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POSSIBILITIES OF USING WEAPONS SCIENCE IN THE INVESTIGATION OF CRIMINAL OFFENSES

POSSIBILIDADES DO USO DE ARMAS CIENTÍFICAS NA INVESTIGAÇÃO DE CRIMES

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Abstract: The utilization of scientific and technological methods in addressing criminal offenses presents itself as a pivotal concern within contemporary criminology. Numerous scholars have extensively studied various aspects of technical and forensic practices, such as the examination of criminal traces, forensic accounting, the organization and legal framework governing the application of specialized knowledge, and the use of automation and computer technology. Undoubtedly, experts in weapons possess a greater proficiency in evidence collection, owing to their expertise in detecting, repairing, and securing weapons, as well as examining pertinent traces and other weapon-related characteristics that may elude investigators, lacking sufficient knowledge in this domain. Consequently, the collaboration between criminalists and weapons experts assumes a critical role in optimizing the criminal investigation process. The primary objective of this article is to elucidate the distinctive characteristics associated with the application of weapons science in the investigation of criminal offenses. Furthermore, it seeks to delineate avenues for enhancing the efficacy of scientific and technological approaches in the detection and investigation of criminal offenses. By doing so, this study aims to identify key domains wherein these possibilities can be effectively realized. Methodology. During this study, the authors employed a range of research methodologies to study and process data. These methodologies encompassed induction, deduction, analysis, synthesis of information, systemic and structural approaches, comparative analysis, logical and linguistic analysis, abstraction, and idealization. Furthermore, to identify crucial aspects of the process of investigating criminal offenses, the authors conducted an online questionnaire survey. Results. Drawing upon the outcomes of the study, the authors discern the paramount theoretical facets associated with the utilization of firearms science. Furthermore, they scrutinize the perspectives of legal scholars and practicing criminalists concerning the fundamental elements pertinent to the application of weapons science in the investigation of criminal offenses.

Keywords: Weapons science. Weapons. Criminal offense. Pre-trial investigation. Criminal records. Investigative (detective) action. Forensic examination.

Resumo: A utilização de métodos científicos e tecnológicos no tratamento de infrações penais apresenta-se como uma preocupação central da criminologia contemporânea. Numerosos estudiosos estudaram extensivamente vários aspectos das práticas técnicas e forenses, como o exame de vestígios criminais, contabilidade forense, organização e estrutura legal que rege a aplicação de conhecimento especializado e o uso de automação e tecnologia de computador. Sem dúvida, os especialistas em armas possuem maior proficiência na coleta de evidências, devido à sua experiência em detectar, reparar e proteger armas, bem como examinar vestígios pertinentes e outras características relacionadas às armas que podem iludir os investigadores, sem conhecimento suficiente neste domínio. Consequentemente, a colaboração entre criminalistas e especialistas em armas assume um papel crítico na otimização do processo de investigação criminal. O objetivo principal deste artigo é elucidar as características distintivas associadas à aplicação da ciência das armas na investigação de infrações penais. Além disso, procura delinear caminhos para aumentar a eficácia das abordagens científicas e tecnológicas na detecção e investigação de infrações penais. Ao fazer isso, este estudo visa identificar domínios-chave em que essas possibilidades podem ser efetivamente realizadas. Metodologia. Durante este estudo, os autores empregaram uma variedade de metodologias de pesquisa para estudar e processar dados. Essas metodologias englobavam indução, dedução, análise, síntese de informações, abordagens sistêmicas e estruturais, análise comparativa, análise lógica e linguística, abstração e idealização. Além disso, para identificar aspectos cruciais do processo de investigação de infrações penais, os autores realizaram uma pesquisa por questionário online. Resultados. Com base nos resultados do estudo, os autores discernem as facetas teóricas primordiais associadas à utilização da ciência das armas de fogo. Além disso, eles examinam as perspectivas de juristas e criminalistas praticantes sobre os elementos fundamentais pertinentes à aplicação da ciência das armas na investigação de crimes.

Palavras-chave: Ciência armamentista. Armamento. Infração penal. Inquérito pré-julgamento. Antecedentes criminais. Ação investigativa (detetive). Exame forense.

1. Introduction

The inception of weapons science as a distinct domain of scientific knowledge is intrinsically linked to the concept of forensic technology, which encompassed the comprehensive scope of forensic science. This discipline was perceived as a multifaceted amalgamation of engineering and natural sciences, offering valuable insights applicable to criminal investigations (Kruis et al., 2023).

