Forensic Laboratories: Handbook for Facility Planning, Design, Construction, and Moving

U.S. Department of Justice
Office of Justice Programs
National Institute of Justice

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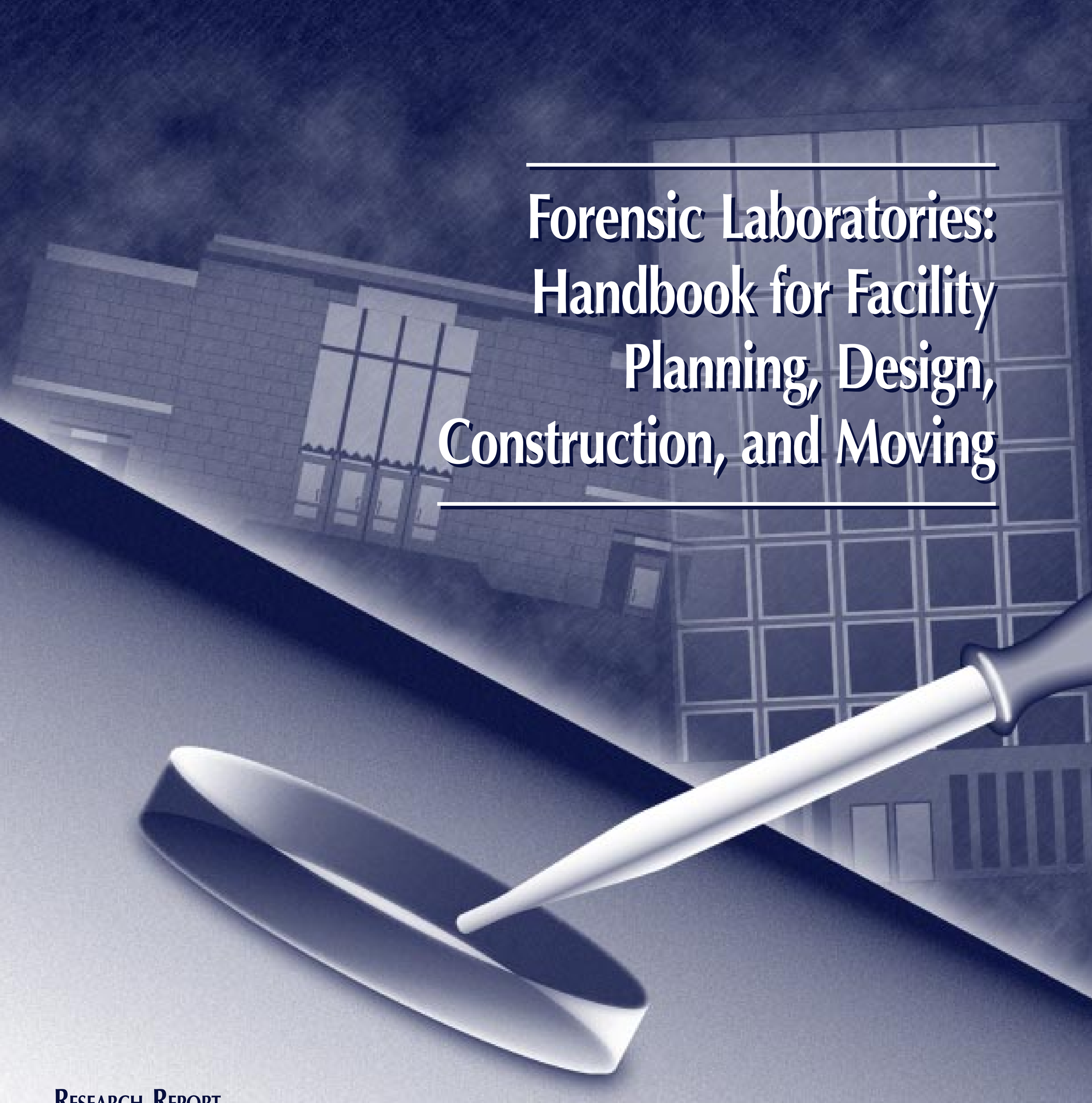

RESEARCH REPORT

National Institute of Justice
Department of Justice

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U. S. Department of Justice
Office of Justice Programs
810 Seventh Street N.W.
Washington, DC 20531

Janet Reno
Attorney General
U.S. Department of Justice

Raymond C. Fisher
Associate Attorney General

Laurie Robinson
Assistant Attorney General

Noël Brennan
Deputy Assistant Attorney General

Jeremy Travis
Director, National Institute of Justice

Office of Justice Programs
World Wide Web Site:
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Forensic Laboratories: Handbook for Facility Planning, Design, Construction, and Moving

Law Enforcement and Corrections
Standards and Testing Program

Coordinated by
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Jeremy Travis
Director

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This report was prepared with the assistance of the Office of Law Enforcement Standards (OLES) of the National Institute of Standards and Technology (NIST) under the direction of Alim A. Fatah, Program Manager for Chemical Systems and Materials, and Kathleen M. Higgins, Director of OLES. Editorial support was provided by Aspen Systems Corporation.

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David G. Boyd, Director, Office of Science and Technology.

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Foreword

As president of the American Society of Crime Laboratory Directors (ASCLD) during 1995–96, I received numerous requests for information on many topics. Information on forensic laboratory design was one of the more frequently requested items.

The need for a document that dealt with the many aspects of building a new laboratory was obvious. I requested assistance from Dr. Richard Rau at the National Institute of Justice to develop such a document. Under Dr. Rau's direction and through the leadership of Kathleen Higgins, Director, Office of Law Enforcement Standards (OLES), this project was funded by the National Institute of Standards and Technology/OLES. Additionally, they provided support and direction throughout the development of this document.

The document, *Forensic Laboratories: Handbook for Facility Planning, Design, Construction, and Moving*, is the product of a 2-day seminar where 23 professionals met, divided into four groups, and created this handbook. The handbook is **not a standard** but a resource for those faced with building a new facility or the redesign of an existing facility. Each group had its own style, so each section has its own unique format. It is our hope that this document will help laboratory managers maximize organizational efficiency, ensure the economical expenditure of resources, and develop a safe, secure, and well-designed facility. We hope that the resulting facilities will provide adequate space for forensic scientists to perform their very important tasks today and will include adaptability for tomorrow as technologies change.

I appreciate the time and effort the committee members and participants have given to this project, the work of the outside reviewers from Harley Ellington Design, and the editorial support of Aspen Systems Corporation.

*   *   *   *   *

One committee member, Dr. William J. "Bill" Hartner, who has served the forensic science community for 37 years, passed away on February 28, 1997. Everyone deeply mourns his passing and applauds his personal achievements and the tremendous impact he had on forensic science. He was past president of ASCLD, 1993–94, and was commander of Metro-Dade's Crime Laboratory Bureau, where he had served since 1960.

We therefore dedicate this document to the wonderful memory of :

Dr. William J. Hartner
February 10, 1935–February 28, 1997

Carrie Morgan Whitcomb
Past President 1995–96
ASCLD

Technical Working Group

Victor Cardona
Smith, Hinchman & Grylls
Washington, D.C.

Kenneth G. DeBoer
Earl Walls Associates
San Diego, California

Dr. Alim A. Fatah
NIST/OLES

Frank Fitzpatrick**
Orange County
Sheriff/Coroner
Forensic Science Services

Dr. William Hartner*
Laboratory Bureau
Metro-Dade Police
Department

Kathleen M. Higgins
NIST/OLES

Dr. Mitchell Holland
Armed Forces DNA
Identification Laboratory

Robert Horn*
Crime Laboratory
New York State Police
(Retired)

Robert A. Jarzen
Sacramento County
Laboratory of Forensic
Services

John Klosterman
Illinois State Police
Forensic Sciences Command

James L. McClaren
Ruth and Going, Inc.
McClaren & Wilson, Inc.

Michael Mount
AIA
Smith, Hinchman &
Grylls Southwest Inc.

Dr. Richard Rau
National Institute of Justice
Office of Science
and Technology

Dr. Dennis Reeder
NIST/Chemical Science and
Technology Laboratory
Biotechnology Division

Earl Roberts
FBI Laboratory

Dr. Carl M. Selavka
New York State Division of
Criminal Justice Services
Office of Forensic Services

Michael R. Somin
Earl Walls Associates
San Diego, California

Rich Tanton*
Palm Beach Sheriff's
Department
Crime Laboratory

Dr. Victor W. Weedn
Department of Defense
DNA Registry

Carrie Whitcomb*
U.S. Postal Inspection
Service Crime Laboratory

Joseph Wichmann
Illinois State Police
Joliet Forensic Science
Laboratory

Dan Wierec
Walsh Construction

Dr. Richard Wilk
New York City Police
Laboratory

* Past President, ASCLD
** President-elect, ASCLD

Executive Summary

The measure of a forensic laboratory's success is how well it meets the current and future needs of the occupants.

Designing and building a forensic laboratory is a complicated undertaking. Design issues include those considerations present when designing any building, with enhanced concern and special requirements involving environmental health and safety,[1] hazardous materials, management, operational efficiency, adaptability, security of evidence, preservation of evidence in an uncontaminated state, as well as budgetary concerns.

To help laboratory directors get through the process, the National Institute of Justice (NIJ), the National Institute of Standards and Technology (NIST)/Office of Law Enforcement Standards (OLES), and the American Society of Crime Laboratory Directors (ASCLD) held a joint workshop November 13–14, 1996 at NIST in Gaithersburg, Maryland, to develop guidelines for planning, designing, constructing, and moving crime labs.

The guidelines serve as a general tool to which forensic laboratory directors can refer when considering building a new laboratory or refurbishing an existing one. There is not one universally correct plan for forensic laboratory design. No two labs are the same. Technical laboratories such as toxicology, biological science/DNA, firearms analysis, or trace evidence have specialized needs unique to their areas of work. Ultra-clean rooms or higher levels of containment may be required for some analytical procedures. Highest performance standards are required for cleanliness, temperature, humidity, and vibration controls to create an environment suitable for forensic science.

Staff needs and functional processes are the driving factors. From the start, the scientists who will occupy the building should be involved with the design/build team to explain their special requirements for the laboratory.

Flexibility is also a key element in driving a forensic laboratory's design and configuration. Crime labs must be designed with the flexibility to support adaptability and change or risk obsolescence in a few years.[2]

At the beginning of the process, it should be decided whether the project is driven primarily by needs or budget. Will the needs of the laboratory determine the budget, or is the budget preset and the laboratory economically limited to a specific amount at the outset?

The technical work performed in forensic laboratories must be able to withstand any evidentiary challenge. When detailing the needs of the laboratory, be ready to defend those needs against questions that will arise because of the cost involved. Quality laboratory service is expensive, and the buildings in which these services are provided tend to be expensive as well. Cost-cutting that would jeopardize the lab's testing quality cannot be an option.

The guidelines in this handbook are designed to empower laboratory managers to improve their situation. They are designed to safeguard the integrity and objectives of the profession, maximize organizational efficiency, ensure economical expenditure of resources, and provide a safe working environment for employees.

Overview

The process of constructing a new forensic laboratory revolves around four general activities: *planning, design, construction,* and *moving.* Specific activities vary within each phase of the process, and each stage is discussed in detail in the following pages. Throughout the process, from conception through opening day, careful planning and excellent communication among those involved are critical to success.

Planning. The key to a successful planning stage is the preparation of a *Needs Assessment/Design Program,* two documents frequently combined into one that form the baseline for the project. The *Needs Assessment* documents user and facility needs, evaluates the existing facility, defines space requirements, and provides project cost data. The *Design Program* provides a guide to design the project, translating and expanding the *Needs Assessment* into a form that will be used by architects and engineers in the design process. The *Needs Assessment/Design Program* may initially be an idealized statement of requirements that will later need to be reconciled to the actual budget or resources available.

Design. There is not one universally correct plan for forensic laboratory design. Design will vary with each laboratory's specific needs. Functional requirements of specific scientific disciplines, equipment, and instrumentation are a few of the variables that generate space, dimension, and adjacency requirements that impact the overall design. Hazardous materials handling and preservation of evidence are just two of the many variables that need to be considered. The future also needs to be considered. A forensic laboratory must be designed with the flexibility to change along with the needs of its occupants, technology, or scientific methodologies.

