

Reflection on the Scientific and Practical Aspects of On-Site Investigation

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Keywords: On-site investigation, investigative practice, dual nature, evidence collection, crime scene reconstruction

Abstract: On-site investigation plays an indispensable dual role in the criminal justice process, possessing both scientific and practical characteristics. Its scientific nature is reflected in a rigorous methodology and technical means, involving the systematic application of steps and scientific principles to collect irrefutable evidence. The practical aspect emphasizes the hands-on application of theories in actual crime scenes to reconstruct the authentic circumstances of the crime. One of the objectives of on-site investigation is to ensure a comprehensive understanding of the crime scene, utilizing scientific methods to collect highly credible evidence. This encompasses the collection, preservation, and analysis of physical, biological, and other relevant evidence. Another goal is to reconstruct the process of the crime scene, aiding investigators in understanding the motive, sequence of events, and potential suspect movements, thereby facilitating more targeted subsequent investigative efforts. Through in-depth research on on-site investigation, we can gain a more comprehensive understanding of its pivotal role in criminal investigations, providing theoretical and practical support to enhance its efficiency and quality. This may involve the introduction of new technological tools, elevating the training levels of investigators, and strengthening legal frameworks to support and regulate on-site investigations. A holistic consideration of both scientific and practical aspects contributes to the establishment of a more sophisticated on-site investigation system, promoting progress in criminal justice.

1. Introduction

On-site investigation plays a vital role in criminal investigations, serving as both a scientific process and a practical task. It not only aids in gathering crucial evidence but also facilitates the reconstruction of crime scenes, providing the court with objective evidence. This paper will examine the dual nature and objectives of on-site investigation to assist criminal investigators in effectively carrying out this critical task.

2. The Scientific Aspects of On-site Investigation

2.1. Definition and Characteristics of On-site Investigation

On-site investigation is an integral part of criminal investigations, aimed at conducting a series of

activities at the crime scene to gather information related to the case, collect physical evidence, document traces, and reconstruct the crime scene. This process exhibits distinct characteristics, including immediacy, as it requires immediate action following a crime to ensure the integrity of evidence and the authenticity of information.[1] Moreover, one of the core tasks of on-site investigation is the collection and preservation of physical evidence and traces, such as bloodstains, fingerprints, weapons, fibers, and footprints, which serve as crucial references for subsequent investigations and courtroom proceedings. It also demands comprehensiveness, necessitating a systematic study and analysis of the crime scene, integrating various pieces of information to reconstruct the crime process and identify key leads. Additionally, on-site investigation mandates detailed documentation of all activities, including photographs, recordings, notes, and investigation reports, to ensure traceability. Lastly, on-site investigation often requires interdisciplinary knowledge, such as forensic science, chemistry, physics, and psychology, to gain a comprehensive understanding and analysis of the crime scene.[2]

2.2. Scientific Principles of On-site Investigation

The scientific nature of on-site investigation is based on a set of critical scientific principles, ensuring the accuracy of information and the reliability of evidence. These principles are crucial for the success of criminal investigations, and here are some key scientific principles:

Firstly, the Locard's principle, also known as the principle of exchange, emphasizes that every contact leaves a trace, which is fundamental to on-site investigation. It implies that any contact will inevitably leave or take away corresponding trace evidence, and investigators can gradually reconstruct the facts of the crime through the information reflected by this trace evidence. Furthermore, it provides a complete chain of evidence that plays a crucial role in conviction and sentencing in the current "trial-centered" litigation system, where an intact chain of evidence is essential.

Secondly, the principle of causality is a fundamental principle of investigative science, and the work of on-site investigation cannot do without its application. Especially during the phase of on-site analysis, after the on-site visits and field inspection, investigators can obtain a wealth of verbal and physical evidence. They can use these pieces of evidence to reconstruct the course and results of the crime, retroactively infer the criminal motive, and determine the direction and scope of the investigation.

