAND, OHIO	14	2076000.	27.5	6142.	53.6	46728.	44.0
PITTSBURGH, PA	15	2366000.	28.7	5999.	54.7	49830.	45.1
KANSAS CITY, MO.-KANS	16	1300000.	29.3	5921.	55.7	38873.	46.0
NEW ORLEANS, LA	17	1033000.	29.8	5642.	56.6	35093.	46.8
DALLAS, TEX	18	1457000.	30.6	4857.	57.5	33680.	47.5
MINNEAPOLIS-ST.PAUL, MINN	19	1691000.	31.4	4602.	58.2	51302.	48.7
SEATTLE-EVERETT, WASH	20	1311000.	32.1	4439.	59.0	43645.	49.7
TAMPA-ST. PETERSBURG, FLA	21	898000.	32.5	3941.	59.7	30912.	50.3

Figure 6-1 - Crime Laboratory Demand Analysis Standard Metropolitan Statistical Areas
Ranked by Violent Crime Based on Uniform Crime Reports - 1968

SMSA	RANK	POPULATION	CUM PERCENT NATIONAL POPULATION	CRIMES OF VIOLENCE	CUM PERCENT OF NATIONAL CRIMES OF VIOLENCE	TOTAL INDEX CRIMES	CUM PERCN OF TOTAL NATIONAL CRIMES
DENVER, COLO	22	1125000.	33.1	3936.	60.3	35252.	51.1
JACKSONVILLE, FLA	23	532000.	33.3	3711.	61.0	18857.	51.6
INDIANAPOLIS, IND	24	1056000.	33.9	3523.	61.6	28019.	52.2
SAN ANTONIO, TEX	25	854000.	34.3	3099.	62.1	29767.	52.9
PHOENIX, ARIZ	26	896000.	34.7	3035.	62.6	31093.	53.6
CHARLOTTE, N.C.	27	387000.	34.9	2900.	63.1	11372.	53.8
NORFOLK-PORTSMOUTH, VA	28	651000.	35.3	2852.	63.6	19882.	54.3
SAN BERNARDINO-RIVERSIDE-ONTARIO, CALIF	29	1102000.	35.8	2785.	64.0	33811.	55.0
GARY-HAMMOND-EAST CHICAGO, IND	30	621000.	36.1	2782.	64.5	20244.	55.5
BUFFALO, N.Y.	31	1332000.	36.8	2780.	65.0	26145.	56.0
PORTLAND, OREG-WASH	32	945000.	37.3	2777.	65.5	29047.	56.7
ATLANTA, GA	33	1314000.	37.9	2747.	65.9	31949.	57.4
LOUISVILLE, KY-IND	34	812000.	38.3	2727.	66.4	26982.	58.0
CINCINNATI,OHIO-KY.-IND	35	1411000.	39.0	2596.	66.8	22145.	58.5
NASHVILLE, TENN	36	557000.	39.3	2564.	67.3	16147.	58.9
GREENSBORO-HIGH POINT, N.C.	37	632000.	39.6	2479.	67.7	10638.	59.1
COLUMBUS, OHIO	38	874000.	40.1	2425.	68.1	24168.	59.7
FORT LAUDERDALE-HOLLYWOOD, FLA	39	567000.	40.3	2406.	68.5	17572.	60.0
BIRMINGHAM, ALA	40	777000.	40.7	2395.	68.9	17067.	60.4
FLINT, MICH	41	487000.	41.0	2324.	69.3	12594.	60.7
DAYTON, OHIO	42	820000.	41.4	2300.	69.7	17000.	61.1

Figure 6-1 (Continued)

SMSA	RANK	POPULATION	CUM PERCENT NATIONAL POPULATION	CRIMES OF VIOLENCE	CUM PERCENT OF NATIONAL CRIMES OF VIOLENCE	TOTAL INDEX CRIMES	CUM PERCNT OF TOTAL NATIONAL CRIMES
ANAHEIM-SANTA ANA-GARDEN GROVE, CALIF.	43	1280000.	42.0	2165.	70.1	37786.	61.9
SAN DIEGO, CALIF	44	1269000.	42.7	2046.	70.4	27720.	62.6
MEMPHIS, TENN.-ARK	45	1800000.	43.1	2016.	70.8	20578.	63.0
MILWAUKEE, WIS	46	1404000.	43.8	1990.	71.1	24126.	63.6
SACRAMENTO, CALIF	47	768000.	44.1	1924.	71.4	26398.	64.1
AKRON, OHIO	48	669000.	44.5	1845.	71.7	16075.	64.5
TOLEDO, OHIO-MICH	49	695000.	44.8	1775.	72.0	12340.	64.8
OMAHA, NEBR-IOWA	50	519000.	45.1	1760.	72.3	13285.	65.1
LITTLE ROCK-NORTH LITTLE ROCK, ARK	51	339000.	45.3	1675.	72.6	9349.	65.3
FORT WORTH, TEX	52	672000.	45.6	1602.	72.9	17266.	65.7
PATERSON-CLIFTON-PASSAIC, N.J.	53	1353000.	46.3	1584.	73.2	24732.	66.2
ROCHESTER, N.Y.	54	849000.	46.7	1518.	73.4	14886.	66.6
OKLAHOMA CITY, OKLA	55	601000.	47.0	1470.	73.7	13829.	66.9
RICHMOND, VA	56	320000.	47.3	1469.	73.9	12838.	67.2
SAN JOSE, CALIF	57	983000.	47.7	1389.	74.2	24255.	67.7
HARTFORD-NEW BRITAIN-BRISTOL, CONN	58	803000.	48.1	1344.	74.4	17806.	68.1
BAKERSFIELD, CALIF	59	331000.	48.3	1329.	74.6	10657.	68.3
JERSEY CITY, N.J.	60	607000.	48.6	1303.	74.8	13805.	68.7
MOBILE, ALA	61	435000.	48.8	1283.	75.0	8928.	68.9
WEST PALM BEACH, FLA	62	311000.	49.0	1275.	75.3	8508.	69.0
AUSTIN, TEX	63	272000.	49.1	1224.	75.5	7005.	69.2

Figure 6-1 (Continued)

SMSA	RANK	POPULATION	CUM PERCENT NATIONAL POPULATION	CRIMES OF VIOLENCE	CUM PERCENT OF NATIONAL CRIMES OF VIOLENCE	TOTAL INDEX CRIMES	CUM PERCNT OF TOTAL NATIONAL CRIMES
TULSA, OKLA	64	456000.	49.4	1185.	75.7	11773.	69.5
ORLANDO, FLA	65	412000.	49.6	1155.	75.9	8576.	69.7
SHREVEPORT, LA	66	319000.	49.7	1154.	76.1	5604.	69.8
SYRACUSE, N.Y	67	622000.	50.0	1138.	76.3	11830.	70.0
FRESNO, CALIF	68	417000.	50.2	1075.	76.4	16184.	70.4
BRIDGEPORT-STAMFORD-NORWALK,CONN	69	781000.	50.6	1040.	76.6	17783.	70.8
COLUMBIA, S.C.	70	313000.	50.8	1019.	76.8	7925.	71.0
PROVIDENCE-PAWTUCKET-WARWICK, R.I	71	759000.	51.2	1015.	77.0	20934.	71.5
WILMINGTON, DEL.-N.J.-MD	72	493000.	51.4	1011.	77.1	10471.	71.7
GRAND RAPIDS, MICH	73	523000.	51.7	983.	77.3	10115.	71.9
NEW HAVEN-WATERBURY, CONN	74	739000.	52.0	946.	77.5	17754.	72.3
TRENTON, N.J	75	304000.	52.2	934.	77.6	9355.	72.5
TACOMA, WASH	76	385000.	52.4	928.	77.8	8563.	72.7
YOUNGSTOWN-WARREN, OHIO	77	544000.	52.7	914.	77.9	7664.	72.9
WICHITA, KANS	78	400000.	52.9	913.	78.1	8612.	73.1
CHARLESTON, S.C.	79	318000.	53.0	899.	78.2	6890.	73.2
BEAUMONT-PORT ARTHUR, TEX	80	319000.	53.2	894.	78.4	5840.	73.4
STOCKTON, CALIF	81	280000.	53.3	866.	78.5	9752.	73.6
SAVANNAH, GA	82	210000.	53.4	846.	78.7	5885.	73.7
SALT LAKE CITY, UTAH	83	547000.	53.7	841.	78.8	13287.	74.0
CORPUS CHRISTI, TEX	84	296000.	53.8	825.	79.0	7637.	74.2

Figure 6-1 (Continued)

SMSA	RANK	POPULATION	CUM PERCENT NATIONAL POPULATION	CRIMES OF VIOLENCE	CUM PERCENT OF NATIONAL CRIMES OF VIOLENCE	TOTAL INDEX CRIMES	CUM PERCNT OF TOTAL NATIONAL CRIMES
DURHAM, N.C.	85	176000.	53.9	816.	79.1	3254.	74.2
PEORIA, ILL	86	349000.	54.1	811.	79.2	6691.	74.4
LAS VEGAS, NEV	87	276000.	54.2	803.	79.4	8513.	74.6
FAYETTEVILLE, N.C.	88	198000.	54.3	785.	79.5	3968.	74.7
EL PASO, TEX	89	354000.	54.5	783.	79.6	8024.	74.9
CHATTANOOGA, TENN.-GA	90	302000.	54.7	762.	79.8	7431.	75.0
GREENVILLE, S.C.	91	283000.	54.8	756.	79.9	5806.	75.2
HUNTSVILLE, ALA	92	254000.	54.9	750.	80.0	4469.	75.3
KALAMAZOO, MICH	93	200000.	55.0	730.	80.2	4342.	75.4
AUGUSTA, GA.-S.C.	94	266000.	55.2	717.	80.3	3650.	75.4
SAGINAW, MICH	95	214000.	55.3	692.	80.4	3405.	75.5
KNOXVILLE, TENN	96	399000.	55.5	689.	80.5	5864.	75.6
LANSING, MICH	97	356000.	55.7	687.	80.6	9159.	75.8
GALVESTON-TEXAS CITY, TEX	98	168000.	55.7	672.	80.7	4256.	75.9
WORCESTER, MASS	99	625000.	56.1	656.	80.9	14681.	76.3
TUCSON, ARIZ	100	341000.	56.2	649.	81.0	8536.	76.5
MUSKEGON-MUSKEGON HEIGHTS, MICH	101	166000.	56.3	630.	81.1	3843.	76.5
ROANOKE, VA	102	183000.	56.4	626.	81.2	4193.	76.6
ALBANY-SCHENECTADY-TROY, N.Y.	103	708000.	56.9	625.	81.3	9095.	76.8
EVANSVILLE, IND.-KY	104	230000.	56.9	619.	81.4	5347.	77.0
SALINAS-MONTEREY, CALIF	105	239000.	57.0	618.	81.5	7744.	77.1

Figure 6-1 (Continued)

SMSA	RANK	POPULATION	CUM PERCENT NATIONAL POPULATION	CRIMES OF VIOLENCE	CUM PERCENT OF NATIONAL CRIMES OF VIOLENCE	TOTAL INDEX CRIMES	CUM PERCNT OF TOTAL NATIONAL CRIMES
RALEIGH, N.C.	106	207000.	57.1	613.	81.6	3504.	77.2
DAVENPORT-ROCK ISLAND-MOLINE, IOWA-ILL	107	337000.	57.3	605.	81.7	5606.	77.3
NEWPORT NEWS-HAMPTON, VA	108	284000.	57.4	604.	81.8	5009.	77.5
FALL RIVER-NEW BEDFORD, MASS	109	421000.	57.6	602.	81.9	9942.	77.7
BROCKTON, MASS	110	301000.	57.8	596.	82.0	6808.	77.8
HONOLULU, HAWAII	111	634000.	58.1	577.	82.1	19804.	78.3
SOUTH BEND, IND	112	287000.	58.2	567.	82.2	5085.	78.4
ANN ARBOR, MICH.	113	210000.	58.3	561.	82.3	5470.	78.5
HUNTINGTON-ASHLAND, W. VA.-KY.-OHIO	114	261000.	58.5	549.	82.4	3699.	78.6
VALLEJO-NAPA, CALIF	115	246000.	58.6	522.	82.5	6730.	78.7
JACKSON, MICH	116	143000.	58.7	505.	82.6	2459.	78.8
SPRINGFIELD-CHICOPEE-HOLYOKE, MASS	117	559000.	58.9	496.	82.6	11341.	79.0
WILMINGTON, N.C.	118	104000.	59.0	472.	82.7	2412.	79.1
LORAIN-ELYRIA, OHIO	119	259000.	59.1	470.	82.8	3109.	79.2
OXNARD-VENTURA, CALIF	120	340000.	59.3	462.	82.9	8386.	79.4
PENSACOLA, FLA	121	239000.	59.4	461.	83.0	5439.	79.5
COLORADO SPRINGS, COLO	122	217000.	59.5	448.	83.0	4371.	79.6
ATLANTIC CITY, N.J.	123	183000.	59.6	444.	83.1	7018.	79.7
LEXINGTON, KY	124	166000.	59.7	444.	83.2	5382.	79.9
LAWTON, OKLA	125	122000.	59.8	442.	83.3	2694.	79.9
RACINE, WIS	126	165000.	59.8	440.	83.3	2994.	80.0

Figure 6-1 (Continued)

SMSA	RANK	POPULATION	CUM PERCENT NATIONAL POPULATION	CRIMES OF VIOLENCE	CUM PERCENT OF NATIONAL CRIMES OF VIOLENCE	TOTAL INDEX CRIMES	CUM PERCNT OF TOTAL NATIONAL CRIMES
WACO, TEX	127	151000.	59.9	437.	83.4	3447.	80.1
CHARLESTON, W.VA.	128	242000.	60.0	435.	83.5	3582.	80.1
LUBBOCK, TEX	129	204000.	60.1	430.	83.6	5424.	80.3
FORT WAYNE, IND	130	264000.	60.3	423.	83.6	5327.	80.4
LAFAYETTE, LA	131	102000.	60.3	421.	83.7	1986.	80.4
DES MOINES, IOWA	132	272000.	60.5	417.	83.8	5399.	80.5
TOPEKA, KANS	133	163000.	60.5	408.	83.8	3368.	80.6
ERIE, PA	134	258000.	60.7	395.	83.9	3235.	80.7
SANTA BARBARA, CALIF	135	248000.	60.8	387.	84.0	6671.	80.8
ROCKFORD, ILL	136	275000.	60.9	386.	84.0	4019.	80.9
AMARILLO, TEX	137	195000.	61.0	384.	84.1	3305.	81.0
LAKE CHARLES, LA	138	168000.	61.1	369.	84.2	2471.	81.1
COLUMBUS, GA-ALA	139	259000.	61.2	363.	84.2	3622.	81.1
DECATUR, ILL	140	127000.	61.3	361.	84.3	2340.	81.2
WICHITA FALLS, TEX	141	134000.	61.4	347.	84.4	2055.	81.2
ALLENTOWN-BETHLEHEM-EASTON,PA.-N.J.	142	531000.	61.6	346.	84.4	5440.	81.4
HARRISBURG, PA	143	391000.	61.8	307.	84.5	4017.	81.5
TEXARKANS, TEX-ARK	144	104000.	61.9	300.	84.5	2043.	81.5
SPOKANE, WASH	145	298000.	62.0	299.	84.6	5494.	81.6
PUEBLO, COLO	146	130000.	62.1	289.	84.6	2393.	81.7
JACKSON, MISS	147	258000.	62.2	286.	84.7	3140.	81.7

Figure 6-1 (Continued)

SMSA	RANK	POPULATION	CUM PERCENT NATIONAL POPULATION	CRIMES OF VIOLENCE	CUM PERCENT OF NATIONAL CRIMES OF VIOLENCE	TOTAL INDEX CRIMES	CUM PERCNT OF TOTAL NATIONAL CRIMES
MONROE, LA	148	117000.	62.3	277.	84.7	1157.	81.8
SPRINGFIELD, ILL	149	158000.	62.4	271.	84.8	3278.	81.8
YORK, PA	150	315000.	62.5	267.	84.8	2833.	81.9
MANSFIELD, OHIO	151	131000.	62.6	262.	84.8	2256.	82.0
WATERLOO, IOWA	152	125000.	62.6	261.	84.9	1928.	82.0
READING, PA	153	293000.	62.8	237.	84.9	2597.	82.1
NEW LONDON-GROTON-NORWICH, CONN	154	217000.	62.9	232.	85.0	3509.	82.1
CHAMPAIGN-URBANA, ILL	155	150000.	63.0	231.	85.0	1890.	82.2
VINELAND-MILLVILLE-BRIDGETON, N.J	156	126000.	63.0	225.	85.0	2315.	82.2
SALEM, OREG	157	184000.	63.1	224.	85.1	2737.	82.3
BROWNSVILLE-HARLINGEN-SAN BENITO, TEX	158	152000.	63.2	222.	85.1	2383.	82.4
LIMA, OHIO	159	170000.	63.3	217.	85.2	2212.	82.4
LYNCHBURG, VA	160	124000.	63.4	211.	85.2	1233.	82.4
ASHEVILLE, N.C.	161	144000.	63.4	208.	85.2	2097.	82.5
TERRE HAUTE, IND	162	173000.	63.5	208.	85.3	2516.	82.5
FORT SMITH, ARK-OKLA	163	156000.	63.6	204.	85.3	1655.	82.6
STEUBENVILLE-WEIRTON, OHIO-W. VA	164	166000.	63.7	199.	85.3	1614.	82.6
OGDEN, UTAH	165	129000.	63.7	192.	85.4	2277.	82.7
BAY CITY, MICH	166	115000.	63.8	191.	85.4	1498.	82.7
EUGENE, OREG	167	204000.	63.9	188.	85.4	4025.	82.8
LANCASTER, PA	168	298000.	64.0	188.	85.5	1858.	82

Figure 6-1 (Continued)

