

Using Systemic and Praxeological Approaches for Modeling Social Impact Assessment of Research

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Abstract: By assessing the impact of scientific research, it is possible to track the effects of previously undertaken research initiatives, adapt subsequent ones to current social needs, and strengthen public trust. Assessment results influence decisions regarding selecting and modifying research financing strategies, creating innovation policies to ensure significant benefits for local and regional communities, and sometimes even of global significance. In the process of building models of this type of assessment, the concept of an action system and praxeological analysis can be used, which is one of the methods of goal-oriented explanation. This paper aims to demonstrate how the systems approach and praxeology can be applied to model the social impact assessment of scientific research. By using these approaches, the key elements of the action system and their interrelationships were identified. This enabled the development of a general model for the assessment system, which can be further refined based on the specific characteristics of information and decision-making processes. This model lays the foundation for a new methodological direction in evaluating the impact of scientific research. System analysis provides opportunities for a rational way of solving complex and interdisciplinary problems related to socio-economic and technical systems. The obtained research results confirm that combining systemic and praxeological approaches is useful for interdisciplinary modeling and improving goal-oriented systems. Such approaches enable a good understanding and structuring of the evaluation problem and reflect its complexity and multi-aspect nature. The universality of the proposed solutions creates the possibility of continuing research on expanding the scope of classical praxeological and systemic considerations towards applications of computer systems supported by artificial intelligence algorithms.

Keywords: Systems Approach, Praxeology, System of Action, Model of the Assessment System, Social Impact of Scientific Research

1. Introduction

Research centres in different parts of the world are interested in directing research results towards sustainable society development and improving social impact assessment to support sustainable and socially beneficial initiatives (Areesophonpichet *et al.*, 2025). The criteria for assessing research projects carried out within various programs, e.g., Horizon (excellence, impact, and quality and efficiency of the implementation), are generally consistent with the assumptions of the classical science of efficient action (praxeology, praxiology). Within the classical praxiological studies, sub-disciplines were created in connection with the needs in the area of planning, supporting decision-making, conducting evaluation, and other quite close business and management studies (Gasparski, 1987). The Polish Praxiological School has made a significant contribution to proposing the application of the terminology of praxeology as a basis for developing metatheory for management sciences, praxiological systematization of management sciences, and the idea of praxiological efficaciousness (Szpaderski, 2006).

It is interesting to reach for classical approaches when considering the effects of actions taken in connection with scientific research. The conscious, purposeful, complex and unique human actions related to them, which are aimed at achieving the intended goals, should be accompanied by in-depth reflection on the effects in the broadly understood societal impact. Such analyses should be conducted drawing on the rich achievements related to the systemic praxeological trend and the systems approach close to it. These approaches are very general in nature, which makes them of an application nature and facilitates the construction of assessment models with universal properties, i.e., referring to very diverse, complex, and unique scientific and research projects. Forecasting expected social effects, tracking them during the implementation of activities, and examining the achieved effects is close to the issues of quality management and management studies.

The problem of assessment according to the impact criterion is a particularly interesting and still insufficiently researched field, which concerns the estimation of expected and realized effects in the project environment and generally the creation of long-term benefits for society. The proposed methodological approach is consistent with the needs concerning the assessment of public projects assessed in terms of their usefulness in meeting social and environmental needs and long-term impact analyzed in many aspects: socio-political, economic, cultural, technological and others. Project products in the form of research results and their scientific quality are of lesser importance compared to the expected benefits analyzed in a broader context. In the case of

praxeological analyses, the main attention is paid to the assessment of the effectiveness and efficiency of the processes of actions leading to the achievement of planned impact aspects.

It is therefore worthwhile to use the concept of the action system and praxeological analysis (which is one of the methods of goal-oriented explanation) in the process of building models supporting the assessment of the impact of scientific research, because it is necessary to track the effects of previously undertaken research initiatives, adapt subsequent ones to current social needs and strengthen public trust by ensuring the achievement of significant benefits of local, regional and even global significance.

