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Forensic Science Laboratory: A Setup

OP Jasuja

Crime and its investigation exist and evolve side by side and both criminals and crime investigating agencies take clue from each other. All type of technologies is available in free market environment due to globalization. Though similar type of the technologies is used by both, it has been observed that criminals are not one but many steps ahead than the criminal investigation agencies to use them first. While criminal investigating agencies are bound by law of land to act, when using these technologies, criminals are free to use the same in a manner which suits them most. Therefore, there is an urgent need of having a dynamic system in criminal investigation so that these agencies may update themselves with the latest rather than depending upon inefficient methods. In that context, it may be correct to say therefore that the testimonies based on physical evidence examination may attract more attention and weightage than the conventional eye witnesses (Just for example, in computer related crimes, there is no eye witness but technology may be able to establish the involvement of a particular machine in crime). Thus an increase in demand for more forensic science labs may be obvious. Forensic science contributes in a very significant manner in administration of criminal justice system by providing scientific and fundamental information to investigating agencies and finally to the courts. Moreover, due to impact of electronic media, investigating journalism, tele-serials like medical detective, CSI and x-files contributed a lot in awareness of general public about the use of forensic analysis in criminal justice. It may not take any opinion on its face value and demand for analysis in more accurate way (for example, Nithari case and Arushi murder case). It will not be incorrect to say that public has developed the skills to oversee the activities of a Forensic Science Laboratory.

A Forensic Science laboratory has a unique place in administration of justice system. As per requirements, scientific expert witness is to act neither for prosecution nor for the defense but for the court only and in no case he is supposed to give a biased witness. Keeping this fact in view, to act with full efficiency and in unbiased manner, all the facilities to analyze the evidence material should be available as well as a conducive environment must be there in the laboratory. To make it possible, therefore, there should be a well-planned laboratory which not only fulfills today's requirements but also has a scope to adapt for future as per changing needs and demand of time.

To materialize an idea of establishing a forensic science laboratory, whether in public or private sector, may demand a very high budget as well as skills therefore all the issues concerning this be addressed so that organizational efficiency could be maximized. This could be achieved by providing safe working environment for all the staff by using resources most economically. To begin with, a forensic science laboratory may be started with following steps:

A. PLANNING FOR THE LABORATORY

It includes a thorough assessment of the needs of the laboratory and statement of requirements. Planning should be such that all the forensic facilities are made available under one roof so that maximized organizational efficiency, economic utilization of all recourses in a safe, secure well-designed laboratory could be achieved.

B. DESIGN OF A LABORATORY

While preparing for a design of the laboratory, it should be kept in mind about the handling hazardous material (Biological evidence may be infected, explosive devices, etc.) and their storage. Also future needs of the laboratory should be kept in views so that suitable alterations/expansions, etc. may be made without affecting the current working of the laboratory. Design of the laboratory should be such that health and safety of all the employees is not compromised while maintaining full operational efficiency, security and preservation of evidence without contamination. With the availability of advanced technology, it is possible to achieve highest performance standards for cleanliness, temperature, humidity. Vibration control may be one of the very important factors for uniform and reproducible test result as it affects significantly the working of various sophisticated instruments used in forensic science laboratory. While designing of a laboratory, a fine balance of available budget and needs of the laboratory is to be achieved. Both are equally important and therefore while listing the needs of the laboratories should be done by keeping the priority of needs in mind. If flexibility in budget is desired then it must also be seen that in the very beginning itself, such needs may not be listed which may become obsolete by the time laboratory starts working. Similarly, it may be of utmost importance that quality of the testing is not affected due to reservations of budget.