Construction. Following acceptance of bids and contract negotiation, construction can begin in earnest. The construction stage offers a last chance before occupancy to make changes to the proposed lab structure that were missed in the construction documents or during the planning and design stages. Every change has a potential financial consequence. Some changes may be too costly to make. Each laboratory's situation is unique. Changes to local and State regulations may also affect each construction project. Be ready for unforeseen issues that may affect construction such as subsurface conditions or obstructions. Fixtures, furnishings, and equipment will also need to be budgeted for and purchased. An evaluation process and criteria to ensure that the contractors are qualified to complete the job as specified must be established.

Moving. Laboratory work must continue even as the shift is made from the old facility to the new. Develop a strategic plan for the move. Phase and schedule move activities so that routine daily events occur as smoothly and efficiently as possible. Consider the tasks and activities, the order in which they need to be accomplished, and who is going to be responsible for them. The plan can be divided into premove, move, and postmove activities. Always keep in mind the date that the move needs to be completed.

Planning

Designing and building a forensic science laboratory can be an enormous undertaking. Careful planning is critical to success. Staff needs are the driving factor. From the start, the scientists who will occupy the building should be involved with the design/build team to explain their needs and special requirements for the laboratory. It is crucial to take the necessary time on the front end of the process to gather this important information.

Key to the planning stage is a *Needs Assessment/Design Program*, two documents frequently combined into one that form the baseline for the project and are used throughout the entire process. The *Needs Assessment* documents the requirements for the facility. The *Design Program* provides a guide to design the project. Keep the document simple and straightforward—the people with budgetary authority need to understand it.

What follows is a suggested approach for forensic science laboratory directors to use for the planning stage. Presented in a question and answer format, it covers the essential, basic elements of the planning process that directors need to know.

1. **QUESTION:** I have a need for new facilities now—what do I need to do and where should I be heading to assure success?

   ANSWER: Perform a preliminary self-evaluation to define the "mission" of operations/organization and detail your current, past, and future operations.

2. **QUESTION:** If my self-evaluation reveals the need for new/expanded space, what do I do?

   ANSWER: Plan to develop an *Architectural/Engineering Needs Assessment and Design Program.*

3. **QUESTION:** What is a *Needs Assessment?*

   ANSWER: [Definition] *Needs Assessment*—An essential planning tool that must be developed by independent professionals who have requisite experience that quantifies and evaluates operations and ultimately projects present and future requirements.

   The *Needs Assessment* is a planning, developmental, and political tool. It assesses user and facility needs, assesses the existing facility, defines all space requirements, provides project cost data, and accounts for external influences such as building codes.

4. **QUESTION:** What is a *Design Program?*

ANSWER: [Definition] *Design Program*—A document that translates and expands the *Needs Assessment* into a form that will be used by architects and engineers.

The *Design Program* defines design requirements and contains comprehensive information for the architect and engineers. Both the *Needs Assessment* and *Design Program* require extensive input from lab staff; these two documents are frequently combined into one.

5. **QUESTION:** What do I do to get the program started?

ANSWER: Assemble an internal team to develop a Request for Proposals (RFP) for conducting an *Architectural/Engineering Needs Assessment/Design Program.*

6. **QUESTION:** What criteria need to be considered in the RFP?

ANSWER: The criteria to be considered in the RFP should include:

Health/Safety (Liability Issues).

Codes.

Technologies (existing and projected new).

Crime Trends.

Existing Constraints: financial, personnel, location, etc.

7. **QUESTION:** After the consultant selection is made, then what?

ANSWER: Assemble the best team to conduct an *Architectural/Engineering Needs Assessment/Design Program.*

Identify Members of the Team.

- ✧ Client Representative/Steering Committee, examples could include:
  - Laboratory representative.
  - Facilities.
  - Public works.
  - Budget.
  - Contracts.
  - Data/Telecommunications.
  - Security.

- ✧ *Needs Assessment/Design Program* Team.
  - Architectural/Programmer/Engineer.
  - Cost Consultant.
  - Others as needed—environmental/traffic.

Establish a practical budget to use to retain the consultant team that will conduct the *Architectural/Engineering Needs Assessment/Design Program* (The Study).

Define the Duration of Program (Study).

8. QUESTION: What can I expect as I start the *Needs Assessment/Design Program?*

ANSWER: The *Needs Assessment/Design Program* must:

Demand full user/client participation.

Show that the final product is not just a customer "wish list"—(provide justification for size/cost).

Result in resolving issues related to: expansion, splitting operations, renovations/expansion, or building a new facility.

Include answers to How big?; Estimated cost?; Site Evaluation/Selection—where should the building be placed?

9. QUESTION: What is the process for developing the document that comes from the *Needs Assessment/Design Program?*

ANSWER: There is a Three-Step Process for *Needs Assessment/Design Program* (the document).

Data Gathering.

- ✧ Questionnaires.
- ✧ Management and staff interviews.
- ✧ Comparable facility tours.
- ✧ Existing facilities assessment.
- ✧ Users must be involved in process, not just management.

Data Synthesis.

- ✧ Assemble and organize data.
- ✧ Develop data into usable and meaningful information.
- ✧ Draw conclusions and then test/check the *Needs Assessment/Design Study* against:
  - Mission/goals.
  - Operational needs.

- Standards, operational codes.
- Resource constraints.

Document Preparation.

- ✧ Assemble synthesized data into a usable draft document.
- ✧ Review, correct, and issue final document.

10. QUESTION: What do the elements of the document include?

ANSWER: Elements of the document should include:

Preface.

- ✧ Introductory Statements.
  - Statement of authorization to perform the study.
- ✧ Identification of the Team.
  - Architect, engineers, consultants, etc.
- ✧ Acknowledgments.

Executive Summary.

- ✧ Introduces the Project.
  - What the project consists of.
  - Summary of legal issues.
  - Accreditation requirements.
  - National technical working groups, e.g., Technical Working Group on DNA Analysis Methods (TWGDAM), Technical Working Group on Materials (TWGMAT).
- ✧ Description of Existing Facilities.
  - Overcrowding, safety and security concerns, inability to meet codes, recent changes in technology, crime trends, liabilities, accreditation issues, etc.
- ✧ Mission Statement.
  - Assist investigations.
  - Testify in court.
  - Discuss chain-of-custody requirements.
  - Explain difficulty or impossibility of accomplishing mission under existing conditions.
- ✧ Summarize All Conclusions.
  - Area.
  - Staff.

- Site.
- Budget.

✧ Provides the "Bottom Line."

- Decision makers should be provided with all the information necessary to make informed decisions. That information should appear in the executive summary.

Objectives and Methodology.

✧ State Goals and Objectives of the Study.

- *Needs Assessment*.
- *Design Program.*
- Define both.

✧ Identify Methodology.

- State all tasks accomplished to create the document.

✧ Three-Step Process.

- Describe in detail.

Trends and Influences (demographics).

✧ Analyze Emerging Social, Economic, Political, Population, Environmental, and Crime Trends.

- Describe purpose.
- Describe methodology.

✧ Relate Data to Staff and Facility Needs.

- Show how trends affect individual laboratory sections and impact future requirements.
- Relate data to individual and overall caseload.
- Relate data to facility needs regarding expansion and flexibility.

✧ Project Future Needs.

- Relate data to new size and nature of facility and staff.

Facility and Space Descriptions.

✧ Describe the Entire Facility in General Terms. (Provide as much narrative information as possible to tell the designers what is unique and unusual about the laboratory.)

✧ Describe Nomenclature and Acronyms.

✧ Organization Chart.

- Chart is an introduction to descriptions of laboratory spaces.

- ✧ Description of Spaces by Laboratory Sections (see Appendix I).
  - Describe purpose and function of each laboratory section.
  - Provided so that design team will have better understanding.
- ✧ Space Data Sheets.
  - Explain that these sometimes are used in lieu of space descriptions and equipment data sheets.

Designer Guidelines—Define Special Requirements: covers architectural, ventilation, mechanical, plumbing, and electrical design requirements and includes those design requirements necessary to implement the facility's security strategy. Adaptability needs to be emphasized to allow for interior and exterior changes, flexibility to expand.

- ✧ Safety, Security, and Adaptability.
  - Describe primary design objectives.
  - Examples regarding safety:
    - ❍ Fume hoods and biological safety cabinets.
    - ❍ Emergency deluge shower and eyewashes.
    - ❍ Passage widths between laboratory benches.
  - Examples regarding security.
    - ❍ Passive security design features.
    - ❍ Electronic security design features.
    - ❍ Proximity access systems.
    - ❍ Site security features including landscape design.
  - Examples regarding adaptability.
    - ❍ Need for flexibility in each section, e.g., DNA.
    - ❍ Need for expansion of facility.
    - ❍ Growth trends in forensic science.
- ✧ Building and Site.
- ✧ Overall Laboratory.
- ✧ Crime Laboratory Sections.
- ✧ Special Plumbing, Mechanical, Electrical, and Structural.
- ✧ Unusual or Unique Features.

Space Standards.

- ✧ Generic Office or Nonlaboratory Standards.
- ✧ Laboratory Space Standards (customary—Federal requirements, State requirements, county requirements, etc.).

Adjacencies.

- ✧ Internal—Define what components/sections of the building need to be placed next to each other.
  - Evidence flow.
  - Work flow.
  - Promotion of staff interaction(s)/interactions with supervisor(s).
  - Compartmentalization/public access.
- ✧ External—Relationship to Client, e.g. Medical Examiners/ Law Enforcement/District Attorney/Courts/etc.

Equipment Data Sheets.

- ✧ Present and Future Equipment.
- ✧ Manufacturer's Data/Field Examination of Equipment/ Manufacturer's Specifications.

Move-in and Future Staff Needs.

- ✧ Define Milestones.

Move-in and Future Space Needs.

- ✧ Define Milestones.

Site Analysis (NOTE: Issues associated with site analysis may require a more extensive or separate document).

- ✧ Location and Access Analysis.
  - Is the site acceptable in terms of its location?
  - Is the proper and required access to the site available?
- ✧ Assessment of Existing Physical Features and Conditions.
  - Topography.
  - Vegetation.
  - Rock outcroppings.
  - Surveys.
  - Geotechnical analysis.

- ✧ Analysis of Building Coverage and Location on the Site.
  - Allowable coverage per codes and ordinances.
  - Where is the best location on the site for the building?
- ✧ Parking Requirements.
  - Codes and ordinances.
  - Practical parking needs (safety, etc.).
  - Evidence delivery parking.
- ✧ Landscape Requirements.
  - In terms of security.
  - Practical issues: leaves, pollen, etc.
- ✧ Site Security Issues.
  - Site CCTV surveillance.
  - Fence enclosures and security gates.
  - Secured parking.
- ✧ Public Access.
  - Public transportation.
  - Highways—easily accessed.
- ✧ Who Are My Neighbors?—Various Considerations/Public Relations.
- ✧ Outdoor Air Quality Issues—e.g., Industrial Emissions.
- ✧ Other "On-Site Resources" or Proximities.
  - Training academy.
  - Conference facilities.
  - University resources.
  - Lodging.
  - Dining/restaurants.

Special Studies—Examples To Include.

- ✧ Multistory vs. Single-Story Building.
- ✧ Environmental Impact.
- ✧ Protection from Terrorist Access and Proximity.
- ✧ Construction Phasing Analysis.
- ✧ Incinerator Study.

- ✧ Migration Studies.
  - How to move people.
  - Impacts on staff.

Establish a Reasonable Construction Budget (Range of Costs, Alternatives).

- ✧ Square Footage Cost Estimate.
  - Simple estimate based on estimated cost per square foot.
- ✧ Materials and Systems Take-Off Cost Estimate.
  - Professional estimator provides complete take-off estimate.

11. QUESTION: How can I get just a rough idea of how big my crime lab should be?

ANSWER: Over the past 5 to 10 years the numerous forensic laboratories that have been designed and constructed seem to point to a space ratio based on area per staff member. This ratio for most new facilities tends to fall within the range of 65.03 to 92.90 m^2 (700 to 1000 ft^2) per staff member. In "Forensic Sciences Progress 5" (Springer-Verlag, 1991), the ratio of 92.90 m^2 (1000 ft^2) per staff member is offered as a recommended standard. This ratio refers to gross square feet, not net square feet, and therefore, accounts for a prorated portion of circulation corridors, mechanical rooms, toilet rooms, lobbies, etc., for each technical and support staff member. It must be understood, however, that this ratio represents only a very loose rule of thumb that can be drastically affected by a number of variables. For example, laboratories with large amounts of low occupant space, such as evidence storage or vehicle examination bays, will unrealistically skew the ratio. The only way to fully and accurately assess space needs is through the *Needs Assessment* and *Design Program* process.

