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FACULTY OF ECONOMICS

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METHODOLOGY AND ORGANIZATION OF SCIENTIFIC RESEARCH

Lecture notes

Part 1

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The educational component “Methodology and Organization of Scientific Research (in English)” forms a student’s systemic worldview and developed analytical thinking for studying scientific processes. It contributes to mastering fundamental research approaches, logical structuring of scientific research and the application of modern methods for solving complex problems, thereby ensuring effective organization and implementation of scientific work, and improving professional communication skills in English.

The lecture notes consist of two parts. The first part covers the concept of science and its evolution, the development of a scientist as a person and the regime of scientific work, as well as the methodology of scientific research, including general and special methods.

Recommended for publication and use in the educational process of UkrSURT for applicants of the second (master's) level of specialty D3 Management of the OP "Sustainable Logistics and Supply Chain Management" from the educational component "Methodology and Organization of Scientific Research (in English)" for all forms of education.

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Освітній компонент «Методологія та організація наукових досліджень (англ. мовою)» формує у здобувача системний світогляд та розвинене аналітичне мислення для вивчення наукових процесів. Він сприяє оволодінню фундаментальними дослідницькими підходами, логічним структуруванням наукового пошуку та застосуванню сучасних методів для вирішення складних проблем, тим самим забезпечуючи ефективну організацію та виконання наукової роботи, та покращенню навичок професійного спілкування англійською мовою.

Конспект лекцій складається з двох частин. Перша частина охоплює поняття науки та її еволюцію, розвиток вченого як особистості та режим наукової праці, а також методологію наукових досліджень, включаючи загальні та спеціальні методи.

Рекомендовано для публікації та використання в навчальному процесі УкрДУЗТ для здобувачів другого (магістерського) рівня спеціальності D3 Менеджмент ОП «Стала логістика та управління ланцюгами поставок» з освітнього компонента «Методологія та організація наукових досліджень (англ. мова)» для всіх форм здобуття освіти.

Іл. 2, табл. 2, бібліогр.: 44.

Конспект лекцій розглянуто та рекомендовано до друку на засіданні кафедри економіки та управління виробництвом та комерційним бізнесом 19 червня 2026 р., протокол № 12.

Reviewer

prof. M. V. Korin

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INTRODUCTION

The primary objective of this educational component is to equip graduate-level management students with the competencies necessary to autonomously formulate and address novel scientific and operational challenges, while fostering the innovative application of contemporary scientific and technological advancements within professional practice.

At the end of studying this educational component higher education students will be able to:

- communicate freely on professional and scientific issues in national and foreign languages orally and in writing higher education students;
- communicate in professional and scientific circles in the state and foreign languages;
- make effective decisions under uncertain conditions and requirements that require the use of new approaches, methods and tools of socio-economic research;
- provide personal professional development and time management;
- justify management decisions regarding the effective development of economic entities, taking into account goals, resources, limitations and risks.

The lecture notes consist of two parts. The first part covers the concept of science and its evolution, the development of a scientist as an individual and the regime of scientific work, as well as the methodology of scientific research, including general and special methods.

LECTURE 1. The Concept of Science and Its Evolution

Outline

1.1 The Essence of Scientific Cognition, Knowledge, and Scientific Research.

1.2 Stages of the Formation and Development of Science.

1.3 The Essence, Objectives, and Functions of Science.

1.4 Core Concepts of Science and Their Characteristics.

1.5 Classification of Sciences.

1.1 The Essence of Scientific Cognition, Knowledge, and Scientific Research

The fundamental aspects of scientific cognition, the structure of knowledge, and the methodology of research have been extensively examined by numerous scholars and are well-documented in a wide range of academic textbooks [1–4; 7; 8; 11-15, 17–19; 22; 24 - 26]. These foundational principles serve as a cornerstone for understanding the nature of scientific inquiry and the development of theoretical frameworks across various disciplines.

Science emerged when humanity first became aware of its own limitations, creating an objective need to systematically acquire knowledge. Knowledge is essential for orientation in the surrounding world, for explaining and predicting events, and for the planned acquisition of new insights.

Cognition is defined as the process of moving human thought from ignorance toward understanding. It is grounded in the reflection and reproduction of objective reality within human consciousness, occurring through social, productive, and scientific activity—a set of processes collectively termed *practice*. As the foundation of all scientific inquiry, cognition acts as a complex dialectical process that maps the essence of environmental phenomena into human consciousness. Through this process, humanity strives to understand the world and transform it to improve living conditions.

Scientific cognition is a rigorous form of research inquiry defined by specific goals, tasks, and methodologies for acquiring and validating new knowledge. Its primary aim is to master natural forces, comprehend the laws of social development, and effectively influence the course of historical and social events.

Epistemology (the theory of knowledge) investigates the regularities of the cognitive process, its methods and forms, and the criteria for verifying truth. The cognitive journey proceeds from direct observation to abstract reasoning, and from there, to practice. **Thinking** is understood as an indirect and generalized reflection of the essential properties, causal relationships, and interconnected patterns of reality within the human brain.

Knowledge represents the practice-verified result of cognition—an adequate reflection of reality within human consciousness. It is the ideal reproduction, expressed in linguistic form, of generalized concepts regarding the objective laws governing our world.

The primary functions of knowledge include:

- **generalization:** The systematization of scattered ideas regarding the regularities of nature, society, and human thought;
- **application:** The preservation of generalized ideas for practical use in professional and social activities [5, 26].

Development is impossible without knowledge, as all creation depends upon it. To progress, resources must be transformed into functional objects, a process necessitating intellectual input. In the most economically advanced nations, information and knowledge have become critical factors—often surpassing land, machinery, or labor in their impact on the standard of living.

The foundation and driving force of cognition is **practice**, which provides science with the empirical data required for theoretical comprehension.

Cognition emerges from practice and is ultimately directed toward the practical mastery of reality. Thus, practice serves as both the starting point and the natural conclusion of every cognitive process.

Finally, the ultimate aim of all scientific inquiry is to achieve **truth**—knowledge that accurately reflects reality. Only verified scientific knowledge empowers humanity to effectively transform the environment and forecast future development.

The distinction between scientific and everyday knowledge is a fundamental issue in the philosophy of science. While both systems organize information, they differ significantly in purpose and depth. Everyday knowledge serves the immediate requirements of daily life, whereas science seeks not only to identify *what* occurs but to explain *why* it occurs, moving beyond descriptive instructions to uncover the underlying regularities of reality.

As defined in classical methodology (following Kant), science is a body of knowledge structured around universal principles, regularities, and causal connections. By translating empirical observations into abstract frameworks, science achieves a level of objectivity independent of individual discovery. Knowledge within this system is categorized as:

- **relative knowledge:** A generally accurate reflection of reality, which may nonetheless contain incomplete correspondence between the conceptual model and the object;

- **absolute knowledge:** An exhaustive reproduction of an object's essence, representing finalized, immutable truth.

Scientific Research is the methodical study of phenomena, aimed at deriving verified, practically applicable solutions. Its primary **goal** is the comprehensive analysis of a specific object—its structure, internal characteristics, and external connections—resulting in a coherent system of concepts, laws, and theories [5].

A **scientific result** is defined as new knowledge derived from fundamental or applied research and formally recorded on established information carriers.

Any research project requires a precise distinction between its object and subject matter:

- **the Object:** A specific segment of reality or phenomenon targeted for investigation. The selection of the object is critical, as it determines the study's scope and efficiency. Key attributes to consider include the presence of unexplored qualities, the dynamic nature of the object, and its inherent divisibility, which allows for the fragmentation of complex problems into manageable sub-tasks;
- **the Subject Matter:** The specific aspects, causal links, or developmental regularities of the object that the research seeks to explain.

Stages of the Scientific Research Process:

- the emergence of an idea;
- formation of concepts and statements;
- making hypotheses;
- generalization of scientific facts;
- verification (proof of the correctness) of hypotheses and statements.

The integrity of this process depends on **methodology**—a systematic set of techniques and modes of inquiry. To ensure validity, research must be viewed as a continuous process, grounded in the dialectical connection between theory and practice, and executed through established cognitive methods such as systematic observation and experimentation.

1.2 Stages of the Formation and Development of Science

The development of science represents a significant intellectual transition from rudimentary empirical observation to a highly structured framework of theoretical and experimental inquiry. A comprehensive perspective on this historical progression—from the foundations of Ancient Greek natural philosophy to the complex paradigms of the modern era—is given in the following seminal books:

- "The Structure of Scientific Revolutions" by Thomas S. Kuhn [35]: A foundational analysis examining the nature of scientific progress and the periodic shifts in dominant intellectual paradigms;
- "The Invention of Science: A New History of the Scientific Revolution" by David Wootton [45]: An inquiry into the emergence of experimental methodology and its decisive impact on historical development;
- "A History of Western Science" by Anthony M. Alioto [29]: A comprehensive overview integrating the philosophical foundations of scientific thought with its historical evolution from antiquity to the present.

The history and evolution of scientific thought are documented extensively in various academic textbooks [13, 17, 21, 29, 31, etc.].

Scientific development evolved from early practical observations of nature into a sophisticated system of theoretical inquiry. This progression is traditionally divided into several key stages.

The Ancient World: Natural Philosophy. Early science, emerging in civilizations like Babylon, Egypt, India, and China, was purely empirical and practical, functioning as a set of guidelines for activity. In Ancient Greece, cognition reached a theoretical level. Scholars such as Euclid (geometry), Archimedes (mechanics), and Ptolemy (astronomy) utilized abstractions to describe objective regularities. Aristotle established a system that eventually differentiated into distinct disciplines like physics, biology, and ethics.

Medieval Scholasticism and the Renaissance. While medieval European scholasticism focused on dogmatics, it refined the art of theoretical debate. Simultaneously, Islamic scholars including Ibn Sina and al-Biruni made critical contributions. The Renaissance marked the transition to modern natural science, characterized by experimental research and the institutionalization of fundamental disciplines at universities.

The Scientific Revolutions (16th – 19th Centuries) The transition from natural philosophy to experimental science was driven by a revolutionary shift in methodology. N. Copernicus and G. Galileo established the heliocentric system, while R. Descartes, I. Newton, and G. Leibniz developed analytical geometry and calculus. The application of experimentation, pioneered by Galileo and F. Bacon, became the cornerstone of scientific power.

The Industrial Revolution further accelerated progress. The 19th century witnessed monumental breakthroughs:

- Energy: The law of conservation of energy (J.R. von Mayer, H. Helmholtz, J. Joule);
- Biology: Cell theory (T. Schwann, M. Schleiden) and the theory of evolution (C. Darwin);
- Chemistry: The periodic law (D. Mendeleev);
- Physics: Electromagnetism (J.C. Maxwell).

Modern Science (20th – 21st Centuries) The 20th century introduced quantum mechanics (M. Planck) and molecular biology. By the middle the 20th century, the Scientific and Technological Revolution had solidified science as the central engine driving societal development. That momentum has only accelerated in the 21st century, as digital transformation, artificial intelligence, and biotechnology have become woven into the very fabric of research. Global collaboration now powers rapid progress in areas ranging from renewable energy to synthetic biology. Today, science acts as the primary force for human advancement, increasingly relying on interdisciplinary approaches to tackle multifaceted challenges such as climate change and automation. In the process, it continues to fundamentally redefine how people interact with and shape the natural world.