SMSA	RANK	POPULATION	CUM PERCENT NATIONAL POPULATION	CRIMES OF VIOLENCE	CUM PERCENT OF NATIONAL CRIMES OF VIOLENCE	TOTAL INDEX CRIMES	CUM PERCNT OF TOTAL NATIONAL CRIMES
KENOSHA, WIS	169	120000.	64.1	174.	85.5	2137.	82.9
LINCOLN, NEBR	170	164000.	64.2	172.	85.5	2390.	82.9
ABILENE, TEX	171	124000.	64.3	159.	85.5	1910.	83.0
MUNCIE, IND	172	123000.	64.3	156.	85.6	2058.	83.0
MADISON, WIS	173	272000.	64.5	132.	85.6	3724.	83.1
DULUTH-SUPERIOR, MINN.-WIS	174	272000.	64.6	130.	85.6	4263.	83.2
SIOUX CITY, IOWA-NEBR	175	118000.	64.6	130.	85.6	2408.	83.2
SCRANTON, PA	176	228000.	64.8	109.	85.7	1812.	83.3
UTICA-ROME, N.Y.	177	349000.	64.9	108.	85.7	2488.	83.3
WHEELING, W.VA.-OHIO	178	190000.	65.0	108.	85.7	1382.	83.4
WILKES-BARRE-HAZELTON, IA	179	341000.	65.2	107.	85.7	2051.	83.4
PORTLAND, MAINE	180	188000.	65.3	100.	85.7	2585.	83.5
ANDERSON, IND.	181	137000.	65.4	99.	85.8	1467.	83.5
BINGHAMTON, N.Y.-PA	182	302000.	65.5	92.	85.8	3098.	83.6
CEDAR RAPIDS, IOWA	183	146000.	65.6	80.	85.8	1838.	83.6
PROVO-OREM, UTAH	184	125000.	65.7	77.	85.8	1307.	83.6
MANCHESTER, N.H.	185	215000.	65.8	76.	85.8	1744.	83.7
MCALLEN-PHARR-EDINBURG, TEX	186	200000.	65.9	76.	85.8	1208.	83.7
JOHNSTOWN, PA	187	271000.	66.0	74.	85.8	1137.	83.7
SPRINGFIELD, MO	188	142000.	66.1	72.	85.8	2094.	83.8
BOISE, IDAHO	189	102000.	66.1	60.	85.9	1322.	83.8

Figure 6-1 (Continued)

SMSA	RANK	POPULATION	CUM PERCENT NATIONAL POPULATION	CRIMES OF VIOLENCE	CUM PERCENT OF NATIONAL CRIMES OF VIOLENCE	TOTAL INDEX CRIMES	CUM PERCNT OF TOTAL NATIONAL CRIMES
PITTSFIELD, MASS	190	146000.	66.2	59.	85.9	1841.	83.9
ALTOONA, PA.	191	141000.	66.3	52.	85.9	958.	83.9
FARGO-MOORHEAD, N. DAK-MINN	192	113000.	66.3	47.	85.9	1258.	83.9
GREEN BAY, WIS	193	143000.	66.4	25.	85.9	1351.	83.9

Figure 6-1 (Concluded)

STATE	RANK	PERCENTAGE OF NATIONAL CRIMES OF VIOLENCE		PERCENTAGE OF STATES VIOLENT CRIMES OCCURRING IN SMSA	PERCENTAGE OF STATES VIOLENT CRIMES OCCURRING IN OTHER CITIES	PERCENTAGE OF STATES VIOLENT CRIMES OCCURRING IN RURAL AREAS
		EACH	CUM			
NEW YORK	1	16.5	16.5	98.2	1.1	0.8
CALIFORNIA	2	13.8	30.3	96.7	1.8	1.5
ILLINOIS	3	7.6	37.9	96.1	2.0	1.9
MICHIGAN	4	6.1	44.0	92.6	3.4	4.0
TEXAS	5	5.0	49.0	87.0	5.6	7.4
FLORIDA	6	4.7	53.8	81.1	8.9	10.0
MARYLAND	7	4.0	57.7	96.9	1.3	1.9
OHIO	8	3.6	61.3	92.8	4.0	3.2
PENNSYLVANIA	9	3.4	64.7	94.5	2.5	2.9
NORTH CAROLINA	10	3.0	67.7	46.8	19.9	33.4
NEW JERSEY	11	2.8	70.6	88.1	11.0	0.8
MISSOURI	12	2.6	73.2	90.2	2.9	7.0
LOUISIANA	13	2.0	75.2	75.2	9.1	15.7
VIRGINIA	14	1.8	77.0	69.8	10.4	19.9
GEORGIA	15	1.7	78.7	51.0	17.0	32.0
INDIANA	16	1.7	80.3	87.2	8.3	4.4
MASSACHUSETTS	17	1.5	81.9	98.0	1.5	0.5
TENNESSEE	18	1.5	83.3	66.9	9.5	23.7
ALABAMA	19	1.4	84.8	65.3	13.2	21.5

Figure 6-2

STATE	RANK	PERCENTAGE OF NATIONAL CRIMES OF VIOLENCE		PERCENTAGE OF STATES VIOLENT CRIMES OCCURRING IN SMSA	PERCENTAGE OF STATES VIOLENT CRIMES OCCURRING IN OTHER CITIES	PERCENTAGE OF STATES VIOLENT CRIMES OCCURRING IN RURAL AREAS
		EACH	CUM			
WASHINGTON	20	1.2	85.9	82.8	10.0	7.2
SOUTH CAROLINA	21	1.0	86.9	48.9	22.6	28.5
COLORADO	22	0.9	87.8	86.7	5.2	8.1
KENTUCKY	23	0.9	88.7	66.4	18.8	14.8
MINNESOTA	24	0.9	89.6	92.1	3.7	4.2
ARIZONA	25	0.7	90.4	83.7	8.8	7.5
OKLAHOMA	26	0.7	91.1	72.0	11.1	16.9
ARKANSAS	27	0.7	91.3	54.7	23.7	21.6
OREGON	28	0.7	92.5	78.1	10.4	11.6
CONNECTICUT	29	0.6	93.2	93.1	3.1	3.8
KANSAS	30	0.6	93.8	72.3	16.3	11.4
WISCONSIN	31	0.6	94.3	82.3	6.5	11.2
MISSISSIPPI	32	0.6	94.9	13.3	49.7	37.0
VERMONT	33	0.5	95.4	0.0	46.7	53.3
NEW MEXICO	34	0.4	95.8	53.3	35.7	11.0
NEBRASKA	35	0.4	96.2	87.4	6.0	6.6
WEST VIRGINIA	36	0.3	96.5	52.8	16.3	30.8
IOWA	37	0.3	96.9	62.2	26.8	11.0
NEVADA	38	0.2	97.1	93.0	2.7	4.3

Figure 6-2 (Continued)

STATE	RANK	PERCENTAGE OF NATIONAL CRIMES OF VIOLENCE		PERCENTAGE OF STATES VIOLENT CRIMES OCCURRING IN SMSA	PERCENTAGE OF STATES VIOLENT CRIMES OCCURRING IN OTHER CITIES	PERCENTAGE OF STATES VIOLENT CRIMES OCCURRING IN RURAL AREAS
		EACH	CUM			
RHODE ISLAND	39	0.2	97.3	80.9	16.7	2.4
UTAH	40	0.2	97.5	92.4	2.0	5.6
DELAWARE	41	0.2	97.7	82.1	7.5	10.4
HAWAII	42	0.1	97.8	87.2	5.1	7.7
MONTANA	43	0.1	97.9	27.7	20.8	51.5
MAINE	44	0.1	98.0	21.7	44.7	33.6
SOUTH DAKOTA	45	0.1	98.1	11.0	31.1	57.9
IDAHO	46	0.1	98.2	11.6	46.9	41.5
ALASKA	47	0.1	98.3	0.0	64.8	35.2
NEW HAMPSHIRE	48	0.0	98.3	27.2	52.7	20.1
WYOMING	49	0.0	98.4	0.0	41.0	59.0
NORTH DAKOTA	50	0.0	98.4	19.7	37.6	42.8

Figure 6-2 (Concluded)

APPENDIX 7

TABULATION OF LABORATORY SERVICES

This tabulation of laboratory services, shown in Figure 7-1, is an attempt to describe a "full service crime laboratory," embodying the bulk of procedures and responsibilities commonly encountered. The categories and their definitions and limits are approximations and are not intended to be rigid benchmarks.

Service Category--a laboratory division frequently used to separate functions, according to specialties, instruments or procedures.

Evidence Input--form of evidence.

Tests--procedures performed or objectives of tests.

Time Required--approximate maxima and minima. Time is a function of inherent minimum for procedure and difficulties imposed by form, quantity and purity of evidence.

Equipment/Costs--instruments commonly employed with price range, recognizing that any instrument may be purchased with the most exacting tests in mind, recognizing that it might also function on a cruder basis.

Reference Standards--either established collections or case comparison material.

Technician Skill-Degree--minimum training and minimum formal education.

Degree of Identity vs. Identification--the results of a test might serve as an aid to investigation, as classifying information or as positive or negative identity of unique source.

Crimes--A general suggestion of the crime that might generate items of clue material. An activity might produce all or none of the range of physical evidence.

TABULATION OF LABORATORY SERVICES

Service Category Crime Scene Service

EVIDENCE INPUT	TESTS	TIME REQUIRED	EQUIPMENT/ COST	REFERENCE STANDARDS	TECHNICIAN SKILLS-DEGREE	DEGREE OF IDENTITY vs IDENTIFICATION	CRIMES
2D and 3D reproductions; foot and tire prints, tool marks, fabric impressions, fingerprints	Casts of impressions in soil and on suitable surfaces are made using plaster of Paris or silicone rubber, as conditions dictate. Scaled photographs precede casting. Choice of media for casting depends upon size and detail of impression	30 min.-1 hr., depending on technique required	Expendables, $.25-1.00/cast		Practice with technique, H.S.+	The resulting cast is used for comparison with suspect objects	Homicide Agg. assault Sex offenses Burglary Hit and run Arson Armed robbery
Location, preservation, identification, collection, transportation of physical evidence and crime scene standards	Physical evidence may be any solids, liquids, or gases, pure or mixed, organic or inorganic, that will reconstruct the suspicious event or link a suspect to some criminal activity. The degree of importance of any single item will vary with the circumstances of the crime. What evidence is collected, how it is treated will depend on the experience, training and supervision of the collector. Remote location of laboratory facilities may require shipment by mail, express or other secure means.	1-4 hr., depending on extent of crime scene, number of technicians involved, and gravity of crime vs. available time and case load.	Usually a special vehicle, van, truck or station wagon provides magnets, vacuum cleaners, boxes, bags, tools, etc., in a wide variety of sizes and modes. $2,000-5,000		Wide general knowledge of crime laboratory and evidence capabilities. H.S.+	Depends on evidence collected, analyzed and compared.	All crimes
Assistance to investigator	Provide general knowledge of a wide variety of criminal and bizarre behavior patterns, i.e., burglary M.O., unusual sexual behavior (autoeroticism), atypical suicides, etc. Often the crime scene technician can link multiple crimes through similar M.O. or similar evidence, and suggest suspects to the investigator.	30 min. +		Extensive library support in periodicals and texts.	Somewhat scholarly and imaginative approach to his responsibility H.S.++		All crimes
Identity of unidentified bodies	Record fingerprints where tissue is suitable. Collection of clothing and other associated evidence for tags, labels, laundry marks, etc. Record dental patterns. Assist pathologist in removal of hands or fingers if laboratory development of fingerprints is necessary.	1-2 hr.			Experience and understanding of requirements of fingerprints or other personal identification procedures. H.S.+	Positive, if resulting comparison with known standards produces sufficient matching detail.	Homicide Sex offenses

Data Source

Figure 7-1

CONTINUED

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TABULATION OF LABORATORY SERVICES

Service Category Crime Scene Service

EVIDENCE INPUT	TESTS	TIME REQUIRED	EQUIPMENT/ COST	REFERENCE STANDARDS	TECHNICIAN SKILLS-DEGREE	DEGREE OF IDENTITY vs IDENTIFICATION	CRIMES
Photography	General crime scene coverage. Macrophotography of various evidence, i.e., blood stains, wounds, impressions, location of physical evidence, etc. Microphotography of tool marks, impressions, trace evidence. Aerial photography. Motion pictures (video tape) All of the above records may be processed in the crime laboratory photo facility, making whatever copies are required. Note: Although a great deal of the evidence submitted is collected by the case investigator, the shallow depth and narrow breadth of coverage clearly indicates that the vast majority of criminal investigations can profit by specialized assistance. Reference was made to this need in the President's Commission Report, The Challenge of Crime in a Free Society. Complete coverage of this topic in Svenssen and Wendell, The Techniques of Crime Scene Investigation, American Elsevier.	1-5 hr.	35 mm camera $300 4 x 5 camera $300-400 Accessory lighting, tripods, etc. $200		2-4 weeks training H.S. +	Provides record of scene in various media, principally for court presentation. Microphotos may be used for comparisons and identifications. Aerials may be used to orient witnesses and/or jury. Motion pictures may be used for court, training, investigative aid, etc.	Homicide Agg. assault Sex offenses Burglary Hit and run Arson Armed robbery
Crime scene sketches	The exact location of evidence is recorded by precise (± 1/4 in.) measurements. The exact dimensions of the crime scene and major items are recorded. When needed for courtroom presentation, a scaled drawing is produced in the laboratory. The scaled drawing serves to place evidence and witnesses in the crime scene area with the degree of precision that both defense and prosecution may be aided. In a few major cases, measurements have been translated into scaled models.	2-4 hr., depending on number of tech. and area covered.	Measuring tape, drawing instruments, $100.		Some skill in measurement and mechanical drawing and/or model making H.S.+	Places evidence and witnesses with same exactness	Homicide Agg. assault Sex offenses Burglary Hit and run Arson Armed robbery
Latent fingerprint development and collection, at crime scene	All suitable surfaces are examined using appropriate lighting, and processed for fingerprints or other skin impressions, using appropriate powders, fumes or solutions. When made visible, the impressions are photographed (macro) and "lifted" or preserved on a portable object.	1-8 hr. depending on area to be processed and number of technicians employed. Case load/man dictates extent of coverage.	Fingerprint brushes and powder, etc. $25-50		Practice with technique H.S.+	When compared with the known prints of suspects, the identity can be positive if sufficient matching points are found.	All major and minor crimes have potential latent impressions.
Assistance to pathologist and medical examiner	Provide a link between crime scene and autopsy in order that pathologist can aid in reconstructing the activities of the victim. Assist the pathologist in the preservation of pertinent evidence through photography and evidence collection procedures. Often the crime scene technician suggests special and routine items for collection.	2-3 hr.	Normal evidence collection equipment and photographic equipment		Some understanding of autopsy procedures and a wide general knowledge of crime laboratory and evidence capabilities. H.S.+	Depends on evidence collected and circumstances surrounding case.	Homicide Sex offenses

Data Source

Figure 7-1 (Continued)

TABULATION OF LABORATORY SERVICES

Service Category Firearms Identification

EVIDENCE INPUT	TESTS	TIME REQUIRED	EQUIPMENT/ COST	REFERENCE STANDARDS	TECHNICIAN SKILLS-DEGREE	DEGREE OF IDENTITY vs IDENTIFICATION	CRIMES
Weapons; revolvers, pistols, rifles, shotguns machine guns, zip guns, etc.	Determine possible owner from fingerprints and debris in mechanism. Usually performed by other associates in lab.	20-30 min.	stereomicroscope	standards of suspects' fingerprints and pocket debris	Specialty in fingerprint development and comparison Specialty in fiber and trace analysis	possible to positive	Homicide Agg. Assault Armed Robbery
	Recency of firing by debris in barrel or decay of NO_2 vs. time	20 min.-24 hr.	stereomicroscope $700 spectrophotometer $500-$5000	Lit. or slide collection	Skill in microanalysis and instrumental analysis HS +	May be used to refute alibi	Homicide Agg. Assault Armed Robbery
	Operating condition of weapon; trigger pull, effective operation of safeties and other parts. If parts are broken, assess recency of break and restore to working order -- Fire tests	20-60 min.	Hand tools, set of weights.	collection of guns or parts	Intimate knowledge of operation of guns -- 6 mos. -1 yr. HS +	Investigative aid	Homicide Agg. Assault Armed Robbery
	Comparison with bullets and cartridges in case See: Cartridge and bullet sheets						
Bullets; fired and unfired	Evidence of ricochet ; adhering debris	10-20 min.	Stereomicroscope $700	literature and standards from scene	If present, work shared with microanalyst HS +	Aid in reconstruction of event	Homicide; Agg. Assault; Armed Robbery
	Blood and tissue adhering (usual blood tests employed)	10 min.-6 hr.	stereomicroscope $700	usual blood standards	BS +	Aid in reconstruction of event.	
	Class characteristics; type of weapon	10 min.-30 min.	stereomicroscope $700	collection of fired bullets	2-3 weeks training H.S.	Determines possible guns as invest. aid.	Homicide Agg. Assault; Armed Robbery
	Comparison between two or more bullets in case to establish one or more guns. Also, comparison with open case file. Identification of weapon by comparison of tests vs. evidence bullet.	20 min. - 3 hr. per bullet. Greater than for ctgs due to possible mutilation	Comp. microscope; $1200 - $5000	case tests Open file	Skill developed by comparing several hundred pairs of fired bullets matched and mismatched, under supervision; 3-4 months; HS ⟶ BS	can be positive if sufficient rifling impression is available	Homicide Agg. Assault; Armed Robbery
Cartridges, Fired and unfired	Manufacture, caliber and type, type of weapon	10 min.-30 min.	stereomicroscope $700	cartridge collection	2-3 weeks H.S.	Investigative Aid	Homicide Armed Robbery Assault
	Comparison; fired in same or different weapons	30-60 min.	comp. microscope -- $1200 $5000	case specimen	2-3 months H.S. +	positive identification	
	Recency of fire; accumulated debris	15 min.	stereomicroscope $700	Lit	1-2 weeks	Investigative Aid	
	Gain or loss of weight vs. time	1-3 days	Balance analyt. $300 - $500	Lit.	BS	Investigative Aid	
	Decay of NO_2	1-2 days	spectrophotometer $500 - $5000	Lit.	BS	Investigative Aid	
	Identification of weapon by comparison with tests from suspect gun. Also comparison with open case file.	20-60 min. per ctg.	Comp.micro- $1200 - $5000	case tests open file	Skill developed by comparing several hundred pairs of fired ctgs., matched and mismatched 2-3 months concentration under supervision HS ⟶ BS	can be positive identification if sufficient marks are available	Homicide Armed robbery Assault

Data Source

Figure 7-1 (Continued)

TABULATION OF LABORATORY SERVICES

Service Category Firearms Identification (including powder residue)