Design

Introduction

A variety of functional elements can drive the architectural and engineering designs of a forensic laboratory. Functional requirements of scientific disciplines, equipment, and instrumentation are just a few of the variables that generate space, dimension, and adjacency requirements that affect the overall design. There is not one universally correct plan for a forensic laboratory design, as individual cases will differ according to the needs of the users. For example, technical laboratories such as toxicology, biological science, and firearms analysis have specific needs unique to their specialized areas of work. The success and efficiency of a forensic laboratory depends on designing a layout that supports and optimizes the individual laboratory's particular fields of expertise. During review of this section, the reader is encouraged to refer to the Laboratory Design Standards and Modules document found in Appendix II.

Flexibility should be a key element in driving a forensic laboratory's design and configuration. In recent years, one message in particular has been made clear to the scientific, architectural, and building industry professions: Today's forensic laboratories must be designed with the flexibility to support adaptability and change. Adaptability in a laboratory is a function of how the buildings, rooms, and systems can grow and change with the needs of its occupants. For example, over the past 2 years scientific advancement in the field of DNA research has forced forensic laboratories to adapt to new designs in order to decrease the risk of contamination and ensure the accuracy of technical data. As science and technology advance, forensic laboratories must be capable of embracing the future, or risk falling into obsolescence.

Although the laboratory building presents some very complex and challenging design issues, elements of the site design must also be addressed in order to ensure a successfully designed forensic laboratory facility. Issues such as site access, proximity of secured and unsecured parking areas, and even landscaping have implications regarding the efficiency and security of the overall site and building design.

It cannot be overemphasized that the design standards presented herein are merely *recommended guidelines.* Although different laboratories possess many identical and similar characteristics, there may be other characteristics that are considered unique to a particular laboratory. The uniqueness of a laboratory is generally dictated by differing laboratory procedures (for example, one laboratory might be doing both Restriction Fragment Length Polymorphism (RFLP) and Polymerase Chain Reaction (PCR) procedures in their DNA analysis, while another might be doing only PCR); or administrative policy (for example, one laboratory might require that all in-process evidence be returned to a central vault at the end of the day, while another might allow for it to be stored in individual lockers within the laboratory work space).

Building site conditions and characteristics might also show similarities from one laboratory to another, yet in some instances sites might be completely dissimilar. For example, a regional laboratory facility might be located on a spacious rural site, while another laboratory might occupy space in a high-rise urban building. The designers must review all of these recommended design guidelines with appropriate laboratory staff to determine their applicability to that particular laboratory.

Site Design

- Site access.
  - ✧ It is desirable that the site be designed with access from at least two directions to ensure access to the site despite traffic conditions, street maintenance work, acts of sabotage, or other unforeseen site disruptions.

- Emergency and service access.
  - ✧ Coordinate with laboratory staff and local authorities to ensure emergency access for fire department and other emergency vehicles. Access for shipping and receiving must comply with code requirements without compromising site security.

- Site lighting.
  - ✧ The site lighting should be designed to enhance security and discourage vandalism and unauthorized entry. Lighting comparable to that of a college campus offering night classes might serve as a guideline.

- Landscape design.
  - ✧ Landscaping should be designed to enhance site security by preventing potential vandals, burglars, and saboteurs from hiding in the landscaping until after dark. The following types of landscape design should be avoided:
    - Dense shrubbery within 3.048 m (10 ft) of the building or any security fence.
    - Large clusters of shrubbery, 0.61 m (2 ft) to 1.83 m (6 ft) high.
    - Tall evergreens with branches less than 1.52 m (5 ft) above grade.

- Parking design.
  - ✧ Like landscaping, the design of parking areas should consider site security requirements. The following are recommended levels of security for parking:
    - Level 1, unsecured. Visitor parking located near the visitors' entrance to the building allowing entry and departure without security barriers.
    - Level 2, partially secured. Fenced area for use by persons having business at the facility. For example, shipping and receiving, biological and toxic waste pickup, dumpster replacement, and evidence delivery. The area should be gated, and the gate may be left open during business hours and locked after hours. Access might be through the level 1 parking area.
    - Level 3, secured. Staff parking area secured 24 h, surrounded by a security fence, and accessible by use of a proximity or card key device. Depending on security policy, this level might be eliminated, and staff could park in the level 2 parking area.
    - Level 4, high security. Vehicle impound parking with limited personnel access and monitored security systems.

General Building Design

- Exterior walls.
  - ✧ Materials. Bullet-resistant, such as concrete or fully grouted masonry.
  - ✧ Windows. Reflective and/or bullet-resistant glazing where exposed to public view.
  - ✧ Window sill design. Windows should be installed flush with the exterior surface of the wall, or if recessed, provide a sloped exterior sill to prevent the placement of explosives at the window.
- HVAC intakes.
  - ✧ Locate in areas inaccessible to the public, such as in secured fenced areas. Design to prevent the possibility of someone introducing a tear gas canister into the intake.
  - ✧ If located in parking areas, design to prevent introduction of vehicle exhaust.
  - ✧ Locate away and upwind from fume hood exhaust.
- Visitor access protection.
  - ✧ Administrative or security receptionist at visitors' access should be protected behind bullet-resistant glazing with adjacent walls of similar bullet-resistive construction.
- Duress alarms.
  - ✧ "Call assistance" or duress/panic alarms should be installed in key areas throughout the facility and concealed as appropriate. Locations might include visitor reception desk, bulk chemical storage spaces, weapons ranges, parking garages, and clandestine lab storage and exam spaces.
- Laboratory tours.
  - ✧ If the facility is to be designed to accommodate guided tours, tour groups should not be allowed into the laboratory spaces. Guided tours should be conducted through the main corridor system with viewing through strategically placed windows in the corridor walls providing viewing into the laboratory spaces.
- Interior glazing.
  - ✧ It is recommended that the use of windows between laboratory spaces be maximized. This is a feature designed to enhance safety of personnel by allowing those in one laboratory space to view the activities of those in other spaces that might be of a more hazardous nature.

- Equipment and systems service and maintenance.
  - ✧ Equipment and systems that are part of the building and might require periodic service and maintenance should be located outside of the laboratory spaces, and particularly outside of any space where evidence or drug standards are stored.
  - ✧ Such equipment and systems might include, but are not limited to, electrical panels, VAV boxes, VAV controls, walk-in cooler compressors, and water purification filters.
- Corridors.
  - ✧ Primary circulation and exit corridors: 1.83 m (6 ft) wide, minimum.
  - ✧ Secondary circulation and non-exit corridors: 1.37 m (4½ ft) wide, minimum.
- Doors.
  - ✧ Double doors to all laboratory sections and spaces that are expected to receive oversized evidence or equipment. Double doors shall consist of a 0.914 m (36 in) wide active leaf and an 0.457 m (18 in) wide inactive leaf.
  - ✧ Freight elevator doors minimum 1.22 m (48 in) wide.

Security Design

- Security Strategy Meeting.
  - ✧ Although this is not a design guideline, it is recommended that a security strategy meeting take place upon completion of an approved schematic design of the building and the site. This meeting should be attended by representatives of the building owner, building users, security staff, the architect, the electrical engineer, and a security design consultant.
  - ✧ The purpose of this meeting is to establish and document a comprehensive security strategy for the new facility. This security strategy will act as a guideline for the design of passive and electronic security systems. This strategy should include, but not be limited to, security policy and procedural issues, site and building access as related to security, types of security electronics systems, performance requirements for security access systems, ASCLD/Laboratory Accreditation Board (LAB) accreditation issues related to security, and any other special security needs that might be identified by the users. Specific considerations regarding hardening the laboratory against terrorist attack may be important, depending on the location and function of the lab.

- Escort only design.
  - ✧ The design of the building should incorporate a security perimeter within which unauthorized persons may enter under an "escort only" policy. This security perimeter should be defined during the Security Strategy Meeting.
  - ✧ The sign-in and badging area should be located at the visitors' entrance.
- Door access systems.
  - ✧ Access to and circulation throughout the facility, as well as key zones of the building, should be provided with controlled access through the use of proximity or card-key access systems. The system should be capable of programming access devices for specific areas and times, and should fully document all access attempts. The system must prevent unauthorized entry while maintaining safe and legal exiting. This security must be maintained in multistory buildings having shared elevator access.
- Door status monitoring.
  - ✧ Key doors throughout the building, particularly exterior doors and doors to evidence storage spaces, should be electronically monitored for open/closed status.
- Closed circuit television (CCTV) systems.
  - ✧ Key areas of the building, both interior and exterior, should be kept under video surveillance. Key areas might include, but are not limited to, exterior doors, lobby/reception areas, parking lots, and evidence delivery areas. Placement of CCTV cameras and features (pan, zoom, tilt, constant sweep, time lapse recording, etc.) should be defined during the Security Strategy Meeting.
- Special security design features.
  - ✧ The security design of the facility should include consideration of such special features as:
    - Motion detection in evidence storage spaces, circulation corridors, or other key areas.
    - Additional security protection for storage of high-value evidence items such as money and jewelry.
    - DEA guidelines for the storage of narcotics.

Mechanical Systems Design Checklist

- Isolation of various spaces.
  - ✧ Biologically hazardous spaces.
  - ✧ PCR amplification room(s).

  - ✧ Mitochondrial DNA room(s).
  - ✧ Firing range.
- HEPA filtered exhausts.
  - ✧ Verify need per local authorities.
- Differential pressure of adjacent spaces.
  - ✧ Verify need for positive and negative pressure spaces.
- Supplemental cooling.
  - ✧ Instrument rooms.
  - ✧ Other spaces with heat-generating equipment.
- Evidence drying room exhausts.
  - ✧ Special handling for putrid items.
- Firing range exhaust.

Plumbing Systems Design Checklist

- Emergency shower and eyewashes and floor drains.
  - ✧ In laboratory spaces.
  - ✧ In areas of refuge.
- Caustic (acid/alkali) waste systems, i.e., neutralization/hazardous waste systems.
- Fume hood and biological hood plumbing utilities.
- Water treatment systems.
  - ✧ Recirculating deionized water.
  - ✧ Point-of-use type 1 water polisher.
- Laboratory gas types.
  - ✧ Hydrogen, nitrogen, helium, air, argon.
  - ✧ Manifolded instrument gas systems.
  - ✧ Central instrument gas distribution systems.
  - ✧ Laboratory compressed air.

- ✧ Laboratory vacuum.
- ✧ Consider hydrogen generators to avoid NFPA gas plumbing requirements.
- ✧ Natural gas.
  - Rarely used in most modern forensic laboratories.
  - Consider small gas cylinders stored beneath fume hood.

- Laboratory gas locations.
  - ✧ At laboratory benches.
  - ✧ In fume hoods and biological hoods.
  - ✧ In instrumentation rooms.
  - ✧ At scanning electron microscope.

- Dry fire suppression systems.
  - ✧ Instrumentation rooms.
  - ✧ Computer room(s).
  - ✧ Scanning electron microscope room(s).

Electrical Systems Design Checklist

- Emergency generator.
  - ✧ Recommend emergency power and lighting for the following spaces:
    - Entire evidence section.
    - All refrigerators and freezers, including walk-in units.
    - Photography darkroom(s).
    - Entire security section, including electronic security systems and telephones.
    - X-ray processing room(s).
  - ✧ Recommend one duplex outlet per 92.90 m^2 (1000 ft^2) and 25 percent lighting for the following spaces:
    - All technical laboratory, examination, and investigation spaces.
  - ✧ Minimal emergency power and lighting per applicable codes:
    - All other spaces in the building not identified above.

- Uninterruptable power supply (UPS).
  - ✧ All computer-driven systems and equipment including, but not limited to, laboratory instrumentation, Automated Fingerprint Identification System (AFIS), Combined DNA Identification System (CODIS), Laboratory Information Management

System (LIMS), Drugfire, Integrated Ballistic Imaging System (IBIS), and LABNET.

- ✧ Central UPS system is preferred, but local UPS units are acceptable.

- Task lighting.
  - ✧ Verify locations, types, and color temperatures with users.

- Local light level control.
  - ✧ Verify locations with users.

- Bench power.
  - ✧ General: single outlets at 0.457 m (18 in) on centers, or duplex outlets at 0.914 m (36 in) on centers.
  - ✧ Special bench power requirements to be verified.

General Laboratory Design

- Fume hoods.
  - ✧ Class A, chemical fume hood with remotely located exhaust blower.

- Biological hoods.
  - ✧ Class II, types A, B2, or B3, depending on specific application, with remotely located exhaust blower.