This rapid evolution in capability is not merely a result of new tools, but stems from a fundamental transformation in how scientists approach discovery, a progression elegantly categorized by the framework of the «Four Paradigms of Science».

The concept of the "Four Paradigms of Science" describes the historical evolution of scientific inquiry from basic observation to modern, data-intensive analysis. a framework popularized by philosopher Thomas Kuhn and expanded by computer scientist Jim Gray (formalized in the seminal work *The Fourth Paradigm: Data-Intensive Scientific Discovery* (Hey, Tansley, & Tolle, 2009), [43]), this framework illustrates how humanity has advanced through four distinct methodological stages (see Fig.1.1).

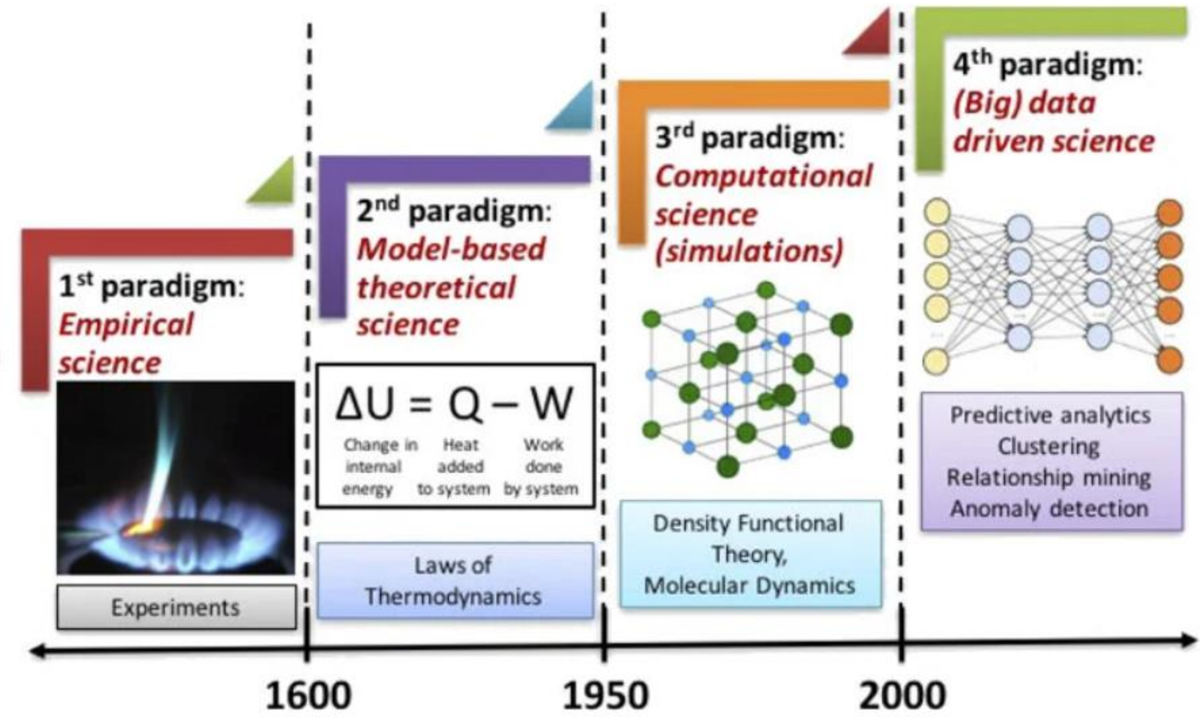

Figure 1.1 – Four paradigms of science [28]

1 ***Empirical (Empirical-Descriptive) Paradigm:*** This is the earliest form of scientific inquiry. Science is founded upon the direct observation of nature and the systematic description of phenomena. This approach has spanned thousands of years, famously championed by figures such as Galileo Galilei,

through his use of the telescope, and Isaac Newton, in his observations regarding gravity.

2 ***Theoretical Paradigm:*** This paradigm emphasizes the use of mathematical models, generalizations, and logical deduction to explain natural phenomena and predict new ones. It involves the formulation of scientific laws, hypotheses, and theories—such as Newton's laws of motion or Maxwell's equations—that provide explanatory frameworks for observed results. Dominant from the 17th century onward. A prime example is Albert Einstein utilizing mathematics to define his theory of general relativity.

3 ***Computational Paradigm:*** Emerging with the development of powerful computers, this stage enabled scientists to create simulations and models of complex phenomena that are otherwise impossible to replicate within a controlled laboratory setting. Emerged in the mid-20th century with pioneers like John von Neumann. It is heavily used in weather forecasting, fluid dynamics, and molecular modeling.

4 ***Data-Driven (eScience) Paradigm:*** Evolved in the 21st century. It is famously associated with computer scientist Jim Gray and powers modern breakthroughs in genomics, astronomy, and material science. This contemporary paradigm is predicated on the processing of massive datasets, or "Big Data." Researchers utilize artificial intelligence algorithms, machine learning, and advanced database systems to identify complex patterns and regularities within extensive information arrays.

The Fifth Paradigm of science is currently emerging as a conceptual evolution of Jim Gray's original framework, characterized by the pivotal role of Artificial Intelligence for Science (AI4R). While the Fourth Paradigm utilized AI primarily as a high-capacity tool for processing vast datasets, the Fifth Paradigm marks a shift where AI functions as an autonomous colleague and an active participant in the research process.

Key Characteristics of the Fifth Paradigm are:

- *Agentic Autonomy:* Intelligent AI agents possess the capability to independently formulate scientific hypotheses, design experimental protocols, analyze discrepancies, and iteratively refine research trajectories with minimal human intervention.

- *Integration of Prior Paradigms:* AI no longer relies solely on identifying correlations within Big Data; modern scientific AI synthesizes the laws of physics and mathematical models (Second Paradigm) with computational simulations (Third Paradigm) to generate original knowledge.

- *Neural Network Emulators:* where traditional supercomputer simulations of complex systems—such as climate or quantum models—may require weeks of processing, AI emulators trained on these simulations can produce highly accurate predictions in seconds, increasing computational efficiency by orders of magnitude.

- *Autonomous AI Laboratories:* the emergence of fully automated chemical and biological laboratories, where robotic systems managed by AI perform continuous, high-throughput experimentation, test execution, and result interpretation.

A definitive example of the Fifth Paradigm is Google DeepMind's AlphaFold. By successfully predicting the 3D structures of nearly all known proteins, it resolved a 50-year-old challenge in biology. AlphaFold achieved this not merely through data synthesis, but through a profound integration of molecular physics and geometry, accomplishing in a short period what would have required billions of years of conventional laboratory experimentation.

1.3 The Essence, Goals, and Functions of Science

Science is a domain of continuously evolving human activity, the primary characteristic and core function of which are the discovery, investigation, and theoretical systematization of objective laws governing objective reality for the purpose of their practical application.

Science is of profound importance to the development of human society, permeating both the material and spiritual spheres of human activity. The fundamental principles, objectives, and operational roles of science are comprehensively addressed within a substantial body of academic literature [1 – 5, 13, 14, 17 – 19, 22, 23, 26, 31].

The literature offers various interpretations of the concept of "science." Some define it as the sum of knowledge acquired by humanity, while others view it as a form of human activity aimed at expanding the comprehension of the laws of nature and societal development. However, the most comprehensive definition conceptualizes ***science*** as a sphere of human activity whose functions entail the development and theoretical systematization of objective knowledge regarding reality. The ***immediate objective of science*** is the description, explanation, and prediction of processes and phenomena of reality that constitute its subject of study, based on the discovery of scientific laws.

The concept of "science" encompasses both the activity directed toward acquiring new knowledge and the outcome of this activity—the accumulation of acquired knowledge that forms the foundation of the scientific understanding of the world. In addition, "science" is a language for defining separate branches of scientific knowledge.

Applying scientific knowledge to real-world challenges requires more than just possessing facts; it demands a clear understanding of the rules governing when, how, and for what purpose that knowledge is utilized. Science serves this function by transforming raw information into a systematized framework of objective truth. Thus, ***the primary goal of science*** is to describe, explain, and predict the processes and phenomena that make up our world, ensuring that these insights can be effectively applied to human progress [20, 22].

The subject matter of science comprises centers on the interconnected movements of the physical world and the ways these processes are understood through human consciousness. Diverse fields of study arise from the material objects of nature, each working to reflect and mirror the structure of these objects within a cohesive framework. Consequently, science is best defined as knowledge organized into a rigorous, interconnected system [7, 8, 18].

However, not all systematized knowledge equates to science. For instance, practical manuals on locksmithing, carpentry, or blacksmithing represent a certain system of knowledge, yet they cannot be classified as scientific, as they do not reveal new phenomena in production technology but rather contain specific, continuously repeated operational techniques.

"Knowledge" and "science" are different — and must be distinguished. Knowledge is both a product of science and its raw material. Knowledge is often known as mundane (everyday) or scientific knowledge. Scientific knowledge differs from everyday knowledge by its consistent, systematized character and its capacity to generate new concepts, laws, and theories. Whereas everyday knowledge is based on simple inductive generalizations and empirically established rules, scientific knowledge relies on methods of cognition and objective regularities.

Every science incorporates the following essential ***components:***

- theory, methodology, research techniques, and procedures;
- research outcomes implemented in practice;
- scientists with their knowledge and capabilities;
- research institutions.

Science has its roots in the practice of cognizing the objective world. At a historical level, it only existed for knowledge and understanding reality "as it is." The Industrial Revolution integrated science into the production of material, and 20th-century development established it as a management tool for societal progress. So, at its core, the essence of science can be defined as:

- *theory as a system of knowledge*, which becomes a form of social consciousness and a human intellectual achievement;

- *an important position in the implementation of recommendations* in actual production as the basis of societal development;

Under the state of modern reality, **science performs the following specific functions:**

- *cognitive function:* providing for the human necessity to understand the laws of nature, society, and thought;

- *cultural and educational function* in terms of advancing culture, humanizing education, and shaping human intellect;

- *practical-operational function:* to enrich production and the system of social relations.

The synthesis of these specific functions constitutes the overarching ***core function of science***—the development of a system of knowledge that facilitates the establishment of rational social relations and the utilization of productive forces in the interest of all members of society.

The aim of science is to understand the laws governing the development of nature and society, and how they can be used to impact nature on a good basis. Until the rules are known human beings can only describe phenomena, accumulate and organize facts but cannot explain or predict anything.

Objectives of Science [5, 26]***:***

- gathering of information and generalizing it (ascertainment);
- exposition of the external relationships of phenomena (interpretation);
- explanation of the nature of physical phenomena, their interrelation and contradictions (model building);
- predicting processes and phenomena;
- establishment of potential forms and directions for applying the learning.

Science is a specific activity and has some ***unique features***:

- systematized knowledge (scientific ideas, theories, concepts, laws, regularities, principles, hypotheses, notions, and facts);

- the presence of a scientific problem, and a defined object and subject of research;

- the practical relevance of not only the phenomena (processes) under study, but also the knowledge drawn about them.

