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The Place Of Systematic Approach In The Formation Of Methodological Principles Of Forensic Engineering And Technical Examinations

Abstract. The analysis of scientific works made it possible to come to the conclusion that the scholars have created a fundamental basis for the methodology of forensic examination which is the basis for the formation of the methodological foundations of forensic engineering and technical examination for its further theoretical and practical development. This research paper identifies the place of the system approach in the formation of general principles of the methodology of forensic engineering and technical examinations. It has been established that the methodology can be formulated as a philosophical doctrine on the system of proven principles, norms and methods of scientific and cognitive activity, about forms, structure and functions of scientific knowledge, which are used in solving specific (special) research issues. It is emphasized that three levels are distinguished in the structure of general scientific methods: empirical methods, logical methods and techniques, heuristic methods, a detailed description of the methods of each level is given, and successive stages of experimental research are formed. It has been established that methodology is an independent scientific direction that studies the process of carrying out scientific research, describes and analyzes the stages of research and studies a number of other issues.

This article's purpose is to determine the place of the system approach in the formation of the general principles of the methodology of conducting forensic engineering and technical examinations which will allow the expert to obtain scientifically based results for drawing up a reliable conclusion.

Conclusions. It is determined that the system is a whole, complex, unity (integrity) that consists (combines) of many elements connected with each other in which the element is the smallest part of the whole, necessary for the description of the system which cannot be divided further. The unity of general scientific and philosophical levels of knowledge is the basis of the methodology of scientific and cognitive activity, about forms, structure and functions of scientific knowledge.

The methodology is proposed to be understood first of all as the methodology of scientific knowledge which is a set of theoretical provisions on the principles of construction, forms and methods of scientific and cognitive activity, in addition, it can be considered as a certain system of fundamental ideas. It is proven that methodology is distinguished as a separate scientific direction that studies the process of carrying out scientific research, describes and analyzes the stages of research and studies a number of other issues.

Keywords: system, system approach, levels of knowledge, science, methodology, methods, techniques, forensic engineering and technical



examinations, principles of the methodology of conducting forensic engineering and technical examinations.

Research Problem Formulation. One of the main tasks of the state at every stage of social development is combating crimes. It acquires special importance in the conditions of acceleration of scientific and technical progress, formation and development of new science, improvement and introduction of new devices and equipment. Updating scientific and methodical support for crime prevention, increasing its effectiveness through the implementation of the latest scientific achievements and best practices in the investigation and judicial review form the main tasks that must be solved by the sciences that provide the procedural basis of their activity (criminal process, criminology, forensic examination, etc.), as well as natural sciences, which allow solving a number of practical tasks. An important place in this is occupied by a comprehensive study of the issues of forensic engineering and technical examination, which is aimed at increasing the effectiveness of its use for combating offenses in various spheres of human activity.

Analysis of Essential Researches and Publications. There is a long-standing practice of using forensic engineering and technical examination in the process of uncovering and investigating specific offenses and the subsequent application of the expert's opinion in court proceedings when the court makes a final decision. It should be noted that scholars have made significant efforts to cover the theoretical and methodological aspects of experts' work with various information carriers, as well as the importance of forensic examination in evidence has been determined. Thus, F. M. Dzhabadov studied the conceptual foundations of the development of forensic examination in modern conditions which was highlighted in the scholar's dissertation¹.

The monograph by M. H. Shcherbakovskyi considers the most urgent issues of conducting and using forensic examinations in criminal proceedings, namely: the scientific, legal, and organizational-tactical principles of preparing and appointing forensic examinations, conducting expert research, evaluating the expert's opinion, and using the results of examinations under the time of pre-trial investigation and trial².

The monograph by E. B. Simakova-Yefremian highlights the results of the research of theoretical, methodological, procedural and practical provisions of complex forensic expert studies, on the basis of which ways of solving issues of scientific and methodological provision of justice in Ukraine are proposed³.

I. V. Pyrih, based on the results of the analysis of modern provisions of the general theory of forensic examination, considered the actual theoretical and applied issues of expert support of the pre-trial investigation. He outlined the basic principles of organizational, legal, personnel, scientific-methodical, material-technical and informational components of expert support of pre-trial investigation⁴.

However, the methodological principles of forensic engineering and technical examination were not comprehensively considered, and these and other published scientific works did not outline this issue, but only created a fundamental basis for its further theoretical and applied research, substantiation of new approaches to the understanding and development

Ігор Богданюк

МІСЦЕ СИСТЕМНОГО ПІДХОДУ У ФОРМУВАННІ МЕТОДОЛОГІЧНИХ ЗАСАД СУДОВИХ ІНЖЕНЕРНО- ТЕХНІЧНИХ ЕКСПЕРТИЗ

Анотація. Аналіз наукових праць дозволив дійти висновку, що вченими створено фундаментальну базу методології судової експертизи, яка є підґрунтям формування методологічних засад судової інженерно-технічної експертизи для її подальшого теоретичного і практичного розвитку. У статті визначено місце системного підходу у формуванні загальних засад методології судових інженерно-технічних експертиз. Встановлено, що методологія може бути сформульована як філософське вчення про систему апробованих принципів, норм і методів науково-пізнавальної діяльності, про форми, структуру та функції наукового знання, які застосовуються у вирішенні конкретних (спеціальних) дослідницьких проблем. Наголошено, що у структурі загальнонаукових методів виділяють три рівні: емпіричні методи, логічні методи і прийомні, евристичні методи, наведено розгорнуту характеристику методів кожного рівня та сформовано послідовні етапи експериментального дослідження. Встановлено, що методологія є самостійним науковим напрямом, що вивчає процес виконання наукових досліджень, описує та аналізує етапи дослідження й вивчає низку інших питань.

Метою статті є визначення місця системного підходу у формуванні загальних засад методології проведення судових інженерно-технічних експертиз, яка дозволить експерту отримувати науково обґрунтовані результати для складання достовірного висновку.

Висновки. Визначено, що система – це ціле, складне, єдність (цілісність), що складає (поєднує) безліч елементів, пов'язаних між собою, у якому елемент є найменшою частиною цілого, необхідного для опису системи, яка не може бути поділена далі. Єдність загальнонаукового та філософського рівнів пізнання лежить в основі методології наукового пізнання. Вона може бути визначена як філософське вчення про систему апробованих принципів, норм і методів науково-пізнавальної діяльності,

¹ Джавадов Ф. М. Концептуальні основи розвитку судової експертизи в сучасних умовах : автореф. дис. ... д-ра юрид. наук. Київ. 2000. 29 с.