- Bench top work surfaces.
  - ✧ Epoxy resin in laboratory spaces where fume hood or chemically rated biological hood is installed.
  - ✧ Stainless steel in spaces where biologically contaminated evidence is to be placed on the work surface.
  - ✧ 3.81 cm (1½-in) thick laminated maple in physical examination spaces such as firearms shop and vehicle examination work bench.
  - ✧ Chemical resistant plastic laminate in all other laboratory spaces not identified above.
  - ✧ Standard plastic laminate in nonlaboratory spaces such as offices, conference rooms, lunch room, toilet rooms, etc.

- Laboratory sinks.
  - ✧ Epoxy resin in epoxy resin countertops, all other locations stainless steel.
- Hands-free sinks.
  - ✧ At all clean sinks.
  - ✧ Verify other special locations with users.
- Clean sink areas.
  - ✧ Located at the entrance to every laboratory section.
  - ✧ Used only to wash hands upon leaving a laboratory section.
  - ✧ Provide lab coat hangers.
  - ✧ Provide cabinetry for storage of soap, paper towels, rubber gloves, and other protective garments as determined necessary by the users.
- Caustic (acid/alkali) waste plumbing.
  - ✧ At all epoxy resin sinks and fume hood cup sinks.
  - ✧ May include dilution system, neutralizing filters, or holding vessels, depending on local authority and plumbing design.
- Evidence drying rooms.
  - ✧ Recommended minimum of 12 to 15 air changes per hour, direct exhaust to exterior.
  - ✧ Washable finishes.
- Biovestibules.
  - ✧ Locate between “clean” and “dirty” spaces, for example, between main circulation corridor and entrance to a laboratory section that potentially contains hazardous airborne contaminants.
  - ✧ Shall be designed as an interlock between clean and dirty spaces with air handled through differential pressurization to prevent exfiltration of contaminated air.
  - ✧ Shall contain all the features of the clean sink areas described above.
  - ✧ Minimum size: 5.95 m^2 (64 ft^2).

- Bulk chemical and clandestine lab evidence storage rooms.
  - ✧ Exhaust system to expel both heavier- and lighter-than-air vapors.
    - Explosion-proof electrical fixtures.
    - Blowout panel.
    - Chemical spill containment.
- Finishes.
  - ✧ Laboratory floors.
    - Chemical-resistant sheet vinyl or vinyl tiles with welded seams.
  - ✧ Laboratory walls.
    - Epoxy in all spaces considered highly biologically or chemically hazardous, such as examination rooms, bulk drug analysis, and bulk chemical storage.
    - Semi-gloss latex enamel in all other spaces.
  - ✧ Laboratory ceilings.
    - Epoxy in all spaces considered highly biologically or chemically hazardous, such as examination rooms, bulk drug analysis, and bulk chemical storage.
    - Suspended acoustical in all other spaces.
  - ✧ Nonlaboratory spaces.
    - Acceptable interior finish standards for offices and nonlaboratory support spaces.
- Laboratory casework.
  - ✧ Standard laboratory casework with utility access space behind base cabinets.
  - ✧ Steel or wood preferred, plastic laminate acceptable.
  - ✧ Maximize use of flexible laboratory casework systems.
- Files.
  - ✧ Generally, one four-drawer filing cabinet, or the equivalent file storage space, should be provided for each analyst at the area of the nonlaboratory workstation.
- Special considerations.
  - ✧ Acoustics.
  - ✧ Reflective surfaces.
  - ✧ Vibration-proof flooring.
  - ✧ High-strength flooring.

Technical Laboratory Sections

General Design Comments

The forensic laboratory consists of various laboratories within the overall facility. These various laboratories are commonly referred to as laboratory sections or units. The recommended guidelines provided here are intended to serve as checklists for the design of laboratory space in the technical laboratory sections. Included are functional areas, equipment, and instrumentation that are listed to remind designers of needs that should be considered when designing a layout. Many of the items listed, such as laboratory workstations, are universal components of technical sections. Other items may or may not be necessities, depending upon the needs and size of individual laboratory sections. In some instances area (m^2, ft^2) of floor space or linear footage (lin m, ft) of bench space have been assigned to represent minimum guidelines for space requirements. Items and areas that are not assigned measurements will vary as needed by individual laboratories and the sections within those laboratories.

For most laboratory sections the checklist below follows a common theme. This theme consists of the concept of a main laboratory space for each section, and supporting spaces that are enclosed rooms with direct adjacency to the main laboratory. The main laboratory is where each analyst will have an individual laboratory workstation. The adjacent supporting spaces will be spaces devoted to specific procedures or equipment items and that might be used by each analyst from time to time during the course of his or her examinations.

Administrative Work Spaces

Each laboratory section will identify various nonlaboratory work spaces. A significant amount of the forensic analyst's responsibilities include nonlaboratory tasks such as data analysis, report writing, court testimony preparation, and other administrative responsibilities. The design should provide the analyst with an administrative work area, away from the hazards of the laboratory, where these tasks can be conducted in an efficient and safe environment. Supervisors' offices, case review areas, and space for files can also be included in this environment. With the exception of the supervisors' offices, which shall be private offices, all other spaces in the administrative work area can be designed as open office systems workstations. Some analysts, such as document and latent print examiners, require additional administrative work space since a significant amount of their technical examinations can occur outside of the laboratory environment.

Controlled Substance Section

- Main Controlled Substances Laboratory Space.
  - ✧ Individual analyst laboratory workstation.
    - 4.57 m (15 lin ft) bench space per analyst.
    - Individual in-process secure evidence storage.
    - Individual spot ventilation or fume hood.
    - Sink (may be shared between two analysts).

- Miscellaneous bench space with hood(s) and sink(s) as required for specific equipment and procedures.
- Floor space for refrigerators and other lab equipment as required.
- Vibration-isolation benches as required for analytical balances.

- Instrumentation room.
  - Bench space for each instrument with adjacent layout bench space.
  - Free access space to the rear of each instrument for maintenance and utility access.
  - Instrument maintenance space within the instrument room with fume hood, solvent storage, and sink.
  - Shelving for the storage of references and manuals.
  - Dry fire suppression system.
  - Adequate ports for computers/workstations.
- Evidence storage room.
  - As required in addition to in-process storage in workstations.
- Standards storage room.
  - Lab refrigerator.
  - Secure storage units.
- Reagent preparation.
  - May be separate room or may be part of the main laboratory space.
  - Chemical layout bench space.
  - Fume hood(s) with solvent and separate acid/alkali storage base cabinets.
  - Glassware washer with bench space for glassware sorting.
  - Double sink.
  - Bench space as required for specific equipment and procedures.
  - Flammable materials storage refrigerator.

- Robotics.
  - ✧ May be separate room or may be part of the main laboratory space.
  - ✧ Type of robotics equipment and apparatus will dictate space and utility requirements.
  - ✧ Dry fire-suppression systems.
- Other considerations.
  - ✧ Large bulk seizures.
  - ✧ Light-free room for alternate-light viewing.
- Administrative work spaces.
  - ✧ Supervisor’s office: 11.48 m^2 (120 ft^2).
  - ✧ Analyst’s administrative workstation: 5.95 m^2 (64 ft^2) per analyst.
  - ✧ Case review: space for small table and chairs where three or four analysts can confer informally.

Toxicology Section

- Design as biologically hazardous space with biovestibule, while ensuring no cross-contamination from the drug section.
- Main Toxicology Laboratory Space.
  - ✧ Individual analyst laboratory workstation.
    - 4.57 m (15 lin ft) bench space per analyst.
    - Individual in-process secure evidence storage.
    - Individual spot ventilation, fume hood, or biological hood.
    - Sink (may be shared between two analysts).
  - ✧ Miscellaneous bench space with hood(s) and sink(s) as required for specific equipment and procedures.
  - ✧ Stand-alone specimen processing room may be required in addition to analyst workstations, depending on operation and accreditation requirements.
  - ✧ Special processing of waste may be required.
- Instrumentation room.
  - ✧ Bench space for each instrument with adjacent layout bench space.
  - ✧ Free access space to the rear of each instrument for maintenance and utility access.

- ✧ Instrument maintenance space within the instrument room with fume hood, solvent storage, and sink.
- ✧ Shelving for the storage of references and manuals.
- ✧ Dry fire-suppression system.
- ✧ Adequate ports for computers/workstations.

- Refrigerated storage.
  - ✧ As required in addition to in-process evidence storage in workstations.
  - ✧ May be refrigerators in main laboratory space or in separate room.
  - ✧ May be walk-in refrigerator and/or freezer.
- Reagent preparation.
  - ✧ May be separate room or may be part of the main laboratory space.
  - ✧ Chemical layout bench space.
  - ✧ Fume hood(s) with solvent and separate acid/alkali storage base cabinets.
  - ✧ Glasswares washer with bench space for glassware sorting.
  - ✧ Double sink.
  - ✧ Bench space as required for specific equipment and procedures.
  - ✧ Flammable materials storage refrigerator.
- Robotics.
  - ✧ May be separate room or may be part of the main laboratory space.
  - ✧ Type of robotics equipment and apparatus will dictate space and utility requirements.
- Radioimmunoassay room.
  - ✧ 11.48 m^2 (120 ft^2).
  - ✧ Fume/biological hood.
  - ✧ Sink.
  - ✧ Bench space as required for equipment and procedures.

- Administrative work spaces.
  - ✧ Supervisor's office: 11.48 m^2 (120 ft^2).
  - ✧ Analyst's administrative workstation: 5.95 m^2 (64 ft^2) per analyst.
  - ✧ Case review: space for small table and chairs where three or four analysts can confer informally.

Firearms/Toolmarks Section

- Design as biologically hazardous space with biovestibule.
- Main Firearms/Toolmarks Laboratory Space.
  - ✧ Individual analyst laboratory workstation.
    - 4.57 m (15 lin ft) bench space per analyst (6.1 m [20 lin ft] if individual comparison microscope is included).
    - Individual in-process secure evidence storage.
    - Sink (may be shared between two or more analysts).
  - ✧ Miscellaneous bench space with hood(s) and sink(s) as required for specific equipment and procedures.
  - ✧ Floor space for refrigerators and other lab equipment as required.
- Comparison microscopy room.
  - ✧ 1.524 lin m (5 lin ft) per microscope (allow for attachment of power and light sources).
  - ✧ Some users may prefer individual microscopes in their individual workstations.
  - ✧ Light level control.
- Test fire range.
  - ✧ Minimum width, 2.438 m (8 ft); optimum width, 6.096 m (20 ft).
  - ✧ Minimum length, 12.192 m (40 ft); optimum length 22.86 m (75 ft).
  - ✧ 2.438 lin m (8 lin ft) bench for weapon layout.
  - ✧ Ventilation for airborne unspent powder and lead/metal particulates (see OSHA and NIOSH regulations).
  - ✧ Acoustically designed for containment and absorption of sound.

- Projectile recovery room.
  - ✧ Ventilated water tank.
  - ✧ Ventilated cotton box.
  - ✧ Ventilated test fire container.
  - ✧ Acoustically designed for containment and absorption of sound.
- Toolmarks shop.
  - ✧ Tools storage.
  - ✧ Sink.
  - ✧ Drill press.
  - ✧ Grinder.
  - ✧ Compressed air.
  - ✧ Additional bench space as required for tools and equipment.
- Computer room.
  - ✧ Drugfire workstation(s).
  - ✧ IBIS workstation(s).
  - ✧ Server(s) associated with automation platform, if applicable.
  - ✧ Dedicated phone line(s) and additional data ports as required.
- Chemistry lab.
  - ✧ Might be part of the main laboratory space.
  - ✧ Fume hood(s) with solvent and separate acid/alkali storage base cabinets.
  - ✧ Sink(s).
  - ✧ Additional bench space as required for evidence layout and equipment.
- Gunshot residue room. (Note: could be part of chemistry lab.)
  - ✧ Biovestibule entry.
  - ✧ Biological hood(s).

    - ✧ Sink.
    - ✧ Stainless steel examination surface (bench or mobile table).

- Gun references storage room.
- Ammunition storage room.
    - ✧ Follow safety recommendations.
- Standards storage.
    - ✧ Might be in main laboratory space.
- Evidence storage.
    - ✧ As required in addition to in-process storage in workstations.
- Administrative work spaces.
    - ✧ Supervisor's office: 11.48 m^2 (120 ft^2).
    - ✧ Analyst's administrative workstation: 5.95 m^2 (64 ft^2) per analyst.
    - ✧ Case review: space for small table and chairs where three or four analysts can confer informally.