1.4 Core Concepts of Science and Their Characteristics

The core concepts of science are given below.

Scientific Idea – an intuitive explanation of a phenomenon (process) without the use of intermediate argumentation nor, in the context of a broader network of connections, a complete understanding of the connectedness surrounding the conclusion (the inference). It builds off established knowledge but uncovers regularities that have not been noticed before. Science makes a distinction between two kinds of ideas, one constructive and one destructive—i.e., ideas that have or do not have significance for science and practice. A hypothesis provides the specific materialization of an idea.

The hypothesis – a scientific assumption posited to account for particular phenomena (processes) or the causal relationships resulting in a given effect. The theory is based on which your hypothesis serves as a beginning of an investigation for truth by which you deducible the search for truth which saves a lot of time and effort through the purposeful accumulation of facts and its categorization. Like ideas, hypotheses (like all ideas) are probabilistic in nature, they progress through three stages of construction:

- the building up of factual material, and then inferring from them;

- establishing an idea, the formulation of the hypothesis and an acceptable theory founded on that hypothesis;

- the empirical test of the results for which the hypothesis is tested by using the methods presented and the refinement of the hypothesis [12, 25].

If the consequence is validated as accurate and indeed as to be the case, the hypothesis becomes a scientific theory. A hypothesis is posited with the expectation that it will become knowledge, if it does not become knowledge at all then at least partly.

Law – an intrinsic and necessary relationship among phenomena that governs their regular, lawful course of development. A law obtained via conjecture must then be logically established; it is only then that it is recognized by science. Science uses judgment to establish a law.

Judgment – a thought in which something is affirmed or denied through the connection of concepts. A judgment is possible about an object (or phenomenon) either through direct observation of a fact or indirectly through inference.

Inference is based on a mental operation, and a subsequent judgment is derived from a certain number of given judgments.

Science is a body of theories. ***A theory*** consists of generalizing propositions that comprise a science, or a subgroup thereof. That is to say, it takes each of the scientific theories from the sources within these principles, and builds up an understanding of the whole and explains how to make it better. This sort of science operates as something of a new synthetic knowledge, in which what has a new meaning will lose its original distinctiveness and become elements of a coherent unitary system.

A new theory should meet the following ***requirements:***

- the scientific theory's adequacy relative to the described object;
- the capacity to substitute experimental research with theoretical investigations;
- completeness in describing a particular phenomenon of reality;

- the capacity to explain the interrelations between various components within the framework of the given theory;
- internal consistency of the theory and its alignment with empirical data.

A theory represents a system of scientific concepts, principles, propositions, and facts.

Scientific Concept – a system of views, theoretical propositions, and core ideas connected to the object of scientific investigation, unified by a specific central idea. Conceptuality is the determination of the content, essence, and meaning of the subject matter being addressed. Within a scientific theory, a principle means the most abstract definition an idea carries. A principle is a rule arising from objectively rationalized experience.

A concept is a thought reflected in a generalized form. It deals with the fundamental characteristics (essential and necessary properties) of objects and phenomena, their interrelations, and the relationship between them. Once a concept has entered scientific discourse, it is designated by a single word or a combination of words known as ***terms***. It deals with the fundamental characteristics (essential and necessary properties) of objects and phenomena, their interrelations, and the relationship between them. Once a concept has entered scientific discourse, it is designated by a single word or a combination of words known as terms.

Disclosing the content of a concept is termed its definition. The latter must fulfill two main prerequisites: indicate the proximate generic concept; indicate the specific characteristics that distinguish this concept from others.

A concept generally represents the culmination of scientific research, a synthesis of empirical or theoretical results obtained by the researcher. Core concepts constitute the framework upon which conceptual science develops.

Scientific Fact — an event or phenomenon which forms the basis for a conclusion or verification. It is thus an elemental component that, together with other components, forms the bedrock of scientific knowledge, reflecting the objective properties of phenomena and processes. Based on scientific facts, the regularities of phenomena, theories, and laws are identified and constructed.

Methodology enables the progression of thought from ignorance to knowledge. ***Methodology of Scientific Cognition*** is the study of the principles, forms, and modes of scientific research activity. ***Research Method*** is a systematic way of applying established knowledge to acquire new knowledge, serving as the primary instrument for obtaining scientific facts [1 – 7, 19].

Scientific Activity is an intellectual creative activity aimed at the acquisition and application of new knowledge. It has various forms: scientific research activity; scientific organizational activity; scientific informational activity; scientific pedagogical (educational) activity; scientific auxiliary (support) activity, among others. Each of these types of scientific activity have its own specific functions, tasks, and operational outcomes.

In the domain of scientific research activity scientific investigations are carried out. ***Scientific Research*** – purposeful process of cognition, the outcome of which is presented as a structured system of concepts, laws, and theories.

Two broad kinds of scientific inquiry are distinguished, fundamental and applied. ***Fundamental Scientific Research*** is scientific theoretical and/or experimental activity undertaken to ascertain objective regularities of the development and interrelations of nature, society, and humanity. In ***Applied Scientific Research*** it involves scientific and technological activities aimed at the acquisition of knowledge and the application of knowledge to certain practical purposes. Scientific research is systematically conducted with the ultimate objective of generating a distinct scientific result.

Scientific Result – new knowledge acquired in the process of fundamental or applied scientific research and recorded on scientific information carriers in the form of a scientific report, scientific work, scientific paper, scientific communication regarding research and development work, monographic study, scientific discovery, etc. ***Scientific-Applied Result*** – a new design or technological solution, an experimental prototype, or a completed test that has been implemented or can be implemented into social practice. A scientific-applied result may be a report, draft design, engineering or technological documentation for scientific and technical products, full-scale prototype, etc. [26].

The main results of scientific research include:

- scientific abstracts; scientific papers (reports/communications) at conferences, meetings, seminars, and symposia;
- term papers, bachelor's, and master's theses;
- reports on scientific research (experimental design, experimental technological) work;
- scientific translations;
- dissertations (Candidate or Doctoral); author's abstracts of dissertations;
- deposited manuscripts; monographs; scientific articles;
- analytical reviews; inventor's certificates, patents;
- algorithms and software programs;
- reports on scientific conferences;
- preprints; textbooks, study guides (manuals);
- bibliographic indexes, etc.

The subjects of scientific activity comprise: scientists, scientific workers, scientific-pedagogical workers, as well as scientific institutions, scientific organizations, institutions of higher education (HEIs), and public associations operating within the sphere of scientific and scientific-technical activity.

A significant cohort of professionals is engaged in scientific research activity. Individuals who pursue this path on a permanent basis are systematically categorized as researchers, scientists (scientific workers), and scholars.

Researcher – an individual who executes systematic scientific investigations. **Scientist** – an individual involved in the scientific domain who actively generates new knowledge and holds specialized expertise in a specific field of science. **Scholar (Scientist)** – a natural person who conducts fundamental and/or applied scientific research aimed at acquiring verifiable scientific and technological results. **Scientific Worker** – a scholar whose primary professional mandate under an employment contract is dedicated to scientific, scientific-technical, or scientific-pedagogical activity, and whose qualifications are validated through established institutional attestation or professional certification frameworks [26].

In the contemporary research ecosystem, members of the scientific community hold specialized credentials and operate either independently or by integrating into permanent or temporary research collectives, cross-border virtual networks, and recognized scientific schools.

1.5 Classification of Sciences and Their Structural Characteristics

The diverse manifestations of matter and information dictate the structural layout of modern scientific knowledge. In contemporary global practice (aligned with OECD and UNESCO taxonomic frameworks), sciences are no longer viewed as isolated branches but are classified into comprehensive, interconnected domains. The core pillars include *Natural Sciences, Engineering and Technology, Medical and Health Sciences, Agricultural Sciences, Social Sciences, and Humanities*. Standing alongside these empirical domains are the Formal Sciences (mathematics, logic, and computational data sciences), which provide the structural and analytical tools for all other fields.

To map the internal architecture of modern science, researchers employ methodological, epistemological, and logical frameworks.

The Methodological Approach: This approach is based on the interaction, interdependence, and cross-disciplinary synthesis of scientific principles. Methodological classification is determined by both external and internal systemic linkages. *External linkages* operate on the principle of coordination (the horizontal integration, alignment, and network-centric interaction between different fields, such as bioinformatics or neuroeconomics). *Internal linkages* rest on the principle of subordination (hierarchical dependence, where foundational disciplines support specialized applied branches).

The Epistemological Approach: This framework distinguishes between objective and subjective principles of classification. Objective mapping derives scientific connections directly from the properties of the observed objects or systems themselves. Subjective mapping relies on the investigator's capacity for abstract modeling, conceptualization, and structural interpretation of data.

The Logical Approach: From a logical perspective, taxonomy map out the universal cognitive path from the general to the specific, balancing abstract principles with concrete empirical data. It tracks how broad, overarching scientific frameworks scale down into highly specialized, domain-specific models.

In the contemporary research ecosystem, the classification of science is fundamentally defined by its orientation toward public and industrial practice, dividing the spectrum into basic (fundamental) and applied research (Table 1.1).

Table 1.1 – The Research Spectrum: Fundamental vs. Applied

Dimension	Fundamental Research (Basic Science)	Applied Research and Development
Primary Objective	Discovery of foundational principles, objective laws of nature, society, and formal systems	Resolution of specific practical challenges, optimization of technologies, and actionable problem-solving
Driving Force	Curiosity-driven inquiry; expanding the boundaries of human knowledge	Mission-oriented innovation; addressing immediate societal, economic, or industrial demands
Core Output	New concepts, theoretical frameworks, paradigm shifts, and systemic models	Patents, technological workflows, experimental prototypes, and actionable algorithms
Metric of Success	Epistemic truth, peer validation, and long-term impact on the global scientific commons	Direct implementation capability, socio-economic utility, and practical scalability

The Modern Convergence: In the current scientific paradigm, the historical boundaries between "pure" and "applied" sciences have largely dissolved. Modern R&D increasingly operates within Stokes' Quadrant ("use-inspired basic research"), where fundamental theoretical discoveries (such as quantum dynamics or genomic sequences) are pursued with immediate, revolutionary applied utility in mind.

Integration of National and International Classification Frameworks in Ukraine

As an EU candidate country, Ukraine aligns its research evaluation and statistical monitoring with international standards by utilizing the OECD Fields of Science and Technology (FOS) classification. However, this international taxonomy serves a purely analytical and statistical function; it is not directly used for the formal defense of academic dissertations or the conferral of degrees. The FOS framework divides global scientific knowledge into six macro-groups:

1 Natural Sciences;

2 Engineering and Technology;

3 Medical and Health Sciences;

4 Agricultural Sciences;

5 Social Sciences *(includes disciplines such as Economics, Law, and Psychology within this domain)*;

6 Humanities and the Arts.

To bridge this international macro-classification with the practical management of the national educational and scientific ecosystem, Ukraine employs a specialized regulatory registry. Grounded in the aforementioned six foundational groups, the structure of academic training and professional qualification is legally governed by *Resolution of the Cabinet of Ministers of Ukraine No. 266, dated April 29, 2015, "On Approval of the List of Fields of Study and Specialties for the Training of Applicants for Higher and Vocational Pre-Higher Education"* (with subsequent amendments) [3] (from the list of laws).