In the theoretical segment of this study, the author provides a substantiation of the concept and constituents underpinning the utilization of weapons science in the investigation of criminal offenses.

The practical section of the study encompasses two primary practical dimensions associated with the application of weapons science in criminal investigations. Firstly, it investigates the effectiveness of employing diverse weapons science methods in aiding criminal offense investigations. Secondly, it explores the most promising avenues for harnessing the potential of weapons science in the realm of criminal investigations.

Based on the findings of the study, conclusions are derived about the addressed issues. It has been ascertained that the foremost areas of employing weapons science in criminal investigations encompass the utilization of technical means to bolster criminal investigations, the tactical collaboration among specialists, and the dissemination of diverse information and expert guidance.

2. Literature Review

Weapons science emerged at the convergence of technical sciences and forensics, encompassing scientific methodologies and technical resources for studying weapons, ammunition, and traces associated with their presence. It drew upon the principles and techniques employed in the examination of clothing materials, soil, and other material objects. The investigation of firearms products, as well as other substances and materials that might have contributed to the demise of individuals and animals, necessitated the utilization of specialized expertise from weapons experts within the realm of forensics (Singh, 2021), (Newport, 2019).

The particulars surrounding the utilization of weapons-related data in operational and investigative endeavors are intertwined with the application of specialized equipment or technical resources. Diverse technical methodologies, purposefully designed or adapted for the operations of these entities in detecting, investigating, and thwarting crimes, encompass forensic, chemical, optical, photographic, and electronic means. The deployment of such means is partially linked to devices, equipment, materials, and substances (Rowhani-Rahbar et al., 2018), (Bartosch, 2021), (Winkler, 2018).

Over time, this process has undergone significant expansion and witnessed distinct organizational transformations, correlated with the establishment of an extensive network of forensic units and the engagement of chemists, physicists, and biologists in weapons-related endeavors. It is worth noting that in contemporary times, the integration of modern instrumental techniques with high sensitivity into forensic science has become more pronounced. These include methodologies such as microscopy, chromatography, X-ray imaging, research photography, and others, which enable thorough examination of physical evidence (Brunson & Wade, 2019), (Hureau, 2022).

The methodologies and instruments devised by forensic science serve as a complementary resource to criminal procedural science. Criminal procedural science acts as the "recipient" of the pertinent forensic methodologies, including weapons science, employed in the

process of evidence collection, examination, evaluation, and utilization. This hierarchical arrangement is governed by the principles governing the interaction between forensic technology and the science of criminal procedural law. Forensic technologies play a pivotal role in enhancing the efficacy of forensic procedures. The methodologies and instruments developed within the domain of forensic technology must adhere to the stipulations set forth by criminal procedural requirements for their application in evidence collection and examination within the context of criminal investigations (Olson et al., 2021), (Schaeffer, 2021), (Kleck, 2019a).

The significance of exploring the application process of weapons science lies in the understanding that forensic equipment is not merely an assortment of disparate devices, tools, equipment, and associated usage methods. Instead, it constitutes a unified, integrated, and scientifically grounded system that has evolved through the examination of the requirements inherent in the operations of pre-trial investigation bodies. It is crucial to underscore that weapons science, being a subdivision of forensic science, also represents a systematic amalgamation of scientific definitions, information, and knowledge (Braga & Cook, 2018), (Koper et al., 2018).

An essential characteristic of criminal offense investigations is the obligatory participation of experts in the field of weapons science within the framework of criminal proceedings. This requirement arises from several factors. Firstly, the involvement of ballistics and explosives experts is crucial during the examination of crime scenes involving weapon-like objects, as well as in the analysis of the weapons themselves. This necessity primarily stems from the imperative to ensure the safety of all participants involved in investigative actions, as well as to provide accurate and detailed descriptions of the weapons and their proper seizure for subsequent investigation. Secondly, in all criminal proceedings related to offenses involving the use of weapons, it is indispensable to conduct examinations of the weapons, traces, and circumstances surrounding their use, or examinations of explosives. These investigations are vital as they elucidate the core elements of the crime. Thirdly, the aforementioned experts serve as professionals in diverse capacities, including identifying locations of weapon sales, conducting investigative experiments on suspects to ascertain their proficiency and knowledge in weapon usage, interviewing individuals who possess relevant information on the manufacturing and use of weapons, to assess, clarify, and verify their testimonies (Gramlich, 2019), (Morral, Schell & Tankard, 2018), (Rossy & Morselli, 2018).