² Щербаковський М. Г. Проведення та використання судових експертиз у кримінальному провадженні : монографія. Харків : В деле, 2015. 560 с.

³ Сімакова-Єфреміан Е. Б. Комплексні судово-експертні дослідження: теорія та практика : монографія. Харків. Право. 2016. 456 с.

⁴ Пиріг І. В. П. Теоретико-прикладні проблеми експертного забезпечення досудового розслідування : монографія. Дніпропетровськ : Дніпроп. держ. ун-т внутр. справ ; Ліра ЛТД, 2015. 432 с.

про форми, структуру та функції наукового знання.

Під методологією запропоновано розуміти перш за все методологію наукового пізнання, яка є сукупністю теоретичних положень про принципи побудови, форми і способи науково-пізнавальної діяльності, крім того, її можна розглядати і як певну систему основоположних ідей. Доведено, що методологія виокремлюється як окремий науковий напрямок, що вивчає процес виконання наукових досліджень, описує та аналізує етапи дослідження й вивчає низку інших проблем.

Ключові слова: система, системний підхід, рівні пізнання, наука, методологія, методи, методики, судові інженерно-технічні експертизи, засади методології проведення судових інженерно-технічних експертиз.

of the provisions cited in the scientific literature and various scientific recommendations.

Article Purpose to determine the place of a systematic approach in the formation of the general principles of the methodology of conducting forensic engineering and technical examinations which will allow the expert to obtain scientifically substantiated results for drawing up a reliable conclusion.

Main Content Presentation. Given that the concept of “methodology” differs from the concepts of “method” and “technique”, it is quite fair that it does not have a clear meaning and boundaries. Terminologically, the methodology is understood in two ways. Thus, a large explanatory dictionary of the modern Ukrainian language provides the following definitions of methodology:

- doctrine about the scientific method, knowledge and transformation of the world, its philosophical and theoretical basis;
- a set of research methods used in any science according to the specifics of the object of its knowledge⁵.

On the one hand, the methodology is defined as the doctrine of structure, logical organization, methods and means of activity. On the other hand, the methodology of science is the teaching of principles of construction, forms and methods of cognition. Regarding forensic engineering and technical examination, it is advisable to simultaneously use these two concepts in relation to expert research as a process of developing new knowledge about the circumstances of a specific event. Along with this, it should be noted that the second interpretation also has a philosophical basis, since scientific research has a reflection and is connected with the process of cognition for the formation of a worldview, that is, it has a general epistemological character. The above makes it possible to consider the methodology as a system characteristic.

We can and should talk about the system of this concept as a single approach in the development of modern scientific knowledge. The main basis for such a statement is that all research conducted within the framework of this approach is, in one way or another, aimed at studying the specific characteristics of complexly organized objects - systems.

According to the philosophical definition, a system is a set of elements that are in certain connections and relations with each other, which creates unity and integrity. Systems can differ in physical, chemical, biological, social, and spiritual nature, their substrate, functional and other features. The concept of a system is related to the concepts of “structure”, “element”, “connection”, “relationship”, “subsystem”, etc. L. Bertalanffy, one of the founders of the general theory of systems, defined a system as a complex of interacting elements. At the same time, some scientists distinguish the ontological and epistemological aspects of this category:

- in the ontological aspect, the concept of “system” appears as a set of elements and connections between them that exist objectively, regardless of the will and consciousness of people;
- in the epistemological aspect, it refers to the use of the concept of “system” and other related concepts as a tool for learning the essence of complex material systems. Philosophers call this aspect epistemological and methodological.

The expanded definition of the system implies a more complex system in which, in addition to the elements, there may be connections between certain sets of elements that form a subsystem. By combining various elements of the system, the subsystem contributes to the execution of a complete program in the development of the system. As an element of a system, a subsystem, in turn, is a system in relation to its components. A detailed definition of the system is formulated: “a system is a complex of subsystems, elements and components and their characteristic properties, the interaction

⁵ Великий тлумачний словник сучасної української мови (з дод. і допов.) Уклад. і голов. ред. Бусел В.Т. К.: Ірпінь ВТФ «Перун», 2005. 1728 с., с. 672.



between which and the environment determines a qualitatively or essentially new integrity"⁶.

The same system can be viewed from different points of view. The system approach involves the selection of a certain system-forming parameter, which conditions the search for a set of elements, a network of connections and relations between them - its structure. The system is always in a certain environment. The systemic approach takes into account its connections and relations with the environment. Hence, the second requirement of the system approach is to take into account that each system is a subsystem of another, larger system, and vice versa - to highlight smaller subsystems (elements) in it, which in another context are themselves considered as systems. Mandatory for the system approach is solving the issue of determining the properties of the whole based on the properties of the elements, as well as the properties of the elements based on the characteristics of the whole. At the same time, they believe that the essential properties of the system are determined not so much by the properties of the collection of elements as by the properties of its structure, the system-forming connections of the object⁷.

By solving the above-mentioned questions, the following definition of the system can be given: "System S on object A with respect to the integrative property is a set of such elements that are in relationships that generate this integrative property." It is indisputable that the existence of integration properties, i.e., properties inherent in the system as a whole and not inherent in any element of the system, is a defining property and a characteristic feature, the essence of the system. In other words, the properties of the system are not reduced only to the properties of its elements.

According to the system approach, the system is defined by integrity, which is the unity of regularly arranged and interconnected parts. The main features of the system include the presence of:

- simplest units – elements that make it up;
- subsystems – results of the interaction elements ;
- components – results of the interaction of subsystems which can be considered in relative isolation, out of connection with other processes and phenomena;
- internal structure of connections between these components, as well as their subsystems;
- a certain level of integrity, the sign of which is that the system, thanks to the interaction of components, obtains an integral result;
- in the structure of system-forming connections that unite components and subsystems as parts of a single system;
- communication with other systems of the external environment.

Each specific science, activity, or object can be considered as a certain system that has a set of interconnected elements, components, subsystems, defined functions, goals, composition, and structure. The general characteristics of the system include integrity, structure, functionality, relationship with the external environment, hierarchy, purposefulness, and self-organization.