This statutory resolution establishes the official national matrix of fields of study and specific specialties. It serves as the primary legal and structural framework for designing higher education curricula and degree programs, regulating institutional licensing and academic accreditation, and mapping specialized academic councils authorized to evaluate and approve the defense of doctoral dissertations.

LECTURE 2. The Development of a Scientist as an Individual and the Regime of Scientific Labor

Outline

2.1 Core Attributes of a Scientific Researcher.

2.2 Distinctive Characteristics of Intellectual Labor.

2.3 The Organization of Creative Activity.

2.4 The Cultivation of Creative Capabilities.

2.5 The Structure of a Researcher's Working Day.

2.1 Core Attributes of a Scientific Researcher

Science constitutes a distinct domain of human activity, demanding specific qualities from those who engage in it.

Purposefulness is paramount. A researcher must be steadfastly oriented toward overcoming the various difficulties that inevitably arise. One must maintain confidence in one's own capacities and the validity of the chosen path of inquiry. This single-minded focus enables a clear visualization of the project's long-term prospects and allows for the structured planning of its individual phases.

Industriousness is an indispensable prerequisite for scientific success. It requires continuous, intensive labor, characterized by an endless search and persistent attempts to resolve a given scientific problem.

Perseverance and continuity of inquiry are essential because scientific work predominantly consists of setbacks, with only a minor fraction of creative activity being associated with a state of "inspiration." The biographies of eminent scientists bear witness to this reality. For instance, when Newton was asked how he discovered the law of gravitation, he replied: "By thinking on it continually." Similarly, Edison noted that his inventions were comprised of 98 % perspiration and 2 % inspiration. Academician V.A. Ambartsumian posited that if a young scientist limits themselves to a mere 7-hour workday and fails to work more than 10 hours a day, they doom themselves to failure in their chosen field of knowledge. This occurs because they fail to allocate sufficient time to read the necessary scholarly literature, attend lectures, and listen to reports, thereby consistently falling behind the requirements of their expected academic standard.

Consequently, intensive labor serves as the foundational condition for the success of a novice researcher. It is imperative to remember that scientific labor defies rigid temporal regulation. It frequently occurs that the necessary insight into a problem or the breakthrough resolution of a question materializes entirely outside of formal working hours.

An indispensable attribute of a researcher is ***absolute integrity in their work***. A subjective approach to empirical results, or the inclination to "fit" data to accommodate conclusions that do not logically derive from the conducted investigation, is strictly impermissible.

A scientific researcher must embody ***modesty and self-criticism***, without notions of infallibility, and respect the perspectives of peers. A pivotal trait of a scholar is an acute sense of novelty and the active endorsement of progressive advancements—the capacity to keep pace with the era and remain attuned to its overarching trajectory.

Throughout all stages of an investigation, a scientist must strive to elucidate facts, objects, and phenomena, seeking to uncover novel insights within the discipline. Consequently, scientific creativity is inherently characterized by continuous, painstaking intellectual labor. In this context, it is fitting to invoke a Chinese proverb: "There are three paths to wisdom: the path of personal experience, which is the most bitter; the path of imitation, which is the easiest; and the path of reflection, which is the noblest."

Substantial results are achieved by those who have *trained themselves to engage in continuous reflection* and to concentrate their attention unswervingly on the subject of inquiry.

It is critically important to develop the capacity to independently navigate complex theoretical and practical issues, engage rigorously with scholarly literature, and discern the foundational, decisive element under given conditions. The ability to isolate core scientific problems enables a researcher to accurately formulate strategy and substantiate long-term, prospective development plans.

A researcher must be a comprehensively developed specialist, thoroughly versed in both domestic and global advancements within their respective field. Furthermore, the capacity for teamwork is indispensable; currently, the resolution of monumental scientific challenges necessitates the consolidation of efforts across a vast community of scholars.

Tremendous significance is placed upon the *researcher's awareness of practical, real-world operational challenges,* alongside the exchange of experience with industry practitioners. Such creative deliberation on pressing issues frequently serves to catalyze novel ideas and advance contemporary scientific thought.

Erudition (Extensive Knowledge). Through persistent dedication to the subject of inquiry and scholarly literature, a researcher acquires comprehensive, multifaceted knowledge. Such knowledge is indispensable for understanding the extant contributions of prior investigators. Concurrently, no direct correlation exists between an individual's repository of knowledge and the development of their creative capacities. It is entirely possible to possess immense erudition within a specific discipline while remaining creatively sterile. Consequently, although extensive knowledge serves as a critical prerequisite for creative output, it does not constitute an indicator of creativity itself [12, 19, 23].

Traditionally, it is posited that a scientist must possess an exceptional memory. This assumption holds true primarily during the initial phases of scholarly activity, when the accumulation of information occurs. In subsequent stages, an overreliance on memory may even manifest as an impediment, obstructing the generation of novel scientific ideas by fostering deep-seated skepticism toward unorthodox concepts.

According to findings by French sociologists of science, the possession of creative capabilities and industriousness enhances research productivity to a significantly greater degree than a combination of these traits with mere erudition. Remarkably, the vast majority of scientific breakthroughs are attributable to researchers of this specific profile, despite their accounting for a mere 3% of the total academic cohort.

The aforementioned conclusions, however, should not engender unearned optimism in a novice researcher who neglects comprehensive reading within their specialization. A cursory review of the literature devoid of critical analysis, and lacking the systematic documentation of original insights generated during the examination of articles or specific problems, yields negligible scholarly utility.

Personal Initiative. Personal initiative, a sense of "inner creative passion," and sustained proactivity in formulating and evaluating specific research inquiries are of paramount importance in achieving meaningful scientific outcomes. As a rule, personal initiative is catalyzed by an acute awareness of novelty. If an emerging researcher remains confined within the parameters of paradigms initially suggested by their academic supervisor or extracted verbatim from the existing literature—and fails to discern novel dimensions of the problem—there is little basis to anticipate original contributions from them. Consequently, nurturing personal initiative in a young scholar represents a critical imperative in their professional development as a scientist.

Critical Evaluation of Scientific Achievements. The rigorous, critical analysis of scientific milestones established by both predecessors and contemporaries is an essential attribute of a researcher. This analytical stance derives not from idiosyncratic traits or a sense of intellectual superiority over peers, but rather from a dialectical comprehension of historically accumulated knowledge regarding nature and society. Furthermore, the continuous evolution of science and technology yields novel capabilities to design experiments and extract empirical data with greater depth and innovative methodology, utilizing advanced technological foundations.

Imagination (Mental Representation). Imagination constitutes the cognitive transformation of sensory impressions and the formulation of mental imagery based upon them, the realization of which leads to the creation of novel material and spiritual values. A specific manifestation of imagination is fantasy and science-fictional imagery, representing a "leap" of intellect from current reality into the prospective future [23].

Intuition. A pivotal role in scientific creativity is ascribed to ***intuition.*** It originates precisely where the logical pathway of scientific analysis terminates, manifesting as an intuitive sense of perspective and novelty in problem-solving. Intuition presupposes a substantial repository of knowledge and experience; as a rule, it is grounded upon a vast corpus of information accumulated relative to a specific research problem.

Mastery of the correct methodology of scientific cognition is of paramount importance. Every investigated phenomenon must be examined dynamically within the context of its historical and evolutionary development.

The subjects of scientific activity comprise scientists, researchers, and academic faculty (scientific-pedagogical workers), alongside scientific institutions, research organizations, higher education institutions of the III and IV levels of accreditation, and public organizations operating within the domain of scientific and technological activity.

Consequently, scientific research engages a vast cohort of individuals. Certain salient attributes of researchers are outlined in Table 2.1, as compiled by V.M. Sheiko and N.M. Kushnarenko in their textbook, Organization and Methodology of Scientific Research Activity. Broadly, the multifaceted personal characteristics of scientists can be synthesized into three primary dimensions: creative capabilities, erudition, and professional attributes (specifically, industriousness).

Table 2.1 – Core Attributes Corresponding to the Status of a Scientific Researcher [23]

Creative and Professional Attributes	Core Characteristics
1	2
1 Professional Knowledge	Possession of knowledge that satisfies the requirements of the chosen domain of activity. Mandatory components include a high level of foundational education, computer literacy, and proficiency in both the native and foreign languages
2 Inquisitiveness	A profound intrinsic drive toward discovering truth, attentiveness to the unknown and inexplicable, and a keen interest in acquiring new knowledge—particularly regarding scholarly literature as a primary source
3 Observational Acumen	The capacity for the purposeful perception of the objective properties of investigated phenomena, processes, and objects
4 Initiative	The capacity for autonomous decision-making and an intrinsic motivation toward novel modalities of activity

Continuation of table 2.1

1	2
5 Responsive-ness to Innovation	Inventiveness, active endorsement of innovation, a creative approach to institutional activity, and an intolerance for dogmatism
6 Commitment to the Field	The presence of motivational drives and ideas that stimulate research; viewing scholarly labor as a significant and intrinsically rewarding pursuit
7 Punctuality and Diligence	The timely and high-quality execution of research work plans, assignments, and administrative duties
8 Responsibility and Reliability	The capacity to assume accountability for a specific scope of work, project, or domain, as well as for one's own or others' conduct, actions, and statements
9 Interpersonal Skills	The ability to establish rapport and stable professional connections with individuals varying in age, temperament, and institutional rank
10 Benevolence	Humanity, respect for peers, and the capacity to celebrate and share in the collaborative achievements of the research group
11 Ambition	The aspiration to achieve professional recognition, renown, and career advancement within the institutional hierarchy
12 Professional Appearance	A harmonious synthesis of personal presentation and an elegant, professional style of attire

There is a relatively low probability that an individual inherently possesses all of these attributes in their entirety; rather, they must be systematically cultivated. Continuous self-improvement is essential for developing cognitive capacities, memory, focus, and observational acumen, as well as for the formation of core professional skills.

In addition to the previously delineated characteristics of a researcher, ***general cultural literacy*** represents a vital asset. As is widely recognized, any scientific investigation culminates in the composition of a research report or a scholarly article. Consequently, a scholar must possess the ability to articulate empirical findings accurately and proficiently, adhering to formal scientific terminology and standard literary language.

An indispensable trait of a researcher is the capacity to express ideas with clarity and precision, addressing the core substance of an issue without resorting to superfluous detail, and guiding the audience through the critical phases of the study in a logical, sequential manner to yield well-substantiated conclusions. Achieving this standard requires the meticulous preparation of academic communications and consistent practice in public speaking before professional audiences.

2.2 Distinctive Characteristics of Intellectual Labor

The notion that scientific labor is effortless is relatively widespread; however, this is a profound misconception. Scientific research demands a substantial expenditure of energy; it is inherently exhausting and can precipitate severe overfatigue. Consequently, the primary objective of the "hygiene of intellectual labor" is to sustain high productivity, which is achieved through the periodic alternation of activities.