3. Aims

The objective of this study is to ascertain the perspectives of legal scholars and practicing criminalists regarding the distinct aspects related to the utilization of weapons science in criminal investigations. Additionally, the study aims to identify, based on the obtained results, the directions for enhancing the efficacy of employing weapons science in the realm of criminal investigations.

4. Methods and materials

A practical investigation was conducted to examine the contemporary trends concerning the application of firearms science in the investigation of criminal offenses. The study entailed interviews with 218 legal scholars and 264 practicing criminalists from the Khmelnytskyi, Volyn, Chernihiv, Rivne, Zhytomyr, and Kyiv oblasts of Ukraine. The research was organized and implemented during April and May 2023, employing an online approach facilitated by the Survey Planet service.

5. Results

Figure 1 depicts the outcomes of the survey regarding the efficacy of weapons science methodologies that can be employed by forensic scientists in the investigation of criminal offenses (Figure 1).

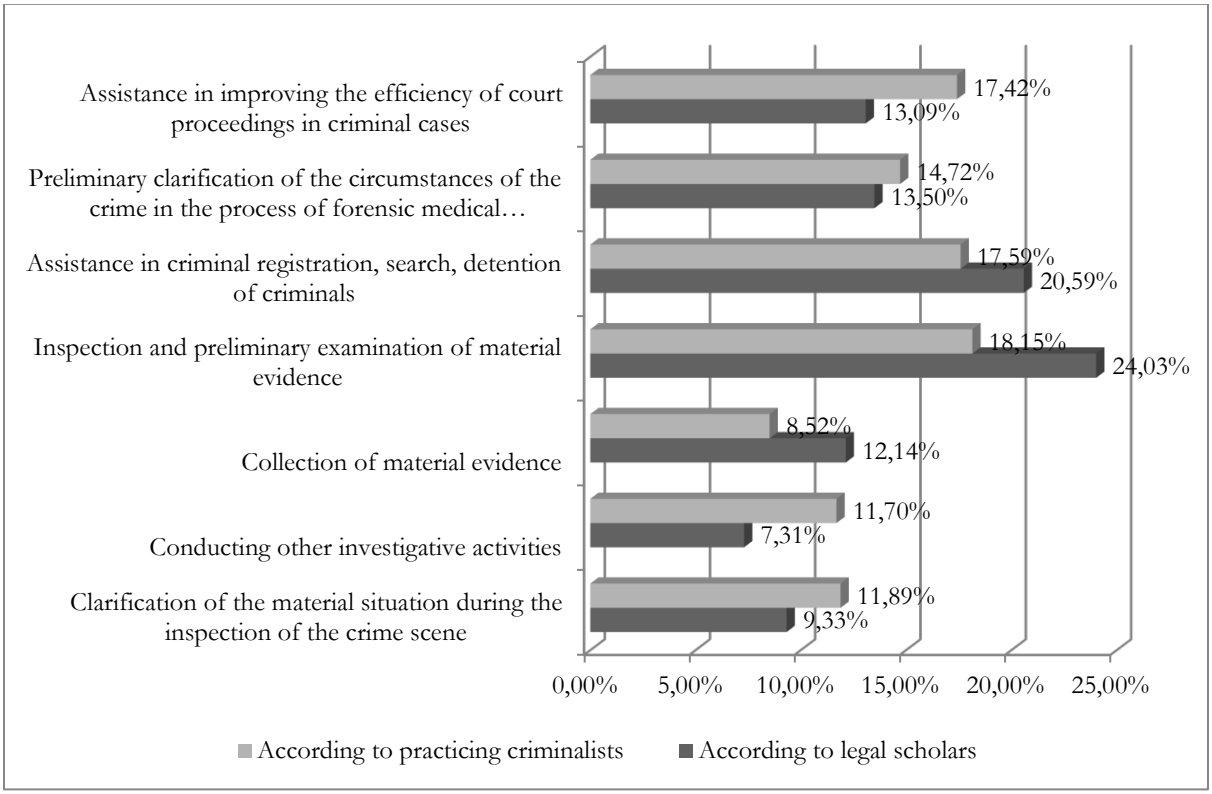
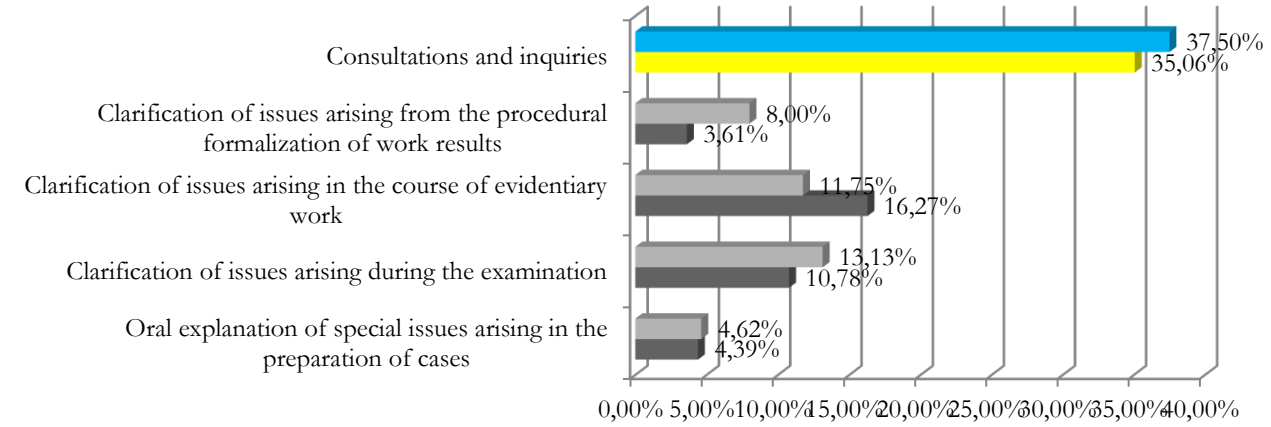


