

Investigative Science

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The forensic science in its simplest form can be defined as common sense fortified by experience, and in this form it has been used since ages all over the world to resolve and elucidate doubts in innumerable number of cases for delivering the justice. Today forensic science derives application from every field of science and technology and has access to very sensitive and efficient analytical instruments, and computerized data processing techniques.

Comprehensive forensic science laboratories examining all kind of physical clues under one roof came up in nineteen fifties in the country. Earlier the institutions of chemical examiners and scientific sections of CIDs of the state police were handling different types of physical clues, which could be broadly put in two groups namely chemicals (including biological samples) and physical (fire arms and ammunition, fingerprints and other impressions, questioned documents etc.). The scientific investigation of crime scenes was not in vogue in those days. The cases were referred to chemical examiner laboratories under specific directions of courts. The scientific section of CIDs could examine the cases on the request of the investigating agencies as well. In a way the scientific sections were catering to the needs of investigators directly. The scientific support to criminal justice system has undergone a sea change after the establishment of comprehensive forensic science laboratories in all the states in the country. The examination of scenes of crime by forensic scientists has now gained significant momentum.

The expected scientific support in investigation; and in judicial decision making may be viewed in slightly different perspectives. In the process of investigation a hypothesis of crime is formulated on the basis of the information gathered and various elements of the hypothesis are verified/corroborated with the help of the physical evidences. If need be the hypothesis of crime may be modified in the light of the outcome of preliminary findings about the physical clues. In judicial decision making, the accused is presumed to be innocent and emphasis is on the proof of crime. The difference in the perspectives of the investigation and judgment are summarized in the following table.

Table 1

The difference in the perspectives of investigation and judgment

Investigation <i>(Investigative Science)</i>	Judgment <i>(Forensic Science)</i>
Probability of guilt	Presumption of innocence
Associative Potential	Discriminative Potential
Testing hypothesis of crime	Proof of crime

Collection of physical clues

Analysis of physical clues

Suggestive opinion

Definitive opinion

Proactive Approach

Reactive Approach

For an example, if a chance fingerprint (partial) is developed at the scene of crime and the expert finds seven matching points in the specimen fingerprint of the suspect, as per the criteria of match a negative opinion would be given. But, from the point of view of investigation we can not eliminate the suspect and additional physical clues or intelligence should be looked for. Thus, the requirements of the investigation and judicial process differ. It is only after exhausting the ways and means of gathering clinching evidences, the relevant and supporting forensic evidences are put up for judicial decision making. At the same time if there are clinching evidences against involvement of the suspect in the crime, those are submitted for exonerating the suspect; for example mismatching DNA of semen sample of the suspect in a rape case.

The scientific investigation of crime has expanded further and has made in road in the process of formulation of hypothesis of crime also. The role and contribution of scientific methods in investigation and judicial process can be categorized as: **Investigative Science** and **Forensic Science**. The Investigative Science covers the methods and techniques of collecting information and intelligence, formulation of hypothesis of crime, collection of physical clues, and testing of hypothesis in the light physical clues. If need be, revision of the hypothesis of crime and retesting. The process continues till the solution of crime is achieved. The investigative and forensic sciences play critical role in the rightful conviction of criminals as well as the exoneration of innocent person. The effectiveness of the forensic science in the judicial decision making can be sustained only by the quality of the reports. The technical capabilities of the laboratory and the abilities of the scientists in the laboratory are, no doubt, very important factors in maintaining the quality. However, these can be easily defeated if the physical clues are not proper or have been tampered with. The analysis can be no better than the samples submitted for analysis and hence the crime scene investigation and the tamperproof collection of the physical clues have a vital role to play in the success of laboratory examination.

Collecting information and intelligence regarding ‘mens rea’ and ‘modus operandi’ of crime to formulate the hypothesis of crime and to discover some of the hidden physical clues are the basics of crime investigation. The age old methods of interrogation for extracting information are so frightening that the society never approved them and, presumably, because of that the statements/confessions before the police are not acceptable under the prevailing law of the land. Recently, the techniques of ‘Narco analysis (truth Serum)’, ‘Brain Electrical Oscillation Signature Profiling (Brain Fingerprinting)’, and ‘Polygraph (Lie Detector)’ are being employed to obtain information and verify the truth. In narcoanalysis the subject becomes dis-inhibitive under the influence of drugs and talks freely without inhibition. In this process a lot of information is revealed some of which may not be relevant to the crime in question. In

polygraph test if the subject tries to lie there is a 'response conflict' in his mind causing various physiological reactions. The strength and rate of pulse, galvanic skin response, strength and rate of breathing, and blood pressure are recorded by the instrument to monitor the physiological changes in the human body. For interrogation, the accused is put to various questions and his physiological reactions during the question hour are recorded and analyzed to detect deception, shown by abrupt changes in physiological reactions. In brain electrical oscillation signature profiling an effort is made to differentiate between 'conceptual knowledge' and 'experiential knowledge' to make the findings more specific. Keeping in mind the capabilities of the techniques and needs of investigation, I am of the view that the suspect should be subjected to narcoanalysis to collect information regarding the main issue at hand and related questions. The information thus obtained and inputs from interview of eye witnesses and locals, and other relevant information (including intuition) should be collated. Based on this 'information bank' a plausible hypothesis of crime should be formulated and unresolved questions (missing links) should be sorted out. A set of questions for verification (or lie detection) should also be prepared. The exhaustive set of questions should be reviewed, revised, and reassessed before the subject is given BEOSP or polygraph test for verifying the facts of the case. The reports of the above tests would provide a firm ground for the solution of crime.