EVIDENCE INPUT	TESTS	TIME REQUIRED	EQUIPMENT/ COST	REFERENCE STANDARDS	TECHNICIAN SKILLS-DEGREE	DEGREE OF IDENTITY vs IDENTIFICATION	CRIMES
Powder patterns; shot pattern	Detection of powder particles by infra red photography, visual examination, chemical detection (Walker test), spectroscopic identification of lead, barium and antimony, soft x-ray detection of lead. All of the above tests are used to determine distance of shooting; some are sensitive 0-9 ft., other 0-24 in. Determination of distance requires preparation of a series of test patterns using gun and ammo of same make and lot.	2-6 hr. depending on test used and problems offered by support materisl	stereomicroscope $700 spectrograph $6,000 + Soft x-ray $1000-$3000 Camera, etc. $200 - $400	case patterns; case weapon case ammo	skill varies from 1-2 wks for easily visual patterns to 2-3 mo. for complex instrumentation HS . BS +	Distance may be determined to ±2" - ±4" for powder patterns to 1' to 6' for shot patterns	Homicide Agg. Assault Armed Robbery
Primer residue; Harrison test or NAA	Harrison test - 0.1NHCl swabs of hands in 5-7 regions. Swabs tested for Pb, Sb and Ba. controls of gun tests and fired cartridges.	2-4 hr/test	expendables	case ctgs. and weapon	considerable practice in performance of test. 2-3 weeks BS +	Fairly good presumption of firing of gun. Investigative Aid	Homicide Agg. Assault Armed Robbery
	NAA - irradiation of wax gloves of suspects hands	2-6 days	contract testing $150/test		Ph.D	Fairly good presumption of firing of gun Investigative Aid	Homicide; Agg. Assault; Armed robbery

Data Source

Figure 7-1 (Continued)

TABULATION OF LABORATORY SERVICES

Service Category Questioned Documents

EVIDENCE INPUT	TESTS	TIME REQUIRED	EQUIPMENT/ COST	REFERENCE STANDARDS	TECHNICIAN SKILLS-DEGREE	DEGREE OF IDENTITY Vs IDENTIFICATION	CRIMES
Handwritten documents	Evaluation of the school of penmanship or the social and ethnic background of writer. (This is not graphology or character analysis. Any attempt to evaluate the personality of the writer is considered scientifically unsound and beyond the needs of forensic certainty.) Comparison of handwriting or handprinting with standards from specific suspects. Based on a variety of repeated peculiarities in the individual's writing.	2 hr. - 1-2 days depending on quantity & quality of evidence & standards	Stereomicroscope $700 Cameras $200-500 Comparison microscope $1,200-3,000	Collection of penmanship styles, ethnic and grammatical characteristics Collection of standard writings of known forgers. Collected or dictated standards of particular suspects.	Knowledge of cultural and educational impact on writing of people in area. H.S.+ Training under qualified expert, 1-2 yr. examining a large volume of simulated and actual case material B.S.+	Investigative aid With adequate quantity of writing, standards and questioned, a qualified document specialist is often able to render an opinion as to the writer of a document.	Homicide investigation Obscene literature Extortion or threatening letters Fraud Gambling Larceny Bombs
Typewritten documents	Class characteristics of type and typewriter.	1-2 hr.	Stereomicroscope $700 Photographic equipment $200-500 Comparison microscope $1,200-3,000	Extensive collection of known typewriter standards	Knowledge of variations in typewriters and experience in mfg. identification, 3-6 months training and experience A.A.+	Identification of possible manufacture, age and model of machine	Homicide investigation Obscene letters Extortion or threatening letters Fraud Embezzlement Arson Bombs
	Comparison of questioned document with standard typing from suspect machine. Comparison of questioned document with known typing of suspect on known machine.	2 hr. - 1-2 days	Ditto above	Standards from suspect machine	Extensive training under qualified expert, 1-2 yr. (concurrent with training in handwriting comparison). Examination of large volume of simulated and actual case material. B.S.+	Identification of specific machine and, occasionally, indication as to typist.	
Printed material, hand stamps, commercial printing	Questioned documents, such as checks, may be prepared for a limited use by means of hand presses, hand stamps, etc. Separate documents may be linked by comparing printing or documents may be compared to stamp or type source if suitable comparison material is available. Where documents are prepared by extracting material from mass media, the possible source may be identified by type style, mode of reproduction, etc.	1-4 hr. 1-4 hr.	Stereomicroscope $700 Cameras $200-500 Comparison microscope $1,200-3,000	Literature and collection standards of type faces, stamps, various means of reproduction	Extensive knowledge of graphic arts and printing practice.	May be positive as to source, if suitable material is available.	Extortion Threat of harm Obscene material Slander Fraud Forgery Bombs

Data Source

Figure 7-1 (Continued)

TABULATION OF LABORATORY SERVICES

Service Category Questioned Documents

EVIDENCE INPUT	TESTS	TIME REQUIRED	EQUIPMENT/ COST	REFERENCE STANDARDS	TECHNICIAN SKILLS-DEGREE	DEGREE OF IDENTITY vs IDENTIFICATION	CRIMES
Writing material, pen,pencil, etc., for comparison or elimination	Documents of unknown source may be traced through an identification of the possible sources of the writing material. Tests involving micro identification of components as well as instrumental comparisons with standard reference collections or case reference standards might identify or eliminate general and specific sources. TLC, paper chromatography, electrophoresis, spectrophotometry, special wavelength photography represent some of the methods in this area.	14 days	Appropriate to method used $50-10,000	Extensive collection of appropriate material	Analytical training plus experience with micro and instrumental procedures	Elimination of source can be certain. Identification of source can be based on probability factors	Fraud Larceny Forgery Obscene matter Threat or extortion Bombs
Special problems: Erasures Indented writing Obscured writing	Restoration of erasures might use special wavelength photography, fuming, or the application of special solutions. The development of indented writing usually involves oblique light photography. The disclosure of obscured writing may depend on mechanical or chemical removal of the overlying material or the physical detection by special wavelength photography.	Since these problems are infrequent and often unique, they may be time-consuming in terms of literature research and experimentation. Therefore, no time estimates are possible.	Cameras $200-1,000 Stereomicroscope $700 Special lighting $100-200 Misc. chemicals	Extensive literature in document problems	Some of these problems will be handled exclusively by the document expert; others will be performed together with or under the supervision of the document expert by staff photographers or chemists. B.S.++	The use to which successful results will be put depends on the nature of the case. The reconstruction alone may show criminal activity or some facet of suspicious nature. In some cases unique identity is possible.	Fraud Embezzlement Threatening or extortion notes Bombs or other Arsonous packages Stealing
Writing or typing sequence	Questions of order of writing and/or age detection by additions over folds can be answered by the use of low power microscopy or macro/micro photography.						
Fasteners and adhesives	The attachment of documents, sealing and resealing of adhesives can be studied by physical, instrumental and chemical examinations.						

TABULATION OF LABORATORY SERVICES

Service Category Latent Fingerprint Development

EVIDENCE INPUT	TESTS	TIME REQUIRED	EQUIPMENT/ COST	REFERENCE STANDARDS	TECHNICIAN SKILLS-DEGREE	DEGREE OF IDENTITY vs IDENTIFICATION	CRIMES
Various objects; or checks and other documents,glass, weapons,containers,etc.	Because of a lack of local skilled technicians, various objects suspected of having been handled by a criminal may be collected, preserved (often inappropriately, i.e., the weapon in a handkerchief) and transported to the crime laboratory for processing. Suitable methods will be employed by the laboratory. These procedures may involve photography, fuming, immersion in solutions, etc. The fingerprint or skin impressions developed will be given to fingerprint experts for comparison with suspects.	1 hr.-days (in the case of difficult photography)	Photographic cameras and special lights, chemicals, etc. $200-1,000	Note: Fingerprint files will be found in identification division of department. Degree of classification (single vs. other groupings) will depend upon staffing & department needs.	Expert photographers, and skill in the development of fingerprints on unusual surfaces. H.S.+	Can be positive if suitable characteristics can be developed.	All crimes

Data Source

Figure 7-1 (Continued)

TABULATION OF LABORATORY SERVICES

Service Category Microanalysis

EVIDENCE INPUT	TESTS	TIME REQUIRED	EQUIPMENT/ COST	REFERENCE STANDARDS	TECHNICIAN SKILLS-DEGREE	DEGREE OF IDENTITY vs IDENTIFICATION	CRIMES
Blood stains	Preliminary tests - Benzidene, LMG, Luminal (color, spot test) Phenolphthalein	10 min/test	stereomicroscope $700	dried blood	1 day exp. no degree	could be blood	homicide
	Teichmann or Takyamma (crystal test)	10 min/test	100 x microscope burner $250 - $2,000	dried blood	1-2 day exp. No degree-AA	is blood yes - no	rape/SO
	Species determination (precipitin, immunodiffusion)	30 min/test	centrifuge - $80 stereomicroscope $700	control sera blood antisera	5 day exp. AA - BS	human or other species	burglary agg. assault
	Blood type absorption - inhibition	8 hr/test	100 - 200 x microscope $250 - $2,000 refrigerator	known stain known blood antisera	2-3 weeks AA - BS	A B O grouping	adulterated food
	absorption - elution	2 hr/test	100 - 200 x microscope $250 - $2,000 refrigerator oven	known stain known blood antisera blood of suspect	2-3 months BS +	A B O grouping MN	narcotic invest.
	Note: Since five laboratories have reported using agar gel, or various forms of electrophoretic separation, these have not been included. Age of blood is a constant problem. Dynamics may be determined from geometry of stain, often more important than typing.						
Blood stains	Differentiation between venous, fetal and menstrual blood by associated cells and fibrin content	1 - 3 hr.	Microscope $250 - $2000		Knowledge of cell morphology and fibrin determination AA - BS	Invest. aid. important to refute alibi	Abortion
Seminal Stains	Ultraviolet and visual examination	10 min/ garment	UV lamp - $40		1 day exp. no degree	location of suspect area	Homicide
	Florence Crystal	10 min/test	100 - 200 x microscope and Burner $250 - $2,000		1 - 2 day exp. No degree - AA	False neg. and False positive possible	Rape
	Acid Phosphatase	15 min/test	Visual color or quantity by spectrophotometer $4 - $6,000	color stds King-Armstrong units	5 day exp. AA - BS	strong indication of prostatic fluid. Certainty dependent upon circumstances	Bestiality Child molest
	Microscopic identification of spermatozoa in extract of stain	30 min - 3 hr	Centrifuge - $70 200 x - 400x microscope $250 - $200	standard slide of spermatazoa, human and other animals	1 - 2 weeks (several exams) AA - BS Biology	poc, ident. of semenal material indicates a sex episode without index of legality	Sodomy
	Species - immune tests; for human semen or blood type	8 hr.	microscope, centrifuge, agar plates	anti sera, known stains blood type of victim and subject	2-3 weeks (several tests) BS + (biology, microbiology	Type, if secretor species, seminal material without legal index	

Data Source

Figure 7-1 (Continued)

TABULATION OF LABORATORY SERVICES

Service Category Microanalysis

EVIDENCE INPUT	TESTS	TIME REQUIRED	EQUIPMENT/ COST	REFERENCE STANDARDS	TECHNICIAN SKILLS-DEGREE	DEGREE OF IDENTITY vs IDENTIFICATION	CRIMES
Organic environmental traces; seeds, pollen, botanical fragments as food on clothing, in body orifice on objects such as tools	(This is a little used area, although reported for many years starting in C. Doyle and Hans Gross. Because the objects to be studied are microscopic and not tripped over the investigator seldom collects or considers their importance. In defense of the investigator, few crime laboratories are equipped to handle this type of evidence in a creditable fashion.) Microscopic examination and comparison	may be substantial, depending on entrainment material and obscurity of items.	Stereomicroscope $700 100-1000x phase microscope $2000 SEM seems to have real potential because of extreme depth of field. $80,000-$100,000	Standard text; Standards from known sources; Standards from known case source	considerable experience in micro botanical technique; some understanding of frequency of distribution of objects studied; BS +	Identity of source would depend upon total probability; May be of value for exclusion	Homicide Sex offense Assault Burglary Theft
Cosmetics; Powders, perfumes, lipstick	Visual and low power microscopic comparison.	20-30 min.	Stereomicroscope	case stand.	Familiarity with color matching - BS +	Preliminary sort	Homicide Sex Offenses Assault
	Chromatography; TLC	30 min - 2 hr.	$50 - $200	case stand.	1-3 weeks experience analyzing and comparing similar material BS +	Probable match Probable source	Homicide Sex Offenses Assault
	IR & UV Spectra	20-60 min.	UV or IR spectrophotometer -- $4000 - $10,000	case stand. Reference spectra	Familiarity with technique; BS +	Probable match - Probable source	Homicide Sex Offenses Assault
	Olfactronics - GLC, applicable to essential oils and perfume	20-60 min.	collection and concentration equipment -$1,000 GLC - $4000 - $10,000	graphs of known oils; case stand.	Familiarity with application to this class of materials; 1-2 Weeks	Similarity of scent, probable source	Homicide Sex offenses Assault
Explosives and products of explosion	Spot test with diphenylamine reagent	5 min/test	-	-	1-2 day use of reagent B.S.	Any oxidizing agent including powder residue	Homicide Bombing
	GLC - olfactronics	30 min +	Collection and concentration equipment $1,000 -- GLC $4-10,000	Charts of known explosives & residue	2-4 weeks familiarization with application B.S. +	Compound used in explosion	Arson Burglary
	Microscopic examination of objects close to explosive	20-30 min.	Sterecmicroscope $700	-	Familiarity with appearance of bomb fragments B.S.	Identification as bomb fragments	

Data Source

Figure 7-1 (Continued)

TABULATION OF LABORATORY SERVICES

Service Category Microanalysis

EVIDENCE INPUT	TESTS	TIME REQUIRED	EQUIPMENT/ COST	REFERENCE STANDARDS	TECHNICIAN SKILLS-DEGREE	DEGREE OF IDENTITY vs IDENTIFICATION	CRIMES
Saliva	Ptyalin (action on starch)	30 min.			1 - 2 hrs B.S.	Invest. Aid	Extortion letters
	Type, Blood factors	3-8 hr.	100 - 200 x microscope - $250 - $2000	Known blood sera known standard cells	2-3 weeks AA - BS	ABO grouping	Sex Offenses, Oral
Fecal stains	Parasites and food residue - comparisons vs. standards	3-8 hr.	100 - 400 X microscope	known standard slides; comparison std. from suspect	Understanding and experience in parasitology microbiology B.S. +	May be specific depending on factors studied	Sex Offenses Burglary
	Blood type factors	8 hr.	100 - 200 x microscope $250 - $2000	anti sera; known blood of suspect	2-3 months BS +	ABO grouping	Sex Offenses Burglary
Fibers	Physical comparison; class, type, color, etc. by micro determination of refractive index, action on polarized light, etc.	1-3 hr.	Stereomicroscope $700 Petrographic microscope - $1000 to $5000	immersion liquids; standard fiber collection; fibers from known case source	Familiarity with petrographic tests; Experience with identification of fibers, 2-3 months; BS +	Each fiber can be identified as to mfr. class; Some understanding of frequency of distribution of particular fiber may permit a total probability evaluation	Homicide Sex offense Burglary Theft Agg. Assault
	Chemical comparison -- UV, IR, Dye extraction, DTA, GLC, Mass spect.	3-5 hr.	Equipment specific for test performed; $5000 - $50,000	Fiber collection; fibers from known case source	Considerable skill in instrumental analysis; High level of familiarity with the results of particular tests on fibers. 1-2 yrs. BS +	Identification might extend to lot of manufacture, or to environmental changes affecting fiber polymers	Homicide Sex offense Burglary Theft Agg. Assault
Hairs	Species Identification	30 min/ specimen	stereomicroscope -- $700 100 - 400 x microscope -$250 -- $2000 Hardy micrometer $100	Books and slides of animal hairs	2-3 months practice AA - BS	Positive for major animal class	Homicide Sex offense Burglary Theft
	Comparison, if human -- using color, diameter, medullary structure, ref. index, scale count, etc., comparing characteristics to those of standard from suspect.	1-4 hr.	100 - 400 x microscope - $250 to $2000 AO comp. microscope $4000 Filar micrometer $100	standards from suspect	4-6 months studying many samples of human hairs from a variety of sources. BS+	Exclusionary, some possibility of moderate identity by NAA	Agg. Assault
	Blood type - absorb. - inhibition	8 hr.	Microscope - 100 - 200 x $250 - $2000; Ultrasonic generator - $500	Known anti sera; Known blood	4-6 months BS +	ABO	

Data Source

Figure 7-1 (Continued)

TABULATION OF LABORATORY SERVICES

Service Category Microanalysis - Instrumental Analysis

EVIDENCE INPUT	TESTS	TIME REQUIRED	EQUIPMENT/ COST	REFERENCE STANDARDS	TECHNICIAN SKILLS-DEGREE	DEGREE OF IDENTITY vs IDENTIFICATION	CRIMES
Hairs	Neutron Activation Analysis	1-8 + days	reactor and counter (may be irradiated elsewhere and counted at crime lab) $10,000 - $250,000	elemental standards	BS - PhD with considerable skill and experience with hair	Identity is questionable at this time since current data is conflicting	Homicide sex offense Burglary Theft Agg. Assault
Objects stained with soil (earth), safe insulation; building material	Low power examination and sorting. Color comparison, particle size distribution, particle classification	2-4 hr.	Stereomicroscope $700 Seives Comparison microscope - $1200 -- $3900	material collected from crime scene and standards	2-3 months experience with trace analysis BS +	Moderate identity, if enough components are available	Burglary Homicide Sex offenses Auto Theft
	Density gradient comparisons	3-24 hr.	Expendables	case standards collected at scene	considerable experience cross matching many specimens of similar nature 2-3 months BS +	According to Kirk, may be specific for source; not widely evaluated at this time	Burglary Homicide Sex offenses Auto Theft
	Chemical - instrumental; XRD, DTA, NAA, petrography, emission spect., electron microprobe	3hr.-8 days	appropriate to technique used;	case stand. from scene, known component collection	considerable instrumental experience BS ++	with suitable components, could be moderately specific as to identity	
Paint; on suspect, on objects	Low power sort and comparison of color. Layer comparison, if possible	30 min - 2 hr.	stereomicroscope $700	case standard, paint	1-2 days AA - BS	Only with several matching layers, is identity possible	Burglary Hit & Run Homicide Theft
	Chemical - instrumental; XRD, DTA, NAA, GLC, Mass Spect., solvent response, emission spect., electron microprobe. Note: The order of testing would be from totally non-destructive ⟶ totally destructive. Note: Many of the tests above and others available in research laboratories, have not received the degree of exploration to assess their value for identity. The present use exposes the evidence to some technique with subsequent testimony based on a "gut" feeling of identity. Where some attempt has been made to run lot by lot studies on paint using normally available instruments, the results have shown an inability to differentiate. Perhaps years of experience might refine methods to suitable sensitivity.	3 hr.-8 days	Appropriate to technique used $5000 - $60,000+	Case standards collected at scene	Considerable experience cross matching many specimens of similar nature 2-3 months BS + +	See note under Tests	Burglary Hit & Run Homicide Theft

Data Source

Figure 7-1 (Continued)