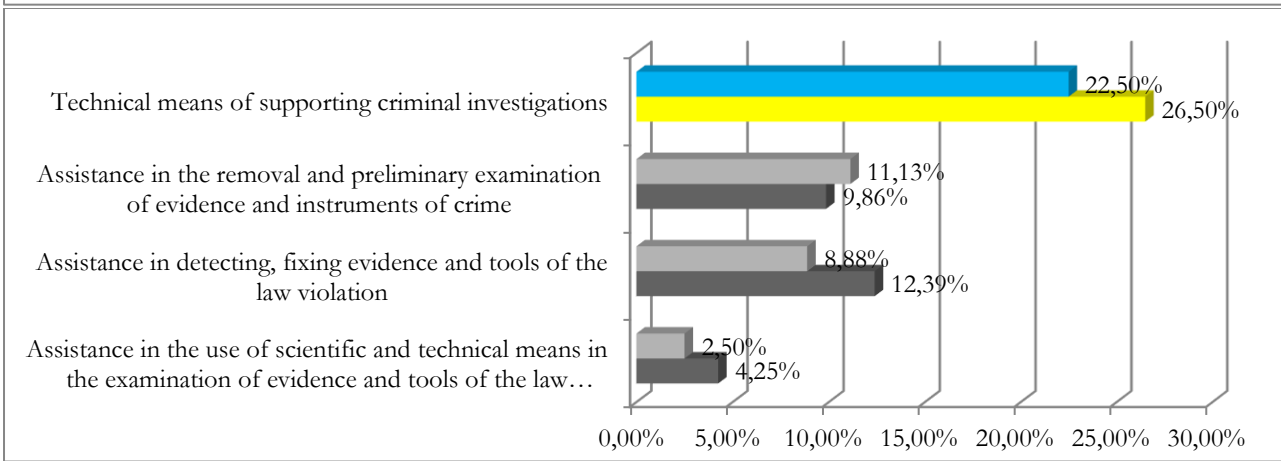
Figure 1. Efficacy in the use of weapons science methodologies in the investigation of criminal offenses.

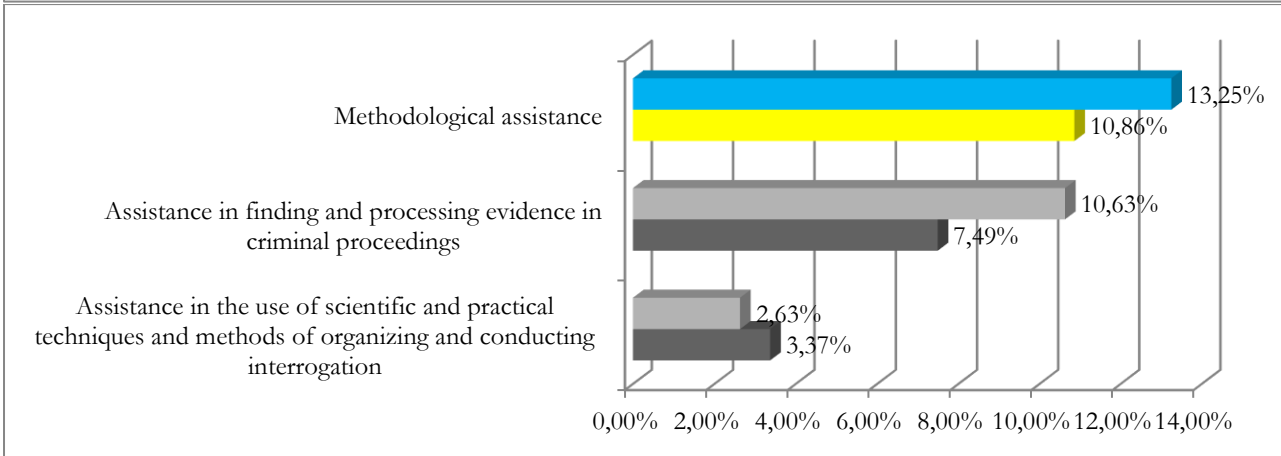
Source: built by the authors.