This paper aims to outline how the systems approach and praxeology can be used in modeling the social impact assessment of scientific research. Using these approaches, elements of the system of activities and the relationships between them were identified, which allowed for the formulation of a general model of the assessment system, which can lead to a more detailed methodological analysis in the form of characteristics of information and decision-making processes. It also creates a basis for proposing an outline of directions for the development of methods for assessing the impact of scientific research. The obtained research results confirm that combining systems and praxeological approaches is useful for interdisciplinary modeling and improvement of goal-oriented systems. Such approaches enable good understanding and structuring of the assessment problem and reflect its complexity, multi-aspect nature, and are also open to extending the scope of classical praxeological and system considerations to computer systems operating in accordance with artificial intelligence algorithms.

2. Social Impact Assessment of Research

The quality of scientific research can be understood and measured in various ways, and only one of them is the evaluation of research in terms of creating new and useful knowledge that leads to the creation of innovative solutions and positive socio-economic effects. This type of understanding of quality is related to the attitudes adopted by scientists, who should be open to interdisciplinary cooperation and co-creation of scientific knowledge in innovation ecosystems (Haukipuro *et al.*, 2024).

Improving the quality of research can be supported by using indicators of innovation, productivity and, above all, impact (on society, the environment or a selected scientific discipline). Achieving satisfactory values of indicators, as well as high-quality scientific and socio-economic effects should be supported by the combined use of funding from public institutions and the business sector (Ou *et al.*, 2024). The broadly understood quality and excellence of scientific research should be assessed from the point of view of planned and achieved goals oriented towards new knowledge that is socially useful and that is the basis for building bridges between scientific results and their social impact on diverse groups of stakeholders, e.g. recipients and users of research, who may be individuals, groups of people or organisations experiencing the impact (Woolley and Molas-Gallart, 2023).

Difficulties in measuring the social effects of scientific research are particularly visible for scientific disciplines not related to the humanities and social sciences. Additional problems are generated by the lack of consensus on the accepted definition of social impact and uniform evaluation criteria. It is generally known that research impact concerns mainly socio-economic and environmental changes, which are of particular importance outside the academic environment, for diverse groups of stakeholders: those affected by the impact of research projects, political decision-makers developing strategies for financing and developing science, the economy, companies and selected areas of society (Dwivedi *et al.*, 2024).

Societal impact has a multi-faceted nature, which can be reflected in comprehensive qualitative research based on universal methodological approaches and expert opinions, which can sometimes raise doubts and suspicions of bias, as there are different views on the understanding of social impact, methods of its assessment and implemented directions for improving the strategy of developing scientific research aimed at achieving beneficial social effects, even in countries with great traditions and accumulated experience (Newman, 2024). The methods of assessing social impact are mainly peer reviews and surveys of expert opinion based on case studies, interviews, observation, mixed methods, bibliometrics, document analysis, assessment reports, alternative indicators and metrics, as well as advanced methods using data mining (Grzeszczyk, 2024). Methodological research is warranted into models that support universal (for different scientific disciplines), effective, and trustworthy assessment of the impact of scientific research.

The justification for undertaking research related to the use of integration threads in systems research is the need to provide methodological support for expert evaluators providing recommendations to support the

decision-making processes of decision-makers managing funds intended for financing research centers. The results of such evaluations have a significant impact on their position, prestige, and sometimes force the implementation of personnel policy and possible restructuring.

3. Integration Threads in Systems Research

General system theory is known and has been used for years in scientific research related to various scientific disciplines. The key concepts are: system, systems approach, systems science, systems thinking, systems research, system analysis, system research, system paradigm, system solution and system school. Analysis conducted within systems theory, based on the concept of an independent system or as a subsystem constituting an element of a larger whole, is particularly useful in research conducted within business and management studies. Organizations, individual research projects or sets of projects (programs) can be analyzed according to a simple input-output scheme - their functioning is explained by the transformation of input resources into results consistent with the adopted goals. Within an organization, various types of systems can be distinguished: socio-economic, information and knowledge.