There are people who are apprehensive about the use of these techniques and quote many case laws, which may also be out of context, against these techniques. To the best of my comprehensions there is nothing too serious against the use of these techniques and I am sure soon there will be quotable case laws in favor of the techniques as well, to be quoted in proper context.

Once the hypothesis of crime is formulated the effort is to be made to put the physical (circumstantial) evidences together, which satisfy the judicial conscience by providing the complete chain of events pointing to the accused and none else. This exercise also helps in framing right questions for analysis of physical clues sent to the forensic science laboratory. Without the right questions being thoughtfully and carefully framed there is a little hope of getting all the relevant answers to corroborate, prove, or reconstruct various circumstances of crime

It is not always easy to recognize and collect physical clues from the scenes of crime. The scientist (scene of crime officer) has to be trained to develop necessary expertise in crime scene investigation. A checklist (look at, and look for) should be carefully prepared for major crimes so that a systematic search is made for potential physical clues. However, every crime scene is unique in itself, and the checklist should be only for the guidance. It can never be exhaustive in any case. One has to carefully scan and search the crime scene for all possible clues of crime. There has been appreciable development and progress in the scene of crime technology in the recent years. A number of test kits, collection kits, light sources, imaging techniques, and portable analytical equipments are in vogue for preliminary screening and collection of physical clues from the scene of crime.

Dependable crime scene processing is essential and crucial for the scientific aid to justice delivery system. At the same time, the integrity, authenticity and the chain of possession of physical clues is of paramount importance in the utilization of the evidential value of exhibits in a crime case. Recently, a number of cases have come to light where there are allegations of tempering the physical clues by the investigating agency or the examining agency. To avoid such allegation and dispute it would be desirable to record all the activity of the crime scene processing including packing and sealing of the samples. The opening of the packages in the laboratory should also be videographed so that the chain of possession of the samples may be authenticated. In this process it is important to emphasize on the shape, size, and characteristic features of the samples and the seals put on the packages while videographing for this purpose. As per necessities/requirements close-ups/enlarged photographs should also be taken.

The recordings of the crime scene processing, collection of physical clues and receiving (opening of the packed physical clues) of the exhibits by the experts in the laboratory should be transmitted and stored in a central server, which will serve as a databank for future reference in the case of any question raised about local tampering of the recordings.

The forensic experts reach the scene of crime soon after the crime has been committed to carry out the scientific investigation and assist the investigating officers in the collection of vital physical clues and also give preliminary suggestions regarding the crime. Such services are provided round the clock to the Police Force in various states. In order to transmit data from the scene of crime transportable VSAT Van can be used. The van will reach the crime scene as and when required. The scene of crime officers can then take pictures of the clues through digital camera and record the video of the proceedings at crime scene through a digital handy camera. There may be instances wherein a mobile van cannot reach the exact crime spot and may be required to be parked on the main road that may be at some distance. Under such circumstances, the experts can carry a suitcase/briefcase type of mobile portable videoconferencing system along with them to the exact crime location.

Forensic science is a multi disciplinary activity involving almost all the discipline of science and technology. While it may be feasible for someone to have general knowledge and understanding of various disciplines, it is quite impossible for him to acquire knowledge, ability, and expertise in all the disciplines. It is not practical to provide experts of all the disciplines for crime scene processing, therefore, to provide guidance to the person at the scene of crime; it would be advisable to have some access to the experts in the laboratory. This can be achieved by providing connectivity between the crime scene and the Forensic Science Laboratory. Therefore, a link has to be provided for connection between the portable videoconferencing system at the crime spot and the mobile van VSAT system. This will enable the field officers/experts to have live interaction with the forensic experts sitting at the laboratory head quarters through the satellite link from the mobile van VSAT terminal. The forensic experts at the head quarters may be able to see the processing of the scene of crime live and interact with field officers on the spot.

The physical clues collected from the scene of crime are forwarded to the forensic science laboratory in sealed parcels. The opening of the parcels in the relevant division of the laboratory by the concerned expert should be videographed, highlighting the general condition of the parcels, seals on the parcels, contents of the parcels, and characteristic features of the exhibits noted and recorded at the scene of crime. This process would establish complete chain of evidence (physical clues) from the scene of crime to the expert, who examines the exhibits.

There should be a central server to process and store detailed information including video clips. Suitable data authentication method should be adopted to preserve the original information stored in the central server. It will serve as a referral database for disputes, if any, in future regarding physical clues or any other point related to a crime scene.