As per the responses provided by the survey participants, the most effective application of weapons science tools in the investigation of criminal offenses pertains to the examination and initial analysis of physical evidence. This particular form of support received the highest rating from the respondents (18-24%). Additionally, assistance in criminal investigation and apprehension of offenders was also regarded as highly valuable (17-20%) by the survey participants.

An integral outcome of the survey is to ascertain the viewpoints of scientists and practitioners regarding potential areas where the broader implementation of weapons science may yield maximum effectiveness in terms of overall efficacy in criminal investigations (Figure 2).


Consultations and inquiries
37,50%
35,06%
Clarification of issues arising from the procedural formalization of work results
8,00%
3,61%
Clarification of issues arising in the course of evidentiary work
11,75%
16,27%
Clarification of issues arising during the examination
13,13%
10,78%
Oral explanation of special issues arising in the preparation of cases
4,62%
4,39%
0,00% 5,00% 10,00% 15,00% 20,00% 25,00% 30,00% 35,00% 40,00%


Technical means of supporting criminal investigations
22,50%
26,50%
Assistance in the removal and preliminary examination of evidence and instruments of crime
11,13%
9,86%
Assistance in detecting, fixing evidence and tools of the law violation
8,88%
12,39%
Assistance in the use of scientific and technical means in the examination of evidence and tools of the law…
2,50%
4,25%
0,00% 5,00% 10,00% 15,00% 20,00% 25,00% 30,00%


Methodological assistance
13,25%
10,86%
Assistance in finding and processing evidence in criminal proceedings
10,63%
7,49%
Assistance in the use of scientific and practical techniques and methods of organizing and conducting interrogation
2,63%
3,37%
0,00% 2,00% 4,00% 6,00% 8,00% 10,00% 12,00% 14,00%

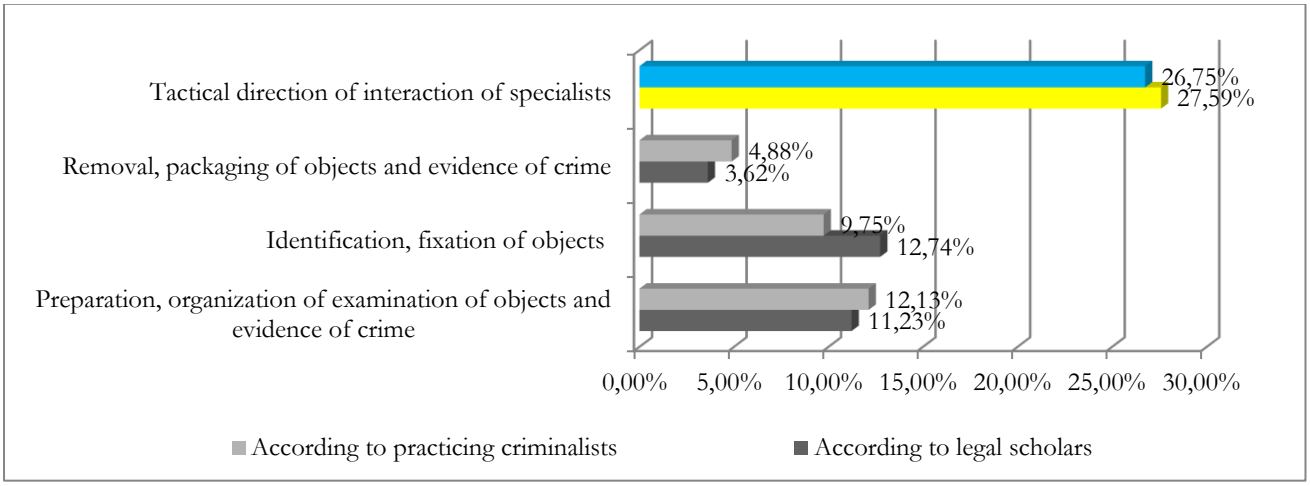


Figure 2. The most promising areas for expanding the use of weapons science in criminal investigations, %.