Intellectual and physical labor represent two interconnected dimensions of human activity. Mental activity constitutes the most complex and rigorous modality of labor. It demands the heightened activation of attention, cognitive processes, and other psychological functions, and is accompanied by pronounced neuropsychological and emotional tension, as well as elevated sensitivity.

Mental activity manifests through a distinct neurophysiological state: it induces an increased blood supply to the brain, elevates cerebral bioelectric activity, and accelerates the energy metabolism of neurons. Furthermore, it amplifies the neuropsychological strain associated with the perception and processing of information during scientific inquiry, imposing a heavy emotional load.

This neuropsychological burden stimulates cardiovascular and respiratory activity, thereby accelerating energy expenditure. For this reason, the labor of educators and scientists is physiologically comparable to physical labor. Notably, intellectual exertion induces cognitive fatigue within 3 to 4 hours, whereas physical labor typically leads to exhaustion after 8 hours.

A defining characteristic of intellectual labor is that fatigue accumulates gradually, whereas acute overfatigue manifests abruptly. Consequently, the systematic alternation of cognitive and physical exertion is highly recommended.

An effective means of restoring cognitive capacity is leisure activity connected to hobbies such as sports, literature, music, fine arts, chess, angling, and nature walks. As Goethe posited: "Every individual should acquire a beneficial habit, through which they might find entertainment in days of joy and solace in days of mourning."

However, as with any general rule, notable exceptions exist. An exemplar of sustained high productivity without the alternation of activities is the life of the astronomer William Herschel, who worked uninterruptedly over many years and lived to the age of 87. Conversely, Charles Darwin is known to have worked for only two to three hours daily over a span of many years, yet did so with profound fruitfulness and intensity.

For instance, during the research process a state of depression or discouragement may occur. This condition is extreme and severe, that is, where the work itself ceases to have any sense for the researcher. He or she may see the inquiry as a lost cause, losing all confidence in its success. Long-term depression, if left unchecked, can lead to a complete stagnation of scientific work and the collapse of long-term career ambitions and work aspirations. Normally, the reason for this depression usually includes physical as well as mental fatigue, especially if the research fails to achieve the expected results or intellectual fulfillment for long periods of time.

Addressing the need for interventions to prevent this state of depression requires specific activities. A traditional break or temporary mental detachment from the project works only when the depression flows from exhaustion. In contrast, if the problem derives from insufficient progress or systemic roadblocks in the research, an effective strategy is to thoroughly limit the investigation and focus on an isolated, very narrow question that can be effectively solved. This part is critically important to gain the approval of an academic supervisor, colleagues, or any outside expert.

Work capacity is a central aspect of success in education. The human organism is a complex and highly nuanced system, and shaping one's own productivity and creative vitality is an important goal for every scholar; that is, it is the need to practice disciplined processes of systematic work. Empirical evidence suggests that habits of daily and repeated actions develop over time in the form of habitualized behavior. Therefore, it is necessary to remain in a routine every day. An independent work plan is essential even under conditions of being pressed, and you have to carve out an independent time to study with the scientific method to develop a discipline to get the best from the "left over" time intervals [23]. Also, it is important to be able to organize the work area correctly. This involves the efficient collection of instruments, research material, and reference literature at the most optimal level; it also involves organizing instruments, research materials, and reference articles strictly organized and classified into theme and section.

2.3 The Organization of Creative Activity

Such is evident from the biographies of outstanding scientists which invariably show that they were men of extreme industriousness, whose academic accomplishments stem from profound labor, unprecedented patience, assiduity and tireless devotion. Scientific creativity's efficacy and the potential of a researcher's latent potential are contingent upon the rational arrangement of labor.

Higher organizational levels help scholars produce much more within shorter timeframes. And on the other hand poor research activity organization prolongs the time of the investigation, deteriorates the performance and efficiency of the research process. Although there are many different paths for the scientific structuring of labor, these are in general chosen from different methods, focusing on the individual cognitive/operational characteristics of the researcher.

However, there are some ***general principles*** that constrain the scientific work:

- *Creative Approach:* The application of innovative methodologies to problem-solving;
- *Structured Thinking:* Continuous cognitive engagement and rigorous reflection;
- *Systematic Planning:* The plan-driven orientation and deliberate sequencing of research phases;
- *Dynamism:* Adaptability and responsiveness to evolving data or research contexts;
- *Collectivism:* Collaborative engagement and integration within the broader scientific community;
- *Self-Organization:* Internal discipline and autonomous management of workflows;
- *Resource Efficiency:* The optimal and economical expenditure of time, energy, and materials;
- *Criticality and Self-Criticism:* The objective evaluation of both external data and one's own hypotheses;

- *Continuous Self-Improvement:* Ongoing intellectual, professional, and personal development;

- *Professionalism (Businesslike Disposition):* A methodical, serious approach to administrative and research tasks;

- *Vigor:* Sustained energy and high vital capacity dedicated to inquiry;

- *Pragmatism:* Practicality and a focus on the real-world viability of scientific outcomes [22, 23].

A portion of these principles is dictated by the constraints and opportunities of the external environment, whereas others pertain directly to the intrinsic psychological attributes and personality of the individual researcher.

Creative approach implies that at all stages of investigation, a researcher must endeavor to elucidate facts, objects, and phenomena, striving to introduce novel insights into the scientific domain. Consequently, scientific creativity is inherently characterized by continuous, painstaking intellectual labor. In this regard, it is fitting to invoke an ancient Chinese proverb, which posits: "There are three paths to wisdom: the path of personal experience, which is the most bitter; the path of imitation, which is the easiest; and the path of reflection, which is the noblest."

Scientific labors require both conscious and deliberate reflection as a core component of the process. While the way people carry out this process differs greatly from one another, great results are obtained by those who have conditioned themselves to keep thinking for a long time and be undividedly intently engaged by the question of investigation.

It is a necessity for every scholar to develop such good habits of mind. For one of the tenets of scientific labor, one of the paramount importance is the intellectual engagement of the mind over the long run with the essence and specificity of the object of research and the subject of the study.

The investigator has to continually consider the domain of their investigation. But while developing creative tendencies and competences, a researcher must show perseverance often with fortitude, equanimity, and patience, along with creative engagement. Under these conditions, one can succeed in overcoming multiple obstacles and pitfalls that are an unavoidable part of the way to truth. That reality is borne out by a good many historical precedents, not least of which is Galileo's defiant protest to the Inquisition court: "And yet it moves!"

Creativity in this context represents a form of ***scientific production*** that inherently necessitates structured planning. Systematic planning is indispensable; given the complexity, labor-intensiveness, prolonged duration, and high cost of contemporary scientific research, rigorous planning discipline serves to mitigate unjustified expenditures of time and resources, ensuring that scientific objectives are realized within designated timeframes.

In scientific creativity, planning is operationalized through various long-term and working plans, research programs, schedules, timelines, and individual investigator agendas. These structured frameworks serve as benchmarks against which research progress is evaluated, ideally on a daily basis.

Research planning is an iterative process; as initial outlines evolve, continuous monitoring and strategic adjustment of both macro and operational goals are essential. Although individual in nature, academic research is embedded within a collective environment where departmental advice and peer discussion refine the inquiry. An effective research team, balancing diverse expertise and clear mentorship, enhances productivity. Ultimately, the quality and defense-readiness of a thesis remain a shared responsibility between the candidate and their academic collective.

Great importance, if not the primary role, belongs to the principle of self-organization of the researcher's labor, since scientific creativity can only be regulated within broad limits. Consequently, each researcher independently determines the complex of measures to ensure their own success.

The elements of self-organization include:

- organization of the workspace, ensuring optimal conditions for highly productive labor;
- adherence to labor discipline;
- consistency in the accumulation of knowledge throughout one's creative life;
- systematic adherence to a single methodology and technology when performing specific tasks.

Achieving ***a systematic approach to work*** can be accomplished by following ***certain rules:***

- constantly think about the subject of research;
- do not work without a plan;
- when executing a major piece of work, one should free oneself from secondary matters;
- before undertaking work, weigh and allocate your energy and time;
- prepare everything necessary for the work in advance so as not to be distracted;
- do not do two things at the same time;
- perform creative work before mechanical work, and complex tasks before simple ones;
- bring initiated work to completion and do not scatter your efforts;
- continuously monitor your work, make timely adjustments, and limit the depth of detailed elaboration;
- strive to see the ultimate goal.

Thus***, self-limitation***, discipline, self-management, self-tracking, self-control, and other "self-" oriented attributes play a major role in self-actualization. This includes autonomy—the capacity to independently identify the root causes of obstacles and eliminate them. Furthermore, it entails strict adherence to a work regimen and schedule, discipline of thought, and the ability to maintain deep focus without disrupting the logical progression of an idea.

The principle of economy, or self-limitation, is of equal significance and should guide every researcher throughout all stages of scientific inquiry. This principle manifests itself, first, in the necessity of bounding a study both in terms of its thematic breadth and the depth of its elaboration. Second, by establishing specific timeframes for the investigation, the researcher inherently imposes structural limits. Self-limitation is particularly critical during the data collection phase, where one must selectively gather only the material directly relevant to resolving the specific research problem.

This principle also presupposes the development and cultivation of ***self-criticism and humility***, alongside the ability to tactfully defend one's convictions. This necessity arises because the very nature of science as a domain dedicated to knowledge production dictates that its driving engine is conflict—the juxtaposition of competing scientific schools and worldviews, contradictions between theory and practice, the evolution of criticism and self-criticism, and an intolerance for dogmatism or blind faith in authority. Consequently, every researcher, particularly the novice, must foster a critical posture toward both their own findings and the reception of external ideas and viewpoints.

Original creativity carries profound weight. It is prudent, first and foremost, to attempt to discover independent pathways for problem-solving and an individualized trajectory of scientific inquiry; literature reviews are useful primarily to the extent that they prevent the replication of past errors. Crucially, scholarly progression demands not merely demonstrating the invalidity of a peer's scientific proposition, but actively presenting an alternative theory or methodology that is more valid, robust, and well-substantiated.

Ultimately, the rational organization of scientific labor entails maximizing the full spectrum of the researcher's individual characteristics, leveraging both their ethical principles and volitional character traits.

2.4 The Cultivation of Creative Capabilities

In the public consciousness, the figure of the scientist is frequently associated with rigid logic, strict schedules, and highly codified formulas. However, genuine scientific progress is seldom conceived within sterile intellectual incubators. Every fundamental paradigm shift—ranging from Newtonian mechanics to quantum entanglement—constitutes, first and foremost, an act of radical creativity. Devoid of creative capacity, a researcher risks becoming a high-quality yet passive repository of data: cognizant of *how* a law operates, but fundamentally unprompted to question *why* it must do so. Fostering creative capabilities in future investigators does not imply introducing arts education during intervals between mathematics instruction; rather, it entails shaping a distinct cognitive framework [33, 34, 36, 40].

The following sections delineate specific steps for the cultivation of creative capabilities.