Trace Analysis Section

- Design as biologically hazardous space with biovestibule.
- Main Trace Analysis Laboratory Space.
    - ✧ Individual analyst laboratory workstation.
        - 4.57 m (15 lin ft) bench space per analyst.
        - Individual in-process secure evidence storage.
        - Individual spot ventilation, fume hood, or biological hood.
        - Sink (may be shared between two analysts).
    - ✧ Miscellaneous bench space with hood(s) and sink(s) as required for specific equipment and procedures.
    - ✧ Floor space for refrigerators and other lab equipment as required.
- Instrumentation room.
    - ✧ Bench space for each instrument with adjacent layout bench space.
    - ✧ Free access space to the rear of each instrument for maintenance and utility access.

  - ✧ Instrument maintenance space within the instrument room with fume hood, solvent storage, and sink.
  - ✧ Shelving for the storage of references and manuals.
  - ✧ Miscellaneous bench space with hood(s) and sink(s) as required for specific equipment and procedures.
  - ✧ X-ray Diffraction (XRD).
  - ✧ Space for remotely located chiller.
  - ✧ Dry fire-suppression system.

- Microscopy room.
  - ✧ 1.524 lin m (5 lin ft) bench space per microscope.
  - ✧ Light level control.
- Scanning electron microscope room.
  - ✧ 11.48 m^2 (120 ft^2).
  - ✧ 2.438 lin m (8 lin ft) bench space with sink.
  - ✧ Manuals and references shelves.
  - ✧ Light level control.
  - ✧ Dry fire-suppression system.
  - ✧ Isolation pad or minimal floor vibration.
- Evidence storage room.
  - ✧ As required in addition to in-process storage in workstations.
- Standards storage.
  - ✧ May be separate room or may be part of the main laboratory space.
- Arson investigation room.
  - ✧ Fume hood(s) for vacuum extraction, if required.
  - ✧ Bench space and sink(s) as required for layout and examination.

- Evidence drying room(s).
  - ✧ See "General Laboratory Design."
  - ✧ May be within the laboratory section or centrally located outside of the laboratory section.
- Evidence examination (scraping or processing) rooms.
  - ✧ Minimum of two rooms to separate victim and suspect evidence. One additional room for every six analysts.
  - ✧ Minimum 13.935 m^2 (150 ft^2)each room.
  - ✧ Mobile exam table with access all around.
  - ✧ Evidence hanging apparatus above exam table.
  - ✧ 2.438 lin m (8 lin ft) bench layout space with sink.
  - ✧ Light level control.
- Administrative work spaces.
  - ✧ Supervisor's office: 11.48 m^2 (120 ft^2).
  - ✧ Analyst's administrative workstation: 5.95 m^2 (64 ft^2) per analyst.
  - ✧ Case review: space for small table and chairs where three or four analysts can confer informally.

Forensic Biology/DNA Section

- Provide general requirements for separation of laboratory space in accordance with TWGDAM guidelines.
- Design as biologically hazardous space with biovestibule.
- General contamination prevention is critical.
- Main Forensic Biology Laboratory Space.
  - ✧ Individual analyst laboratory workstation.
    - 4.57 m (15 lin ft) bench space per analyst.
    - Individual in-process secure evidence storage.
    - Sink (may be shared between two analysts).
  - ✧ Miscellaneous bench space with hood(s) and sink(s) as required for specific equipment and procedures.
  - ✧ Floor space for refrigerators and other lab equipment as required.

- Evidence examination (scraping or processing) rooms.
  - ✧ Minimum of two rooms to separate victim and suspect evidence. One additional room for every six analysts.
  - ✧ Minimum 13.935 m^2 (150 ft^2) each room.
  - ✧ Mobile exam table with access all around.
  - ✧ Evidence hanging apparatus above exam table.
  - ✧ 2.438 lin m (8 lin ft) bench layout space with sink.
  - ✧ Light level control.
- Wet blood preparation.
  - ✧ Minimum 9.29 m^2 (100 ft^2).
  - ✧ Biological hood(s).
  - ✧ Sink(s).
- Refrigerated storage.
  - ✧ As required in addition to in-process evidence storage in workstations.
  - ✧ May be refrigerators in main laboratory space or in separate room.
  - ✧ May be walk-in refrigerator.
- Freezer storage.
  - ✧ May be walk-in freezer.
  - ✧ Ultra-low temperature freezer storage.
- Evidence drying room(s).
  - ✧ See "General Laboratory Design."
  - ✧ May be within the laboratory section or centrally located outside of the laboratory section.
- Reagent preparation room.
  - ✧ Fume hood(s) with solvent and separate acid/alkali storage base cabinets.
  - ✧ Double sink.
  - ✧ Glasswares washing and storage.

- Autoclave.
- Flammable materials storage refrigerator.
- Minimum 18.581 m^2 (200 ft^2).
- Negative pressure ventilation.

- Electrophoresis.
  - May be in separate room or on benches in main laboratory space.
  - Approximately 18.581 m^2 (200 ft^2).

- Photo room.
  - 1.83 lin m (6 lin ft) bench space per photo station for equipment and layout.
  - Light level control.

- X-ray processing room. (Note: needed only if using radioisotopes.)
  - Photographic darkroom design.
  - X-ray viewer.
  - Minimum 13.935 m^2 (150 ft^2).
  - Safe lights.
  - Some processing equipment requires supplemental water connections and floor drains.

- PCR preparation room.
  - Minimum 11.48 m^2 (120 ft^2).
  - Biological hood(s).
  - Refrigerator.
  - Layout bench space with sink.

- PCR amplification/detection room.
  - Interlock vestibule entry designed like biovestibule. Design to prevent cross-contamination of airborne product from PCR room to surrounding spaces.
  - Negative pressure relative to adjacent spaces.
  - Refrigerator(s).

- ✧ 9.29 m^2 (100 ft^2) per analyst.
- ✧ Miscellaneous bench space for equipment and layout.
- ✧ Storage space.

- Mitochondrial DNA (mtDNA) room.
  - ✧ Interlock vestibule entry designed similar to biovestibule. Design to prevent double cross-contamination, i.e., airborne product from mtDNA room to surrounding spaces, and airborne materials from surrounding spaces to mtDNA room.
  - ✧ Minimum 18.581 m^2 (200 ft^2).
  - ✧ Miscellaneous bench space with hood(s) and sink(s) as required for specific equipment and procedures.

- Research and development/methods development.
  - ✧ Minimum 18.581 m^2 (200 ft^2).
  - ✧ Miscellaneous bench space with hood(s) and sink(s) as required for specific equipment and procedures.

- Computer lab (CODIS).
  - ✧ 1.524 lin m (5 lin ft) bench space for each computer workstation.
  - ✧ 0.9144 m (3 lin ft) bench space for each video imager.
  - ✧ One video imager shared between two computer workstations.
  - ✧ Shelving for references and manuals.
  - ✧ Space for network servers and/or other computer hardware.
  - ✧ Dedicated phone line(s) and additional data ports as required.
  - ✧ X-ray viewer(s).
  - ✧ Can be considered nonlaboratory space and located accordingly.
  - ✧ Secure storage areas.

- Administrative work spaces.
  - ✧ Supervisor's office: 11.48 m^2 (120 ft^2).

- ✧ Analyst's administrative workstation: 5.95 m^2 (64 ft^2) per analyst.
- ✧ Case review: space for small table and chairs where three or four analysts can confer informally.

Latent Prints Section

- Design as biologically hazardous space with biovestibule.
- Main Latent Prints Laboratory Space.
  - ✧ Individual analyst laboratory workstation.
    - 3.048 lin m (10 lin ft) bench space per analyst.
    - Individual in-process secure evidence storage.
    - Sink (may be shared between two analysts).
  - ✧ Miscellaneous bench space with hood(s) and sink(s) as required for specific equipment and procedures.
  - ✧ Floor space for refrigerators and other lab equipment as required.
- Evidence storage.
  - ✧ As required in addition to in-process storage in workstations.
- Cyanoacrylate processing.
  - ✧ May be part of the main latent prints laboratory space.
  - ✧ Multichambered cabinets with individually controlled exhaust.
- Dusting stations.
  - ✧ May be part of the main latent prints laboratory space.
  - ✧ 1.524 lin m (5 lin ft) bench space per dusting station.
  - ✧ Task lighting.
- Chemical processing.
  - ✧ May be part of the main latent prints laboratory space.
  - ✧ Bench space with hood(s) and sink(s) as required for specific equipment and procedures.
  - ✧ Humidity test chamber.

- Alternate light source room(s).
  - ✧ Fume hood with large sink for dye processing.
  - ✧ Layout bench.
  - ✧ Minimum 11.48 m^2 (120 ft^2).
- Laser room.
  - ✧ Light level control.
  - ✧ Minimum 13.935 m^2 (150 ft^2)
  - ✧ Design as darkroom with sink, or provide access to darkroom with sink.
- Photo room.
  - ✧ 1.83 lin m (6 lin ft) bench space per photo station for equipment and layout.
  - ✧ Light level control.
- Automated Fingerprint Identification System (AFIS) room.
  - ✧ 1.524 lin m (5 lin ft) per computer workstation.
  - ✧ Hardware and other space requirements vary per vendor.
  - ✧ Light level control.
  - ✧ Can be considered nonlaboratory space and located accordingly.
- Administrative work spaces.
  - ✧ Supervisor's office: 13.935 m^2 (150 ft^2).
  - ✧ Analyst's administrative workstation: 9.29 m^2 (100 ft^2) per analyst.
  - ✧ Case review: space for small table and chairs where three or four analysts can confer informally.

Questioned Documents Section

- Main Questioned Documents Laboratory Space.
  - ✧ North exposure with natural light.
  - ✧ Individual in-process secure evidence storage (may be at nonlaboratory workstations).

- Miscellaneous bench and floor space as required for specific equipment and procedures.
- Mobile tables for individual case examination; approximately one table per examiner.

- Evidence storage room.
  - As required in addition to in-process storage at workstations.
- Chemical processing room.
  - Fume hood(s) with solvent and separate acid/alkali storage base cabinets.
  - Bench space for equipment and evidence layout with sink.
  - Minimum 11.48 m^2 (120 ft^2).
- Administrative work spaces.
  - Supervisor's office: 13.935 m^2 (150 ft^2).
  - Analyst's administrative workstation: 9.29 m^2 (100 ft^2) per analyst.
  - Case review: space for small table and chairs where three or four analysts can confer informally.

Computer Evidence Section

- May be designed as computer hardware space. Chemical and biological hazards will not be present. A sample statement of work (SOW) for a forensic computer examination laboratory is found in Appendix III.
- Main computer evidence laboratory space.
  - Individual analyst laboratory workstation: 7.62 lin m (25 lin ft) bench space per analyst.
  - Miscellaneous computer evidence bench: 7.62 lin m (25 lin ft) bench space per analyst.
  - Independent data line with two jacks.
  - Various types of telephone lines.
- Evidence room.
  - 9.29 m^2 (100 ft^2) per analyst.
- Equipment room.
  - 9.29 m^2 (100 ft^2) per analyst.

- Administrative work spaces.
  - ✧ May be included as part of the main computer evidence laboratory space.
  - ✧ Supervisor's office: 13.935 m^2 (150 ft^2).
  - ✧ Analyst's administrative workstation: 9.29 m^2 (100 ft^2) per analyst.
  - ✧ Independent data line with two jacks.
  - ✧ Various types of telephone lines.
  - ✧ Two National White Collar Crime Center (NWCCC) network connections.
- Dry fire-suppression system.

Universal Facility Design Components

Although no two forensic laboratories are alike, there are basic functional components and areas that are universal to most laboratory buildings. For example, office space, training rooms, and technical support areas are standard necessities that must be considered for space during the design phase. The following set of checklists serve as recommended guidelines and requirements for universal laboratory building components, and have been divided into four categories: *administrative, building, technical support,* and *general technical*. Administrative areas are nontechnical and primarily consist of office space used for evidence support. Building areas are not directly related to evidence analysis, and needs will vary for freestanding laboratories or laboratories occupying only part of a building. Technical support areas are directly related to, but are not used for, evidence analysis. General technical areas are shared by most laboratory sections within a building, and needs will vary depending upon laboratory size and functions.

Administrative

- Design standards for these spaces should be based on acceptable office space design standards.
- Private offices.
  - ✧ Based on existing space standards, if any.
- Offices for support personnel.
  - ✧ Shared offices or open office systems furniture.
- Files for active cases.
- Clerical, administrative, and case support.
- Mail, photocopy, and facsimile.