Thus, a system is a whole, complex, unity (integrity) that makes up (combines) many elements connected to each other, in which the element is the smallest part of the whole, necessary to describe the system, which cannot be divided further.

However, such a definition of the system cannot be considered incomplete, since it is aimed at considering the elements of the research

Thor Bohdaniuk

MIEJSCE SYSTEMATYCZNEGO PODEJŚCIA W KSZTAŁTOWANIU METODOLOGICZNYCH PODSTAW INŻYNIERII KRYMINALISTYCZNEJ I BADAŃ TECHNICZNYCH

Abstrakcyjny. Analiza prac naukowych pozwoliła dojść do wniosku, że naukowcy stworzyli fundamentalne podstawy metodologii badań kryminalistycznych, które są podstawą do kształtowania metodologicznych podstaw inżynierii sądowej i badań technicznych dla jej dalszego rozwoju teoretycznego i praktycznego. W artykule określono miejsce podejścia systemowego w kształtowaniu ogólnych zasad metodyki badań kryminalistycznych i technicznych. Ustalono, że metodologię można sformułować jako filozoficzną naukę o systemie sprawdzonych zasad, norm i metod działalności naukowej i poznawczej, o formach, strukturze i funkcjach wiedzy naukowej, które są wykorzystywane w rozwiązywaniu określonych (specjalnych) badań problemy. Podkreślono, że w strukturze metod ogólnonaukowych wyróżnia się trzy poziomy: metody empiryczne, metody i techniki logiczne, metody heurystyczne, podano szczegółowy opis metod każdego poziomu oraz uformowano kolejne etapy badań eksperymentalnych. Ustalono, że metodologia jest niezależnym kierunkiem naukowym, który bada proces prowadzenia badań naukowych, opisuje i analizuje etapy badań oraz bada szereg innych zagadnień.

Celem artykułu jest określenie miejsca podejścia systemowego w kształtowaniu ogólnych zasad metodyki przeprowadzania badań kryminalistyczno-technicznych, które pozwolą biegłemu uzyskać naukowo ugruntowane wyniki do sformułowania wiarygodnego wniosku.

Wnioski. Ustala się, że system jest całością, złożoną jednością (integralnością), która składa się (łączy) z wielu połączonych ze sobą elementów, w których elementem jest najmniejsza część całości, niezbędna do opisu systemu, która nie da się dalej podzielić. Jedność ogólnonaukowego i filozoficznego poziomu wiedzy jest podstawą metodologii wiedzy naukowej. Można ją określić jako filozoficzną naukę o systemie sprawdzonych zasad, norm i metod działalności

⁶ Качан Н.С. Взаємозв'язок системи і структури: філософсько-економічний аспект. Наукові праці Кіровоградського національного технічного університету. Економічні науки, вип. 17 Кіровоград: КНТУ, 2010. с. 77-83

⁷ Філософський словник соціальних термінів. Видання третє, доповнене. Харків. «Р.І.Ф.», 2005. 672 с. ; Навчальний економічний словник-довідник (політекономія, мікроекономіка, макроекономіка, економічний аналіз, економіка підприємства, менеджмент, маркетинг, фінанси, банки, інвестиції, біржова діяльність); Терміни, поняття, персоналії. / За наук. ред. Г. І. Башнянина і В. С. Іфтемчука. 2-ге видання, виправлене і доповнене. Львів: "Магнолія 2006", 2007. 688 с. (с. 361)

naukowej i poznawczej, o formach, strukturze i funkcjach wiedzy naukowej.

Metodologię proponuje się rozumieć przede wszystkim jako metodologię wiedzy naukowej, która jest zbiorem teoretycznych postanowień dotyczących zasad budowy, form i metod działalności naukowej i poznawczej, ponadto można ją uznać za pewien system fundamentalnych idei. Udowodniono, że metodologia wyróżnia się jako odrębny kierunek naukowy, który bada proces prowadzenia badań naukowych, opisuje i analizuje etapy badań oraz bada szereg innych problemów.

Słowa kluczowe: system, podejście systemowe, poziomy wiedzy, nauka, metodologia, metody, techniki, inżynieria sądowa i ekspertyzy techniczne, podstawy metodyki prowadzenia ekspertyz sądowo-inżynierskich i technicznych.

object. However, in the case of considering the definition of the concept of "system" in relation to the research object as something integral (namely, it determines its originality, uniqueness, peculiarity), it is necessary to consider this concept as a separate set. For example, the properties of the object, the study of which requires the application of a set of different views, and ideas about the object of research, the reproduction of which, in turn, means the need to use a set of methods. In other words, the concept of a system has a double meaning, internal and external, which is the subject of this study.

Thus, the unity of general scientific and philosophical levels of knowledge is the basis of the methodology of scientific knowledge. It can be defined as a philosophical teaching about the system of proven principles, norms and methods of scientific and cognitive activity, about the forms, structure and functions of scientific knowledge.

As scholars noted, "the methodology of science, based on general philosophical principles and laws, historically arose and develops on the basis of gnosiology and epistemology, logic, as well as history, sociology, social psychology and cultural studies, is closely related to philosophical teachings" [8, c].

Let us emphasize that the application of the concept of system to methodology allows us to provide the following definition of this concept – "methodology (from the Greek *metodos* - a way, method of research, teaching, presentation) - a set of techniques, methods and operations of knowledge and practical activity."

O. V. Krushelnyska notes that the concept of methodology is complex and is explained in different ways in different literary sources. In many foreign scientific works, the concepts of methodology and research methods are not distinguished. Domestic scientists consider methodology as the teaching of scientific methods of cognition and as a system of scientific principles, on the basis of which research is based and the choice of cognitive means, methods and methods of research is made. The most appropriate is the definition of methodology as a theory of research methods, the creation of scientific concepts, as a system of knowledge about the theory of science or a system of research methods⁹.

According to the definition of other scholars, "methodology is a conceptual statement of the purpose, content, and methods of research that ensure obtaining the most objective, accurate, systematized information about processes and phenomena [10, c]. Note that the main functions of the methodology were formulated in this definition which boils down to the following:

- determination of methods for obtaining scientific knowledge that reflect dynamic processes and phenomena;
- determination of a certain path on which the goal of scientific research is achieved;
- ensuring the comprehensiveness of obtaining information regarding the process or phenomenon being studied; забезпечення всебічності отримання інформації щодо процесу чи явища, яке вивчається;
- introduction of new information to the foundation of the theory of science;
- clarification, enrichment, and systematization of terms and concepts in science;
- creation of a system of scientific information based on objective facts;
- formation of a logical and analytical tool of scientific knowledge.