Every scene of crime is different from the others and the experience of the scene of crime officers plays a vital role in processing the scene of crime. The collection of recordings of crime scene processing and observations will provide primary data for creation of a databank of typical observations and interpretations at the scene of crime. The information thus generated may be indexed and accessed as and when required. Such databases would be quite helpful to the scene of crime officers and supervisors and improve the quality of crime processing and ultimate use of science and technology in criminal delivery system. Just to cite a few examples, it may be mentioned that in a crime a Improvised Explosive Device (IED) was spotted at the scene of crime, which was relayed on TV channels. After seeing the shape, size, and characteristic of the IED one of the forensic experts pointed out that the same type of device was found in another case in another city. The two may have some common connection. Similarly, in another case some cartridges of the foreign origin were found at a crime, but the scene of crime officers could not relate them while working on the spot. A photograph of the head stamps of the cartridges was sent to another laboratory which has the data base of head stamps and they could determine the origin of the cartridges. Such and other situations, for example, determination of the type of explosives used from the crater dimensions of the explosion; could be easily handled if there is a connectivity of the scenes of crime with the central server. One can not always remember such data but these can be easily retrieved from the data bank by remote connectivity for guidance while working at the scene of crime. Of course, the remote connectivity will also facilitate on line access to other data banks like fingerprints, DNA profiles, handwritings, marks on fired bullets; modus operandi, facial features, and peculiar traits of hard core criminals etc.

Software for the generation and maintenance of database; and interrogation and retrieval from the database in the central server should also be developed so that all the laboratories and scenes of crime officers connected to the central server may gain from the experiences of others in the profession.

The satellite technology can link geographically scattered, hilly, remote and rural areas, and islands, It results in time saving and reduction in transportation costs. Satellite services are being used for healthcare (remote consultation), accessing medical databases,

tele-education, and administration of community initiatives, by relief organizations during emergencies, international libraries, etc. ISRO has already configured Mobile Telemedicine Vans to few hospitals with VSATs, for connectivity from a remote location to a super-specialty hospital through satellite. These vans are taken to far-flung villages to provide the villagers, consultations from super-specialty hospitals- using a telemedicine system. These vans use a VSAT with roof-mounted antenna for communication with the satellite. The above use of the technology is also similar to the above application. The vans will be able to connect the scene of crime officers in the districts as well as far-flung areas with the forensic science laboratory head quarters enabling efficient and time saving interactions between scene of crime officers and experts at the laboratory head quarter.

One of the major requirements of the proposed application is that the images should be transferred from crime scene without loss of resolution and in near real-time. As such, a minimum bandwidth of 512Kbps may be planned using H.264 video standard. Following lists the overall service requirements from the network:

- Video recording at the crime scene
- Live transmission and interaction through videoconferencing
- Online or Offline Image/Data transfer (related to crime, important clues. etc.)
- Voice-over-IP (VoIP) facility for voice interaction only

The goal of the **teleforensics** suggested above is to create a higher level of available competence at crime scenes. The goals can be summarized as follows:

- Tamperproof collection of physical clues of crime. Recording of crime scene processing, and transmission of the proceedings at the crime scene to a central server for record and future reference.
- Crime scene linkage with Forensic Science Laboratories through fast and efficient data delivery via satellite to enable a live interaction of investigating officers/scene of crime officers with a team of senior forensic scientists/experts.
- Creation of crime scene database on a central server, which shall include crime scene images, recorded video clips of crime scene proceedings/clues, etc.
- Prompt finalization of some cases on the spot, which will reduce the burden on the main laboratory.
- Reduce the frequent on site visits of senior scientists/experts which will increase their availability and enhance the disposal of cases.

- Immediate transferring of some evidences like finger prints to the main station for database search and identification.
- Introduce innovative procedures, upgrade the techniques and technologies to improve the quality of forensic analysis, which will help in better justice delivery.
- Update knowledge and skills through Forensic Science Education, and Training of Judicial Officers, Police, Forensic Scientists, etc.

Specific **accreditation program for crime scene investigation** should be started to ensure consistent practice. In general the biggest challenge in ensuring consistency is the human factor and not infrastructure or management. The most crucial aspect of crime scene investigation is the task of evidence recognition that is the selection of relevant from irrelevant. As is known, even in the simplest crime scene no two are exactly alike and each may contain numerous items of potential physical evidence. Thus, the evidence recognition requires flexibility in the application of methods as well as methodical in approach. This is the challenge in developing a rigid protocol for crime scene investigation. The modern crime scene examiner should make, and has to make, decisions at the scene. These decisions should be based on the application of a scientific approach. The examiner should record not only what has been done but why. Consistency is not about the blind use of micro detailed standard methods, it is about adherence to core and critical elements with the backup of professional practice and a quality system.

If we really want to play our role to help the criminal justice system and provide noble service to man kind in maintaining peace and order in the society, we need to work harder to design and build the system which will put the **investigative science**, in respect of all its deliverables, on a sound basis.