- Conference room(s).
- Lobby/reception.
- Consultant offices.
- Library.
  - Book stacks.
  - Periodicals shelves.
  - Study carrel(s)
  - Study table(s)
  - Computer information terminal(s)

Building

- Mechanical.
  - Heating, ventilation, and air conditioning (HVAC) equipment rooms.
  - Air handling systems.
  - Fume and biological hood exhaust equipment.
  - Laboratory compressed air and vacuum systems.
  - Central plant water treatment systems.
  - Domestic hot and cold water systems.
  - Fire extinguishing systems and sprinkler control rooms.
  - Instrument gas manifold and distribution systems.
- Communications.
  - Computer rooms and/or closets.
  - Telephone equipment rooms and/or closets.
  - Premise wiring rooms and/or closets.
  - Data line provisions.

- Electrical.
  - ✧ Service entrance and main switch gear.
  - ✧ Emergency generator.
  - ✧ Uninterruptable power supply (UPS) equipment.
  - ✧ Electrical closets.
  - ✧ Electrical service panels.
- Staff use.
  - ✧ Lunch room.
  - ✧ Break room(s).
  - ✧ Locker rooms with showers.
  - ✧ Rest rooms.
- Other.
  - ✧ Janitorial closet(s).
  - ✧ Passenger and/or freight elevator(s).
  - ✧ Recycling.
  - ✧ Lab coat cleaning.
  - ✧ Shipping and receiving.
  - ✧ Hazardous waste disposal.
  - ✧ Compressed gas cylinder storage.
  - ✧ General waste disposal.

Technical Support

- Storage.
  - ✧ General laboratory storage.
  - ✧ General supplies storage.
  - ✧ Long-term files storage.

- ✧ Chemical storage.
  - Dry fire-suppression system.

- Evidence.
  - ✧ Evidence receiving and return counter from and to submitting agencies.
  - ✧ After-hours secure evidence lockers.
  - ✧ Evidence disbursal and return counter to and from laboratory sections.
  - ✧ Evidence custodian workstations: minimum 5.95 m^2 (64 ft^2).
  - ✧ Evidence supervisor office: minimum 11.48 m^2 (120 ft^2).
  - ✧ Evidence storage.
    - General evidence storage shelving.
    - Refrigerated and frozen evidence storage: refrigerators and freezers or walk-in units.
    - Secure narcotics storage.
    - Secure valuables storage.
    - Flammable evidence storage: fire-rated, ventilated storage room, or ventilated flammable storage cabinets.
    - Biohazardous evidence storage.
    - Gun storage.
    - Long-term evidence storage.
  - ✧ Evidence workroom.
    - Mail room features for packaging, sending, and receiving evidence.
    - Layout countertop space with sink.
    - Photocopy and facsimile.
  - ✧ Evidence case review/triage/conference room(s).
  - ✧ Evidence drying.

General Technical

- Vehicle processing.
  - ✧ Securable and air conditioned/heated forensic garage bay(s).
    - At least one bay large enough to accommodate vans and motor homes.
  - ✧ Workbench space: 3.048 lin m (10 lin ft) per bay.
  - ✧ One shop sink per bay.
  - ✧ Laser or remote fiber light source.

  - Vehicle lift (fixed or portable).
  - High-intensity lighting.
  - Additional pull-down lighting.
  - Tools storage.
  - Evidence drying room(s).
  - Compressed air.

- Forensic photography.
  - Can be utilized for laboratory support only or offer full services, including public relations and graphic arts.
  - Film and print for black and white and color processing.
  - Chemical storage and mixing space.
  - Studio.
  - Finishing.
  - Computer-aided design and drafting (CADD) for graphic arts.
  - Photographic equipment and supplies storage.
  - Refrigerator.

- Computer imaging.
  - Video and photographic enhancement.
  - General enhancement of latent prints, footprints, etc.
  - Virtual reality crime scene recording.

- Training.
  - Classroom(s).
  - Audio/visual media room.
  - Exhibit storage.
  - Mock crime scene room(s).
  - Training laboratory.

  - ✧ Breath alcohol training.
  - ✧ Video conferencing.
  - ✧ Computer and television networking.
- Quality assurance.
  - ✧ Proficiency testing/sample preparation laboratory (might be shared with training laboratory).
  - ✧ Conference/office.
  - ✧ Record storage and archival facilities.
- Crime scene unit.
  - ✧ Equipment storage.
  - ✧ Staging area.

Construction

The Construction Process

During this phase all the facility planning and design work will be brought to fruition and the forensic laboratory facility will be built.

During the construction phase a team of individuals represents the laboratory's interests, ensuring that all the laboratory concepts are fully implemented. Each member of the team has a defined set of responsibilities. The laboratory will need to rely on the team members' collective expertise with respect to interpretation of the contract documents, resolution of technical construction issues, and unforeseen construction conditions, such as ground water or bad soil. This team often includes:

- The building owner's project manager or site representative, usually from facilities planning and design, the laboratory planner, and the contracting officer.
- Members of the design team, including the architect, and structural, mechanical, and electrical engineers.

It is critical that the laboratory director monitor progress during construction and make available to the project team an individual who is knowledgeable about all laboratory design requirements. This person will assist and act as a resource to the project team, answering questions and responding to issues directly affecting the forensic laboratory's functional design requirements and facilitating the exchange of information between laboratory staff and the construction team when required.

Laboratory Technical Coordinating Officer (LTCO)

The laboratory technical coordinating officer (LTCO) is the individual assigned to represent the laboratory's interests and to act as a facilitator/coordinator during the construction phase. The LTCO must be:

- Knowledgeable about the project requirements.
- Readily available and willing to continue to serve through the construction phase.
- Familiar with the design requirements and concepts and previously involved in the design process.
- Able to clearly communicate and effectively work with all team members to realize complete success.

Remember, this is a once in a lifetime responsibility that:

- Requires a great deal of time and commitment.
- May require the LTCO to give up other responsibilities.
- The LTCO is probably not formally trained to do.

All construction team members, including the LTCO, must understand their responsibilities and the limits of their authority and rely on the other members of the team for support.

The LTCO has a role on and is part of a much larger team. The LTCO should report and work through the individual responsible for administration of the construction contract on the owner's behalf. The LTCO should not be allowed to work directly with the contractor or his subcontractors.

A very complex set of relationships exists between the contractor, subcontractors suppliers, the building owner, and the architect/engineer. These relationships are clearly defined by the contract agreements. These documents must be fully understood. If the LTCO has questions or concerns, they should be discussed with the contracting officer and the project manager.

Defining Responsibility and Authority

It is difficult to outline precisely everyone's role and responsibility during the construction of a facility. Each project is different. The form of contract agreement by which the construction project is being delivered and differences in a building owner's ability to manage a construction project can vary. It is therefore important that the laboratory director and the LTCO both review and understand the contract agreement and formal lines of communication established for their project.[3]

Forms of Construction Contracts

Traditional Construction Contract

Under a traditional construction contract, drawings and specifications are advertised for receipt of bids from interested contractors. (The contractors submitting bids on the project may or may not be prequalified). Each general contractor and their subcontractors estimate the cost of construction and submit a binding bid to the owner's representative. Bids are generally received and opened at a public opening. The qualified bidder deemed to provide the "best value" to the government is normally awarded the construction contract.

A construction contract is then signed. The drawings and specifications are enjoined as part of the contract agreement defining the facility to be constructed for the contracted amount. The general contractor is the sole point of responsibility to construct the building as defined by these documents, including the work of his subcontractors. The greatest advantage to this method of construction delivery is that there is one point of accountability.

Construction Management Contract

Under this type of contract, construction managers (CM's) actually manage the construction of a facility for or with the building owner. Construction managers are often integrally involved during the design process, recommending alternative construction materials and methods based on their experience with local construction practices.

The CM is responsible for managing construction for the owner, guaranteeing that construction will not exceed an agreed-upon maximum price for the facility. The construction manager may elect to do some of the construction, usually the work of general trades. The construction manager negotiates and oversees the work completed by other subcontractors.

The two advantages of this form of construction delivery are the input a construction manager can provide during the design process and the ability to guarantee a maximum price for the facility cost early in the design process.

Design/Build Contract

Based on a definitive description of the facility in a detailed project program, the design/build contractor completes facility plans and specifications and then constructs the facility for a guaranteed maximum price.

In this form of contract, it is imperative that the facility description be extremely accurate and complete whether it is a written narrative, drawings, or a combination. This description establishes a contractual scope of work for the design/build team; additional requirements or changes must be negotiated. The advantage of this form of contract is speed.

Methods To Administer Construction Contracts

The most common way to administer a construction contract is through a facilities management and planning office or contracting agency within the organization. However, some organizations do not have internal groups and must contract with another outside agency.

For example, some Federal organizations work through GSA or the Army Corps of Engineers. Some State organizations work through a State facilities management and planning office. Some State or local agencies will contract with a construction management firm under separate contract outside of the construction agreement.

It is important for the LTCO to understand who contractually represents the owner through the construction process.

Process

As the construction process moves through a series of steps, there are issues about which the laboratory director should be concerned to ensure the satisfactory completion of the facility.

Prequalify Bidders

Forensic laboratory facilities are extremely complex and require a contractor with demonstrated experience building this type of project. The bidding process (especially for government facilities) awards the contract to the lowest bidder; lab directors will not be allowed to disqualify unqualified bidders after bids are received and opened. Therefore, if possible, include a process to prequalify bidders. Prequalification should be based on the following:

- **Company experience.** Has the company:
  - ✧ Successfully constructed similar types of projects?
  - ✧ Successfully constructed projects of similar size?
  - ✧ Provided adequate bonding capacity?
  - ✧ Provided verifiable references?
  - ✧ Met previous construction schedules?
  - ✧ Demonstrated an acceptable record with respect to cost control and change orders?
  - ✧ Been involved with, or had a history of, litigation?
- **Key personnel.** Keep the following in mind when considering key personnel:
  - ✧ Have key personnel, such as the project superintendent, successfully completed similar types of projects?
  - ✧ Have key personnel successfully completed projects of a similar size?
  - ✧ Review key personnel references.
  - ✧ What kind of commitment is the company willing to make with respect to assigning these individuals to the project?

Bidding

During the bidding process, the qualified bidders are invited to prepare bids for the construction of the forensic laboratory. Steps include:

- **Solicitation.** Invitations to bid can take many forms, including:
  - ✧ Direct notification of qualified contractors.
  - ✧ Advertisement in local newspapers.
  - ✧ Advertisement in trade journals.
- **Prebid conference.** This serves to notify all contractors interested in preparing bids of any special conditions of which they should be aware, or issues not clearly addressed in the contract documents.

- **Issue documents.** All interested contractors are provided with sets of plans and specifications, including all necessary bid forms. A nominal fee is usually applied to cover the cost of printing and handling.
- **Requests for Information (RFI's) and addendums**. During the bidding process, many questions will be received from prospective bidders. These questions are referred to as Requests for Information (RFI's). Most RFI's can be simply answered by the design team. However, if there is incomplete or conflicting information, or an error in the documents, it is imperative that all bidders are notified of any revisions in order to make bids comparable. This is called an addendum. Addendums are issued during the bidding process for this purpose and should be issued no later than 14 days prior to bid opening.
- **Bid opening.** Bids received are normally opened and recorded at a public bid opening.
- **Analysis of bids and alternates.** All bids must be evaluated carefully. Often a project includes alternates. Alternates are portions of the work that may or may not be executed. An *additive alternate* is additional work that the building owner may elect to do if the bid cost is within his budget. A *deductive alternate* is work that may be deleted from the contract if the bid cost of construction is too high. Deductive alternates should be avoided as much as possible, as the cost savings realized will be less than if the same portion of work were an additive alternate. Multiple alternates in the bid package can make the evaluation of the bids extremely complex.
- **Award of the construction contract.** Once the successful bidder has been identified and the bid certified as bona fide, the construction contract between the owner and contractor can be signed.

Construction

Hold a preconstruction conference. This facilitates reaching an understanding by members of the construction team of the procedures that are to be followed during construction, establishing:

- Chain of communication.
- Construction schedule.
- Procedures for processing shop drawings, change orders, RFI's, and payments.
- Coordination drawings.

Any areas of specific concern also should be discussed, such as:

- Site security.
- Mockups. Often for critical systems or materials where high expectations of quality exist, a sample panel or mockup is constructed to establish a benchmark or standard for the project. Often, a mockup of an entire laboratory module is constructed and the casework used in the mockup can be reused in the facility.
- Coordination of work.

Periodic Site Inspections, Punch List, and Final Inspection

Hold periodic site inspections throughout construction. Toward the end of construction, compile a punch list. A punch list is a list of items compiled by the contractor that are incomplete or need to be fixed. The list should be reviewed by the building owner and the architect, who should walk through the structure and add to the list as necessary.