Scholars proved that methodology is the science of structure, logical organization, means and methods of activity in general. Therefore, the

⁸ Гуторов О.І. *Методологія та організація наукових досліджень* : навч. посібн. Харків. ХНАУ, 2017. 272 с.

⁹ Крушельницька О.В. *Методологія та організація наукових досліджень* : навч. посібн. Київ. Кондор, 2003. 192 с.

¹⁰ Шейко В. М., Кушнарченко Н. М. *Організація а методика науково-дослідницької діяльності*. Київ. Знання, 2004. 307 с.

methodology is proposed to be understood as the methodology of scientific knowledge which is a set of theoretical provisions on the principles of construction, forms and methods of scientific and cognitive activity. In addition, the methodology can be considered as a certain system of fundamental ideas¹¹. The given definition of the methodology among many existing ones is considered the most complete and reflects the specifics of the researched direction – forensic expert research in general and engineering and technical types of examinations in particular.

The current state of research development in this direction allows us to state that at this stage methodology is distinguished as a separate scientific direction that studies the process of conducting scientific research, describes and analyzes the stages of research and studies a number of other issues. The methodology includes fundamental, general scientific principles that form the basis, and specific scientific principles that underlie the theory of a particular field of scientific knowledge, as well as a set of specific methods that are used in solving specific (special) research issues.

Separately, we should dwell on research activity, which is fundamentally based on general principles, among which O. Kh. Uzakov and O. N. Mukhidova singled out the following main features of research activity:

- a subjective and objective way of looking at the world - focusing on the study of objects that can be included in the activity, as well as their research as subject to the objective laws of functioning and development;
- the ability of science to go beyond the boundaries of each historically defined type of practice and open up new material worlds for humanity, which can become objects of practical development only at the future stages of the development of civilization;
- scientific research activity is regulated by the principles of rationality, which determine the importance of the norms of validity and provenance of knowledge, and even its systematic organization;
- availability and use of special means of activity; means of activity include: special language (empirical and theoretical); special instrument complexes; other instrumental components;
- the presence of a system of developed research methods, when the method serves as a condition for fixing and reproducing the object of research and is a way of solving research tasks. Along with knowledge about objects, science systematically develops knowledge about methods¹².

Note that the development of a scientific theory is organically connected with such factors as:

- the emergence of ideas, formulation of principles, laws, regulations, categories, and concepts;
- generalization of scientific facts;
- use of axioms;
- proposition of hypotheses;
- proof of theorems.

Ideas arise on the basis of practice and change in connection with the development (change) of the theoretical justification of the material world (surrounding environment), phenomena and processes, as well as social life. At the same time, there are advanced, progressive ideas that contribute to the development of a scientific direction or field of knowledge, in particular, and society as a whole, and non-progressive ideas that inhibit it.

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DER STELLENWERT EINES SYSTEMATISCHEN ANSATZES BEI DER BILDUNG DER METHODISCHEN GRUNDLAGEN DER INGENIEURWISSENSCHAFTLICHEN UND TECHNISCHEN

FORENSIK Abstrakt. Die Analyse wissenschaftlicher Arbeiten ließ uns zu dem Schluss kommen, dass Wissenschaftler eine grundlegende Grundlage für die Methodik der forensischen Untersuchung geschaffen haben, die die Grundlage für die Bildung der methodischen Grundlagen der forensischen Ingenieurwissenschaften und der technischen Untersuchung für ihre weitere theoretische und praktische Entwicklung darstellt. Der Artikel definiert den Platz des Systemansatzes bei der Bildung der allgemeinen Prinzipien der Methodik der Forensik und der technischen Untersuchungen. Es wurde festgestellt, dass die Methodik als philosophische Lehre über ein System bewährter Prinzipien, Normen und Methoden wissenschaftlichen und kognitiven Handelns, über die Formen, Strukturen und Funktionen wissenschaftlicher Erkenntnisse formuliert werden kann, die zur Lösung spezifischer (Spezial-) Forschungen verwendet werden. Probleme. Es wird betont, dass in der Struktur allgemeiner wissenschaftlicher Methoden drei Ebenen unterschieden werden: empirische Methoden, logische Methoden und Techniken, heuristische Methoden, eine detaillierte Beschreibung der Methoden jeder Ebene wird gegeben und aufeinanderfolgende Phasen der experimentellen Forschung werden gebildet. Es wurde festgestellt, dass die Methodologie eine unabhängige wissenschaftliche Richtung ist, die den Prozess der Durchführung wissenschaftlicher Forschung untersucht, die Forschungsstadien beschreibt und analysiert und eine Reihe anderer Themen untersucht.

Der Zweck des Artikels besteht darin, den Platz des Systemansatzes bei der Bildung der allgemeinen Grundsätze der Methodik zur Durchführung von forensischen und technischen Untersuchungen zu bestimmen, die es dem Experten ermöglichen, wissenschaftlich fundierte Ergebnisse für die Erstellung einer zuverlässigen Schlussfolgerung zu erhalten.

Schlussfolgerungen. Es wird festgestellt, dass das System eine ganze, komplexe Einheit (Integrität) ist, die viele miteinander verbundene Elemente ausmacht (kombiniert), wobei das Element der kleinste Teil des Ganzen ist, der für die Beschreibung des Systems erforderlich ist und nicht weiter unterteilt werden kann. Die Einheit von allgemeinwissenschaftlicher und philosophischer Erkenntnisebene ist die Grundlage der Methodik

¹¹ Крушельницька О. В. Методологія та організація наукових досліджень : навч. посібн. Київ: Кондор, 2003. С. 59.

¹² Узаков, О. Х., Мухидова, О. Н. Научные исследования: основы методологии. Science and Education. 2021. 2 (12). P. 376–386. URL: <https://openscience.uz/index.php/sciedu/article/view/2180> (дата звернення 27.12.2022).

wissenschaftlicher Erkenntnis. Sie kann definiert werden als eine philosophische Lehre über das System bewährter Prinzipien, Normen und Methoden wissenschaftlichen und kognitiven Handelns, über Formen, Struktur und Funktionen wissenschaftlicher Erkenntnis.