The usefulness of systems research results from the ever-increasing complexity of the analyzed structures and the interdependence of objects related to socio-economic phenomena. Systems of increasingly complex structure consist of many objects that are interconnected and with the environment. The occurrence of uncertainty and ambiguity means the need to build models that integrate approaches that allow for the multi-aspect nature and uncertainty of the studied phenomena.

Integration threads in systems research can be an inspiration for modeling many aspects related to interdisciplinary general methodological considerations and the measurement of the impact of scientific research. In conducting these considerations, it may be useful to take into account the systems approach together, as well as sciences that can be considered systemic, i.e. business and management studies, praxeology and IT systems. The subject of research consistent with the systems theory is a system understood as a set of interconnected elements, each of which is connected to another element directly or indirectly to achieve a specific goal.

The systems approach is a broad concept and sets a paradigm indicating a rational model of procedure for solving complex and interdisciplinary problems concerning socio-economic-technical systems. In the case of such systems and related evaluation problems, accurate and precise data are relatively rarely available, and the analyzed issues are usually very complex, multi-faceted and require multicriteria investigation in conditions of uncertainty. Additionally, analyses related to solving the problem of assessing social impact usually concern considering, in addition to so-called hard problems, also so-called soft issues, e.g. social, environmental, etc. For these reasons, in the processes of modeling social impact assessment, it is necessary to pay attention to integrated approaches that allow for taking into account simultaneously aspects of soft systems and hard systems. Attention is drawn to the need to overcome the limitations of classical systems thinking and to introduce new science of systems, which is based rather on linguistic than mathematical modeling. In accordance with this new thinking, important places are occupied by informatic content, cognitive value and meeting the expectations of stakeholders (Korn, 2019). Another proposed direction of development is to combine static and dynamic aspects in problem-solving with paradigm change in systems thinking (Korn, 2025).

In system analysis, it is necessary to take into account the dynamic development of computational technologies and AI, which create opportunities to cope with the increasing amount of data that should be taken into account, related to, for example, social, economic and environmental aspects. Research should be undertaken on new directions of development of methodological systemic research within business and management studies, in which AI technologies are becoming increasingly important. In particular, such technologies play an increasing role in multicriteria decision-making processes based on intelligent systems, computational intelligence systems, AI systems and knowledge based systems.

4. Modeling Assumptions

The following assumptions were adopted for modeling the social impact of research:

- multi-aspect nature, i.e., taking into account quantitative and qualitative evaluation criteria,
- universality manifested by its usefulness for research from various fields and conducted at several stages (ex-ante, ongoing, ex-post),
- compliance with the requirements of research funding organizations,

- use of integrative features of the systemic approach,
- drawing attention to inspirations from praxeological evaluation criteria,
- openness to the application of ICT and AI technologies,
- primacy of learning over static use of knowledge resources,
- application of feedback and adaptive adjustment to changes in the environment, and ensuring permanent improvement of the evaluation,
- use a general form enabling the later creation of a formalized model – useful during its empirical verification.

The assumptions formulated in this way generally guide not only current but also future research related to creating a model in a form that can be empirically verified. The general model prepared within these theoretical studies provides the possibility of further implementing mathematical modeling, leading to the development of a form suitable for implementation, also using selected AI technologies.

The systems approach opens up possibilities of using the perspective integrating various, mutually complementary approaches, methods, techniques and tools. This approach allows to build a holistic general model with specified: input, output and feedback. In addition to feedback, adaptability can be realized using the situational approach, which together allow to take into account the variability of the system environment. The combined use of the principles of systems approach and the situational approach allows to reduce the limitations resulting from the too general nature of the system analysis and to increase the correctness of results determined in conditions of significant uncertainty, which is typical for real circumstances. Such combined use of the system approach, situational control, fuzzy logic and the main aspects of linguistics is useful when modeling advanced computational intelligence systems (Khayut *et al.*, 2016).

The introduction of an integrative perspective is also facilitated by the use of a praxeological approach, which is of great importance for conducting research related to research methodology for business and management studies, because it constitutes a bridge connecting theoretical philosophical considerations of a general nature with the theory and practice of management, which is characterized by a lower degree of generalization. Using the theory of praxeology, one can develop general principles of research methods and develop inquiries related to more practical methodological aspects.