TABULATION OF LABORATORY SERVICES

Service Category Comparative Micrography

EVIDENCE INPUT	TESTS	TIME REQUIRED	EQUIPMENT/ COST	REFERENCE STANDARDS	TECHNICIAN SKILLS-DEGREE	DEGREE OF IDENTITY vs IDENTIFICATION	CRIMES
Tool marks; hand tools. Power tools, manufacturing operations	Marks range in scope from scratches on staples to shovel marks in clay. Action of tool may be cutting, sliding, shear, compression, drawing in die. Test consists of duplicating case action with case tool in an appropriate media and comparing with case tool mark. Class characteristics and individual characteristics.	½ hr. to several days depending on the degrees of freedom of tool	hand tools. benches, machine tools, $1-2,000 comp. microscope $1,200-5,000	tool catalogs	6-12 mos. experience matching tool marks under supervision; requires ability in shape and line recognition. H.S. +	positive identity depending on quantity of available opinion evidence	Burglary Bombs Arson Homicide Theft of auto parts
Tools, suspected of involvement	Tools are examined for adhering debris indication of case contact. Also examined for adhering debris or fingerprints that identify owner. Test made in appropriate media and compared under comparison microscope. Intermediate casts are made if case material is in form of casts.	20-30 min. per tool ½ hr. to several days depending on the degrees of freedom of test					
Three-dimensional impression, shoe and tire marks, fabric impressions	Comparison of case casts and/or scaled photographs with tests made of suspect objects. Note: literature in this area is very scarce. No clear-cut guidelines exist that can aid a technician in knowing when enough points exists for an identity of source	2-6 hr.	visual and stereomicroscope $700 Photographic equipment	heel and tire collection	2-4 months training in comparison examinations an appreciation for probability theory. H.S.+	positive opinion depending on available detail	All crimes
2-D impressions, shoe prints glove prints skin prints	Comparison of case material with tests made of suspect objects. Note: see note above	2-6 hr.	visual and stereomicroscope $700 Photographic equipment				
Serial Number Restoration	Application of suitable etchants to make visible stress due to die marks. Application of magnetic powders in magnetic field.	15 min. - 6 hrs.	Reagents, glassware magnet.		B.S. +	Traced to files when restored	Burglary, Theft Homicide
Paper, wood, glass, metal objects, paint, tape	Edge match of fracture or tear	1 hr-days	Stereomicroscope $700 Photographic $200-1,000	Case standard from crime source	Appreciation for probability theory Ability to recognize form & shape	Opinion of identity of source	Burglary Homicide Armed robbery Theft of auto parts
	Physical match of transferred material from one surface to another; left and right hand geometric correspondence i.e., stain from one metal surface transferred in negative to contact areas.	1-3 hr.	Stereomicroscope $700 Photographic $200-1,000				

Data Source

Figure 7-1 (Continued)

TABULATION OF LABORATORY SERVICES

Service Category Chemical-Instrumental Analysis

EVIDENCE INPUT	TESTS	TIME REQUIRED	EQUIPMENT/ COST	REFERENCE STANDARDS	TECHNICIAN SKILLS-DEGREE	DEGREE OF IDENTITY vs IDENTIFICATION	CRIMES
Blood and other fluids for ethyl alcohol content	Separation and analysis by distillation, aeration, diffusion, followed by oxidation reactions	1-3 hr. (batched)	$100 titration $500+ spect.	standard alcohol solutions	training in chemical-instrumental analysis; B.S.+	quantitation and ident. of alcohol	DWI liquor law violation
	GLC analysis of head gas over blood specimen	15-20 min.	GLC $2,500-$4,000	"	"		hit and run
	Alcohol dehydrogenase quantitation	2-4 hr.	UV spect. $1,200-$4,000	"	"		homicide
Toxic material in non-fatal and, on occasion, fatal cases; in humans & domestic animals	Physical and chemical separation; identification by chemical reactions and instrumental tests	1-24 hr.	TLC, chemical equipment	lit. standards of chemicals sought	training in microchemical analysis. Some appreciation of toxicology. B.S.+	identification of toxic material	animal poisoning food adulteration attempt homicide

TABULATION OF LABORATORY SERVICES

Service Category Microanalysis - Instrumental - Chemical

EVIDENCE INPUT	TESTS	TIME REQUIRED	EQUIPMENT/ COST	REFERENCE STANDARDS	TECHNICIAN SKILLS-DEGREE	DEGREE OF IDENTITY vs IDENTIFICATION	CRIMES
Narcotics, dangerous drugs	Spot tests; i.e., Marquis, Koppanyi	minutes (may be batched)	spot plate	collection of drugs for comparison	familiarity with color changes; understanding of chemistry. B.S. +	preliminary sorting	narcotics dangerous drugs
	Microcrystalline tests - microfusion	5-20 min. (may be batched)	100-200 x microfilm $250-2000, hot stage	"	"	identification of class and individual compound	
	IR and UV spectra, GLC with pyrolysis; TLC for separation	20-60 min.	$6-20,000 UV and IR spectrophotometer	collection of drugs, collection of spectra	familiarity with instrumental procedure and spectra recognition; B.S.+	identification and quantification of compound; ident. of diluent	
	XRD	1-2 hr.	$10-20,000 XRD with goniometer and cameras	ASTM cards standard graphs and film	familiarity with technique BS+	ident. of compounds in excess of 1%	

Data Source

Figure 7-1 (Continued)

TABULATION OF LABORATORY SERVICES

Service Category Instrumental Analysis

EVIDENCE INPUT	TESTS	TIME REQUIRED	EQUIPMENT/ COST	REFERENCE STANDARDS	TECHNICIAN SKILLS-DEGREE	DEGREE OF IDENTITY vs IDENTIFICATION	CRIMES
Petroleum Products; inflammables lubricants, tars, rubber	Distillation; vacuum or carrier to separate volatiles	3-6 hr.	Vacuum or petroleum distillation equipment $150		Familiarity with technique; 1-2 days	seperation	Arson Hit & Run Burglary
	GLC; with or without pyrolysis	1-2 hr.	GLC with pyrolysis and collection unit	Case standards; general collection of typical petroleum products	Experience in GLC and pyrolysis BS +	Classification, and, if mixture, probability of source if it matches suspect material	Arson Hit & Run Burglary
	UV and IR Spectra	1-3 hr.	UV & IR spectrophotometer $4000-$10,000	standard spectra; collection of standard petroleum products	Experience with technique BS +	Classification of material and possible identification of source, if a mixture	Arson Hit & Run Burglary

TABULATION OF LABORATORY SERVICES

Service Category Cryptography

EVIDENCE INPUT	TESTS	TIME REQUIRED	EQUIPMENT/ COST	REFERENCE STANDARDS	TECHNICIAN SKILLS-DEGREE	DEGREE OF IDENTITY vs IDENTIFICATION	CRIMES
Codes, gambling slips, etc.	Although it is rare to find a criminalist with skill in cryptography, request for service in the area needs consideration in selected cases. As vice enforcement intensifies, gamblers resort to codes, combustible or soluble paper, to minimize detection and prosecution. As a special problem, these are first submitted to the crime laboratory for assistance and advice. In some cases in-house research can handle the problem. In others, outside consultants may be employed.						Gambling Subversive activity

TABULATION OF LABORATORY SERVICES

Service Category Evidence Referrals

EVIDENCE INPUT	TESTS	TIME REQUIRED	EQUIPMENT/ COST	REFERENCE STANDARDS	TECHNICIAN SKILLS-DEGREE	DEGREE OF IDENTITY vs IDENTIFICATION	CRIMES
	When special and infrequent problems arise, the laboratory may serve as a referring agency, coordinating the submission of evidence with specialists and aiding in the interpretation of analytical results to investigation needs.						All crimes

TABULATION OF LABORATORY SERVICES

Service Category Training Support and Public Relations

EVIDENCE INPUT	TESTS	TIME REQUIRED	EQUIPMENT/ COST	REFERENCE STANDARDS	TECHNICIAN SKILLS-DEGREE	DEGREE OF IDENTITY vs IDENTIFICATION	CRIMES
	In order to establish liaison with investigators and other law enforcement officials and to provide information and procedures concerning laboratory utilization, laboratory staff participates in training programs, seminars, law enforcement education, etc. All levels of law enforcement and criminal prosecution may be contacted. The percentage of time involved will depend upon departmental interest and available laboratory staff time. Although peripheral, this is an important part of crime laboratory operation. In addition, laboratory personnel may provide talks and lectures to schools and local civic groups.						

Data Source

Figure 7-1 (Concluded)

APPENDIX 8

LABORATORY PROCEDURES ANALYSIS

In this study we have considered the crime laboratory from two different approaches: emphasizing (1) the types of evidence to be examined, and (2) the type of property to be determined and from these approaches worked towards a realistic but flexible concept for laboratory functions. We have attempted to establish the potential laboratory functions in terms of the types of properties of importance to the examination rather than to relate the examination to specific equipment or methods. The purpose of this approach is to allow flexibility to account for difference in laboratory facilities, differences in local laws and differences of opinion among criminalists regarding properties of values and methods for their determinations.

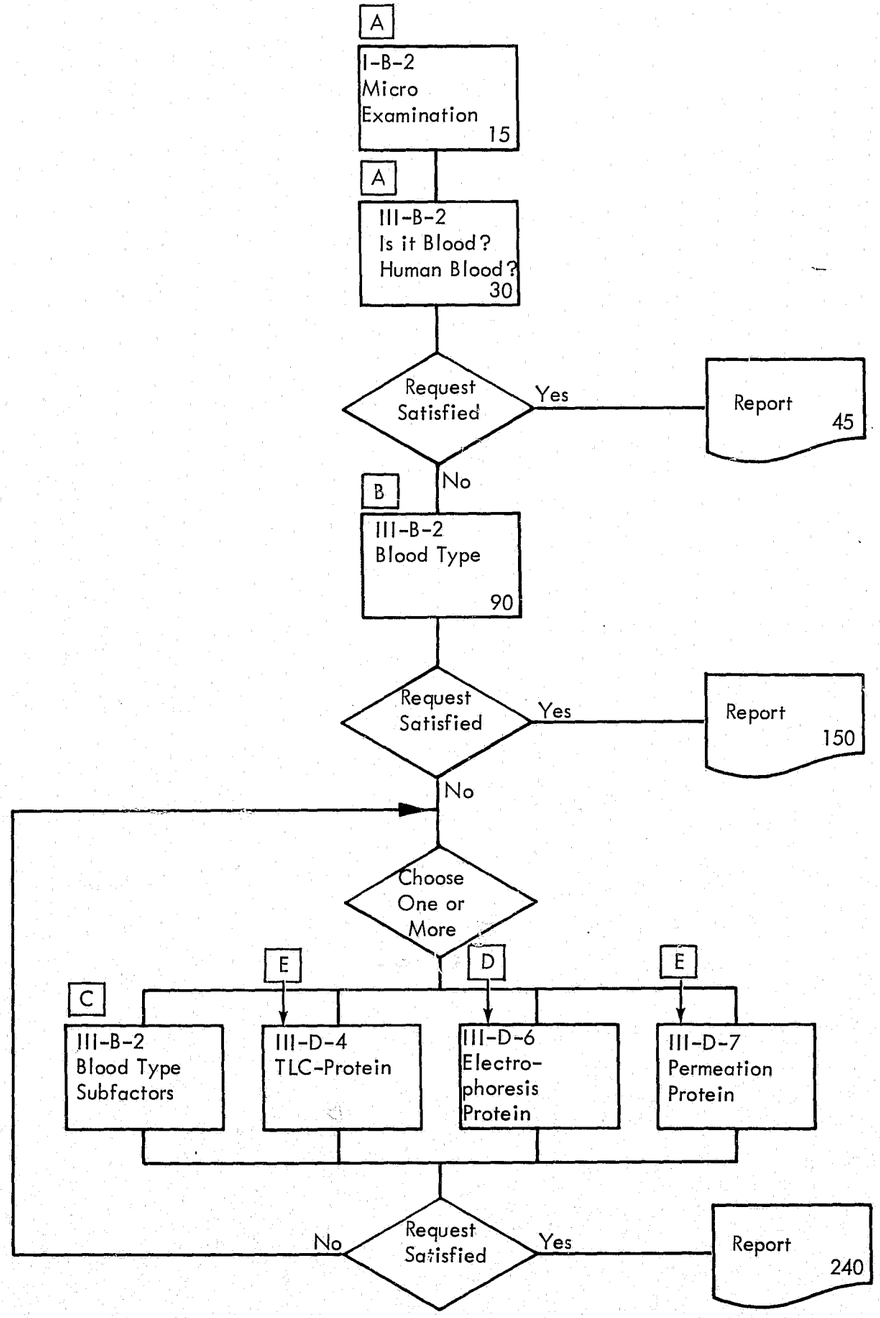
From the type of evidence likely to be encountered and the type of information required, we compiled flow charts shown on the following pages for analytical schemes for typical examples of these evidence categories. The flow charts were not limited to what was considered to be the one best way for examination, but rather, were prepared as a type of questionnaire with many optional routes of methods that might be reasonable for the analysis of the particular evidence item. These questionnaire flow charts were then submitted to the working group of criminalists for their evaluation, modification and comments.

The multiplicity of branches within many of the evidence examination flow schemes generally represented some duplication in the acquisition of essentially identical information by different means. It was not intended that all branches of the schemes would be employed in the examination, but by the presentation of the optional branches, each utilizing its own particular set of instruments, we intended to be able to relate each examination activity to the total laboratory function and thus search for a maximum diversity of technical capabilities per unit of expenditure for various size laboratories.

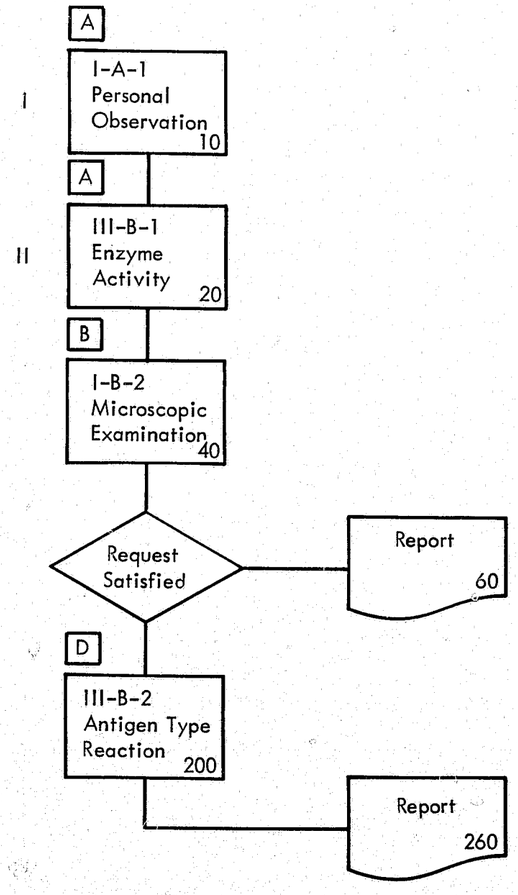
The above concept of optional examination methods aids in the evaluation of priorities for the acquisition of laboratory equipment. For a large laboratory there may be little concern that an instrument is of value primarily for the examination of only one type of evidence since the high utilization of that instrument may make the initial cost of the instrument insignificant per unit examination, but the use of the same instrument in a small laboratory might be completely unjustified due to its low utility, if the examination could be made using a more versatile instrument capable of use in other examinations.

No doubt there are many factors contributing to the choice of the analytical scheme in the examination of evidence. These can include:

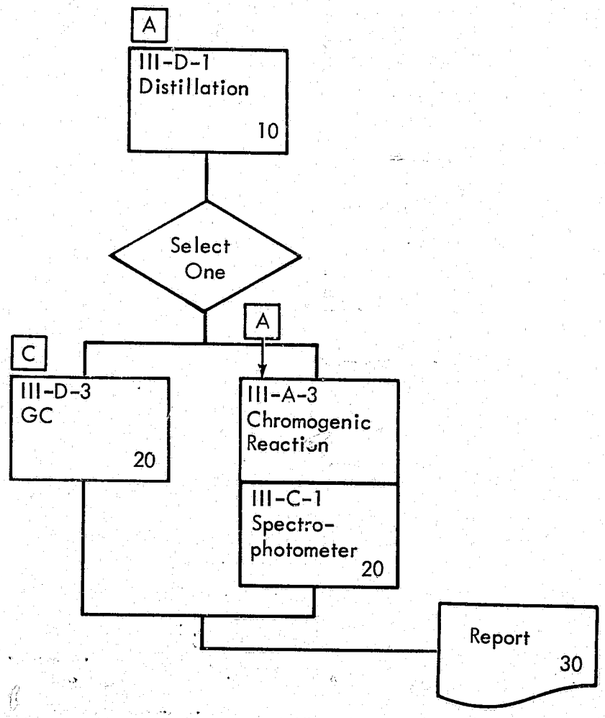
Evidence Item: Stain from crime scene, probably blood.
Request: Is the stain human blood, if so what type?



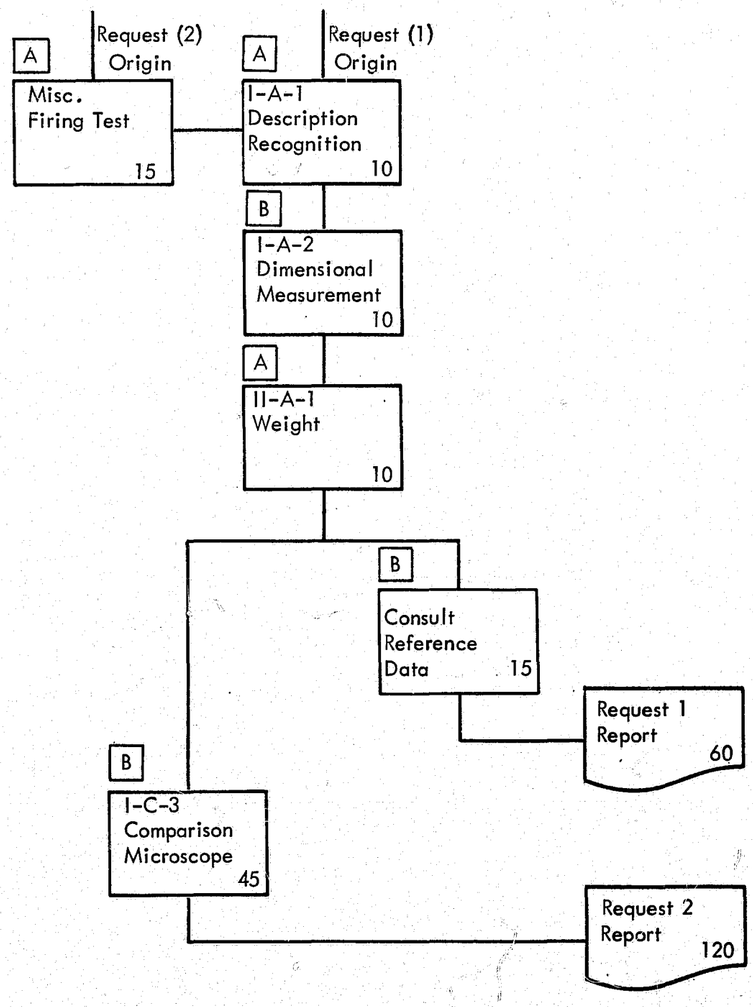
Evidence Item: Sample suspected of containing semen.
I. Stain on clothing. II. Vaginal washing or swab.
Request: Is semen present?