C. CONSTRUCTION OF LABORATORY

Though it is a matter concerned with state or central works department, it is desired that laboratory staff may be involved from the very beginning in the activities related with construction. As already mentioned that many sophisticated instruments are to be installed, whose working may be affected by vibrations. Therefore, building under construction must be resistant to earthquake and all other natural calamities. While constructing the laboratory building, not only all the local and state regulation should be followed but also construction contract should be assigned to well qualified, certified and experienced contractor. Special attention may be given to architectural details, ventilation, mechanical, plumbing and electrical design keeping in view the adaptability factor. The construction should be such that internal and external changes can be made as and when required. While selecting the location of laboratory, factors like Area, Neighboring buildings, Highways access, proximity to on-site resources, environmental parameters as air and water quality should be given paramount importance. Other features like parking requirements, site security, and fence or boundary wall are equally important. While establishing laboratory, various security related features like passive design features, electronic security design features, site security features and proximity access system should be installed. Inside the laboratory factors like health hazards and set up of various sections of laboratory contribute to the overall quality of the working. To maintain the high standards to tackle health hazards, provision for fuming hoods and biological safety cabinets, emergency shower and eye washer, and optimum passage width between laboratory benches must be kept. At the time of allocating space for various sections of the laboratory, factors like evidence flow, staff interaction, and public access should be kept in mind and accordingly, each section should be located in such a way that it may act supplementary as well as complimentary to neighboring section. Relationship with clients, law enforcement agencies, medical officer, District attorney and courts are such factors which may affect the over all working therefore a proper provision for their sitting, organize meeting with lab staff, briefing about the evidence testing, etc. may go a long way to give a positive impression of the laboratory. In nutshell, it can be said that laboratory layout should be based on laboratory processes rather than traditional departmental setup. Once the laboratory has been established, quality of all the activities of the lab is to be controlled and assured to the prescribed standards. For this, following factors play a more important role:

1. Well-equipped instrument room as well as instrumentations maintenance space.
2. Reagent preparation room.
3. Inventory of chemical to be used.
4. Separate storage areas for each major class of chemicals.
5. Chemical hygiene plan (CHP) with respect to chemical inventory as well as standard operating procedures(SOP).
6. Emergency response guide for hazardous chemicals.
7. Administrative work spaces.

Accreditation of the laboratory is one of the most important aspects, with the globalization of all sphere of life, justice administration system has also not been left without its impact and a laboratory with international standards with respect to infrastructural facilities and human resources is highly desired. Getting accreditation, the clients and general public is assured that only widely accepted and well-established methods are being used for forensic analysis. To achieve a goal of delivering best possible services to the clients, it is a must for every laboratory that all its sections are upgraded and updated to the latest advancements in the field but also its professionals are also undergoing continuous training in their respective specialization. They should go through continuous education program to enhance their knowledge, skills and abilities including training in the field of expert witness. These trainings may not be only for freshly employed employees but also be for current employees. Knowledge, skill and experience of the forensic scientist is a very important aspect of Forensic analysis as often it contributes a lot to make decision by the court of law towards acquittal or conviction. Laboratory must maintain standard operating procedure manuals and these may be updated at regular interval too. Laboratory data management software like LIMS (Laboratory Information Management System) should be installed to manage all the data generated in routine work of the laboratory. It is highly desirable that laboratory is fully equipped for research in various fields of specialization and thrust must be given for developing new, more reliable and accurate tests of analysis. With the new technologies, it becomes more pertinent that new methods are developed to cope with problems caused by technology misuse. A forensic science laboratory must have all the advanced facilities of testing the evidence material of different nature and may have therefore a number of sections in general. There may be many cases where activities of one section may overlap the other or the same evidence may be required to be tested by more than one section. Keeping these facts in mind, all the sections may be set up as per requirements of the lab. Various sections of the laboratory are:

1. Forensic Chemistry
2. Forensic Toxicology

3. Forensic Biology
4. Forensic Serology
5. DNA Forensics
6. Questioned document examination
7. Ballistics
8. Latent finger prints
9. Physics
10. Narco Analysis
11. Brain finger printing
12. Lie detective
13. Voice Identification
14. Image processing
15. Computer forensics/Cyber Forensics
16. Crime Scene Investigation
17. Photography
18. Quality Management

Each section may deal with specific type of work and as an example, section-wise description of type of testing conducted by them is give below.

1. Forensic Chemistry
 - a. Identification and estimation of banned drugs as per law of land.
 - b. Analysis of chemicals involved in bribe/trap cases
 - c. Identification and estimation of alcohol and related materials covered under Excise Act
 - d. Identification and estimation of adulterations in various petroleum products as well as extraction. Identification and estimation of same in cases of arson.
 - e. Chemical analysis of trace elements.
 - f. Identification and estimation of explosive residue.
2. Forensic Toxicology
 - a. Identification and estimation of pesticides and insecticides
 - b. Metallic poisons
 - c. Plant poisons
 - d. Animal poisons
3. Forensic Biology
 - a. Examination of body fluids
 - b. Identification of skeletal remains for species origin, age, sex, stature, facial reconstruction and skull superimposition, etc.
 - c. Examination of hair and other fibers
 - d. Identification of wood, pollens, diatoms, botanical evidence
 - e. Forensic entomological examination
 - f. Bite marks examination
 - g. Identification of material received under Wildlife Protection Act
4. Forensic Serology: Detection of blood stains and blood grouping, identification of blood group substances from various body fluids, enzyme typing from blood and other body fluids, their stains, tissue material, etc.
5. DNA Forensic: Examination of biological material as blood, semen, saliva, etc. for paternity disputes as well as other criminal cases.
6. Questioned document examination:
 - a. Identification of handwriting and signatures
 - b. Examination of various type of Alterations in documents
 - c. Examination of printed, photocopies, typewritten and faxed matter
 - d. Examination of lottery tickets and counterfeit currency, stamps papers, postal stamps.
 - e. Examination of indented writings.
 - f. Determination of age, relative age of Document
 - g. Examination of plastic currency/passport, etc.
7. Ballistics:
 - a. Examination of cartridge, bullet and wads, etc.
 - b. Firearm examination and identification (IBIS)