Die Methodik soll in erster Linie als Methodik der wissenschaftlichen Erkenntnis verstanden werden, die eine Reihe theoretischer Bestimmungen zu den Konstruktionsprinzipien, Formen und Methoden der wissenschaftlichen und kognitiven Tätigkeit darstellt, außerdem kann sie als ein bestimmtes System betrachtet werden von grundlegenden Ideen. Es ist erwiesen, dass die Methodologie als eine eigenständige wissenschaftliche Richtung ausgezeichnet wird, die den Prozess der Durchführung wissenschaftlicher Forschung untersucht, die Forschungsstadien beschreibt und analysiert und eine Reihe anderer Probleme untersucht.

Schlüsselwörter: System, Systemansatz, Wissensstand, Wissenschaft, Methodik, Methoden, Techniken, Forensic Engineering und technische Expertise, die Grundlage der Methodik zur Durchführung von Forensic Engineering und technische Expertise.

It should also be noted the difference between engineering and technical knowledge and science. This difference lies in the fact that science involves the productive activity of a person, i.e., conducting scientific research and obtaining knowledge that mankind has never possessed before, and engineering and technical knowledge – reproductive activity, i.e., the use of knowledge that is already known to mankind (for example, designing buildings, equipment, devices according to typical projects or known technologies).

Note that science belongs to a separate type of human cognitive activity aimed at producing objective, systematically organized and substantiated knowledge about the surrounding world. The basis of this activity is: a collection of facts; their critical analysis, generalization, systematization and, on this basis, synthesizing new knowledge that not only describes observed natural or social phenomena, but also makes it possible to build cause-and-effect relationships between them, and as a result, to predict their state and development in future. And it is scholars who are armed with specific expertise and are able to do this. According to one of the scholars' definitions, "science is a set of generalized, systematized statements (knowledge) that describe the real world, and are either true or likely to be true, and also have value for social life"¹³.

Ukrainian scholars, including O. H. Danylian and O. P. Dzoban ¹⁴, O. V. Krushelnyska ¹⁵, O. I. Hutorov ¹⁶, studied issues of the methodology of scientific knowledge and identified a number of immediate tasks of science which should be agreed to be listed in the following list:

- describing phenomena and processes; analysis, systematization of initial data and generalization of facts;
- establishment of relationships; proposing hypotheses; development of theories and regularities (laws) as a set of new knowledge;
- systematization of the totality of new knowledge;
- explanation of the essence of phenomena and processes;
- forecasting the development of new knowledge or a new scientific direction in the general outlook;
- determination of directions and forms of practical use of new knowledge.

The structure of science can be presented differently depending on the elements that make it up. For example, science can be considered as a system consisting of theory; methodology, methods and techniques; practice of implementing the obtained results. In the structure of general scientific methods, three levels are most often distinguished: empirical methods, logical methods and techniques, and heuristic methods. In the future, we consider this division of general scientific methods to be considered in more detail. Thus, the methods of empirical research include observation; experiment, or measurement - as a limited part of the experiment; comparison; description.

One of the leading methods of empirical research is **observation** – the purposeful passive study of subjects, which relies mainly on data obtained from the scholar's senses. Observation can be direct and indirect, performed using various technical means and devices.

The variety of observations is measurement. The **measurement** is the observation that records not only qualitative but also quantitative characteristics of objects, traces of phenomena and processes. Measurement can be considered as a limited part of the experiment. Individual researchers of methodology, as a scientific field, separate the experiment into an independent method of empirical research. The free web encyclopedia

¹³ Черноусенко О. Ю., Чеплюк О. О., Риндюк Д. В. Основи наукових досліджень та інженерної творчості : навч. посібн. Київ : КПІ ім. Ігоря Сікорського, 2016. 270 с.

¹⁴ Данильян О. Г., Дзьобань О. П. Організація та методологія наукових досліджень : навч. посіб. Харків : Право, 2017. 448 с.

¹⁵ Крушельницька О. В. Методологія та організація наукових досліджень : навч. посібн. Київ : Кондор, 2003. 192 с.

¹⁶ Гуторов О. І. Методологія та організація наукових досліджень : навч. посібн Харків : ХНАУ, 2017. 272 с.



“Wikipedia” gives the following definition of an **experiment**: “An experiment is an attempt that requires confirmation or refutation, a form of knowledge, one of the main methods of scientific research, in which the study of phenomena takes place in expediently chosen or artificially created conditions that provide the appearance of those processes, the observation of which is necessary to establish regular connections between phenomena”¹⁷.

The large explanatory dictionary of the modern Ukrainian language provides the following definitions of the experiment:

- one of the main methods of scientific research, in which the study of phenomena takes place with the help of expediently chosen or artificially created conditions;

- the active action of man on nature and the artificial reproduction of its various phenomena with the aim of studying objective regularities¹⁸.

O. H. Danylian and O. P. Dzoban note that “An experiment is an active and purposeful intervention in the course of the researched process, a corresponding change of the researched object or its reproduction in specially created and controlled conditions determined by the goals of the experiment. During the experiment, the object under investigation is isolated from the influence of adverse circumstances and is presented in its “pure form”. At the same time, the specific conditions of the experiment are not only set but also controlled and reproduced many times”¹⁹.

We note that the implementation of this method of scientific research involves the use of certain technical measuring devices, and equipment, as well as the use of measurement scales, standards, etc.

In general, experimental research consists of a number of stages: experiment; proposing a scientific hypothesis; selection of the object and purpose of the research; preparation of the material base; selection of the optimal experiment program; performing the experiment; recording the results of the experiment.

A rational and logical extension of the application of the measurement method to assess the success of the experiment (its admissibility as proper proof of the version or hypothesis in the research being carried out), which can also be considered as a certain stage of the research, is the application of the **comparison or comparison method** because the obtained results in quantitative terms must be correlated with the planned purpose of this study. Scholars provide the following definition of this scientific method: “**Comparison** is a cognitive operation that reveals the similarities or differences of objects (or stages of development of the same object), that is, their identity and difference. To compare means to compare one thing with another in order to identify their relationship. With the help of comparison, both quantitative and qualitative characteristics of objects are revealed”²⁰.