1 The Desacralization of Error and the Legitimation of Cognitive Chaos

The primary and most critical stage involves dismantling the cult of the "singular correct answer." Traditional educational paradigms frequently penalize errors, thereby producing compliant executants who harbor a pathological fear of failure. Conversely, an aspiring scientist must internalize from an early stage that a negative result constitutes a valid scientific outcome, and occasionally, a profound discovery.

Scientific creativity originates precisely where a hypothesis collides with empirical reality. Should a child or student propose an unconventional, or even seemingly absurd, idea, the mentor's obligation is not to dismiss it based on its nonconformity with textbook doctrine, but rather to construct an experimental framework: *"Let us investigate precisely where and why this premise fails."* A creative scientist emerges exclusively from an environment where questioning axioms is permitted.

2 Interdisciplinary Cross-Training for the Mind

Hyperspecialization constitutes a significant impediment to creativity. The most prominent contemporary scientific breakthroughs manifest at the intersections of distinct fields, such as bioengineering, neuroeconomics, and the digital humanities. To stimulate creative cognition, an aspiring researcher requires an expansive cultural and aesthetic background.

Music enhances mathematical intuition and the perception of harmony; classical literature instructs the mind to discern latent causal relationships; and philosophy structures macro-level intellectual thought. A rich, diverse environment fosters the critical mass of neural connections that subsequently catalyzes unexpected scientific insights.

3 Cultivating Intellectual Audacity and Eliciting Pertinent Inquiries

Creativity originates not in the acquisition of prefabricated solutions, but in the capacity to articulate non-trivial, probing questions. The mentorship of a future scientist must be grounded in dialectical dialogue rather than the rote memorization of dogmas.

Instead of providing finalized analytical instruments (such as standard analytical matrices or predefined algorithms), mentors should encourage thought experiments: *"What occurs if we eliminate this foundational variable?"* or *"How does this phenomenon present from the perspective of an entirely disparate system?"* Creativity demands a measure of intellectual audacity—the capacity to challenge established authorities, executed with rigorous adherence to methodology.

4 Allocating Space for Boredom and Unstructured Time

In the contemporary era, where the schedule of a prospective researcher is frequently managed to the minute with extracurricular activities and tutoring, the spatial capacity for epiphany is diminished. A creative brain vitally requires periods dedicated to "mind-wandering"—the activation of the brain's default mode network. It is during these periods of cognitive offloading that the subconscious structures accumulated empirical data and autonomously synthesizes them into novel concepts.

5 Immersion in a collaborative, intellectually stimulating environment

Furthermore, immersion in a collaborative, intellectually stimulating environment is paramount to sustaining creative momentum. A developing researcher must not operate in isolation or, metaphorically speaking, "stew in their own juice." Active integration into the university department facilitates vital scholarly discourse with senior colleagues and established scientists, bridging theoretical gaps through mentorship. Moreover, participating in scientific conferences and peer seminars exposes emerging ideas to rigorous external critique. This continuous engagement with a dynamic professional community fosters the cognitive friction necessary for innovation, ensuring that individual creativity is cross-pollinated, refined, and elevated beyond the constraints of solitary thought.

To sum it all up, cultivating a creative scientist necessitates identifying a delicate equilibrium between rigorous methodological discipline and absolute freedom of imagination. While analytical tools can be mastered within a few years, the courage to engage in divergent thinking is established at the genesis of the intellectual journey. Science, in its truest sense, remains the art of observing what everyone else observes, yet conceptualizing it in a manner that no one else has yet conceived.

2.5 The Structure of a Researcher's Working Day

A researcher’s workday is difficult to predict or forecast. Among the primary rules governing it are:

- a gradual entry into work;
- rhythmic labor;
- work planning [26].

While elements of impulsivity and improvisation are characteristic of scientific activity, long-term success is ultimately ensured by systematic, pre-planned labor. Planning can be structured on a daily, weekly, monthly, quarterly, or annual basis. When planning a daily schedule, the following approach should be considered: before commencing operations, it is necessary to contemplate the upcoming day, isolating the most important and urgent tasks. To properly align collaborative efforts, this planning should be conducted jointly with one's academic supervisor.

An indispensable attribute of every researcher is a ***working notebook*** or diary, in which tasks are organized by date. Alternatively, one can utilize a notepad or a digital calendar—such as a personal computer organizer—which functions as a personal information system designed for the efficient management of working time and scientific labor. In addition to the calendar, such systems typically feature a telephone directory, an address book, and a notepad. Operating one component of an electronic organizer, such as the weekly planner, allows the user to simultaneously view other sections, such as the monthly overview or contact list.

When scheduling workflows, a researcher should be mindful of natural circadian productivity cycles:

- 10:00 AM – 12:00 PM: The most favorable window for executing creative or highly complex tasks;
- 12:00 PM – 2:00 PM: A period characterized by a temporary decline in cognitive activity;
- 2:00 PM – 5:00 PM: The afternoon peak, during which working capacity reaches its secondary high before steadily decreasing.

Additionally, it is critical to mitigate eye strain. When reviewing large volumes of literature or working extensively on a computer, visual fatigue accumulates rapidly. In these situations, it is best to switch tasks or take a brief recess: walk down the hallway, have a coffee, or step away for a brief conversation. Ideally, one should alternate 45 minutes of active work with a 15-minute break, while ensuring that total daily computer usage does not exceed 4 hours.

It is useful to know that a system of working for several hours in a row followed by an equivalent period of rest is a harmful habit. There must be a certain rhythm in the alternation of work and rest. One should take into account the biological rhythms of life activity. Even a regular workweek has its own cycle. Monday is a day for entering the working rhythm; on this day (if possible), it is not advisable to start important matters. Therefore, the most important or most difficult tasks in work, such as writing a dissertation or an article, are started from the middle of the week. Tuesday and Wednesday are the most productive days of the week; by Friday fatigue accumulates, so it is better to rest on Saturday and Sunday.

In many countries around the world, scientists use special ***flat accordion folders***, the pages of which are organized by the days of the month. Through the holes in the right corner of the folder, one can see the documents inserted there, reminder notes, and assignments from the academic supervisor that must be completed within a certain timeframe. If this is not possible, the dissertation materials are stored in regular folders, on each of which the number, name of the chapter or section of the dissertation or article, and the deadline for their writing are indicated [26].

A researcher should maintain a diary or special notebook writing down all questions which interest them during daily work. These are clarified with the supervisor or a specialist in their free time. Along the way, a list of necessary documents (legislative, directive, statistical, etc.) and their locations is determined. That work is done “in reserve,” enabling the researcher to have accurate, forward-looking information available to them. Writing all sections of the work at once is not efficient, but it is advisable to accumulate documents (published and unpublished) for all parts of the research and add new information.

An individual researcher should take into account their characteristics and come up with their ***own strategies for "getting into" work.*** Generally, the greatest difficulties occur in the first minutes and hours of work. There is no one way for anybody to bring themselves to work; it is up to everyone to discover solutions on their own. It is considered advisable to spend the first ten minutes rereading previously prepared material and correcting it.

Typically, after that sort of labor, a willingness to work on fresh material emerges. Work hours should also be selected independently so that creative productivity can peak. The permissible amount of work and the alternation of work time with rest will depend on the type of researcher. Scientific labor must be carried out to a regimen, else one would be unproductive, lose one's confidence in one's own strength, and therefore health.

LECTURE 3. Methodology of scientific research

Outline

3.1 The concept of scientific method and its main features.

3.2 Classification of scientific research methods.

3.3 General scientific methods.

- 3.3.1 Empirical research methods.
- 3.3.2 Methods used for both theoretical and empirical research.
- 3.3.3 Methods of theoretical research.

3.4 Special methods of research.

- 3.4.1 Methods of economic research.

3.1 The concept of scientific method and its main features

In addition to general and specific objects, as well as the subject of research, each science has its own methods of searching for and justifying scientific truth.

Scientific research relies on a diverse toolkit of methods to explore and solve problems [6, 10]. Methodological guides emphasize that research approaches generally break down into qualitative, quantitative, and mixed strategies [13, 20, 32, 37]. Researchers often use quantitative methods—like controlled experiments, modeling, and statistical analysis—when dealing with measurable, numerical data [21, 23, 38, 39]. Conversely, they turn to qualitative tools, such as interviews, field observations, and case studies, when they want to deeply understand human experiences, behaviors, and social contexts [22, 42, 44]. Blending these different techniques often gives a much fuller, more reliable picture of the topic being studied [32, 39].

Method of scientific research is a set of logical reasoning, certain transformations, various techniques or operations, which are aimed at solving certain cognitive tasks, taking into account the goal set.

Ultimately, both the purpose and objectives of research are determined by the spiritual and material needs of society and (or) the internal needs of science itself.

Function of *the method* is in obtaining new information about the surrounding reality, delving into the essence of phenomena and processes, revealing the laws and regularities of the development, formation and functioning of the objects under study. It depends on the quality of the method and the correctness of its application *truth value* acquired knowledge. True knowledge can only be obtained by applying the correct method(s). In XVIII this was stated by the English philosopher Francis Bacon. He compared the correct method in scientific knowledge to a lamp that lights a way in the dark. Therefore, not only the result of the study, but also the path leading to it, must be true.

There are several terms that are used to refer to the concept *"methods",* - scientific approach, principle, means, method, but they do not fully coincide. For example, the concept of scientific approach and principle is broader than the concept of method. And the concept of reception is narrower, more specific. Often, the concept of the method of cognition is identified as a combined category (for example, they say "mathematical method") with a certain specific method (for example, the mathematical method of factor analysis, which is a set of algorithmic techniques).

Each scientific method should have following features:

- *clarity,* that is, a general understanding of the method. This feature distinguishes one method from another;
- *focus,* that is, the subordination of the method to achieving a certain goal, solving certain specific tasks;
- *determinism* — strict sequence of using the method. In other words-its maximum algorithmization;
- *performance*- the ability of the method to ensure the achievement of a specific goal (this includes: *fruitfulness* of the method);
- *reliability* — the ability of the method to provide the desired result with a high probability;
- *cost-effectiveness*—the ability of the method to achieve certain results with the least expenditure of money and time [23].

An important point in the methodology is that *any* research method *should be theoretically justified.*

A method is a way to achieve a goal in the theory being developed. The method is objective, because it allows you to display reality and its relationships, while the method is subjective, because it is used by a certain person with his subjective properties.

3.2 Classification of scientific research methods

Science uses many different methods, approaches and techniques that are closely related logically, structurally and in the research process, that is, they form a system.

The system of scientific research methods can be represented as a set of:

- the general philosophical method;
- general-scientific methods;
- special methods of certain sciences.

Because of its universality, ***the philosophical method*** needs to be concretized and supplemented by other, special methods. Special methods are designed to solve individual general cognitive or specific tasks for each science. The methods used in almost all sciences are fairly characterized as general scientific.

General-scientific methods are such tools and techniques (or a combination of them) that are used with various modifications in all or almost all sciences, taking into account the specifics of specific research objects.

General-scientific methods include: observation; comparison; measurement experiment; generalization; abstracting; analysis and synthesis; induction and deduction; analogy and modeling; idealization; formalization; axiomatic and hypothetical methods; historical, full-scale, model, system approach, etc.