Additionally, the principle of identification is essential for providing a solid foundation for on-site investigation. Various traditional trace evidence exists at the crime scene, such as footprints, fingerprints, and tools used in the crime, as well as diverse types of biological and electronic evidence, such as bloodstains, body fluids, computers, cell phones, documents, etc.[3] The examination and identification of these trace evidence can help investigators determine whether the trace belongs to criminal evidence and whether it can be attributed to specific suspects. It plays a vital role in solving cases. The work of fingerprint identification, handwriting identification, and document examination during the on-site investigation process is all based on the principle of identification.

These scientific principles collectively form the scientific foundation of on-site investigation, ensuring the rigor and credibility of criminal investigations. By adhering to these principles, investigators can better handle the complexity of on-site investigations, enhancing the success rate of case resolution.

2.3. Application of Scientific Technology in On-site Investigation

The application of modern scientific technology plays a crucial role in enhancing the scientific nature and efficiency of on-site investigation. Here are some examples of the application of scientific

technology in on-site investigation:

Firstly, photographic and recording technologies hold a prominent position in on-site investigation. Digital photography and high-definition cameras enable on-site investigators to capture detailed information at the crime scene, including physical evidence, traces, and the overall condition of the scene. Simultaneously, on-site investigation records, such as forms, are used for precise documentation of every detail, ensuring the completeness and traceability of the information.[4]

Secondly, sampling and analysis technologies play a pivotal role in on-site investigation. Scientific instruments and equipment, such as gas chromatographs, mass spectrometers, microscopes, etc., are utilized for the sampling and analysis of physical evidence. These technologies can identify the components, sources, and characteristics of evidence, providing robust evidential support. For example, gas chromatographs can be used to detect and identify chemical substances, while microscopes are employed for the analysis of small-scale physical evidence and traces.

Thirdly, Global Positioning System (GPS) technology provides precise location capabilities in on-site investigation. GPS technology is used to mark the coordinates of the crime scene, helping to determine the positions of various physical evidence and traces. This aids in the reconstruction of the crime scene, identification of key leads, and ensures the coherence of evidence.[5] The application of these modern scientific technologies renders on-site investigation more systematic and efficient, enhancing the scientific quality of the process, and ensuring the success of criminal investigations. By incorporating these technologies, on-site investigators gain better accuracy in collecting information and evidence, providing them with additional tools and resources for criminal investigations.

3. The Practical Aspects of On-site Investigation

3.1. Operational Procedures of On-site Investigation

On-site investigation is a pivotal step in criminal investigations, and its operational procedures are rigorous and orderly to ensure the accurate acquisition of information and the comprehensive collection of evidence. This section will delve into the operational procedures of on-site investigation, including the following key steps:

3.1.1. Preparatory Work

Before conducting on-site investigation, investigators must undertake thorough preparatory work. This includes gathering relevant case information, such as the details of the reported crime, suspect information, and eyewitnesses. Necessary investigation tools and equipment must be prepared, along with measures to ensure the safety of personnel.[6]

3.1.2. Preservation of the Crime Scene

The initial task is to ensure the preservation of the crime scene to prevent evidence from being destroyed or tampered with. Investigators often delineate the boundaries of the crime scene, restrict unauthorized access, and take measures to protect physical evidence and traces.

3.1.3. Observation and Documentation

On-site investigators need to carefully observe various aspects of the crime scene and document every detail. This includes taking photographs and videos, completing investigation records, and utilizing surveying tools to measure the dimensions and distances at the scene.

3.1.4. Collection of Evidence

The collection of evidence is one of the core tasks of on-site investigation. Investigators must gather physical evidence and traces relevant to the case, which may include weapons, bloodstains, fingerprints, footprints, fibers, and more. These pieces of evidence must be sampled, labeled, and protected according to scientific principles.