Architect/Engineer (A/E)

It should be noted that the Architect/Engineer (A/E) usually has primary (but not sole) responsibility for periodic site inspection, punch list and numerous other tasks. A/E services in this area are delivered as a part of his "PCAS" Services. (Post Construction Award Services). These services have usual and customary areas of responsibility/performance, which should be defined in the contract between the Owner and the Architect/Engineer. Some owners may seek to economize on professional services by omitting or reducing these services. This is a false economy.

Commissioning/Occupancy

Ensure that systems are in place and in working order, and that laboratory staff and facilities engineers understand how the building systems work. Obtain training for the facilities engineer and custodial staff on new equipment and systems and arrange for service for the equipment and systems.

Pitfalls

During the construction process, events can occur that may prevent a facility from achieving the laboratory's level of expectation. Many of the issues will be beyond the laboratory's authority to control and the lab will have to rely on the expertise of others to control. Following are common pitfalls to anticipate:

Quality Standards/Expectations

Mockups. For critical systems where high quality is specified and expected, mockups provide a method of examining the systems before the bulk of the materials are either fabricated or installed. If the mockup does not meet specified levels of quality, it is much easier to change.

Shop drawing. Shop drawings are drawings from materials suppliers or subcontractors that precisely detail the installation and materials they propose to use. These drawings should be carefully reviewed by the design team for their compliance with the plans and specifications and by the LTCO for meeting the intent of the laboratory concepts.

Fully Implementing Building and Systems Concepts

Often, as a facility is constructed, design concepts are not fully carried out. In laboratory facilities, the organization of utility distributed systems is critical for adaptability and ease of maintenance. Yet, often during construction, utilities are routed first come, first served, and form a tangled web incapable of serving or fulfilling future project needs. The coordination of drawings of building systems is an issue that should be carefully reviewed at the preconstruction conference and enforced in the contract general conditions.

Equipment Installation and Coordination

The purchase and installation of fixed or major movable equipment is complicated and can result in coordination problems. Often, "or equal" equipment that is bid does not have the same utility requirements or is a different dimension than that used as the basis of design. For example, pit-mounted washers or autoclaves with similar capacity have different requirements for utility connections and require a different pit dimension. These variations must be carefully reviewed early on to avoid problems later in the construction process when equipment is installed.

Existing equipment to be relocated presents a different set of issues. This includes moving the equipment, connecting the equipment, and the potential that some equipment may be replaced during the construction period. The LTCO must be aware of any changes in equipment that may affect the building or utility requirements.

Laboratory Layout Revisions

During the construction process, it is not unusual for a large percentage of the laboratory users to change. This may lead to revisions in the laboratory fit-up. A significant amount of time may be required of the LTCO to coordinate these revisions during constructions.

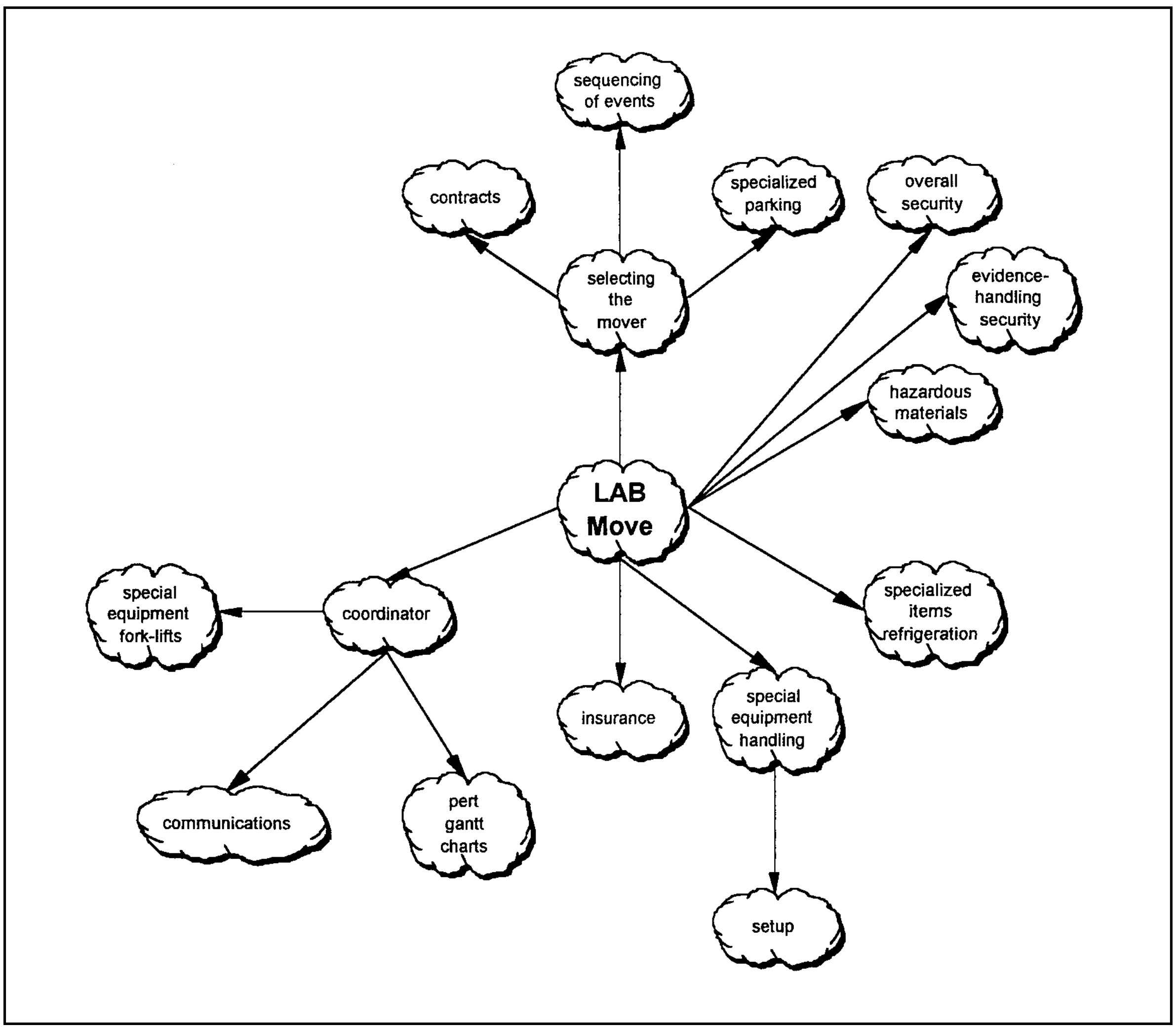
Moving

Executing the move of a forensic laboratory requires a strategic plan. Without such a plan, the move may not be done properly and the consequences can be formidable (see figure 1).

Work must continue even as the shift is made from the old facility to the new. The laboratory and its operations don't stop because the laboratory moves. Phase and schedule move activities so that routine daily events occur as smoothly and efficiently as possible. This requires logistics and planning.

When considering or planning a move, address the following questions:

- What are the tasks or activities?
- In what order are they performed?
- Who is going to do them? And, who has approval or sign-off authority?



A move plan should be based on the projected move-in date and time required to accomplish tasks. Tasks can be assigned "L" for long-range, "I" for intermediate, "S" for short-term, "P" for postmove, or any combination of these terms. The plan should be chronological—a three-phase framework that includes *premove*, *move*, and *postmove activities*.

A move plan should consolidate premove, move, and postmove activities into individual paths. Establish a specific plan and articulate it early and often. Initially, the plan is fluid. It will grow and evolve constantly. Always keep in mind the date the move needs to be completed. Define the end first. Then decide how far prior to this date move activities need to start in order to complete the move successfully. An example of a detailed move plan demonstrating many of the concepts discussed in this section is found in Appendix IV. Specific questions as to labeling, codes, application or intent should be addressed to Robert A. Jarzen of the Sacramento County Laboratory of Forensic Services.

Moving Activities

- **Brainstorm and Sequence Activities.**

Get organized. Write down all the tasks that are part of a strategic move plan. There's a tremendous amount of detail—everything from whether the lab's loading platforms fit the movers' trucks to refrigeration concerns when transporting evidence. Will large pieces of equipment (for example, electron microscopes) fit through the door? If not, should these be moved before the window frames are installed? Are State/county lines being crossed? If so, has the lab complied with the regulations for each region? Just as with the LTCO, someone in the laboratory—not the laboratory director, who is generally too busy—should be assigned to attend to these and the many other details pertinent to the total move process.

Prioritize tasks. The key to the process is the sequencing of events. Sequencing consists of listing every activity necessary for the move, putting the activities into a bounded timeframe, and assigning the tasks. It might be helpful to chart the tasks using available project planning software. Charting the move allows the chief planner to view, review, and modify the plan as needed while making it easily accessible to other interested parties (the State's attorney or agency chief executive).

Transition plan. Include a transition plan for satisfying the lab's clients. Consider an interim step that protects the validity of reagents and materials during the move and keeps the lab operating. Plan for security needs, heating and cooling systems, and especially plan to protect the safety of people. When renovating a facility, identify hazardous conditions, such as the presence of asbestos. Ensure that repairs are complete before staff move in.

Contingency plan. A contingency plan is essential. Plan for late deliveries. What if the lab needs to rent equipment because some of it was dropped from the back of the truck? What will the lab do if the electrical system does not work properly?

- **Assign Human and Dollar Resources.**

Anchor responsibility for the move. Allocate resources, both human and financial. Assign one staff person the responsibility for the move and prioritize specific tasks, including the time it will take to accomplish them.

- **Designate Team/Sector Captains.**

Assign a team captain. Under the team captain, assign sector captains in charge of specific areas such as DNA, firearms, or documents. The sector captains work with the team captain and the movers to decide how to communicate moving instructions. For example, whether boxed materials should have a room number or a color that designates the department (red for serology, green for firearms).

- **Develop a Move Manual.**

Decide the elements of the complete, well-integrated move plan and develop a move manual. The manual may include the following information:

How to select a mover. Selecting a mover varies with individual circumstance. Often, an RFP is required and bids evaluated. There also may be minority vendor set-aside requirements.

Articulation of the plan. Articulate the needs and services required. Is one mover needed, or 14? Security may be needed. Staff time may be needed to ensure that computer ports are functional. Articulate a plan and notify other individuals (clients, staff, other departments involved, the State's attorney's office). Notify them of changes in the plan as well.

Plan for new purchases. Don't wait until 6 months before the move to begin to consider purchasing new equipment. This decision must be made early.

The pack-up. As the move draws near, packing begins. Packing can be done in stages to minimize disruption. Some materials can be packed early, such as those used only monthly. Progress eventually to the equipment which, once it is removed, work stops. The last items packed are those used every day. Before completely halting the old lab's operations, validate the systems in the new facility to ensure it is ready to immediately support lab functions.

- **Devise a New Facilities Manual.**

The new facilities manual will serve as a guidebook of signposts and activities in the new building. Add any new policies and restate those policies from the old facility that will be continued.

Continuous Activity

Several activities are continuous from the time the decision is made to either refurbish an existing facility or build a new one until after the move is completed.

• Inventory.

Before issuing a request for proposals (RFP), determine the size of the job. Specifications include an inventory of the items to be moved. For RFP submission, know how the lab's equipment is currently positioned and future needs. Inventory is crucial because there are different kinds of movers for different kinds of equipment. Speciality movers may be needed.

Inventory each section. Staff in each section of the lab should work with the move captain to plan how their section will move and to where. To enable this planning, be sure that staff are familiar with the new facility.

Interim storage. Arrange for interim secure storage, especially if the lab is moving from one building to another or being renovated in stages, so that inventory can be stored if it needs to be moved before the facility is ready. Rented trailers or a warehouse can be used for interim storage.

• Personnel Coordination.

Personnel coordination is imperative and good communication essential. Hold meetings with staff to discuss how the move should occur and once the course of action is decided, issue memos so there is no misunderstanding. Within the laboratory, everyone should know the plan or their section of it. During the move, one person (the move captain) needs to know what is happening at all times. Have this individual monitor the whole process and report regularly to the lab director.

• Security Assurance and Training.

Maintaining security assurance in the old laboratory while moving and training on the security systems in the new building is essential throughout the process.

• Chemical and Biological Hazards.

Chemical and biological hazards play a large role in determining the type of facility to be built, the placement of equipment, and how items will be moved. They also affect liability and indemnification. Federal, State, and local regulations may apply.

• Custodial Requirements.