Special methods of certain sciences. They are used in separate sciences or in groups that are genetically related or united by the commonality of research objects. For an example, here is the calculation method. It is considered special because it is only used in *the economy.* They include in particular: mathematical statistics; optimization; technical-economic analysis; mathematical methods, etc. [23].

The development of science at the present stage is characterized by their all-penetration, going beyond the area of knowledge that gave rise to a particular method. Mathematical methods used in almost all areas of research are also the most common.

The basis for classifying methods can be not only different degrees of generality and universality, but also the functions they perform.

The following functions are distinguished: *methods used in empirical and theoretical research.*

For *an empirical approach* the level is characterized by the process of establishing and accumulating new facts, their analysis, generalization in order to obtain patterns suitable for practical purposes. On *theoretical* then the synthesis of knowledge is carried out, common patterns for this visual field are put forward and formulated, which make it possible to explain previously discovered facts and empirical patterns, as well as to anticipate and predict future events and facts.

The following methods are typical for empirical research: observation; comparison; measurement; experiment.

Methods used at the empirical and theoretical levels, refer to: analysis and synthesis; abstracting and specifying; analogy; modeling [36, 37, 39 – 41].

Theoretical research is based on: generalization; idealization; formalization; axiomatic and hypothetical methods; induction and deduction; a method of ascending from the abstract to the concrete.

General-scientific and special research methods have their own advantages and limitations in their application. Each of them expresses a certain side, a boundary of the cognitive process, so in its pure form it can be represented abstractly. In the real process of scientific knowledge, all methods are interrelated, interact and complement each other.

Classification scheme for scientific research methods shown in Figure 3.1.

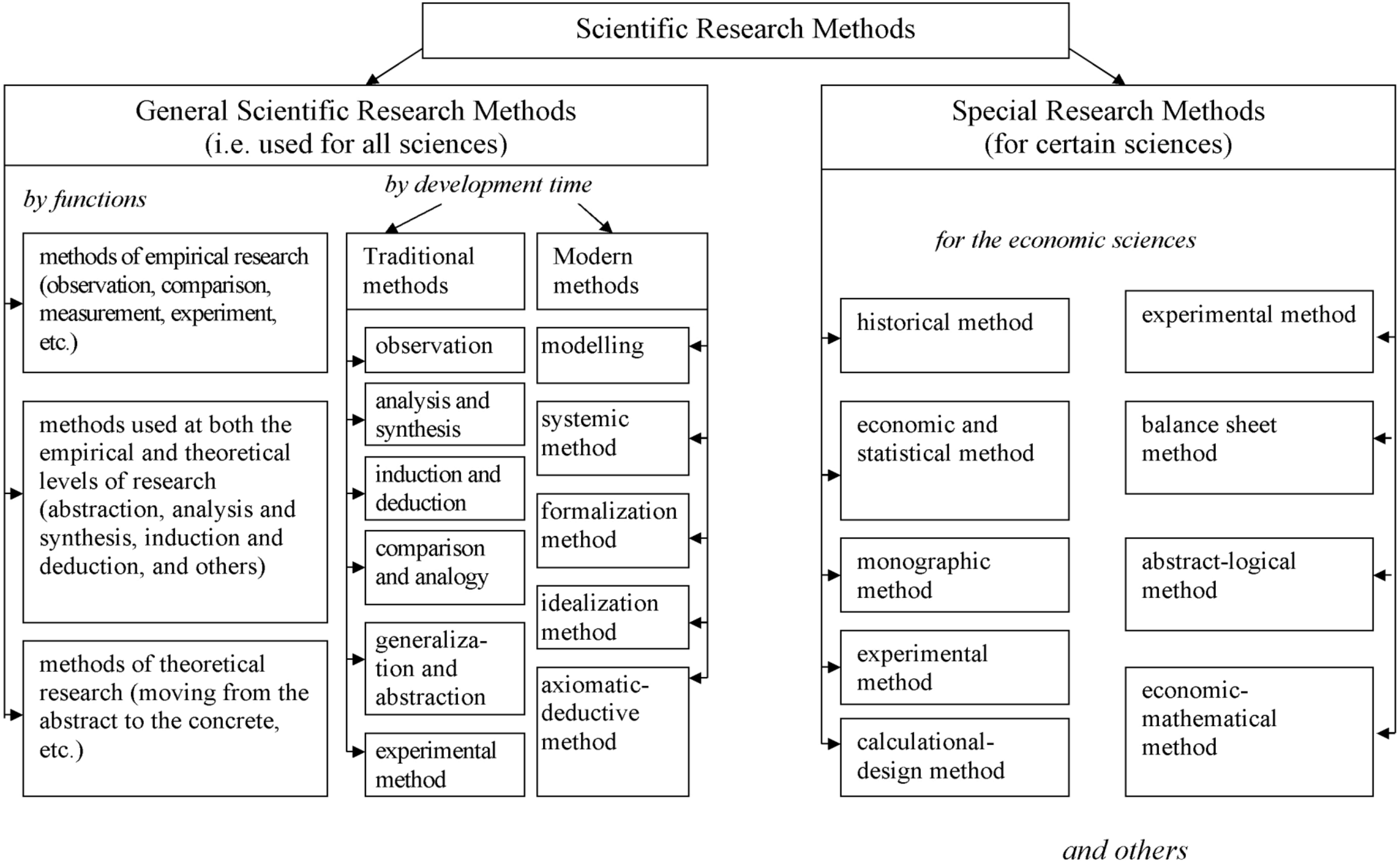

Figure 3.1 – Classification of research methods [23]

3.3 General-scientific methods

General-scientific methods of scientific knowledge are usually divided into three large groups.

I. *Empirical research methods* (observation, comparison, measurement, experiment);

II. *Methods used at both empirical and theoretical levels of research* (abstraction, analysis and synthesis, induction and deduction, modeling, etc.);

III. *Methods of theoretical research* (from the abstract to the concrete, etc.). General scientific methods are used in the vast majority of sciences, scientific disciplines and areas. These methods are also divided into two large groups: traditional and modern (modern), and this division is somewhat conditional (see Figure 3.1)

3.3.1 Empirical research methods

Consider empirical research methods.

Observation – systematic, systematic and purposeful perception of objects as a whole or its individual aspects, in which the researcher does not interfere with the behavior of the object, but only fixes its properties.

In order to be a fruitful method of cognition, observation must meet a number of requirements, the most important of which are: systematic, purposeful, active, systematic.

It is worth remembering that observation as a means of cognition provides primary information about the world.

Comparison – establishing similarities and differences between objects by comparing them (directly) or through an intermediate object (indirectly). Comparison is made if there is a certain commonality of objects based on the most important and essential features.

Measurement – determining the numerical value of a certain quantity using the unit of measurement. Direct measurement-finding the desired value of a quantity directly from experimental data. Indirect measurement-finding the value of a quantity based on a known relationship between this quantity and the values obtained by direct measurements.

Experiment – studying an object based on active, purposeful action on it by creating artificial properties and other features. It involves the use of observation, comparison, and measurement [23].

There is a distinction between full-scale and model experiments. A full-scale experiment is performed directly with the object under study; a model experiment is performed with a model of the object that replaces it on the sides that are of interest to the researcher. Experiment is typically conducted for the following purposes:

- identification of new object properties (research);
- verification of the correctness of theoretical propositions (check).

In an experiment, sometimes some experimental conditions are isolated, others are excluded, and still others are strengthened or weakened. If necessary, the experiment can be organized in such a way as to examine a set of parameters, rather than individual parameters of the object. Such a statement of the research problem is carried out in the theory of experimental planning.

Experimental study of objects in comparison with observation has a number of advantages:

1) in the course of an experiment, it becomes possible to study a particular phenomenon in its pure form;

2) the experiment allows you to study the properties of objects in extreme conditions;

3) provides sufficient repeatability to separate essential features and identify connections [23, 26].

An experiment in economics is the study of economic phenomena and processes by reproducing them, modeling them, and creating artificial or natural conditions. In this case, poll is used – a semi-active form of research using questionnaires, direct or telephone contacts, and interviews. Sometimes it's an interview or tests. The possibilities of economic experiments are limited, since it is difficult to reproduce real conditions, repeat the experiment many times, and you also have to experiment on people and economic entities (which can cause adverse social consequences).

Any experiment can be performed either directly with the object, or with its "substitute" or *a model.* The use of models makes it possible to apply the experimental method of research to such objects that are difficult or even impossible to operate directly with. Therefore, modeling is a special method that is widely used in science.

3.3.2 Methods used for both theoretical and empirical research

Methods used at the empirical and theoretical levels, refer to: analysis and synthesis; abstracting and specifying; analogy; modeling.

Abstracting in mental activity is universal, because the process of thinking is directly related to it or with the use of its results. The essence of this method: it consists of mentally distracting from non-essential properties and connections, objects and simultaneously highlighting (fixing) one or more sides that make up the object of research.

One should distinguish between *the abstraction process* and *the result of abstraction,* named one *an abstraction.* Of course, the result of abstraction means knowledge about certain aspects of objects. Examples of abstractions can be countless concepts that a person uses not only in science, but also in everyday life: tree, house, road, liquid, etc. The process of abstraction in the system of logical thinking is closely related to other research methods, primarily with analysis and synthesis.

Analysis is a method of scientific research by decomposing the subject into its components, whereas ***synthesis*** is a combination of the components obtained in the analysis into a whole system.

Methods of analysis and synthesis in scientific creativity are organically linked and can take various forms depending on the properties of the object under study, the purpose of research, the degree of knowledge of the object, and the depth of penetration into its essence.

Direct or empirical analysis and synthesis. They are used at the stage of cursory familiarization with the object. At the same time, its individual parts are selected, properties are detected, the simplest measurements are made, and the data that lies directly on the surface of the general one is recorded. This type of analysis and synthesis makes it possible to understand the phenomenon, but it is not sufficient to penetrate its essence.

Reverse, or elementary-theoretical, analysis and synthesis. They are widely used as a powerful tool for achieving the essence of the phenomenon under study. Operations of analysis and synthesis are based on theoretical judgments, which can be used as an assumption about the causal relationship of various phenomena and patterns.

S*tructural and genetic analysis and synthesis* allow you to get deeper into the essence of the object. At the same time, assumptions about a causal relationship go further. This type of analysis and synthesis requires identifying in a complex phenomenon such elements or links that represent the central, essential in them, the "basis" that determines all other aspects of the object's essence.

Analogy is a method of scientific cognition, by which one obtains knowledge about certain objects and phenomena based on their similarity to others. This method is the basis of modeling and, due to its clarity, is widely used in science and technology. However, the analogy does not provide reliable knowledge: if the prerequisites of the reasoning are (similarly) true, this does not mean that its conclusion will also be true. An analogy that provides highly useful knowledge is usually called *strict* or *accurate*. Scientific analogies are strict.

The use of analogies can be dictated by various tasks. For example, to gain new knowledge; to make the less clear more understandable, to present the abstract in a more accessible form. Similarly, we can talk about what is inaccessible to direct observation. An analogy can be a means of making new hypotheses.