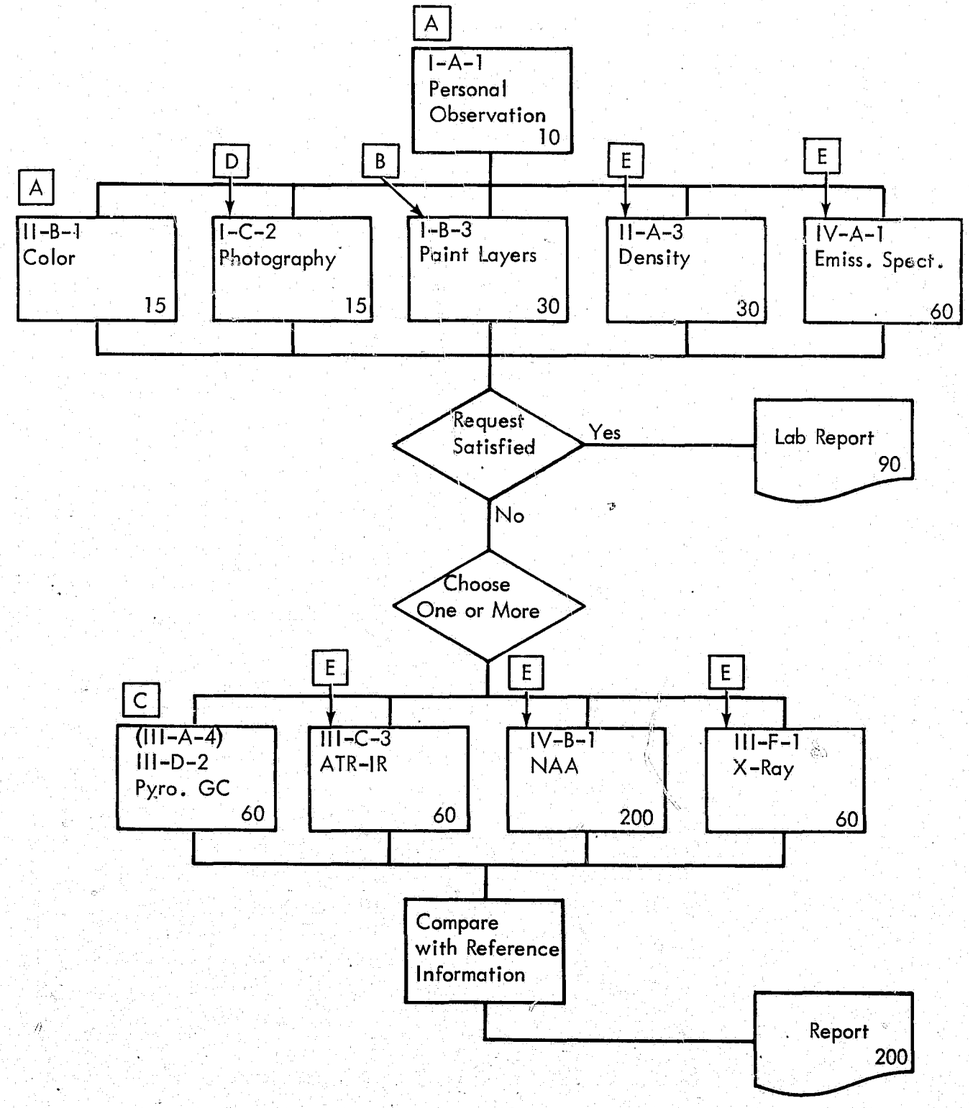
Evidence Item: Blood or urine sample.
Request: What is the alcohol content?



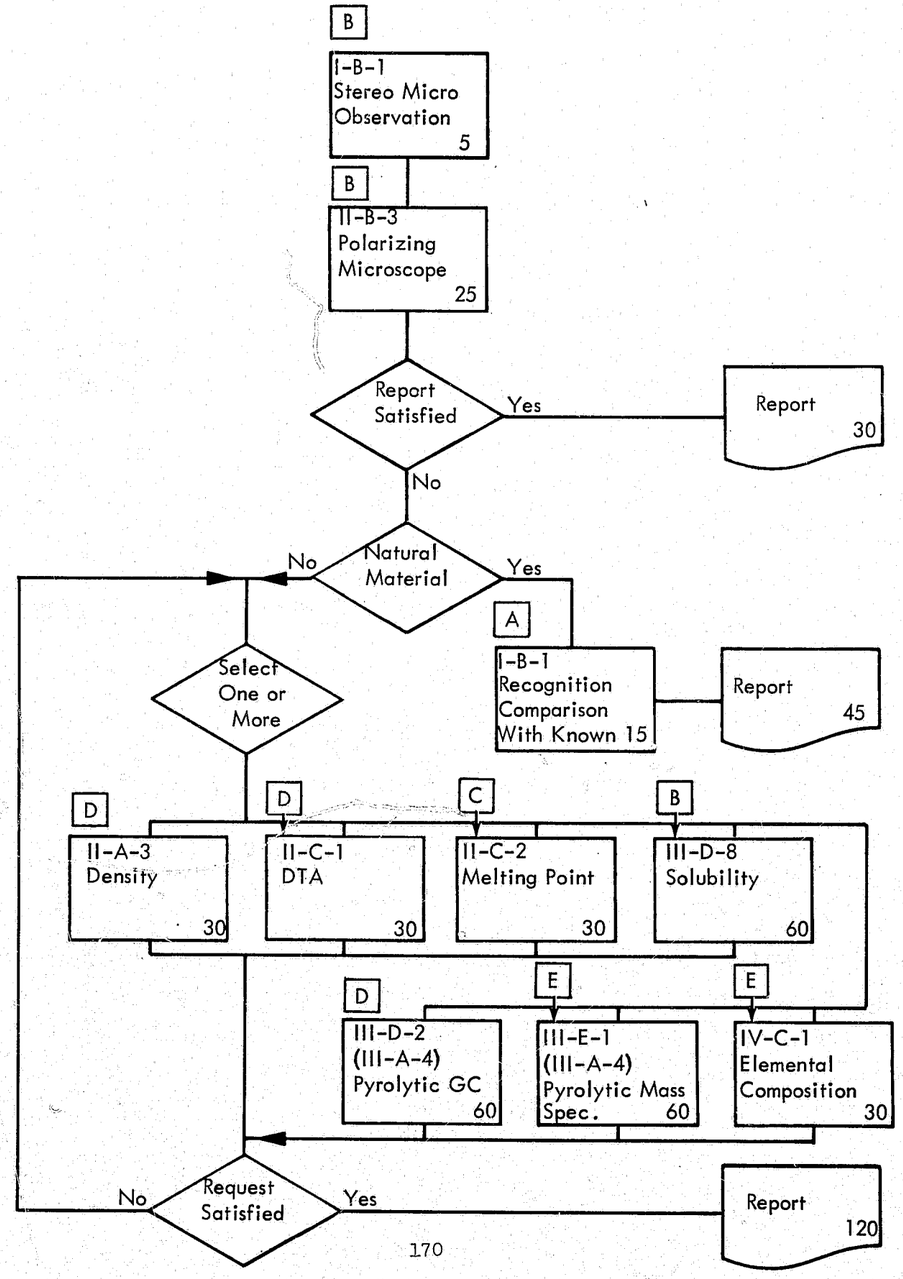
Evidence Item: Bullet or cartridge case from crime scene.
Request: (1) Identify possible weapon.
(2) Was bullet from suspect gun?



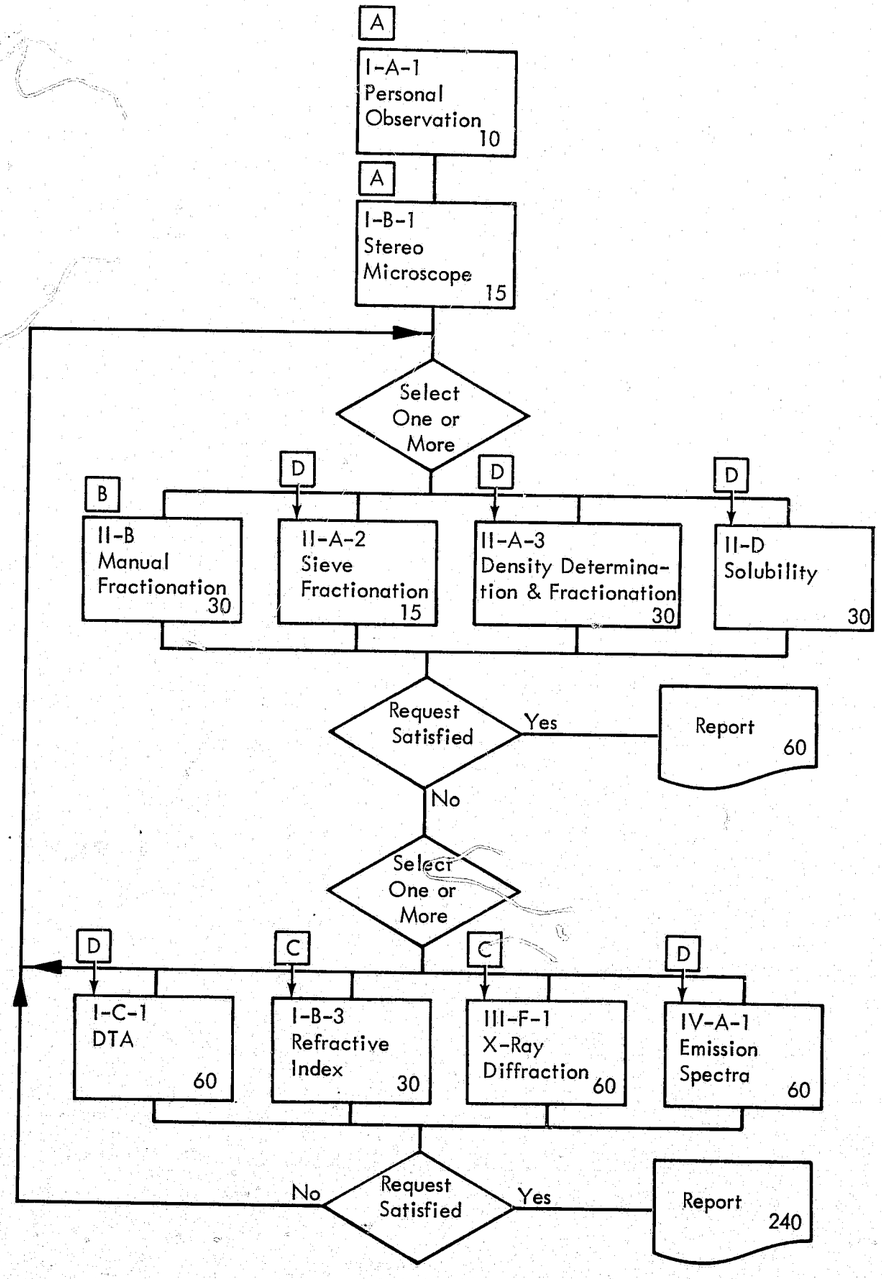
Evidence Item: Paint chip in hit-and-run, without suspect car.
Request: What make and year of car did the paint come from?



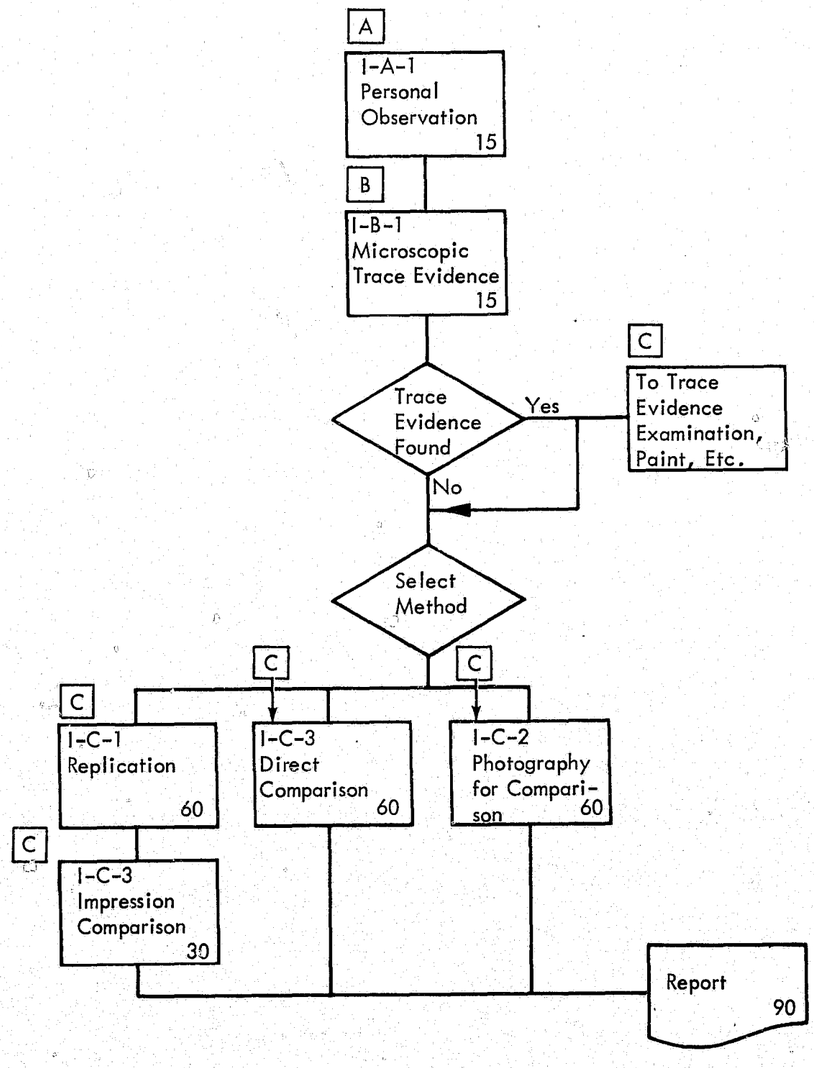
Evidence Item: Fiber or hair.
Request: Identify or compare.



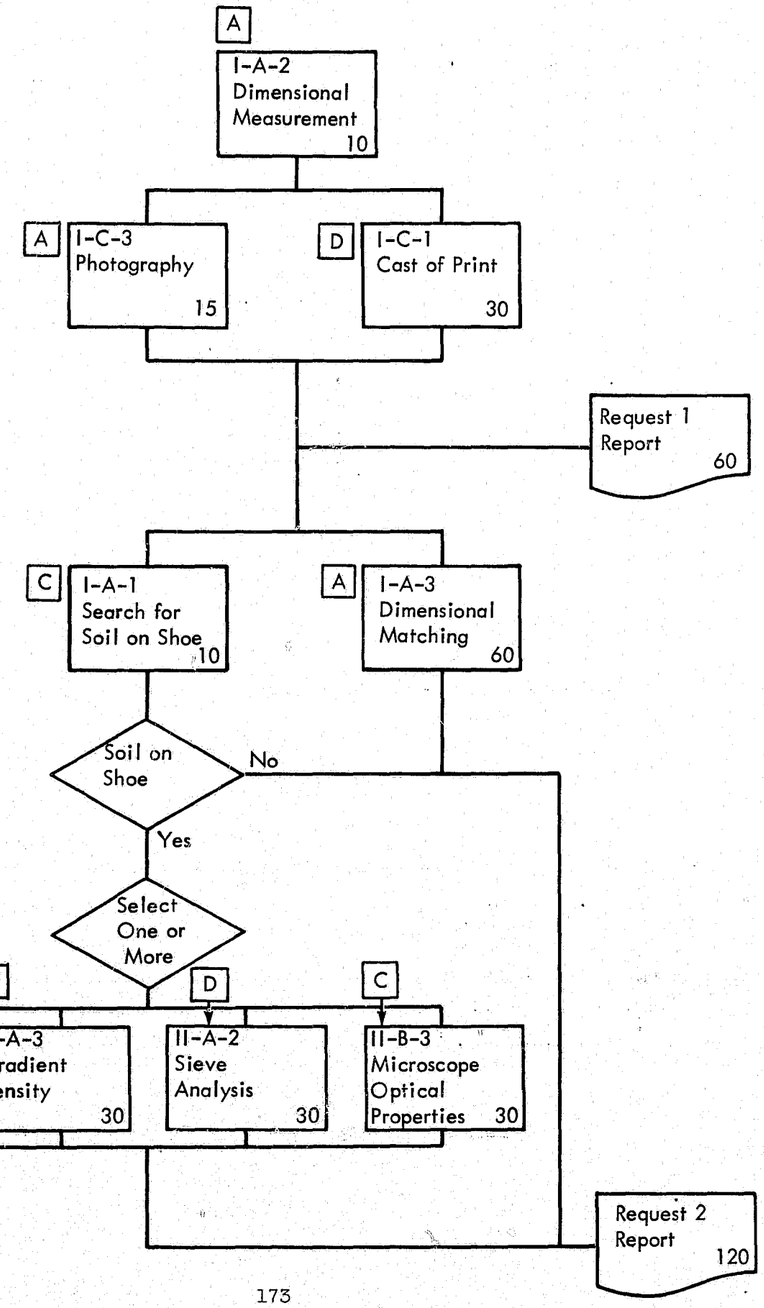
Evidence Item: Building material, fragments and dust.
Request: Is material from crime scene; comparison.