It should be noted that the application of the method is possible under certain conditions that impose restrictions during its application, however, at the same time, it allows to record results of the application of the method as acceptable, reliable and such that, in the final manifestation, they can be unequivocally classified as appropriate in the formation of the evidence base in the forensic expert studies. The above allows us to single out a number of limitations, including:

- use of the same measurement units, scales in comparison;
- application in comparison of homogeneous objects forming a certain class;

¹⁷ web-енциклопедія «Вікіпедія» Internet-ресурс URL: <https://uk.wikipedia.org/wiki/%D0%95%D0%BA%D1%81%D0%BF%D0%B5%D1%80%D0%B8%D0%BC%D0%B5%D0%BD%D1%82>

¹⁸ Великий тлумачний словник сучасної української мови (з дод. і допов.) Уклад. і голов. ред. Бусел В.Т. Київ. Ірпінськ ВТФ «Перун». 2005. С. 340.

¹⁹ Данильян О. Г. Організація та методологія наукових досліджень: навч. посіб. / О. Г. Данильян, О. П. Дзьобань. Харків: Право, 2017. С. 265.

²⁰ Там само. С. 267..

– comparison of objects in the classroom should be carried out according to certain features essential for this study.

We emphasize that this does not exclude the comparison of objects that are compared by one feature but may not be comparable by another feature.

Let's emphasize that the application of the comparison method inseparably causes the need for the researcher to operate with the concepts of similar and identical. The definition of similar and identical objects is considered in detail in the scientific work of S. V. Rohalin based on the signs of similarity formulated by him. Thus, one of the signs of similarity is formulated to determine similarity and consists in establishing in the study the coincidence of a general or defining list of characteristic properties of the compared objects of study. Another sign of similarity is formulated to determine the identity and consists in establishing in the study the coincidence of the general or defining list of characteristic properties of the compared objects of research and the coincidence of conditions and circumstances in which the characteristic properties (parameters) of the compared objects of research are clearly manifested²¹.

The main role of the comparison is to obtain new information not only about the properties of the compared phenomena, but also about their direct and indirect relationships. It must be taken into account that initially the comparison may be caused by the search for information, but it is also the key to cognition. This is what makes it one of the most fruitful areas of scientific research. It should be noted that performing a comparison with the definition of similarity and identity in comparison, the definition of the existence of a functional connection of comparative properties, parameters in their quantitative determination of the objects under study is tangential and inseparable from another empirical method, namely, the method of description.

A **description** is a cognitive operation that consists in recording the results of experience (observation or experiment) using certain notation systems accepted in science. The description is a system of procedures for the collection, primary analysis and presentation of data and their characteristics. As a rule, in-depth scientific research begins with description, since description is its initial stage. The consistent application of the descriptive method involves compliance with the following norms:

- strict objective design of the selected object of description;
- compliance with the sequence in the description of objectively specified signs, parameters and characteristics of the object, which are consistent with the research task;
- orderliness in the secondary processing of the collected material (procedures: grouping, classification, systematization, etc.)²².

The application of this method of empirical research is tangential to the application of a method from another group of general scientific research methods, namely logical methods, because it requires awareness and practical application of such a concept as analysis in describing the object of research, describing the results of measurements, experiments, etc. Logical methods and techniques include: analysis;



²¹ Роголін С.В. Застосування методу моделювання в дослідницькій практиці судових експертиз. *Теорія та практика судової експертизи і криміналістики: Збірник наукових праць*. Вип.19. Харків: Право, 2019. С. 212-225.

²² Данилюян О. Г., Дзьобань О. П. Організація та методологія наукових досліджень : навч. посіб. Харків : Право. 2017. 448 с.

synthesis; induction; deduction; abstraction; specification; generalization; analogy; idealization; formalization; modeling. Analysis as an independent research method is discussed below.

Analysis and synthesis. An analysis (from the Greek *ανάλυσις* – “decomposition”) – the dismemberment of the subject of knowledge, abstraction of its individual sides or aspects. The free web encyclopedia “Wikipedia” provides the following definitions of the concept of analysis:

- a research method that studies a subject, imaginary or real dismembering it into constituent elements: parts of the object, its features, properties, and relations, therefore considering each of the selected elements separately within the limits of a single whole; the opposite of the analysis method is synthesis;

- clarification of the logical form (structure) of reasoning by means of formal logic;

- in a broad sense - scientific research in general;

- determination of the composition and properties of any substance, their research.

It seems appropriate to consider the concept of analysis in the understanding of the method of cognition, which makes it possible to divide the subject into parts, which is foreseen by its primary meaning, embodied in the translation from Greek – “schedule”. Synthesis, on the contrary, is the result of combining individual parts or features of an object into a single whole. Analysis and synthesis are interconnected, they represent the unity of opposites as an embodiment of the law of materialistic dialectics – “The Law of Unity and Struggle of Opposites”.

O. V. Krushelnitska notes that depending on the level of knowledge of the object and the depth of penetration into its essence, different types of analysis and synthesis are used. Direct (empirical) analysis and synthesis are used at the stage of superficial acquaintance with the object. At the same time, the following is carried out: selection of individual parts of the object; identifying its properties; the simplest measurements are carried out; recording of direct data lying on the surface. This type of analysis and synthesis makes it possible to know the phenomenon, but it is not enough to penetrate into its essence.

Reverse (elementary-theoretical) analysis and synthesis are widely used to study the essence of the phenomenon under study. Here the operations of analysis and synthesis are based on some theoretical considerations, that is, assumptions and cause-and-effect relationships of various phenomena.

The structural and genetic analysis and synthesis enables the deepest penetration into the essence of the object when the cause-and-effect relationships are studied in depth. This type of analysis and synthesis requires the selection in a complex phenomenon of such elements, such chains, which are central, main, which decisively affect all other aspects (qualities, properties) of the object²³.

Abstraction and concretization, as well as analysis and synthesis, is a demonstrative example of the embodiment of the Law of unity and the struggle of opposites, which in the process of cognition from the breakdown in analysis to generalizing unification in synthesis moves from an abstract, poorer in content concept to concrete, most complete in content. These two methods of scientific knowledge, despite



²³ Крушельницька О. В. Методологія та організація наукових досліджень. Навчальний посібник. Київ : Кондор, 2003. 192 с.

their methodological opposite, mutually complement each other, and in their systematic qualitative categorical comparison, they raise research to a new level of knowledge.