Modeling. This is the study of objects, phenomena and processes not directly, but with the help of their substitutes-models. In the process of modeling, an experiment in nature is replaced by an experiment in a model.

A model in economy is an image, an image, a copy, a plan, a map, a formula, a graph, a matrix (a rectangular table of numbers), etc. Philosophers define a model as an implicitly depicted or materially implemented system that reflects or reproduces the object of research and is able to replace it in such a way that its study provides new information about this object. So, the model replaces the object, it is it *as an analog* in some respects – by properties, structure, relationships, or functions.

There are two types of models: *subject models* and *sign models* (sometimes they are called material and ideal, respectively, although these are unfortunate terms). Subject models can be full-scale (a smaller copy of a car), physical (mock-ups), and electronic. First of all, they are important for the economy *iconic models.*

Sign models are divided into two classes: *figurative-sign items* (aerial photos and satellite images, maps) and *formal-sign features* (statistical, mathematical, abstract-logical, etc.). Both of these classes are equally important and widely used in economics, interacting in specific research.

In economic research, the model is an important information carrier and a means of recording knowledge.

3.3.3 Methods of theoretical research

The theoretical research is based on:

- generalization;
- idealization;
- formalization;
- axiomatic and hypothetical methods;
- induction and deduction;
- method of ascending from the abstract to the concrete [23].

Generalization method is defining (identification) of a general concept that reflects the main thing, the main thing that characterizes objects of this class. Generalization is widely used in the formation of new scientific concepts, the formulation of laws and theories.

Idealization method involves creating ideal models and comparing the situation under study with the ideal option. Therefore, this is a complex method that uses specific features of some other methods — modeling, analogies, abstraction, and the like. Ideal models are common in many sciences. In physics, for example, this is an ideal liquid (such a liquid that does not compress), an ideal black body (such a body that does not emit any rays to the outside world), and so on.

There are two ways to build ideal models. The first is the abstraction of all but one of the most important features (properties) in a certain aspect, which is brought to "absolute" values (the same ideal liquid). The second method is to provide an ideal model of all possible features and features (functions, relations) that real objects have (an ideal EVC). In the process of research, real objects are compared with ideal ones and recorded: a) the degree of expression in the real object of the property that characterizes the ideal model (the first type of models); b) the presence (absence) in the real object under study of features and features that characterize the ideal model (the second type of models).

In fact, you can create ideal objects relative to all real economic objects and systems and study the latter on their basis. models that are "adequate" to the ideal ones.

Formalization method is the study of objects by displaying their content, structure, form or functioning in a sign form, using artificial languages (sign systems). In the latter aspect, it is close to the modeling method. Because one of the types of formalization method is *mathematical modeling* (it is successfully included in formal sign modeling).

In addition to mathematical formalization, there is also logical and mathematical formalization, especially in the study of the structure of concepts and in logical calculus, as well as sign formalization — using an artificial language of chemical symbols (icons) and operations with them.

Mathematical formalization has been used most fully, especially since the 1960s. In a broad sense, it is the application in science of the principles and provisions, methodological and formal apparatus of mathematics proper and mathematical logic, especially mathematical techniques for processing quantitative information. Application of mathematical tools for processing actual data in order to deduce empirical regularities in the form of mathematical formulas, equations and inequalities or their systems.

Mathematical modeling - this is creating a mathematical model and experimenting with it. A classic example in economics is the well-known formula (model) of demand for goods:

$$Q=f(P), \tag{3.1}$$

where Q – the volume of demand for a certain product, or the maximum number of units of the product that buyers are willing to purchase it for a certain price;

P – the price of this product.

If you change the value of the product price for this model (this will be an experiment), then the original value (the volume of demand) will also change. So, we will receive various volumes of products that customers can purchase at a certain price.

Formalization (mathematization) allows you to use in research — information systems and accordingly information research technologies.

Information technologies became possible after widespread introduction into computer research. They primarily provide for the creation of a database, software packages (mathematical software), primary economic information carriers (snapshots, maps, diagrams, diagrams, graphs, tables, balance sheets, etc.), from which you can automatically remove primary information to form a database, process (transform) it, present and analyze it accordingly. interpret it.

Axiomatic-deductive method is the most often used in the certain sciences (mathematics, physics). It is based on the establishment of an initial set of concepts, the formulation of several *axioms,* that is, truths that do not require proof (which are accepted without proof) and in establishing the rules of logical inference (of course, they are the rules of formal or mathematical logic).

Induction and deduction - a complex of interrelated methods of cognition, forms of thinking (conclusions). Inference-a thought process that involves one or more of the following elements: received statements (premises) get a new statement-conclusion (conclusion, the consequences).

In *deductive inference (conclusion)* the transition from prerequisite to conclusion is based on a logical law, which is why the conclusion from the logical the request is based on received packages.

In *inductive inference (conclusion)* the connection between the prerequisites and the conclusion is not based on a logical law (but on some factual or psychological grounds), which is why the conclusion follows from the accepted premises not with logical necessity, but only with some probability. The validity of prerequisites does not, therefore, imply the validity of the inductive statement derived from them; that is, induction gives only probable or plausible conclusions that require further verification.

Example of deductive inference

Truthful:

If it rains, the ground is wet.

It's raining

The ground is wet

Example of inductive inference

Incorrect:

Italy-Republic, Portugal-Republic, Finland-Republic, France-Republic.

These Western European countries

All Western European countries are republics.

Method of ascending from the abstract to the concrete is a method of cognition, which consists in the movement of thought from abstract definitions of an object through concepts and thoughts to a comprehensive holistic knowledge of a given object of thought. The ascent from the abstract to the concrete is a general form of the movement of scientific knowledge, the law of relativity. display reality in thinking.

According to this method, the process of cognition is divided into two relatively independent stages.

At the first stage, there is a transition from the concrete in reality to its abstract definitions. A single object is divided and described using concepts and judgments. It seems to evaporate, turning into a set of abstractions fixed by thinking, one-sided definitions.

The second stage of the process of cognition is the ascent from the abstract to the concrete. Its essence lies in the movement of thought from abstract definitions of an object to concrete ones in cognition. At this stage, as if the original integrity of the object is restored, it is reproduced in its versatility, but already in thinking.

These two stages of cognition are very interdependent. The ascent from the abstract to the concrete is impossible without first "anatomizing" the object, without moving from the concrete to the abstract and vice versa. Thus, the method under consideration is a process of cognition, according to which thinking moves from the concrete in reality to the abstract in thinking and vice versa — to the concrete in thinking.

3.4 Special methods of research

Special methods are called which are justified by a particular science and are used mainly in it itself. These include: calculation-constructive method; economic and statistical analysis; probability theory; business games method; expert evaluation method and others.

Thus, the modern system of concrete scientific research methods includes a wide variety of means of obtaining scientific truth. In the process of studying a particular object(s), a certain set of methods and techniques is most often used, which allows you to achieve the goal most fully and with optimal effort.

3.4.1 Methods of economic research

Certain phenomena and processes take place in material production. *Economic phenomena* are one of the forms of manifestation of human actions that are constantly repeated in the process of production, exchange and distribution of material goods.

Economic process is a natural, consistent change of phenomena from simple to complex, the characteristic feature of which is the death of the old and the emergence of a new phenomenon. Each phenomenon and process contains a set of deep phenomena, relationships, patterns and laws that determine the trend of their development.

Knowledge of economic phenomena and processes is a complex element of reflecting the essence of laws and laws of their development. It includes and uses the acquired knowledge in practical activities.

Economic science only reaches perfection when it reveals the content of phenomena and processes and can predict their future changes in form and essence.

Special research is conducted to understand economic phenomena and processes. The economic study includes:

- choosing the topic;
- formation of research goals and hypotheses;
- creating a program;
- accumulation of facts;
- putting them in a certain order;
- theoretical generalizations;
- verification of theoretical conclusions;
- development of measures to use them in practice.

The general method of cognition of economic phenomena and processes is dialectics. Basic principles of dialectics are:

- the study of phenomena and processes in the national economy is not isolated from each other, but in their mutual connection (the principle of a systematic approach);
- it is conducted not in a static state, but in historical development (the principle of historicism);
- development is considered as a transition of quantitative changes to qualitative ones, as a unity of opposites;
- inventions of something new and progressive in the existing process (epistemological principle).

Compliance with these principles ensures disclosure of the general laws of development.

At the same time, economic sciences use ***specific research methods*** to understand the essence of phenomena and processes: historical methods; economic and statistical analysis methods; monographic methods; experimental methods; calculation-constructive methods; balance sheet methods; abstract-logical methods; economic and mathematical methods, economic and statistical methods. Their totality makes up the content of the methodology of economic research.

In the study of social phenomena and processes, ***historical research method*** is used , which includes periodization of phenomena and processes, analysis of the internal structure and sources of development, and active action.

Economic and statistical method. It is used in the study of mass phenomena and processes of social life. To understand them, you should study the whole set of facts that form a phenomenon or process.

This method includes:

- observation;
- economic groupings using generalized and analytical indicators (relative values, averages, indicators of variation, etc.);
- statistical and economic analysis of relationships between indicators using graphs, parallel series, indexes, correlation analysis, etc.;
- theoretical generalizations.

Monographic method is used in the study of certain typical social phenomena and the experience of advanced domestic and foreign enterprises.

Increasing the level of scientific research requires the use of an experimental method in the economic sciences.

Experimental method provides high-quality research in the study of the organization and management of production, organization and operation of free economic zones, the use of tariff-free forms of payment, etc.

The experimental method includes: organization of a scientific experiment in accordance with the set goal; quantitative and qualitative accounting of its results; statistical and mathematical processing of the obtained materials; theoretical justification and their additional verification; development of measures for introducing the results into production.

Application ***calculation and construction method.*** It is connected with the prospects for the development of the industry and the enterprise. The constituent elements of the method are: studying the objective reality of new scientific and practical data with identifying established patterns; drawing up the most appropriate options for solving the problem, taking into account research in science and practice; technical, technological and economic assessment of the results of solving this problem, developing measures for the development of the project.

In the economy, it is important to apply ***using the balance sheet method*** the essence of which is to ensure the proportional development of all industries and the distribution of resources. It is also used in analysis to identify relationships between many economic indicators. This method includes: establishing existing relationships between phenomena; determining the main link in the development of phenomena; developing scientifically based standards based on scientific achievements and developing balance sheets based on the requirements of economic laws.

Abstract-logical method requires a purposeful, planned and systematic study of phenomena, logical distribution into components based on abstraction and allocation of the main category (concept), which has all the important features of the phenomenon under study; formation of existing features of the main economic category; logical integration of the components of the phenomenon and establishing patterns of its development. This method of research includes observation of the expediency of people's activities aimed at transforming the nature of society; scientific abstraction using methods of analysis, analogy, induction and deduction; theoretical conclusions from certain concepts, categories and laws that reflect the development of the process.

Economic sciences widely use ***economic and mathematical methods***. Mathematical programming allows you to find the best options for organizing production and using resources [5, 20, 36, 37].

The correct choice of methods and compliance with the requirements for their application can ensure high-quality scientific research [16, 27, 30, 41].

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Lecture notes

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