- c. Identification of GSR
 - d. Determination of Range, etc.
8. Latent fingerprints examination: Visualization of latent finger prints on different surfaces with various optical, powdering and chemical methods. Though latent fingerprint development at crime scene or in laboratory is undertaken by personnel from fingerprint bureau, it is demand of the time for speedy recovery of the evidence material from crime scene, latent print development work is undertaken by forensic science labs only. In our country, a section in Fingerprint Bureau is established to look after this work, where most of the personnel are without any science background. Therefore, they are unable to appreciate a battery of methods available to develop latent prints and thus allow to lose the important due material. In forensic lab, person with chemistry background may be trained with all available methods used to develop latent prints and deputed for this important task.
 9. Forensic Physics:
 - a. Examination of tool marks
 - b. Examination of building and road material
 - c. Examination of glass, paint, metals, soil, etc.
 - d. Examination of tempered electrical equipments
 - e. Restoration of erased chassis/Engine number
 - f. Examination of cables, etc.
 - g. Examination of marks and impression as tire marks, tread marks, etc.
 10. Narco Analysis: Examination of suspects with this method is a recent introduction and not many laboratories in the country are equipped with this facilities.
 11. Brain Fingerprinting: Examination of suspect for interrogation purposes and this technique is also full of controversies. Only in few laboratories this facility is available.
 12. Lie Detection: This is a very old method to interrogate the suspects, witnesses. Almost, all major laboratories of the country have this facility with them in spite of low success rate of the technique.
 13. Voice Identification: Most of the time this is a part of physics division but in many laboratories it is being developed as a separate stream as a lot of scope for research exists.
 - a. Examination of duplicate audio tapes, etc.
 - b. Speech and speaker identification.
 14. Image Processing: Examination of video tapes, CD and DVD, etc. for any possible alteration in images of a recorded event. It also includes the examination of morphed images as well as video clippings recorded by CCTV at malls and other important installations.
 15. Computer forensic:
 - a. Stand alone computer crimes
 - b. Cyber crimes related with networked computer include hacking, defacing of websites, spam, spoofing, stenography and other related matters.
 16. Crime Scene Investigation: It is one of the most important parts of forensic science. It is said that if the clue material is not collected and packed properly its value as evidence may diminish. Only a fully trained investigator who understands the forensic importance of these can successfully collect relevant clue material. Even if a single clue material is left just because of the ignorance of the investigator, its impact on trial may be immense. The mobile forensic units may be stationed at different geographical areas in the jurisdiction of the laboratory so that assistance can reach in minimum time. These mobile units are available in standard format fitted in a van type vehicle equipped with facilities like photography, fingerprint, communication, bomb response, spot test and evidence collection.
 17. Photography: A photographic section is an integrate part of a forensic science lab. To prepare the report, supporting photographs of crime scene, handwriting, signature, fingerprints, etc. are always a must. The juxtaposed charts are very helpful to demonstrate the similarities and differences in the matter under study which can be prepared with the help of photography only. Professional photographer is helpful in photography/videography of crime scene of diverse conditions as in case of Arson, mass disaster and a ill-illuminated crime scene, etc.
 18. Quality Management: Though in industry the concept of quality is very old and many countries like Japan and USA have taken full advantage of quality regime in the form of increased profits and enhanced efficiency, it is a new concept in the field of forensic science. ISO/IEC 17025 guidelines are for quality management of testing and calibrating laboratories and include forensic science also. To look after the quality management of the laboratory is a full-time job and therefore laboratory director may be the quality manager too but it is always for better if a separate section is established for the purpose. While there are many organizations at international level, NABL is the body in our country looking after the accreditation of various forensic science laboratories. Keeping, above mentioned set up of a typical forensic science laboratory in mind, the design of the laboratory may be finalized. There may be special