3.1.5. Compilation of On-site Records

All observations, records, and evidence collected must be compiled and documented to ensure accuracy and traceability. The composition of on-site investigation reports is an indispensable step, which should include detailed descriptions and relevant evidence.

3.1.6. Transfer and Preservation of Evidence

The collected evidence must be securely transferred to the responsible department or laboratory for further analysis and preservation. The chain of custody must be maintained to ensure the integrity of the evidence.

3.2. Tools and Equipment for On-site Investigation

The success of on-site investigation relies not only on the experience and skills of investigators but also on advanced tools and equipment. Here are some commonly used tools and equipment for on-site investigation:

3.2.1. Cameras and Camcorders

Modern digital cameras and high-definition camcorders are used to capture photographs and videos of the crime scene, recording details of evidence and the scene itself. High-resolution images and videos provide robust support for subsequent investigations and courtroom proceedings.

3.2.2. Measurement Tools

Measuring instruments such as rangefinders, angle finders, and scales are used to accurately measure the dimensions and distances at the crime scene. These tools aid in reconstructing the crime scene, determining the positions of physical evidence and traces, and analyzing the crime process.

3.2.3. Sampling Tools

Sampling knives, specimen bags, cotton swabs, gloves, and other sampling tools are used to collect physical evidence and traces, ensuring their integrity and maintaining the chain of custody. Proper sampling is a key step in preventing contamination.

3.2.4. On-site Chemical Analysis Tools

On-site chemical analysis tools include chemical reagents, fluorescent agents, and more, used for the rapid detection and identification of potential evidence, such as bloodstains, urine, chemicals, etc. These tools provide preliminary analysis results on-site, expediting the investigative process.

3.2.5. Light Sources and Microscopes

Ultraviolet light sources and microscopes are used to detect and analyze imperceptible evidence, such as invisible ink and tiny traces. They enhance the observational capabilities of investigators,

aiding in the discovery of crucial leads.

3.3. Difficulties and Challenges in On-site Investigation

Despite being a critical investigative step, on-site investigation often faces various difficulties and challenges in practice:

3.3.1. Personnel Safety

In certain situations, on-site investigation may involve hazardous environments or the presence of suspects, necessitating that investigators ensure their own safety by taking appropriate security measures.

3.3.2. Evidence Contamination

On-site investigators must be cautious to prevent evidence contamination, which could adversely affect subsequent analysis and identification. The use of proper protective equipment and sampling tools is crucial in preventing contamination.

3.3.3. Loss or Omission of Evidence

Due to the complexity of on-site investigation, evidence may sometimes be overlooked or lost, which can have a detrimental impact on the investigation. Hence, meticulous recording and teamwork are vital factors in preventing evidence omissions.

3.3.4. Legal Procedures

On-site investigation must strictly adhere to legal procedures; otherwise, it may result in evidence being deemed invalid or inadmissible. Understanding and complying with legal requirements are crucial for the legality of the case.

3.3.5. Weather and Environmental Conditions

Weather conditions and environmental factors, such as rain, wind, temperature, etc., may affect the efficiency and accuracy of on-site investigation. Investigators must adapt to various environmental conditions.

3.3.6. Public and Media Interference

In some high-profile cases, on-site investigation may be subject to interference from the public and media, adding complexity to the work. Investigators need to handle media and public attention while safeguarding the integrity of the crime scene and the confidentiality of evidence. Considering these challenges and difficulties, on-site investigators must possess a high degree of expertise and adaptability to ensure the smooth progress of the investigative work and obtain reliable evidence.

4. Evidence Collection in On-site Investigation

4.1. Types of Evidence and Collection Methods

In on-site investigation, different types of evidence require different collection methods to ensure their comprehensiveness and reliability. Here are some common types of evidence and their corresponding collection methods:

Firstly, physical evidence refers to tangible items such as weapons, objects, clothing, etc. The collection of physical evidence typically involves the use of gloves to prevent contamination. Physical evidence should be carefully packaged, promptly labeled, and recorded to maintain its source and integrity.