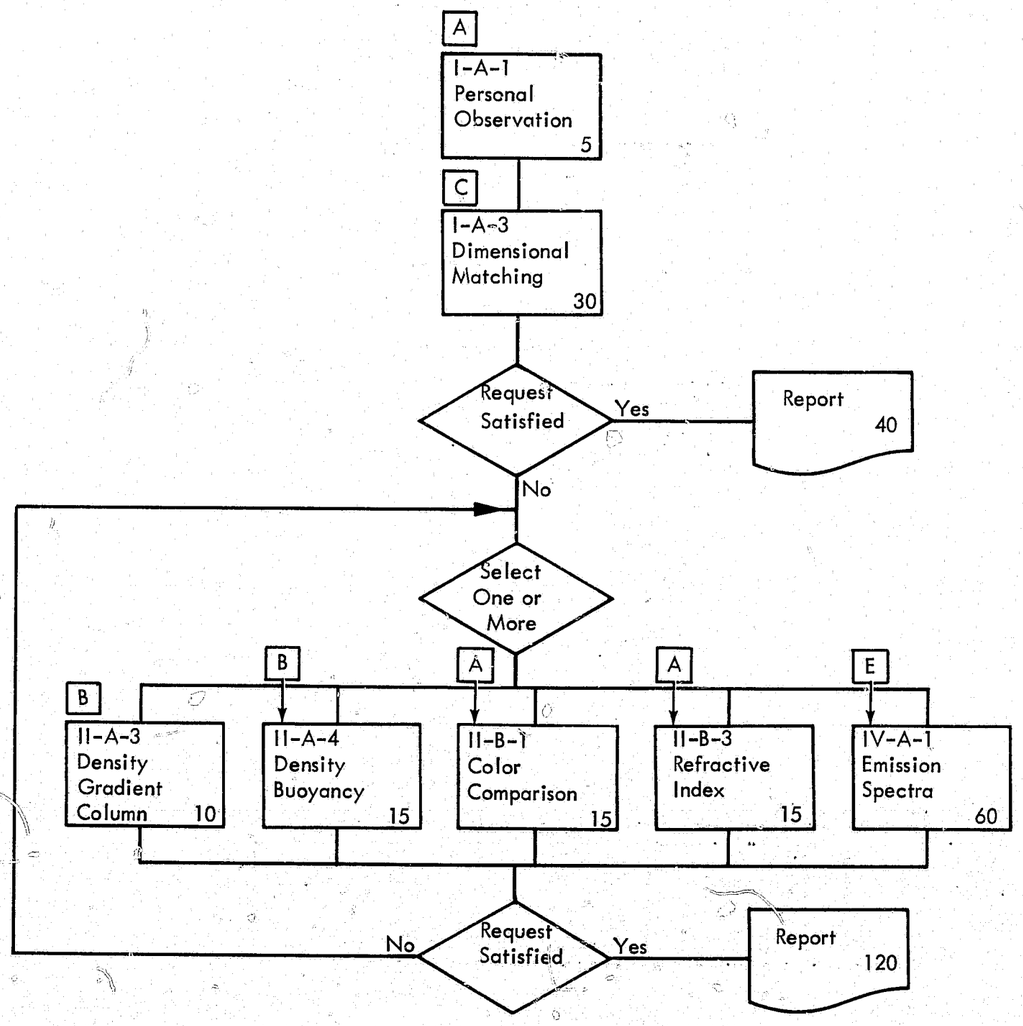
Evidence Item: Portion of damaged window and jimmy.
Request: Was jimmy used to force window?



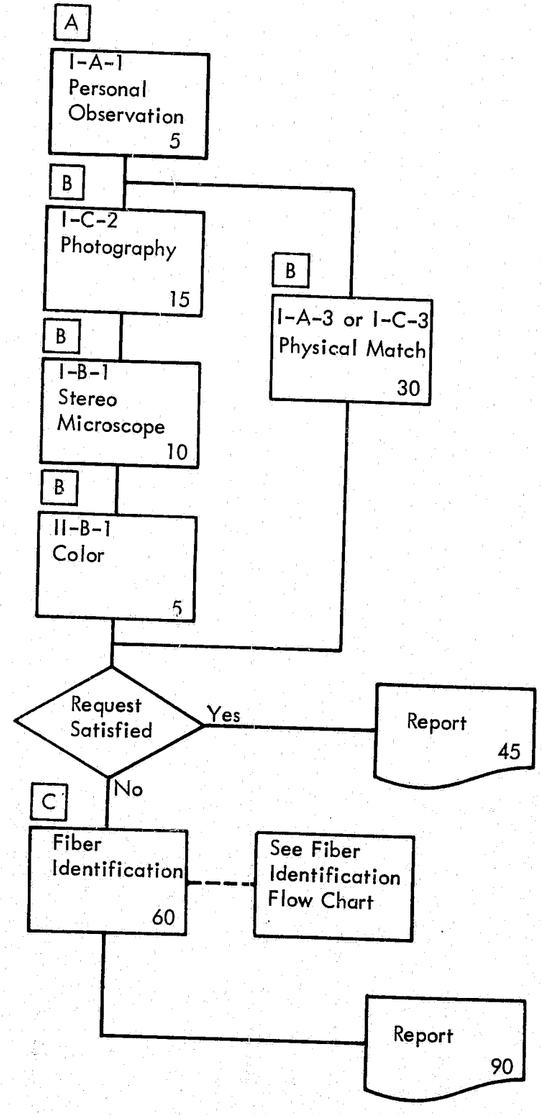
Evidence Item: Shoe print in soft soil.
Request: (1) Preserve evidence?
(2) Was print made by suspects shoe?



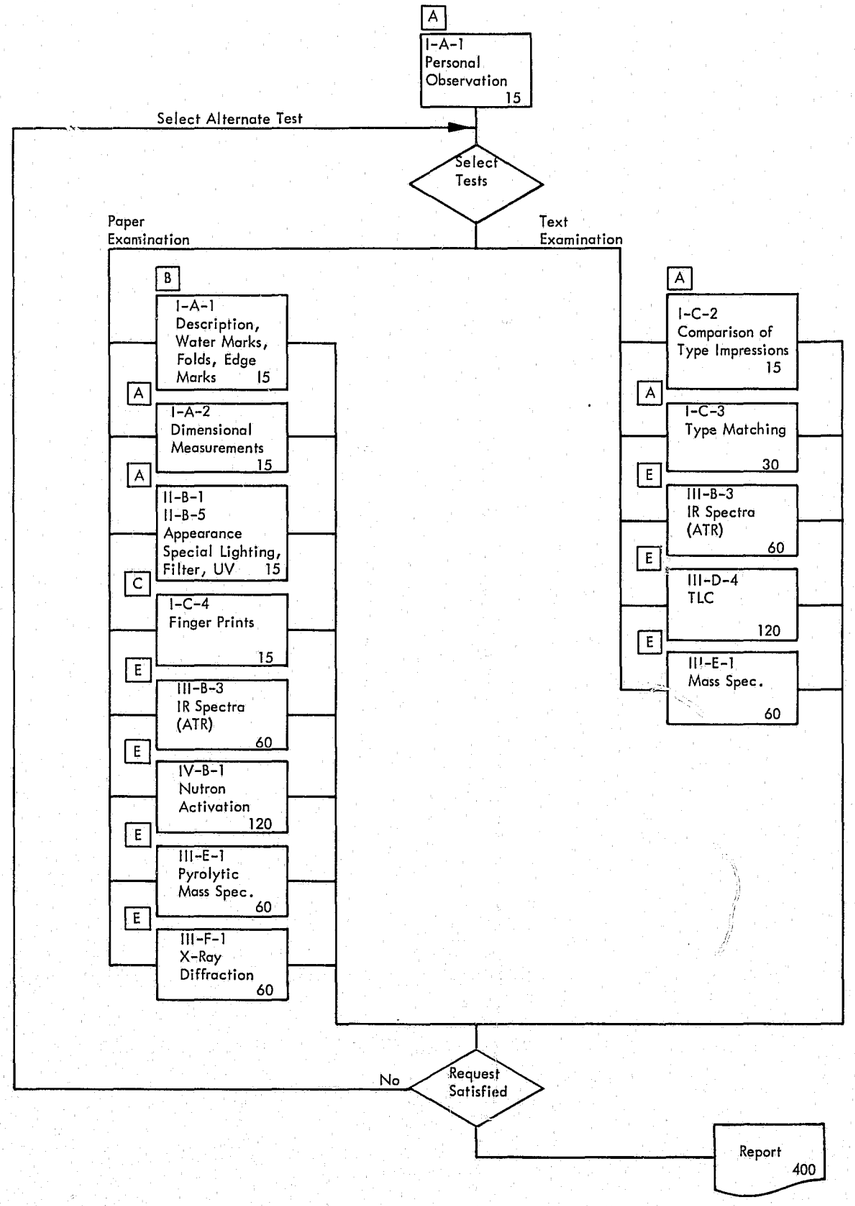
Evidence Item: Glass piece at hit and run scene.
Request: Did fragment come from suspect car?



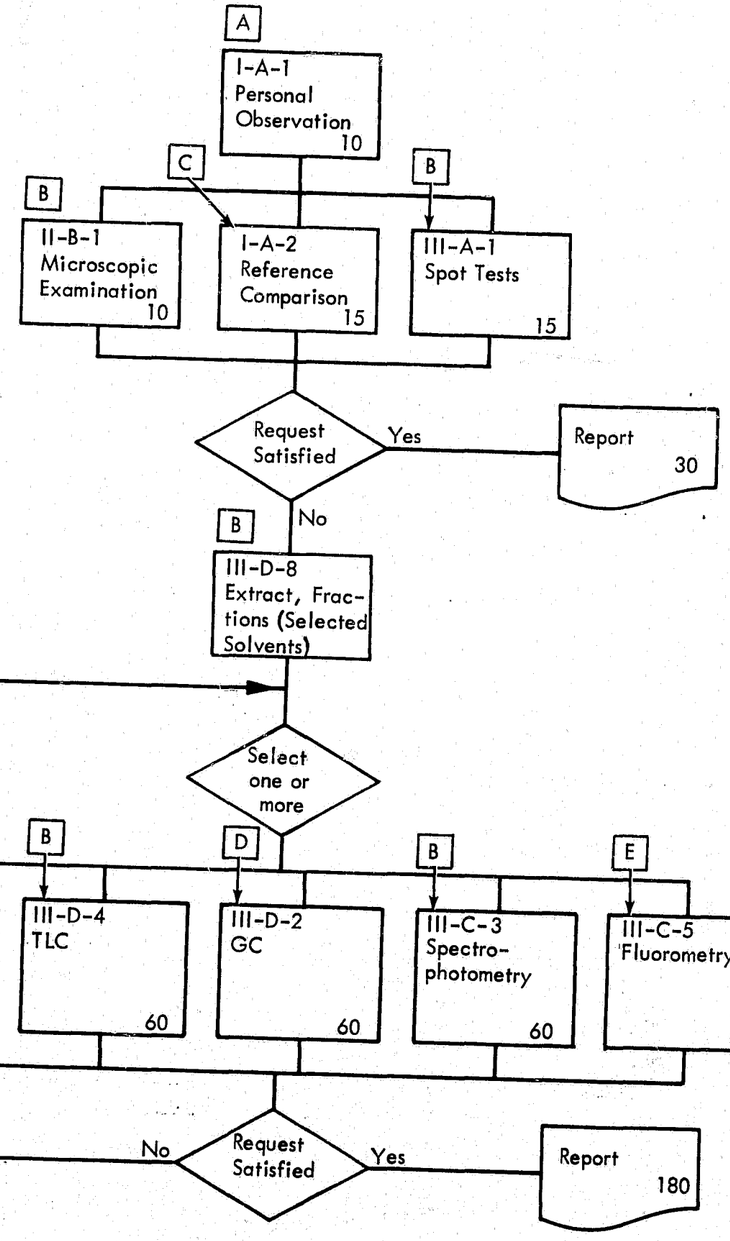
Evidence Item: Fabric fragment, torn from clothing.
Request: Is fragment from suspect?



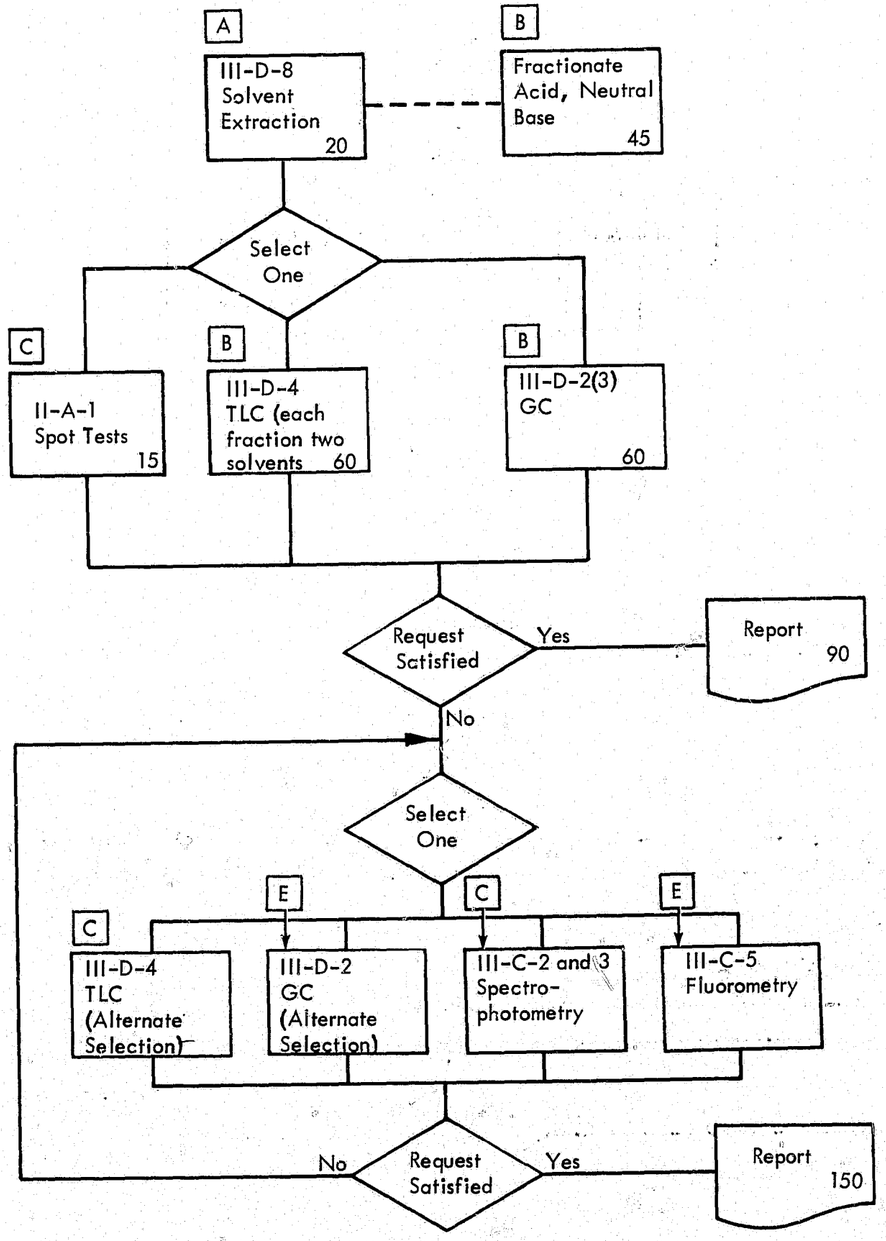
Evidence Item: Multi-page document.
Request: Have changes been made?



Evidence Item: Powders, capsules, tablets.
Request: Is material a drug or narcotic?



Evidence Item: Fluid sample, blood, urine, water spirits.
Request: Are drugs or narcotics present?



complexity of set-up time for the determination and frequency of the examination type, availability of equipment, acceptability of the examination by the courts, and, last but not least, personal preference of the examiner. Each of these factors will vary from laboratory to laboratory and complete standardization of evidence examination is neither possible nor necessarily desirable. There are, however, obvious advantages for the adoption of a standardized method or methods for those evidence categories suitable for standardization and we are not suggesting opposition to standardization.

The priority of acquisition of laboratory facilities must be related to the crime profile of the region being served. Therefore, the priority of acquisitions cannot be the same for all laboratories, but some guidelines can be set. Along with the flow chart questionnaires sent to the working group, a proposed equipment list was submitted and modifications of the list as well as priority ratings of the importance and sequence of acquisition of equipment were requested.

This Appendix consists of revised evidence examination flow charts and equipment lists based on the comments of the working group.

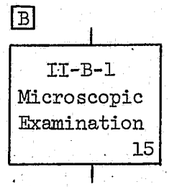
Evidence Examination Flow Charts

In general the working group agreed with most of the evidence flow charts, although, as expected, objections were expressed concerning the advisability of using some of the optional methods presented. There were however, two unanimous objections to the flow charts: (1) the request to identify any type of general unknown, and (2) the extensive examination of documents in a police crime laboratory. The first objection is based on the practical condition that items are examined for relationship to environments; their identity, in and of themselves, is unimportant. It was agreed that documents are not generally examined to any depth in an ordinary crime laboratory and, therefore, facilities to do so are not realistic.

The examination of an item of evidence from a crime is based as much on the information wanted from the item as on the item itself. Thus there is nearly always a stated or implied examination request submitted with the evidence item. The examination flow charts included in this section have been selected to represent typical, common, evidence-request combinations.

Explanation of the Flow Charts

The information in the operational blocks is illustrated by the following typical block:



The small square above the operation block (in this case "B") indicates the probability the operation would be used in the given examination. The key is as follows:

A - Used for all samples in all laboratories (based on our working group survey)

B - Used for most samples in most laboratories

C - Used for some samples or in some of the laboratories

D - Occasionally used

E - Seldom or never used (but possibly will be in the future)

The "II-B-1" is a reference key to the property-equipment list which follows the flow charts. Also included in the operational block is an abbreviated description of the operation, "Microscopic Examination."

The number in the lower right is an estimte of the average time, in minutes, required for the operation. The time in the "report" blocks indicates the total average time for completion of the examination, and may or may not be equal to the total of the times for individual operations but rather represents an estimate of the average optional operations of the scheme.

Equipment Summary

The comments and modifications of the working group concerning the equipment lists have been evaluated and new lists were prepared and are presented here. One major factor that apparently is important in the placement of a priority value on a piece of equipment, particularly on duplication of certain types of equipment, is the organization of overall laboratory facilities. Different laboratories, depending on size and other factors, can share some equipment among the various specialized groups. Priorities will be shifted for some acquisitions depending on the degree of sharing of facilities, or between organizations with, or without, a central service facility. At most, these equipment lists are general guidelines for equipment

acquisition and they must be modified to fit the specific condition. As stated by one of the working group: "Priority and price cannot be planned on a stereotyped basis. They must be tailored for a given operation." On the other hand, this list should be a useful general pattern for the start of specific tailoring.

Individual lists have been maintained for each analysis function and the equipment within each function is divided into categories of High Priority, Medium Priority, and Low Priority. The priority ratings are based on the returned information of the working group.