Logical abstraction involves the elimination during the study of objects, traces of phenomena and processes of non-essential, secondary properties and relationships and the selection of the main, defining one. We have a borderline case of abstraction only when there is only one, but essential feature and property. This provides the researcher with additional opportunities when using another method - modeling. In addition, attention should be paid to the existence of a genetic connection in the application of different types of research methods of the process of cognition of the studied objects, which undoubtedly indicates the systematic approach in scientific research. Regarding the application of logical abstraction with the isolation of a single essential feature (property) of the research object and the application of the modeling method, one should agree with the conclusions of S. V. Rohalin²⁴. Thus, it is possible to distinguish the following stages of expert research in the process of applying the method of **scientific modeling** in the forensic examination:

1. Awareness of the problematic nature of studying the research object (original) in the actual conditions and circumstances recorded in the proceedings (case) materials.
2. Formulation of the task and fixation of all characteristics (parameters, properties) of the research object.
3. Establishing essential characteristics (parameters, properties) of the research object.
4. Determination of non-essential characteristics (parameters, properties) of the research object.
5. Minimization of the list of essential characteristics (parameters, properties) of the research object and maximization of the list of non-essential parameters, properties) of the research object by a successive step-by-step reduction for essential and increase for non-essential lists, which can be performed in groups or in pairs. At the same time, it is necessary to monitor the presence or absence of dependence in groups or in pairs.
6. Preliminary establishment of the sufficiency of the lists of essential and non-essential characteristics (parameters, properties) of the research object;
7. Research optimization by limiting the number of essential and non-essential characteristics (parameters, properties) of the research object. If necessary, it is necessary to introduce a limit (increase or decrease) of the number of essential characteristics (parameters, properties) of the original to obtain quantitative results in the expert's opinion based on the research results, including to determine the accuracy of calculations when obtaining numerical results according to models planned for use.
8. The use of signs of similarity in the construction of a model that adequately describes the determined characteristics (parameters, properties) of the research object (original), conditions and circumstances in which the characteristic properties (parameters) of the original are clearly manifested. The final definition of the list of essential and non-essential characteristics (parameters, properties) of the original. The construction of the model is carried out using the implemented forensic research methods or scientific developments in the relevant scientific areas.
9. Analyzing the model according to the expert task.
10. Transferring the model research results to the research object (original).
11. Providing a reasoned conclusion.

One of the widespread methods of logical research is **formalization**, which can be considered as systematically related to the previous one - the modeling method. In the definition given by O. I. Hutorov, "formalization" is the representation of an object or phenomenon in the symbolic form of any

²⁴ Роголін С. В. Застосування методу моделювання в дослідницькій практиці судових експертиз. *Теорія та практика судової експертизи і криміналістики*: Збірник наукових праць. Вип.19. Харків: Право, 2019. С. 212-225.



artificial language (mathematics, chemistry, etc.), with the help of which a formal study of their properties is carried out²⁵, which in fact, it is practically the embodiment of one of the forms of modeling. Formalization, as a rule, is carried out on the basis of abstractions, idealization and the introduction of artificial symbolic signs. An example of the use of formalization is mathematics, and various natural and technical sciences (physics, theoretical mechanics, resistance of materials, etc.), in which the conclusion of a meaningful proposition is replaced by the conclusion of a formula that expresses it.

Formalization provides an opportunity for systematization, clarification, methodological clarification of the content of the theory and clarification of the nature of the interrelationships of its various provisions. With its help, it is possible to identify and formulate problems that will still have to be solved in the ongoing research, or in the future, that is, in terms of posing a scientific issue. In addition to mathematical formalization, there is a logical-mathematical one, which is especially important when studying the structure of concepts in numerical logic and operations with logical units. This can be used both directly in research and in the processing of quantitative measurement information based on experimental results, as well as in the application of mathematical means of processing actual data in order to derive empirical regularities in the form of mathematical formulas, equations and inequalities or their systems.

It should be noted that the consideration of the types of logical methods of research of **induction and deduction** (by the way, as in the previous consideration of modeling and formalization) allows us to reveal a systemic relationship. Consideration of induction and deduction can be called genetically related to each other and other types of logical research methods, for example with generalization.

Such research can begin with the formation of theoretical foundations. For example, it is found out which concept, theory or subject area can unite and collect together all the developed empirical results or most of them. There are rare cases when part of the results falls out of the same channel and they have to be discarded (for this, see, for example, the sequence of applying the modeling method ahead). There are also cases when it turns out that some of the necessary empirical results are missing, then the empirical part of the study should be continued. After the researcher defines the subject area, the process of building the logical structure of the theory, concept, etc. begins. The process of building a logical structure generally consists of two stages.

The first stage is the stage of **induction** - the descent from the concrete to the abstract. At this stage, the researcher determines the central system-forming link of his version of the existence of the phenomenon or the emergence of the process: the concept; a system of axioms or axiomatic requirements; a single methodological approach, etc. It should be noted that in the process of generalizing the empirical results in the research being carried out, on the one hand, it is necessary to constantly refer to one's subject area in terms of the requirements of the completeness of the theory in the general subject area by referring to known scientific research or reference sources. The researcher at the stage of induction takes a detailed inventory of all the results available to him, as well as everything that may be of interest to this study. He begins to group them according to certain classification grounds into primary generalizations, then into second-order generalizations, etc. An inductive process takes place - abstraction by going from the concrete to the abstract until all the results are reduced to a short but comprehensive formulation that reflects in a general concise form the entire essence of the conducted research and the totality of the obtained results - conclusions.

The next stage is the stage of the deductive process, that is, concretization, which occurs by going from the abstract to the concrete. At this stage, the formulation of the conclusions of the study develops in the aggregate of all factors, conditions, principles, models, mechanisms, etc. Sometimes, if the

²⁵ Гуторов О. І. Методологія та організація наукових досліджень : навч. посібник / О. І. Гуторов; Харк. нац. аграр. ун-т ім. В. В. Докучаєва. Харків : ХНАУ, 2017. С. 40.

research problem is divided into several relatively independent aspects, the conclusions obtained can be formed in several conceptual directions, and those, in turn, develop (divide) in the future. This is how the logical structure of the research is built.