Secondly, trace evidence includes footprints, tire tracks, tool marks, and more. Collecting trace evidence often requires the use of powders or chemical reagents to highlight traces, followed by sampling and preservation using specialized paper or adhesive tape. This helps preserve the shape and characteristics of the traces for subsequent analysis and comparison.

Thirdly, biological evidence encompasses bloodstains, saliva, hair, nails, bodily fluids, and more. Collecting biological evidence necessitates the use of disposable tools to prevent cross-contamination. After collection, it must be stored appropriately and subjected to specimen collection and analysis following forensic procedures to ensure the validity and reliability of the analysis. Finally, documents and records are written or electronic forms of evidence, such as documents, emails, mobile text messages, etc. These types of evidence need to be securely protected and digitally copied to ensure their integrity. Original documents usually require sealing and marking to prevent tampering or loss.

4.2. Establishing the Chain of Custody

Establishing the chain of custody is a crucial step in evidence collection, ensuring that every link from the crime scene to the courtroom is documented to maintain the continuity and integrity of the evidence. Here are key points in establishing the chain of custody:

Firstly, every piece of evidence must be labeled and recorded, including information about the time, location, and personnel involved. These records must be detailed and accurate for subsequent tracking and review. The process of labeling and recording is a critical link in establishing the chain of custody.

Secondly, the integrity of evidence is paramount. Evidence integrity means that the evidence has not been tampered with, altered, or contaminated throughout the handling and storage process. To maintain evidence integrity, the use of appropriate packaging materials and seals to protect physical evidence and traces is necessary. This helps ensure that the evidence remains in its original state for subsequent analysis.

Thirdly, witness testimonies regarding the evidence are also part of establishing the chain of custody. Therefore, their statements and observations must be recorded. Witness testimonies can provide essential information about the discovery, collection, and handling of evidence, aiding the court's better understanding of the formation and maintenance of the chain of custody.

4.3. Preservation and Handling of Evidence

Preservation and handling of evidence are crucial to ensure the availability and reliability of evidence. Key considerations for preserving and handling evidence include:

Firstly, different types of evidence require different storage conditions. Biological evidence, such as blood or fluid samples, typically needs to be stored under freezing or refrigeration conditions to prevent decomposition and degradation. Physical evidence and trace evidence, such as weapons, fibers, footprints, are usually stored in a dry, light-protected, and temperature-controlled environment to avoid moisture, light exposure, or temperature fluctuations affecting them.

Secondly, prevention of contamination is a critical factor. Evidence must be absolutely safeguarded against contamination during storage and handling. Personnel must strictly adhere to hygiene protocols, wear gloves, and use clean tools to prevent cross-contamination when in contact with the evidence. Any contamination can have adverse effects on the reliability and legality of the evidence.

Thirdly, the records must be regularly updated. The records of evidence preservation must be

periodically reviewed, including checking and documenting the status, location, and availability of the evidence. This helps ensure that the evidence can be swiftly located and examined when needed, as well as aids in tracking the chain of custody and history of the evidence.

Finally, the preservation and handling of evidence must strictly adhere to legal procedures to ensure the legality and admissibility of the evidence. This includes maintaining the chain of custody, ensuring that each step is meticulously documented, and taking measures to protect the integrity of the evidence to prevent tampering or harm. Compliance with legal procedures is critical for the success of courtroom trials.

In summary, the preservation and handling of evidence are essential steps in criminal investigations, directly impacting the availability and reliability of evidence. Stringent preservation and handling procedures help ensure that evidence can fulfill its proper role in court, supporting the investigation and trial of cases.