EQUIPMENT SUMMARY

Chemical Analysis Function

Equipment

General Purpose

High Priority	Purchase Price
Balances, general purpose and analytical	$ 900
Glassware	800
Centrifuge	300
Paper and thin layer chromatography	250
Miscellaneous hardware	100
Hot plates	200
Ultraviolet lamp	100
Drying oven	200
Hot water (steam bath)	100
Medium Priority	
Clocks and timers	50
PH and specific ion meter	500
Vacuum pump	100
Low Priority	
Muffle furnace	200

Chemical Analysis Function (concluded)

Equipment (concluded)

Specific

	Purchase Price
High Priority	
Refractometer	$ 200
Reagents	400
UV recording spectrophotometer (1)	7,000
Infrared recording spectrophotometer	6,000
Gas chromotagraph--versatile	8,000
Medium Priority	
Gradient density column (2)	400
Gas chromatograph--dedicated	4,000
X-Ray diffraction	10,000
Emission spectrometer	10,000
Low Priority	
Differential thermal analysis app. (purchase in 2 years)	5,000
Analysis by computer program 1/	

Biological Analysis

Equipment

High Priority	
Balances, general purpose and analytical	900
Glassware and plasticware	800
Centrifuge	300
Miscellaneous hardware	100
Microscope-general stereo	800
Miscroscope-biological	3,000
Reagents	500
Incubator	300
Hot plates	200
Controlled temperature water bath	200
Drying oven	200
Refrigerator	250

1/ Analysis by computer program to correlate known and unknown will save man-hours.
A computer terminal is needed, standard programs are available in increasing numbers.
Terminal cost $100 per month basic plus use time.

Biological Analysis (concluded)

Equipment (concluded)

	Purchase Price
Medium Priority	
Paper and thin chromatography	$ 250
Clocks and timers	100
Hot water (steam bath)	100
PH meter	200
Ultraviolet lamp	100
Deep freeze	800
Electrophoresis	500
Rotator	200
Low Priority	
Colorimeter-spectrophotometer	500

Document Analysis

Equipment

High Priority	
Long and short wave light source (2)	200
Hand magnifiers (2) at $25	50
Micrometer (1) at $50	50
Stereo microscope	800
Medium Priority	
All wave light source (1)	100
Camera	1,000
Supporting lights	100
Lens filter	
Humidity chamber	200
Illuminated magnifier (1) at $50	50
Reagents	200

Document Analysis (concluded)

Equipment (concluded)

Low Priority	Purchase Price
IR bulbs	
Fume cabinet (2) at $100	$ 200
Paper and thin layer chromatography	250
Photomicroscope	4,000
Reagents	200
General purpose balance	75

Physical Analysis

Equipment-Firearms

High Priority	
Comparison microscope	5,000
Micrometer	50
Etching reagents and apparatus	150
Stainless steel water tank, backdrop and holder[1]	5,000
Stereo microscope	800
Reference file	750
Medium Priority	
Camera	1,000
Reloading and assorted tools	

Equipment-Marks and Impressions

High Priority	
Comparison microscope	5,000
Micrometer	50
Hard lens	50
Stereo microscope	800
Replication equipment	50
Medium Priority	
Camera	1,000

1/ Or wooden box.

Physical Analysis (concluded)

Equipment (concluded)

Low Priority	Purchase Price
Analytical and general purpose balance	900
UV and IR light source	$ 80

Crime Scene Analysis

Recommended Equipment

- Press camera
- Lights
- Portable generator
- Vacuum cleaner
- Hand tools
- Fingerprint equipment
- Packaging and marking supplies
- Micro dust collector
- Ladder
- Replication equipment
- Stakes, ropes, signs
- Metal detector
- Sifting device
- Dragging equipment

CRIMINAL EVIDENCE PROPERTIES AND RELATED EQUIPMENT

Property	Equipment
PROPERTY TYPE PROPERTY, SPECIFIC Determination Method or Apparatus Type and value of determination	
I. SPATIAL PROPERTIES	
A. CONFIGURATIONS, MACRO	
1. Observation, Simple Optical Equipment a. Description b. Recognition of evidence item	
2. Dimensional Measurements, Simple Instruments a. Description and classification b. Basis for comparison	
3. Dimensional Matching a. Comparison of edge configurations	
B. CONFIGURATIONS, MICRO	
1. Observation, Stereo or Microscope a. Description b. Recognition of evidence item	1. Horizontal Arm Stereo Microscope
2. Photo Microscope a. Description b. Recognition c. Photographic record	2. Photo Microscope
3. Dimensional Measurements, Microscope Ocular a. Description b. Classification c. Basis for comparison	

Property	Equipment
C. IMPRESSIONS 2-D AND 3-D	
1. Replication (and Casts) a. Preservation of perishable evidence b. Basis for comparison	
2. Photography, Camera, Photomicrography a. Preservation of perishable evidence b. Basis for comparison	2. Photo Microscope
3. Visual Comparison, Comparison Microscope a. Matching similar items	3. Comparison Microscope
4. Image Intensification, i.e., Fingerprint Development a. Increasing contrast for photography	4. Finger Print Kit
II. PHYSICAL PROPERTIES	
A. WEIGHT, VOLUME, SIZE	
1. Determination of Weight, Balance a. Description b. Classification c. Basis for comparison	1. Analytical Balance (0.05 mg.) General Purpose (0.1 gm.)
2. Sieve Analysis a. Description b. Basis for comparison c. Fractionation	2. Sieve Set, With Shaker
3. Density Determination, Gradient Density Column a. Basis for fractionation b. An identifying characteristic	3. Gradient Density Column
4. Other Weight, Volume, Size Determinations (Liquid displacement, buoyancy, Coulter counter settling patterns, pycnometer)	

Property	Equipment
B. OPTICAL PROPERTIES	
1. Color, Comparison, Visual a. Description b. Comparison with standards c. Matching of items	1. Color Standards
2. Color Determination, Instrumental a. Classification b. Comparative	2. Color Comparator
3. Refractive Index (Chemical microscope) a. An identifying characteristic	3. Polarizing Microscope
4. Refractive Index (Refractometer) a. An identifying characteristic	4. Refractometer (± 0.002 units)
5. Fluorescence a. Description b. Item matching	5. UV Lights
C. THERMAL PROPERTIES	
1. Phase Transitions (DTA) a. Comparative b. Identifying characteristics	1. Differential Thermal Analysis
2. Phase Transitions (Microscopic) a. Identifying characteristic	2. Chemical Microscope, Polarizing, With Hot Stage
3. Distillation a. Description and classification b. Basis for fractionization c. Possible identifying characteristic	3. Distillation Equipment
D. MISCELLANEOUS PHYSICAL PROPERTIES (Viscosity, surface tension, hardness, electrical properties, solubility, vapor pressure)	

Property	Equipment
III. MOLECULAR PROPERTIES	
A. CHEMICAL REACTIVITY	
1. Spot Tests for Functional Groups a. Possible identifying characteristic b. Comparative	1,2,3. Reagent and Support Glassware
2. Quantitative Functional Group Determination a. Basis for comparison b. Determination of equivalent weight	
3. Chromogenic Reactions a. Determination of spot in (TLC) chromatography b. Aid in spectral analysis	
4. Thermal Decomposition, Pyrolysis, DTA, DGA a. Characteristic energy pattern b. Preparation for gas chromatography, mass spec.	4. See Related Property
5. Electrochemical Reactions a. Metal ion determination	5. Electro-Analysis Apparatus
B. BIOLOGICAL ACTIVITY	
1. Spot Tests for Biological Activity (Enzyme activity) a. Identifies as biological b. May identify substance, blood, semen, etc.	1,2. Reagents, Special Glassware Microscope
2. Spot Tests for Biological Activity (Antibody-antigen reactions) a. Determination of common blood types b. Determination of subfactors which may be individual specific	

Property	Equipment
C. MOLECULAR SPECTRA	
1. Colorimeter-Spectrophotometer a. Determination of specific materials b. Quantification of chromogenic reaction	1. Nonrecording Spectrophotometer
2. Visible and UV Spectra a. Quantification of chromogenic reaction b. Determination of inorganics	2. Recording Vis.-UV Spectrophotometer
3. IR Spectra a. Determination of organic and inorganic functional groups b. Comparative, with standard spectra or evidence item c. Can be identifying characteristic	3. Recording IR Spectrophotometer
4. Nuclear Magnetic Resonance a. Determined certain, specific bonds b. Comparative c. Can be identifying characteristic	4. N.M.R. Apparatus
5. Fluorescence Spectra a. Identifying characteristic	5. Spectrophotofluorometer
D. FRACTIONATION OF MOLECULES	
1. Distillation a. Crude separation of large samples b. Approximate boiling points and amounts of components	1. Distillation Glassware
2,3. Gas Chromatography a. Provides number and approximate amount of components b. Provides one component characteristic (rentention time) (May be coupled to devices for other characteristics of components) c. For some evidence may be nearly specific identification	2. Versatile G.C. 3. Dedicated G.C.

Property	Equipment
4. Paper, Thin Layer Chromatography a. Separates component, provides one characteristic (R_f) b. Coupled with chromogenic reaction may identify	4. Chromatography Glassware and Chambers
5. Column Chromatography a. Separates components for other analysis	5. Glassware and Fraction Collectors
6. Electrophoresis a. Separation of molecular ions b. Provides characteristic protein patterns	6. Electrophoresis Apparatus
7. Permeation Chromatography a. Characteristic protein patterns	7,8,9. Glassware
8. Extraction, Solubility a. Preparation for other analysis	
9. Miscellaneous (Ion exchange, liquid-liquid chromatography)	
E. MOLECULAR MASS	
1. Mass Spectrometer a. Comparative, other evidence, standard reference b. Can be identifying characteristic	1. Mass Spectrometer
2. Osmotic Determinations of Solutions a. Comparative b. Molecular weight determinations	2. Osmometer
F. MOLECULAR SPACINGS	
1. X-Ray Diffraction a. Can be identifying characteristic	1. X-Ray Diffraction Unit

Property	Equipment
IV. ATOMIC PROPERTIES	
A. ATOMIC SPECTRA	
1. Spark or Arc Emission a. Semiquant detection many metals b. Comparative (i.e., paint pigments, reference samples)	1. Emission Spectrograph
2. Flame Emission a. Determination of many metals (solution)	2,3. A.A.-Emission Spectrophotometer
3. Atomic Absorption a. Determination of many elements	
4. X-Ray Fluorescence a. Detection of surface atomic composition	
5. X-Ray Emission Electron Probe	
B. NUCLEAR PROPERTIES	
1. Neutron Activation Analysis a. Comparative, other evidence items b. Can determine atomic composition (very complex)	
C. ELEMENTAL COMPOSITION (certain elements)	
1. Instrumental Elemental Analysis a. Quantitative analysis of certain elements generally by detection of combustion products	1. Elemental Analyzer

Introduction

The generalized planning technique designated LABS (Laboratory Analysis and Budgeting System) was summarized in Section V (see Figure 9-1). This appendix contains the forms needed to use LABS and presents a sample reflecting data for a typical laboratory.

Forms

The following forms are included for the laboratory planner to use in planning and budgeting a laboratory:

Equipment Table - Figure 9-2

Staff Table - Figure 9-3

Overhead and Cost Summary - Figure 9-4

Overhead and Cost Detail - Figure 9-5

Funds Source Analysis - Figure 9-6

The use of these forms is described in Section V. The majority of entries are self-explanatory. Line numbers are arbitrary and assigned by the planner for reference only. As LABS allows 10 planning periods, which can be quarters, half-years, or years, a "Time Period Acquisition or Start" column is provided to allow the phasing of equipment or personnel. Each form allows designation of several summaries of other lines with accumulations controlled by the line numbers (i.e., Lines 2, 4, 7, 9, and 11 can be referenced to a Summary Line 32 for accumulation of quantities or costs).

The overhead and cost tables allow the optional statement of cost factors either as functions of salary or absolute values where explained on the forms. The final form, Figure 9-6, can be used if desired to plan the allocation of cost, first between outside grants and local share and then between multiple agencies that may be using the laboratory. The cost share formula can be based on any desired factor such as percent of population, crime or police in the region to be served.

Upon completion of the forms, the planner has options for their use ranging from manual through computer processing. These options are described in Section V.

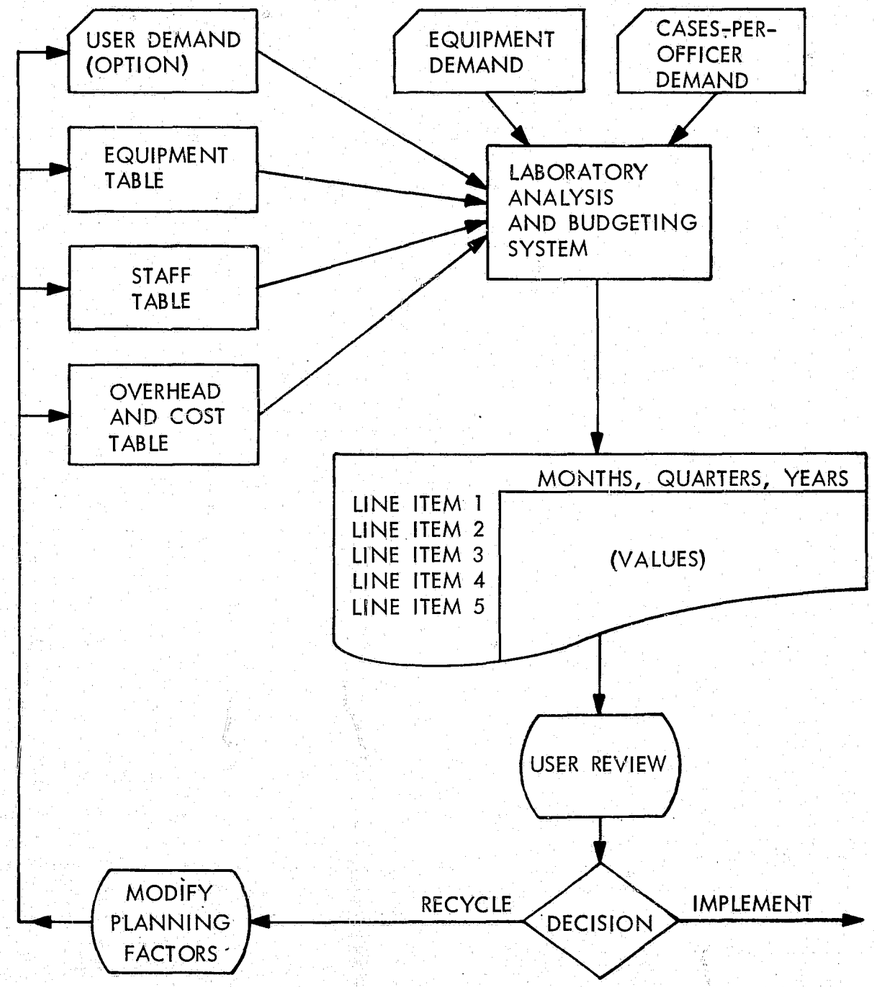


Figure 9-1 - Flow Chart of Laboratory Analysis and Budgeting System (LABS)

EQUIPMENT TABLE

DATE: _____

AGENCY _____ LABORATORY _____ LOCATION _____

EQUIPMENT TYPE: CENTRAL SERVICE ☐ FUNCTIONAL LAB ☐ _____ Function

INDIVIDUAL ☐ _____ Name or Function

LINE NO.	ITEM DESCRIPTION	QTY.	COST* (EACH)	PRIORITY (H,M,L)	TIME PERIOD(S) ACQUISITION	ADD INTO SUMMARY

*Include Required Accessories

ALLOWANCE FOR INSTALLATION _____ %

SUMMARIES DESIRED

LINE NO.	SUMMARY DESCRIPTION	ADD INTO NEXT LEVEL

Sheet _____ of _____

Figure 9-2 - Laboratory Analysis and Budgeting System

STAFF TABLE

DATE: _____

AGENCY _____ LABORATORY _____ LOCATION _____

LINE NO.	TITLE	NO. RQD	BASE SALARY	POLICE OR CIVILIAN	PROFESSIONAL OR SUPPORT	TIME PERIOD(S) START	ADD INTO SUMMARY

SUMMARIES DESIRED

LINE NO.	SUMMARY DESCRIPTION	ADD INTO NEXT LEVEL

Sheet _____ of _____

Figure 9-3 - Laboratory Analysis and Budgeting System

OVERHEAD AND COST TABLE - SUMMARY

DATE:_____

AGENCY_____ LABORATORY_____ LOCATION_____

FACTORS RELATED TO STAFF SALARIES

LINE NO.		CIVILIAN	POLICE
_____	Annual Increases as % of Salary	_____%	_____%
_____	*Fringe Benefits as % of Salary	_____%	_____%
_____	*Operating Expenses as % of Salary	_____%	
_____	*Recruitment Costs as % of New Staff Salaries	_____%	

*Use of These Gross Planning Factors is Optional. Specific Costs Can Be Itemized on Detail Sheet(s).

TOTAL COSTS

LINE NO.		$ TIME/PERIOD	% SALARY
_____	Fringe Benefits	_____	+ _____
_____	Extra Compensation	_____	
_____	Outside Technical Services	_____	
_____	Supplies	_____	
_____	Minor Equipment (Use Equipment Sheets for Major Items	_____	
_____	Office Equipment (Use Equipment Sheets for Major Items	_____	
_____	Other Laboratory Expenses	_____	
_____	Overhead	_____	
_____	Other Expenses	_____	

COST SUMMARIES DESIRED

LINE NO.	SUMMARY DESCRIPTION	ADD INTO NEXT LEVEL

Figure 9-4 - Laboratory Analysis and Budgeting System

OVERHEAD AND COST TABLE - DETAIL

FRINGE BENEFITS	POLICE PERSONNEL $ TIME/PERIOD	POLICE PERSONNEL % SALARY	CIVILIAN PERSONNEL $ TIME/PERIOD	CIVILIAN PERSONNEL % SALARY
Medical Insurance	_____	_____	_____	_____
Life Insurance	_____	_____	_____	_____
FICA	_____	_____	_____	_____
Pension	_____	_____	_____	_____
Other	_____	_____	_____	_____
*Totals	_____ +	_____	_____ +	_____

OTHER LABORATORY EXPENSES	$ TIME/PERIOD
Auto	_____
Travel	_____
Professional Development	_____
Library	_____
Long Distance Telephone	_____
Recruitment	_____ Or % Salary of New Hires Only_____.
Other	_____
*Total	_____

OVERHEAD	$ TIME/PERIOD
Utilities	_____
Insurance	_____
Rent (or Other Occupancy Expense)	_____
Custodial Services	_____
Maintenance and Repair	_____
Other	_____
General and Administrative Assessment	_____
*Total	_____

OTHER OPERATING EXPENSE (ITEMIZE)	$ TIME/PERIOD
*Total	

*Transfer All Totals to Summary Sheet

Figure 9-5 - Laboratory Analysis and Budgeting System

FUNDS SOURCE ANALYSIS

DATE: _____

AGENCY _____ LABORATORY _____ LOCATION _____

FUNDS ALREADY AVAILABLE

LINE NO.	SOURCE	AMOUNT

FEDERAL OR OTHER GRANT APPLICATIONS

LINE NO.	TITLE	SOURCE	AMOUNT	% LOCAL REQUIRED	TIME PERIOD EXPECTED

SHARE FROM USING AGENCIES

LINE NO.	AGENCY	COMMITMENT OR % USE*

*Based on Population, Crime, Police or Other Basis

Figure 9-6 - Laboratory Analysis and Budgeting System

Calculations and Accumulations

The computer version of LABS can accommodate up to 300 planning line items. A line item can be the quantity of a certain type of instrument, the initial cost and depreciation of an instrument, the percent of a criminalist's time that should be reserved for testimony in court, the salary of a certain class of labor; or the lines can be sums or functions of other lines, for example, percent of total man-hours available for bench work, total equipment cost, total labor cost, or total budget.