The level of specific methods (concrete-scientific level) is a set of research methods and methods used in one or another field of knowledge. The specific-scientific level differs from the philosophical and general-scientific levels by greater obviousness, a more obvious nature of functioning. It is independent in the sense that it comes from concrete scientific knowledge itself, and its requirements, but it is relatively independent, as it is also based on philosophical views and ideas that prevail within this or that scientific picture of the world, this or that paradigm.

Along with this, let us emphasize that the basis for the selection of examination classes is the field of specific expertise that it uses, but the field of specific expertise is the basic science for these examinations. The difference between one science and another appears in the form of differences in the subject, object and method. It is they who give individuality and determine the independence of science. However, this is not enough to determine the class of examination, although earlier it was a fairly common opinion that the class defines only the method of expert research.

In the training manual for specialists who intend to obtain or confirm the qualification of a forensic expert "Fundamentals of Forensic Examination", in particular, it is noted that O. R. Shliakhov, regarding the task of examination, noted that it is a scientifically based definition of the subject of examination, formulated in a generalized and systematized manner for genus (species) as a whole; it is related to the subject of judicial evidence and is closely related to objects and methods of expert research²⁶. It is important to systematize the tasks proposed by him according to the specific purpose of the examination results (identification, diagnostic, situational), on the one hand, and according to the degree of commonality (individual, joint), on the other.

The list of tasks performed by science was given above. At the same time, we emphasize that unlike scientific knowledge, the tasks facing engineering and technical knowledge are somewhat narrowed and limited:

- an explanation of the essence of the phenomena and processes investigated by engineering and technical examination;
- forecasting the development of new knowledge (a new scientific direction within the scope of this examination) in the general outlook;
- determination of directions and forms of practical use of new knowledge and the emergence of new subtypes of forensic engineering and technical examination.

Engineering and technical knowledge formed by mankind is a collection of knowledge from technical sciences of various fields of knowledge. The most widespread of the known technical sciences include mechanical engineering, mechanical engineering of various directions, materials science, aviation and rocket engineering, shipbuilding, instrument engineering, electrical engineering, radio engineering, robotics, computer engineering, energy, metallurgy, material processing, chemical and biotechnologies, transport, construction, etc.

At the same time, it should be noted that the following list of types of forensic engineering and technical examination is currently registered in the Ministry of Justice: engineering and transport (automotive, transport and route, railway and transport); road engineering; construction and technical; assessment and construction; land engineering; valuation and land; land management examination; fire engineering; life safety; mining; engineering and environmental; electrical engineering; computer and technical; telecommunication; electric transport examination; examination of the technical condition of elevators; mechanical engineering; water engineering;

²⁶ Основи судової експертизи: навчальний посібник для фахівців, які мають намір отримати або підтвердити кваліфікацію судового експерта / авт.-уклад.: Л. М. Головченко, А. І. Лозовий, Е. Б. Сімакова-Єфремян та ін. Харків: Право, 2016. С. 26.



aviation and technical ²⁷. It should be noted that there is currently a need to make changes to the “Instructions on the Appointment and Conduct of Forensic Examinations and Expert Studies”, changes to the “Scientific and Methodological Recommendations on the Preparation and Appointment of Forensic Examinations and Expert Studies”, namely, the introduction of a new type of forensic engineering and technical examination - heat engineering examination.

The generalization of the above leads to the conclusion that determines the place of forensic expert research in scientific research. They are convinced that the place of forensic research, in contrast to the philosophical level of knowledge, lies in the applied plane, and is fed by the general epistemological task, which is the root of scientific research. During their professional activities, forensic experts are guided not only by normative legal acts (primarily these are: Laws of Ukraine “On Forensic Examination”, “On Scientific and Scientific-Technical Activity”, “On Scientific and Scientific-Technical Examination”, “Instructions on Appointment and Conduct of Forensic Examinations and Expert Research”), but also special forensic methods.

The above allows us to conclude that in their activities, forensic experts apply special methods of scientific research, including those that are implemented in practical application, general forensic methods and special forensic methods, which are used directly and exclusively in engineering and technical types of forensic examinations. and together with the general scientific research methods that form the theoretical base, collectively serve as the methodological basis of engineering and technical forensic examinations as a whole.

Conclusions. It is determined that the system is a whole, complex, unity (integrity), which consists (combines) of many elements connected with each other, in which the element is the smallest part of the whole, necessary for the description of the system, which cannot be divided further. The unity of general scientific and philosophical levels of knowledge is the basis of the methodology of scientific knowledge. It can be defined as philosophical teaching about the system of proven principles, norms and methods of scientific and cognitive activity, about the forms, structure and functions of scientific knowledge.

The methodology is proposed to be understood first of all as the methodology of scientific knowledge, which is a set of theoretical provisions on the principles of construction, forms and methods of scientific and cognitive activity, in addition, it can be considered as a certain system of fundamental ideas. It is proven that methodology is distinguished as a separate scientific direction that studies the process of carrying out scientific research, describes and analyzes the stages of research and studies a number of other problems. The methodology is proposed to be understood first of all as the methodology of scientific knowledge, which is a set of theoretical provisions on the principles of construction, forms and methods of scientific and cognitive activity, in addition, it can be considered as a certain system of fundamental ideas. It is proven that methodology is distinguished as a separate scientific direction that studies the process of carrying out scientific research, describes and analyzes the stages of research and studies a number of other issues. The methodology includes fundamental, general scientific principles that form the basis, and specific scientific principles that underlie the theory of a particular field of scientific knowledge, as well as a set of specific methods that are used in solving specific (special) research problems. Consecutive stages of experimental research were formed: experiment; proposing a scientific hypothesis; selection of the object and purpose of the research; preparation of the material base; selection of the optimal experiment program; performing the experiment; recording the results of the experiment.

²⁷ Інструкція про призначення та проведення судових експертиз та експертних досліджень, затверджена наказом Міністерства юстиції України від 08.10.1998 № 53/5 (зі змінами та доповненнями) Чинна з 03.11.1998. Internet-ресурс URL: <https://zakon.rada.gov.ua/laws/show/z0705-98#Text> (дата звернення 16.07.2022).п. 1.2.2

The generalization of the above leads to the conclusion that determines the place of forensic expert research in scientific research. They are convinced that the place of forensic research, in contrast to the philosophical level of knowledge, lies in the applied plane, and is fed by the general epistemological task, which is the root of scientific research.

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