5. On-site Investigation and Crime Scene Reconstruction

5.1. The Significance of Crime Scene Reconstruction

Crime scene reconstruction is a crucial step in criminal investigations, aiding in the reconstruction of the crime process, understanding case details, and providing the evidence necessary for courtroom trials. The importance of crime scene reconstruction is highlighted by the following aspects: it allows investigators to identify key factors of the crime scene, such as entry points and escape routes, and helps determine the suspect's behavioral patterns and motives. This enables investigators to assess the consistency of witness observations and statements, providing robust evidence required for courtroom trials to support prosecution or defense.

The accuracy and credibility of crime scene reconstruction are paramount for the investigation and adjudication of cases, relying on scientific on-site investigations and meticulous evidence collection.

5.2. Utilizing On-site Investigation for Crime Scene Reconstruction

On-site investigation plays a pivotal role in crime scene reconstruction. Through the following steps, investigators can effectively utilize on-site investigation to reconstruct the crime process:

Firstly, the collection of physical evidence and traces forms the foundation of reconstructing the crime process. These pieces of physical evidence and traces may include bloodstains, fingerprints, footprints, weapons, tools, and more, providing critical information about the crime scene. Through precise collection and preservation, these pieces of evidence become key elements for subsequent reconstruction work.

Secondly, on-site investigators must reenact the circumstances at the crime scene. This involves recreating the positions and actions of the suspect and victim, their movement trajectories, and potential interactions. Through detailed observation and examination, on-site investigators can comprehend the dynamic process of the event, reconstruct the scenario of the crime scene, and establish a timeline. Next, analyzing physical evidence and traces helps unveil critical events during the crime process. For example, analysis can determine the presence of violent conflicts, reveal escape routes, and trace the exchange of items. These analyses provide essential leads and details for reconstructing the crime process.

Finally, conducting detailed interviews with witnesses to understand their observations and statements is integral. Witnesses may offer vital insights into the crime process. Their statements and observations can corroborate the analysis of physical evidence and traces, further enhancing the reconstruction of the crime process. In conclusion, through these steps, on-site investigators can systematically utilize on-site investigation to reconstruct the crime process, understanding how the

crime occurred and its details. This supports the investigation and courtroom trials by providing critical evidence and leads.

5.3. The Relationship between On-site Investigation and the Court

There exists a close relationship between on-site investigation and the court, where the results directly impact the outcomes of courtroom trials. Here are the aspects of the relationship between on-site investigation and the court:

Firstly, the reliability of evidence is paramount to courtroom trials. The court relies on evidence collected during on-site investigations to support its judgments. Therefore, evidence must possess a high level of credibility and accuracy. If on-site investigations are not conducted scientifically or evidence collection is improper, it may lead to evidence being questioned or declared invalid, thereby affecting the trial's outcome.

Secondly, the results of on-site investigations can corroborate witness testimonies, enhancing the credibility of their statements. When witness statements align with physical evidence and traces, it helps establish a strong case. Courts often favor witness statements that align with other evidence, as this increases their credibility.

Lastly, in the courtroom, on-site investigators may be required to testify as witnesses, presenting their investigations and findings. Their testimonies help the court gain a better understanding of the case's background and details. Through scientifically explaining the case and presenting information, on-site investigators assist the court in comprehending the case more comprehensively, contributing to a fair judgment.

In summary, on-site investigations play a crucial role in criminal trials, with their results directly affecting the trial's outcome. The reliability of evidence, its consistency with witness statements, and on-site investigators' testimonies are key aspects of the relationship between on-site investigation and the court. This underscores the importance of conducting on-site investigations professionally and scientifically to ensure fair courtroom trials.

6. Conclusion

This paper through an in-depth exploration of the dual nature and purpose of on-site investigation in investigative practice, underscores its crucial role in criminal investigations. By combining scientific rigor with practical application, on-site investigation not only contributes to ensuring the completeness of evidence but also aids in the reconstruction of crime scenes, thereby better serving justice. In summary, this paper provides valuable insights for investigators on how to improve the execution of on-site investigations and enhance the quality of investigations, while also indicating directions for future development.

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