Source: built by the authors.

As depicted in Figure 2, the survey respondents identified several areas deemed highly significant for the expansion of weapons science implementation in current criminal investigations. Notably, the use of technical resources to bolster criminal investigations garnered significant attention, with 22-26% of respondents recognizing the value of such collaboration. Furthermore, the tactical interaction among specialists was highlighted by 26-27% of respondents as an essential aspect. Additionally, the provision of diverse information and expert guidance was deemed crucial by a substantial majority, with 35-37% of respondents emphasizing its importance.

Simultaneously, when exploring the aforementioned forms of interaction between weapons experts and officials involved in criminal offense investigations, the survey participants emphasized the need to enhance the effectiveness of such collaboration. Notably, expanding the consultation possibilities regarding issues arising during examinations and evidentiary procedures received recognition from 10-13% of the respondents. Among the technical means of supporting criminal investigations, the most impactful contribution was perceived to be assistance in the identification and documentation of offense-related traces. Given the tactical nature of the investigations, respondents placed less importance on methodological support, with only 11-13% of participants rating this form of collaboration favorably. On the other hand, methodological assistance in evidence search and processing garnered a higher percentage (7%-10%), suggesting that this particular utilization of weapons knowledge is considered less in demand, albeit acknowledging its existing relevance according to the survey participants.

6. Discussion

Criminal procedural legislation establishes the protocol for conducting essential procedural actions, such as the identification and collection of samples for comparative analysis. It is important to highlight that the meticulousness, methodological soundness, and technical proficiency of criminalists significantly influence the investigative process of criminal offenses. The field of criminal procedure law continuously confronts the challenge of evaluating forensic tactics, refining existing methodologies, and devising novel tactical approaches to enhance investigative procedures (Newman & Hartman, 2019), (Barry et al., 2019), (Crifasi et al., 2021).

The implementation of automated information retrieval systems and the establishment of comprehensive databases containing integrated data on weapons have created favorable conditions for more effective object search and identification. These databases compile relevant reference information essential for investigating and prosecuting criminal offenses, which is then made available to the investigating authorities. Consequently, the significance of strategically planning the integration of technical and tactical collaboration between criminalists and weapons experts is undoubtedly paramount (Ciomek, Braga & Papachristos, 2020), (Kleck, 2019b).

To ensure prompt detection and investigation of crimes involving the use of weapons, it is crucial to gather information concerning material objects directly at the inspection site. This enables the acquisition of vital initial data required for perpetrator identification, search operations, understanding the event's mechanism, and more. However, if the crime scene examination took place without considering the specificities of the crime or neglecting the assessment of firearm characteristics or the feasibility of conducting forensic ballistics examinations, there arises a necessity for consultation on matters directly linked to the ongoing investigation. Undoubtedly, such consultations mandate a thorough study of the case file or a preliminary examination of the objects, involving the expertise of a weapons specialist. One of the most pivotal responsibilities of said specialist is to perform a preliminary assessment of the weapons, traces of their usage, and other crime-related evidence at the crime scene (Rosenberg, 2021), (Bureau of Justice Statistics, 2020), (De Moor, Vandeviver & Beken, 2020).

The involvement of this expert is essential for elucidating the circumstances surrounding the illicit handling of weapons concerning the investigation and subsequent elucidation of its findings. The expert's presence serves to further clarify the interviewee's responses about the weapon's characteristics and its usage, evaluate the credibility of the interviewee's statements

regarding the weapon. Furthermore, it helps to ascertain whether the interviewee possesses specialized knowledge and expertise in the field of weapons science, gather fresh information crucial for forensic examination, and seek additional clarification from the expert's perspective (Cook, 2018), (Smith & Spiegler, 2020).

7. Conclusion

In summary, it is worth emphasizing that advancements in forensic methodologies and tools, along with the broader scientific and technical capabilities facilitated by weapons science knowledge, give rise to the issue of defining the identity of this field. Consequently, researchers are compelled to revisit the examination of its methodology, essence, subject, and system to ensure a comprehensive understanding.

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