Plan to have a special custodial staff ready as the move occurs in case of spills or breakage. It may be possible to draw from the professional movers or laboratory staff. Plan for custodial requirements in the old and new facilities. The old one needs to be left clean. The new facility requires appropriate maintenance, trained custodial staff, and functioning equipment.

Long-Range Activities

- **Request for Proposals.**

Long-range activities include developing the RFP for movers and considering any specialty aspects such as evaluation of bids, insurance, and instrument handling associated with the move. Meet with the appropriate individual who oversees the RFP process before developing an RFP document. Consider all tasks that need to be performed and when the move must be completed. A sample Statement of Work (SOW) is provided for your information in Appendix V.

- **Warranty Issues.**

Check with the manufacturer(s) before moving equipment to ensure that warranties are not invalidated by a move. Address warranty issues for both the professional movers and laboratory staff. Develop a list of equipment that would require the manufacturers' participation in the move and post-move setup. Allocate funds and set up schedules.

- **Liability Issues.**

Coordinate liability issues. Determine the extent of the laboratory's responsibility if the move is executed in a certain way. Ensure that appropriate bonding is in force for all contractors.

- **Rules of the Game.**

Know the financing rules. Meet with the comptroller or agency that oversees expenditures in the lab's municipality or State.

- **Temporary Storage Needs.**

Temporary storage needs must be part of long-range planning. Waiting until too close to the date of the move may mean that temporary facilities are unavailable.

- **Specialty Movers.**

If specialty movers are needed to handle equipment, build enough time into the plan to accomplish it on schedule. Keep in mind that there are different kinds of movers for different sorts of materials.

- **Furniture/Equipment/Computers.**

For furniture, equipment, and computer systems, decide early in the process:

- ✧ What will be kept?
- ✧ What will be refurbished?

- ✧ What will be disposed of?
- ✧ What will be acquired? (If new supplies will be bought, build in validation time and money.)

Intermediate Activities

- **Evaluate Bids and Select Mover(s)/Contractor(s).**

Intermediate activities include evaluating bids received in response to the RFP and selecting movers and other contractors.

- **Library Considerations.**

Consider the weight of boxes when packing library contents. Boxes that are too heavy may be too difficult to lift. Also consider issues pertinent to the lab's geographic area and climate. For example, do the books need fumigation, or do the shelves require earthquake protection? Build in those kinds of considerations with respect to the library and other items that will be moved from one building to another.

- **Update Lab Information.**

Build in time to update the laboratory's phone numbers, correspondence, stationery, business cards, license, and other permits before the move.

Intermediate to Short-Range Activities

- **Specialty Equipment Coordination.**

Intermediate to short-range activity considerations include any specialty equipment needed to move items from the old building to the new, such as cranes and forklifts.

- **Notification of Clients/Users.**

Notify lab clients (State's attorney's offices, courts, police agencies) well ahead of the actual move, just before the move, and immediately following the move.

- **Refrigeration Concerns.**

Another intermediate to short-range activity that requires lead time is refrigeration. Build in refrigeration and other ways of preserving fragile or friable evidence during the move. Transfer refrigerated items to the new facility quickly. Prior to the transfer, ensure there is power and that systems are operating in the new facility.

• **Systems for Filing of Records, Inventory of Materials, Supplies/Restock.**

Planning is needed for systems of filing, the inventory of materials, and supplies and restocking procedures in the new building. Plan so that people will understand how the system is going to work and build in a method that will make it work correctly.

Short-Range Activities

• **Key/Card Assignments.**

Short-range planning includes determining key and card access assignments. Decide who is going to have access to the building and to which doors.

• **Parking Concerns.**

Where is everybody going to park? Will there be a class system or a free-for-all? Will parking assignments be based on shift work? Build parking concerns into the move process.

• **Assign Work Areas/Office Space.**

At first think of work areas generally as the space where forensic examiners will be assigned. Decide toward the end of the move planning process exactly who is going to sit where. This can be done with more lead time, but choosing to give short-term notification to staff can reduce grievances about personal seating arrangements.

• **Notification of U.S. Postal Service, Couriers, Utilities.**

Notify the U.S. Postal Service, couriers, and other delivery services of the move, as well as the utility companies. Talk to them about timing of services such as shutting off power in the old building on time and turning on power in the new building on time. Cover all billing issues (contractor's liability versus the laboratory's responsibility) well in advance of the move.

• **Electronic/Computer Setups.**

More short-range planning is needed for electronic and computer setups. Ensure that network nodes are working before the move. Then transfer the electronic/computer equipment and set up the network.

• **Packing/Moving Materials.**

Ensure that all the necessary packing and moving materials are on hand if the lab is going to do some of its own packing and moving.

- **Extension Cords.**

Have extension cords on hand on moving day. Items may not be placed exactly as originally directed.

- **Training Related to the Move: Safety, Security, Proper Lifting.**

Train staff prior to the move on the facility's new systems, on safety and security issues, and on how to properly lift items.

- **Determine Facility Hours.**

Decide the facility's hours of operation. For example, there may have been three shifts in the old facility to make adequate use of a small space, and the new larger facility may allow for either two shifts or one. Determine when the facility will be open.

- **Verbal Rehearsal.**

Hold a verbal rehearsal of the move. Talk through the process with everyone involved to familiarize staff with the procedure planned for moving day.

- **Walk Through With Staff and Mover.**

Walk through the move process with staff and the movers together.

- **Test New Facility Systems: Elevator, UPS, Water, Power.**

Before occupying the new facility, ensure that building functions such as elevators, card readers, water systems, and electrical power work. Shut the power off and ensure the emergency lights come on and backup systems are operating. Train staff how to operate these systems.

- **Notification of Normal Vendors and Delivery Schedules.**

Notify the lab's normal vendors (for example, compressed gases, food). Provide vendors proper access to the property and directions on where they should deliver goods. Know the vendors' delivery schedules and have receiving people on hand.

- **Access to Property.**

If the new facility is a stand-alone building, determine building hours and access. If the facility is within a shared building, find out about normal operating hours and after-hours access.

During the Move Activities

- **Monitoring the Movers.**

Station staff members at the old site to ensure that the movers pick up only items that are to be moved. Station staff members at the new site to direct movers on where to bring and place items. Document damage/breakage or injury to personnel.

- **Temporary Signs.**

Laboratory staff and movers need to know where equipment and materials are going to go. Prepare temporary signs to direct the movement of materials into the new facility. Temporary signs can help answer questions before they are asked.

- **Alarms.**

It is imperative that the alarm/security system is in place and operational at the time evidence is moved into the new facility. Just before the move, check the operation and responsiveness of alarm systems for security and for items such as hood monitors and temperature control. Check these again after the move. If it is necessary to have people lock up at night, ensure that it won't set off the building alarm. Check that the alarm works. Know what constitutes an intrusion and what the reaction is to it. Does the alarm merely sound, or do people respond? Another issue of alarm/security is the monitoring by cameras. Will it be done from the first day? Make sure.

- **Computer Shake-Out.**

Have a good computer shake-out. Try to log some evidence into the new computer system. Ensure that all the nodes work for report generation and tracking evidence.

- **Equipment/Evidence Audits.**

Have a clear audit of movement of the lab's equipment and evidence from the old building to the new one. This is helpful both for the lab director and to ensure that the contractors do their jobs.

- **Security Compliance: Restrictions, Tours.**

Consider security compliance concerns. Decide how access will be restricted to lab staff, tour groups, and the general public.

- **Evidence Transfer Integrity.**

The ability to prove integrity of evidence transfer is important. Document it. Seal the evidence in a box, label it, put it on the truck, and send a person along with the truck. An armed guard or police escort may be necessary (for example, with drug evidence). Coordinate this with the county, city, or State's attorney. It is probably best to get approval in writing of the lab's moving plan. For refrigerated evidence (rape kits, biological evidence), leave it in the refrigerator, seal it, put it on the truck, and move it to the new facility. When it arrives, verify that the seals and the evidence are intact.

- **Train Staff on New Systems.**

Training staff on the new building systems is useful. For example, if the temperature is too hot or too cold staff need to know what to do. They need to know the person to call, the button to push, and which monitor to change to correct the situation.

Postmove Activities

- **Gather Feedback.**

After the move, request feedback from staff. Compile a list of problems so the problems can be corrected. Obtaining feedback from staff should be an ongoing process. Staff will feel included and the director will receive a better response if it is a routine and regular practice.

- **Damage and Breakage.**

Identify and list items lost, damaged, or broken during the move and determine responsibility for repair or replacement.

- **Conduct Fire Drill/Safety Inspection.**

Conduct a fire drill and a safety inspection. Ensure everyone knows the location of eyewash stations and first aid kits.

- **Discard Used Moving Materials.**

Discard used moving materials quickly. Many movers will take back boxes and other items. If they do not, the lab is responsible.

- **Set Up and Verify Operation of Equipment, Method Changes, Tracking Systems.**

Set up and verify the operation of any new equipment. Test new computer and evidence tracking systems. If the gas chromatograph has been moved, revalidate it. If work methods have been changed because of the geometry of a room or the availability of new venting, ensure that the methods are verified and are operating appropriately. Test gases and water to ensure they meet specifications.

- **Introductions/Tours for Media Representatives/Dignitaries and the Staff Party.**

Postmove activities may include tours for the media and dignitaries and a staff party.

- **New Facilities Manual.**

Create a new facilities manual. This will establish a system that will allow staff to best use the laboratory and enable a lab director to change policies carried over from the old facility. The manual can address policies such as:

- ✧ Security issues.
- ✧ Fire- and/or safety-related issues.
- ✧ HVAC controls.
- ✧ Building evacuation.
- ✧ Placement of personal art, photos, and belongings.
- ✧ Smoking.
- ✧ Food and drinks.

REFERENCES

[1] Diberardinis, L.J.; Baum, J.S.; First, M.W.; Gatwood, G.T.; Groden, E.; Seth, A.K. *Guidelines for Laboratory Design: Health and Safety Considerations*, 2nd ed.; John Wiley & Sons; New York, 1993.

[2] *Research Facilities of the Future*; Stark, S., Ed.; Annals of the New York Academy of Sciences, Vol. 735; The New York Academy of Sciences; New York, 1994. (Note: Copies of this journal are available from: National Institute of Standards and Technology, Office of Law Enforcement Standards, Bldg. 225, Rm. A323, Gaithersburg, Maryland 20899.)

[3] *The Architects Handbook of Professional Practice*; American Institute of Architects, Manual 4, "Documents." (Includes sample documents for many of the forms of agreement and other documents used during the construction phase.)

(Note: Additionally, the American Institute of Architects (AIA) publishes a number of useful brochures, forms, consultant contract forms and even helpful advice on how to select an architect. While not applicable in all cases, these could prove helpful as a reference. The AIA published 3 or 4 "Handbooks of Professional Practice," which are available through the national headquarters in Washington, DC, and/or through contact with State AIA Chapters.)

For more information on the National Institute of Justice, please contact:

National Criminal Justice Reference Service
Box 6000
Rockville, MD 20849–6000
800–851–3420
e-mail: askncjrs@ncjrs.org

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Other Department of Justice publications noted in this report can be ordered from NCJRS. Most are available free of charge and most can be downloaded from the Justice Information Center Web site.

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About the Law Enforcement and Corrections Standards and Testing Program

The Law Enforcement and Corrections Standards and Testing Program is sponsored by the Office of Science and Technology of the National Institute of Justice (NIJ), U.S. Department of Justice. The program responds to mandates of the Omnibus Crime Control and Safe Streets Act, as amended, which created NIJ and directed it to encourage research and development to improve the criminal justice system and to disseminate the results to Federal, State, and local agencies.

The Law Enforcement and Corrections Standards and Testing Program is an applied research effort that determines the technological needs of justice system agencies, sets minimum performance standards for specific devices, tests commercially available equipment against those standards, and disseminates the standards and the test results to criminal justice agencies nationwide and internationally.

The program operates through:

The *Law Enforcement and Corrections Technology Advisory Council* (LECTAC), consisting of nationally recognized criminal justice practitioners from Federal, State, and local agencies, which assesses technological needs and sets priorities for research programs and items to be evaluated and tested.

The *Office of Law Enforcement Standards* (OLES) at the National Institute of Standards and Technology, which develops voluntary national performance standards for compliance testing to ensure that individual items of equipment are suitable for use by criminal justice agencies. The standards are based upon laboratory testing and evaluation of representative samples of each item of equipment to determine the key attributes, develop test methods, and establish minimum performance requirements for each essential attribute. In addition to the highly technical standards, OLES also produces technical reports and user guidelines that explain in nontechnical terms the capabilities of available equipment.

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