Using the above forms as input, LABS first totals staff by functional area and then by total laboratory. The staff salaries are accumulated and fringe benefits are added. Supporting staff and all costs are then calculated with overhead factors applied to result in a total capital and operating budget for the criminalistics operation.

As the LABS technique uses time increments, the cost can be displayed over several years with the influence of increased demand, increased capability, or inflationary factors illustrating their effect on the budget. Additional line items can also be used to depict expected sources of funds including federal or state grants and the remaining cost to be split between several jurisdictions.

The ease of changing a table or one of the line items and rapid processing enables LABS to be used to evaluate many alternatives. "What if" questions concerning capability, operation, budget, or support can be readily answered.

Reports

Reports that can be generated by LABS if the planning compiler is used are illustrated in Figure 9-7, representing a 2-1/2-year plan (10 quarters). As each page of the figure contains two computer outputs; they are discussed as (upper) and (lower) reports.

Page 1 (upper) is a report of the quantity of professional and support staff that will comprise the laboratory. Staff available to start the lab are shown in Quarter 1 while additions to the staff are scheduled into subsequent quarters.

Page 1 (lower) is a similar report reflecting the planned monthly salary of each staff category. Changes in salary due to planned salary growth factors are reflected in latter quarters.

Pages 2 and 3 contain the cost of specific items of equipment at the point in time at which the item will be added. Specific operating expenses are shown as allowances per quarter (i.e., Line 174 Reagents).

Page 4 is a summary of the plan and budget. It starts with the total number of professional and support staff, presents total salary figures per quarter, indicates cumulative salary costs for years one and two, and details the equipment purchases for each functional laboratory section. The last three lines present the total equipment and staff cost per quarter and accumulate the total cost for years one and two.

STAFF PLAN REPORT — REGIONAL CRIME LAB — L.A.B. MODEL - MAY 1970

PLANNING ITEM	0	1	2	3	4	5	6	7	8	9	10
MANNING SCHEDULE											
26 TOTAL NUMBER PROFESSIONALS	-0.0	10.0	15.0	18.0	18.0	18.0	20.0	20.0	20.0	20.0	20.0
27 DIRECTOR	-0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
28 ASSISTANT DIRECTOR-FIELD OP	-0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
29 ASSISTANT DIRECTOR-LAB. OP.	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
30 LABORATORY ANALYST I	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
31 LABORATORY ANALYST II	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
32 LABORATORY ANALYST III	-0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
33 LABORATORY TECHNICIAN	-0.0	0.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0
34 PHYSICAL EXAMINER I	-0.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35 PHYSICAL EXAMINER II	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
36 PHYSICAL EXAMINER III	-0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
41 PHYSICAL EXAMINER TECH	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
37 LATENT PRINTS COORDINATOR	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
38 DOCUMENTS III	-0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
45 DOCUMENTS I	-0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0
39 SECURE EVID TRANSIT OFFICERS	-0.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
40 CRIME SCENE EXAMINER II	-0.0	1.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
43 SATELLITE ANALYST I	-0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
46 SATELLITE SUPPORT OFFICER	-0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
42 TOTAL NUMBER SUPPORT	-0.0	2.0	4.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
44 PHOTOGRAPHIC TECHNICIAN	-0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
47 ADMINISTRATIVE ASSISTANT	-0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
48 STENOGRAPHER	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
49 CLERK/TYPIST	-0.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
23 CLERK/TYPIST SATELLITE	-0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
DIRECT SALARY BY SKILL											
2 DIRECTOR	1500	1500	1500	1500	1500	1590	1590	1590	1590	0	0
3 ASST. DIRECTOR-FIELD OP	1250	1250	1250	1250	1250	1325	1325	1325	1325	0	0
4 ASST. DIRECTOR-LAB OP	1250	1250	1250	1250	1250	1325	1325	1325	1325	0	0
5 LABORATORY ANALYST I	750.0	750.0	750.0	750.0	750.0	795.0	795.0	795.0	795.0	0.0	0.0
6 LABORATORY ANALYST II	900.0	900.0	900.0	900.0	900.0	954.0	954.0	954.0	954.0	0.0	0.0
7 LABORATORY ANALYST III	1200	1200	1200	1200	1200	1272	1272	1272	1272	0	0
8 LABORATORY TECHNICIANS	600.0	600.0	600.0	600.0	600.0	636.0	636.0	636.0	636.0	0.0	0.0
9 PHYSICAL EXAMINER I	750.0	750.0	750.0	750.0	750.0	795.0	795.0	795.0	795.0	0.0	0.0
10 PHYSICAL EXAMINER II	900.0	900.0	900.0	900.0	900.0	954.0	954.0	954.0	954.0	0.0	0.0
11 PHYSICAL EXAMINER III	1200	1200	1200	1200	1200	1272	1272	1272	1272	0	0
12 PHYSICAL EXAMINER TECH	600.0	600.0	600.0	600.0	600.0	636.0	636.0	636.0	636.0	0.0	0.0
13 LATENT PRINTS EXAMINER	900.0	900.0	900.0	900.0	900.0	954.0	954.0	954.0	954.0	0.0	0.0
14 DOCUMENTS III	1200	1200	1200	1200	1200	1272	1272	1272	1272	0	0
22 DOCUMENTS I	750.0	750.0	750.0	750.0	750.0	795.0	795.0	795.0	795.0	0.0	0.0
15 SECURE EVID TRANS OFFICERS	750.0	750.0	750.0	750.0	750.0	795.0	795.0	795.0	795.0	0.0	0.0
16 CRIME SCENE EXAMINER II	900.0	900.0	900.0	900.0	900.0	954.0	954.0	954.0	954.0	0.0	0.0
17 SATELLITE ANALYST I	750.0	750.0	750.0	750.0	750.0	795.0	795.0	795.0	795.0	0.0	0.0
24 SATELLITE SUPPORT OFFICER	750.0	750.0	750.0	750.0	750.0	795.0	795.0	795.0	795.0	0.0	0.0
18 PHOTO TECHNICIAN	600.0	600.0	600.0	600.0	600.0	636.0	636.0	636.0	636.0	0.0	0.0
19 ADMINISTRATIVE ASSISTANT	825.0	825.0	825.0	825.0	825.0	875.0	875.0	875.0	875.0	0.0	0.0
20 STENOGRAPHER	550.0	550.0	550.0	550.0	550.0	583.0	583.0	583.0	583.0	0.0	0.0
21 CLERK TYPIST	450.0	450.0	450.0	450.0	450.0	477.0	477.0	477.0	477.0	0.0	0.0
77 CLERK/TYPIST SATELLITE	450.0	450.0	450.0	450.0	450.0	477.0	477.0	477.0	477.0	0.0	0.0

Figure 9-7

LAB EQUIPMENT COST REPORT — REGIONAL CRIME LAB — L.A.B. MODEL — MAY 1970

PLANNING ITEM	0	1	2	3	4	5	6	7	8	9	10
PHYSICAL ANALYSIS EQUIP.											
218 TOTAL PHYSICAL EXAMINATION	0	11000	165	2915	165	8195	165	165	165	165	165
192 COMPARISON MICROSCOPE	0	5500	0	0	0	0	0	0	0	0	0
193 TORSION BALANCE	-0.0	150.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
194 MICROMETER	-0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
196 ETCHING REAGENTS + ASSESS.	-0.0	150.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
197 WOODEN FIREARMS BOX	-0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
198 MISCELLANEOUS	-0.0	100.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
199 STEREO MICROSCOPE	-0.0	800.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
195 MEASURING MICROSCOPE	0	0	0	1500	0	0	0	0	0	0	0
200 AMMUNITION	0	2000	50	50	50	50	50	50	50	50	50
MARKS + IMPRESSIONS											
204 TOTAL MARKS + IMPRESSIONS	0	1150	50	1050	50	7350	50	50	50	50	50
210 COMPARISON MICROSCOPE	0	0	0	0	0	5500	0	0	0	0	0
211 STEREO MICROSCOPE	-0.0	0.0	0.0	0.0	0.0	800.0	0.0	0.0	0.0	0.0	0.0
216 WORK BENCH + TOOLS	-0.0	1000.0	0.0	0.0	0.0	1000.0	0.0	0.0	0.0	0.0	0.0
217 MISCELLANEOUS	-0.0	1000.0	15.0	265.0	15.0	745.0	15.0	15.0	15.0	15.0	15.0
DOCUMENT ANALYSIS											
221 TOTAL DOCUMENT ANALYSIS	0	0	2300	125	125	125	125	125	125	125	125
223 LONG+SHORTWAVE LIGHT SOURCE	-0.0	0.0	200.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
229 MEASURING PLATES	-0.0	0.0	300.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
236 STEREO MICROSCOPE	-0.0	0.0	800.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
242 REFERENCE FILES	-0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
243 MISCELLANEOUS	-0.0	0.0	1000.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0	125.0
CRIME SCENE ANALYSIS											
108 TOTAL CRIME SCENE SERVICE	0	7450	6550	6650	450	450	450	450	450	450	450
98 PHOTOGRAPHIC EQUIPMENT	0	2000	1000	1000	0	0	0	0	0	0	0
109 VEHICLE OPERATING EXPENSE	-0.0	100.0	200.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0
110 STATION WAGONS	0	3000	3000	3000	0	0	0	0	0	0	0
111 EQUIPMENT IN WAGONS	-0.0	1000.0	1000.0	1000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
112 RADIOS	0	1200	1200	1200	0	0	0	0	0	0	0
113 SUPPLIES + MISC.	-0.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0
PHOTOGRAPHIC LABORATORY											
117 TOTAL PHOTOGRAPHIC EQUIP.	0	3400	100	100	100	100	100	100	100	100	100
105 ENLARGER, 4X5	-0.0	1000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
104 4X5 TWIN	-0.0	1000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
114 ENLARGER	-0.0	500.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
118 DRYER, PRINT	-0.0	250.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
119 DRYER, FILM	-0.0	750.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
103 MISC	-0.0	500.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
107 WASHER, PRINT	-0.0	200.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 9-7 (Continued)

LAB EQUIPMENT COST REPORT — REGIONAL CRIME LAB — L.A.B. MODEL — MAY 1970

PLANNING ITEM	0	1	2	3	4	5	6	7	8	9	10
EQUIPMENT-CHEMICAL ANALYSIS											
152 TOTAL CHEM. ANALYSIS EQUIP	0	37980	1080	9480	5940	15300	28740	900	21300	900	900
121 BALANCE+GEN + ANALYTICAL	-0.0	900.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
122 GLASSWARE	-0.0	600.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
123 CENTRIFUGE	-0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
124 PAPER + THIN FILM CHROMAT.	-0.0	250.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
125 MISC HARDWARE	-0.0	1000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
127 COLORIMETER - SPECTROPHOTO.	-0.0	500.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
128 MUFFLE FURNACE	-0.0	0.0	0.0	0.0	0.0	0.0	200.0	0.0	0.0	0.0	0.0
129 HOT PLATES	-0.0	150.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0
131 ULTRAVIOLET LAMP	-0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
132 DRYING OVEN	-0.0	200.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
133 MICROSCOPES- GENERAL STEREO	-0.0	800.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
134 MICROSCOPE - CHEMICAL POLAR.	0	5000	0	0	0	0	0	0	0	0	0
135 HOT WATER (STEAM BATH)	-0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
138 REFRACTOMETER	-0.0	800.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
139 DIFF. THERMAL ANALYSIS	0	0	0	0	0	0	0	0	7000	0	0
140 REAGENTS	-0.0	400.0	200.0	200.0	200.0	50.0	50.0	50.0	50.0	50.0	50.0
141 UV RECORDING SPECTRO.	0	0	0	7000	0	0	0	0	0	0	0
142 IR RECORDING SPECTROPHOTOMTR	0	8000	0	0	0	0	0	0	0	0	0
130 CAHN MICROBALANCE	0	1100	0	0	0	0	0	0	0	0	0
143 GC- VERSATILE	0	8000	0	0	0	0	0	0	0	0	0
137 RECORDER	0	2500	0	0	0	0	0	0	0	0	0
144 GC- DEDICATED	0	0	0	0	4000	0	0	0	0	0	0
153 VACUUM PUMP	-0.0	250.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
154 VACUUM DRYING OVEN	-0.0	300.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
145 X-RAY DIFFRACTION	0	0	0	0	0	12000	0	0	0	0	0
146 EMISS SPEC W/DENSITOMETER	0	0	0	0	0	0	15000	0	0	0	0
147 ANALYSIS BY COMPUTER	600.0	600.0	600.0	600.0	600.0	600.0	600.0	600.0	600.0	600.0	600.0
148 ATOMIC ABSORPTION	0	0	0	0	0	0	8000	0	0	0	0
149 SPECTRO PHOTO FLUORIMETER	0	0	0	0	0	0	0	10000	0	0	0
151 INSTALLATION	0	6330	180	1580	990	2550	4790	150	3550	150	150
EQUIPMENT- BIOLOGICAL ANALY.											
181 TOTAL BIO. ANALYSIS EQUIP	0	7172	352	1562	242	1947	462	3487	187	187	187
160 GLASSWARE + PLASTICWARE	-0.0	200.0	200.0	100.0	100.0	50.0	50.0	50.0	50.0	50.0	50.0
161 CENTRIFUGE	-0.0	100.0	0.0	0.0	0.0	300.0	0.0	0.0	0.0	0.0	0.0
136 REFRIGERATOR	-0.0	250.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
163 MISC. HARDWARE	-0.0	1000.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0
168 CONTROLLD TEMPERATURE BATH	-0.0	0.0	0.0	200.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
169 PH METER	-0.0	0.0	0.0	0.0	0.0	200.0	0.0	0.0	0.0	0.0	0.0
170 UV LAMP	-0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
171 DRYING OVEN	-0.0	300.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
172 MICROSCOPE-GENERAL STEREO	-0.0	800.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
173 MICROSCOPE - BIOLOGICAL	0	3000	0	0	0	0	0	0	0	0	0
174 REAGENTS	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0
176 REFRIGERATOR W/DEEP FREEZE	-0.0	500.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
178 AUTOCLAVE	-0.0	0.0	0.0	0.0	0.0	0.0	250.0	0.0	0.0	0.0	0.0
179 SCOPE W/MICROMANIPULATOR	0	0	0	0	0	1000	0	3000	0	0	0
180 MISCELLANEOUS	-0.0	652.0	32.0	142.0	22.0	177.0	42.0	317.0	17.0	17.0	17.0
182 ELECTROPHORESIS	-0.0	0.0	0.0	1000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
175 ROTATOR	-0.0	150.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 9-7 (Continued)

SUMMARY REPORT REGIONAL CRIME LAB L.A.B. MODEL - MAY 1970

PLANNING ITEM	0	1	2	3	4	5	6	7	8	9	10
74 TOTAL NUMBER OF EMPLOYEES	-0.0	12.0	19.0	25.0	25.0	25.0	27.0	27.0	27.0	27.0	27.0
76 TOTAL NUMBER PROFESSIONALS	-0.0	10.0	15.0	18.0	18.0	18.0	20.0	20.0	20.0	20.0	20.0
42 TOTAL NUMBER SUPPORT	-0.0	2.0	4.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
84 TOTAL MONTHLY SALARY + FRING	0	11330	19430	25298	25298	26917	28463	28463	28463	0	0
50 TOTAL SALARY-PROF/MONTH	0	8300	13250	16550	16550	17543	18974	18974	18974	0	0
46 TOTAL SALARY-SUPPT/MONTH	0	1000	2350	4075	4075	4320	4320	4320	4320	0	0
296 TOTAL POLICE SALARY	0	6350	8000	8900	8900	9434	9434	9434	9434	0	0
220 TOTAL CIVILIAN SALARY	0	2950	8200	12325	12325	13065	14496	14496	14496	0	0
92 POLICE MONTHLY FRINGE	0	1587	2000	2225	2225	2358	2358	2358	2358	0	0
92 CIVILIAN MONTHLY FRINGE	0	442	1230	1848	1848	1959	2174	2174	2174	0	0
76 TOTAL MTLY SALARY + FRINGE	0	33990	58290	75896	75896	80452	85389	85389	85389	0	0
261 1ST YEAR COST	0	33990	92280	168177	244074	0	0	0	0	0	0
262 2ND YEAR COST	0	0	0	0	0	80452	165841	251230	336619	0	0
259 TOTAL EQUIPMENT PURCHASE CST	0	56152	3897	14082	6472	25567	29492	4677	21777	1377	1377
153 TOTAL CHEM. ANALYSIS EQUIP	0	37980	1080	9480	5940	15300	28740	900	21300	900	900
141 TOTAL BIO. ANALYSIS EQUIP	0	7172	352	1562	242	1947	462	3487	187	187	187
218 TOTAL PHYSICAL EXAMINATION	0	11000	165	2915	165	8195	165	165	165	165	165
221 TOTAL DOCUMENT ANALYSIS	0	0	2300	125	125	125	125	125	125	125	125
104 TOTAL CRIME SCENE SERVICE	0	7450	6550	6600	450	450	450	450	450	450	450
117 TOTAL PHOTOGRAPHIC EQUIP.	0	3600	100	100	100	100	100	100	100	100	100
251 TOTAL EQUIP + STAFF COST	0	90142	62197	89978	82368	106019	114881	90066	107166	1377	1377
268 EQUIP AND STAFF COST YEAR 1	0	0	0	0	324677	0	0	0	0	0	0
272 EQUIP AND STAFF COST YEAR 2	0	0	0	0	0	0	0	0	418132	0	0

Figure 9-7 (Concluded)

APPENDIX 10

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