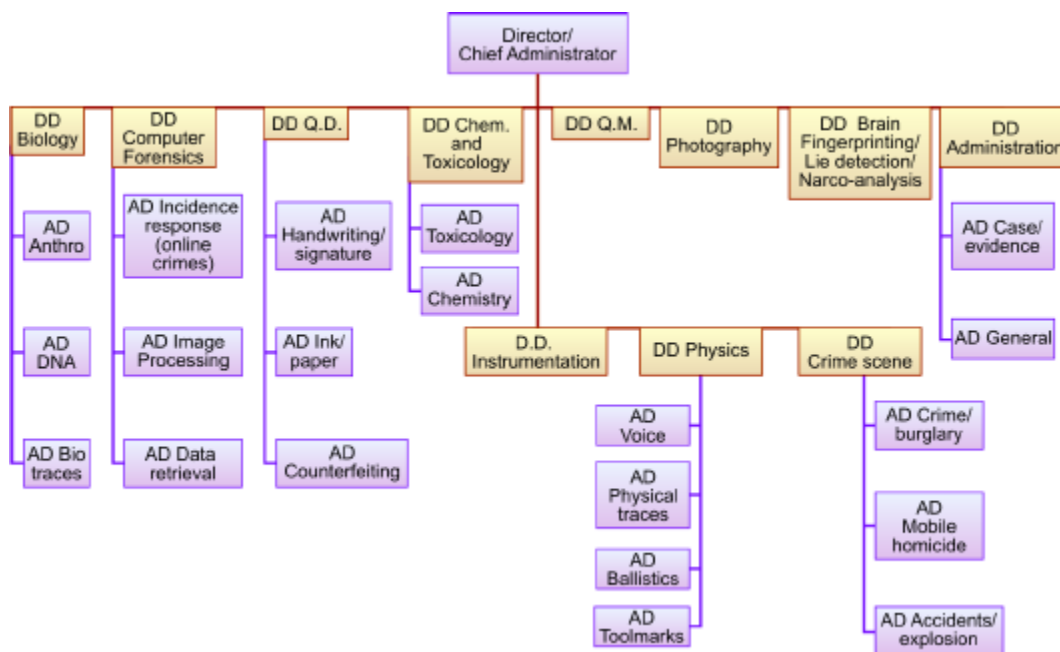
needs of a particular section but in general, facilities like working space, administrative space specification may be common to all. Few tips in this regard are mentioned below:

Facilities serving overall requirements may be –

- I. Instrumentation room.
- II. Laboratory workspace for each section where the entire test is conducted.
- III. Non-laboratory/Administrative work space where analyst may analyze the data, prepare the report and other related matter. It may include office space for all the personnel, document reproduction room, conference rooms, reception, library, Proficiency testing laboratory, audio-visual media room, training/seminar rooms, computer rooms, and telephone exchange/PBAX. Electrical generator room, waste/hazard disposal facility, store for hazardous chemicals, general supplies, fire fighting system, security system having CCTV, access control system, strong room for evidence security and storage. Fuming hoods, reagent preparation room, water treatment system, evidence drying room, central parking area.

Similarly, following may be specific needs for certain section as:

- a. Radio immunoassay room in toxicology section.
- b. IBIS workstation, Test fire range for ballistics
- c. Refrigerated storage/ultra low temperature Freezer storage for biology/serology / DNA sections.
- d. Sound and vibration proof space for voice identification lab.



BIBLIOGRAPHY

1. Forensic Laboratories: Handbook for facility planning, design, construction and moving. National Institute of Justice, USA April 1998.
2. Guidelines for forensic science laboratory ILAC publication no. ILAC- GI9:2002
3. Kopp, I.: Review of resource needs in forensic science laboratory and the wider scientific context in Ireland 2007.
4. McLeod, V and Ketcham, G: The safety guys: planning chemical management for the forensic laboratory. Forensic Magazine, Feb. March 2009.
5. Ritter NM. preparing for the future criminal justice in 2040. NIJ Journal No.255, Nov 2006.
6. Schmitknecht, DA: Building FBI computer forensic capacity: one lab at a time. Digital investigation 2004;(1):177-82
7. SOFT/AAFS forensic toxicology laboratory guidelines 2006.
8. Wolfe, H. Setting up an electronic evidence forensic laboratory. Computers and security 2003; 22(8):670-2.