The praxeological approach is particularly useful for modeling evaluation, i.e., investigating whether a specific action is efficient or inefficient. The usefulness of praxeology for building general models, e.g. for evaluating the social impact of scientific projects, results from its universal nature, as well as praxeological evaluation criteria (effectiveness, economicality and efficacy), which are useful in specific evaluation processes.

5. General Model of Assessing Social Impact

The construction of a general model for evaluating the social impact of scientific study is based on the methodological achievements related to systemic and praxeological approaches. According to these approaches, the identification and characterization of the elements of the assessment system is of key importance. Modeling this system should take into account the broadest possible context of the assessed research, which is facilitated by the general nature of the selected approaches. Assessing the impact of scientific research is usually a very complex and multi-faceted task, because research and development projects often involve significant financial resources, are characterized by a high level of technical and economic complexity, sometimes cause significant effects in time and space, and require taking into account many aspects not only directly but even indirectly related to their implementation.

Research projects and programs are very diverse, and increasingly related to strategies for dealing with serious social problems, permanent and irreversible changes in the natural environment, not only on a national scale, but sometimes even climate change on a global scale. This entails significant requirements for the constructed model and its adaptability, and the implementation of the adaptation processes of the methods and tools used to achieve its objectives and principles. Therefore, in the modelling processes, it is also necessary to take into account, among others, the evolution of the system's objectives and principles, as a result of the evolution of the turbulent and stormy environment. The adaptive development of the model can be considered as an expression of the progress of knowledge regarding the implementation of research and methods of impact assessment. The development and improvement of this model takes place through the use of feedback loops, the combined use of system approaches and praxeology, as well as ensuring openness to the use of new AI technologies.

For the modeling process, the concept of the action system and praxeological analysis, which is one of the types of goal-oriented explanation, are of key importance. The subject of the action is most often an expert performing the impact assessment, who functions within the elements of the assessment system, and among them we can mention: the purpose of the action (meeting the need to implement the assessment process), the subject of the action (research subject to assessment), tools and technologies (in accordance with the adopted methods of action), the resources of the action involved in the assessment process (mainly information resources, expert knowledge and their experience) and the environment of the action system (socio-economic and environmental conditions).

In the case of classical praxeological analyses, the subject of action is understood as an individual person or as a team of people. This subject implements the process of evaluating the project (subject of action) to achieve the objective, using resources and tools, and taking into account the conditions of the system's environment. In accordance with the praxeological approach, the evaluation of the efficiency of action, leading to the achievement of the intended objective, can be identified with a system of assessments covering many criteria typical of the praxeological evaluation process. Accepting the departure from the subject understood exclusively as an individual person is a certain departure from the classical praxeological understanding of the system of action.

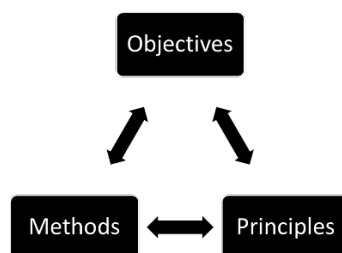


Figure 1: Basic elements of the general model (source: own study)

In the modeling process, it was assumed that the evaluation process is a praxeological system of action, within which three basic elements can be distinguished (objectives, principles, and methods), which is presented in Figure 1. Principles are specified by defining evaluation criteria. Strategic and current objectives achieved thanks to the introduction of the system (meeting the demands of its designer) should be consistent with the objectives and guidelines of public institutions financing research and a specific national system of guidelines and program documents referring to individual priorities, programs and financial instruments related to public interventions. These objectives should be specified in accordance with the applicable more general principles and more detailed evaluation criteria. In turn, the implementation and shaping of the main principles and information and decision-making processes of the system and the determination of its results can be served by socially-technical integrated methodological approaches and specific methods of impact assessment. Among these methods, an important place should be occupied by AI tools and techniques based on continuous learning, adaptation and improvement based on good practices and experiences gathered from previous evaluation processes carried out for different environmental conditions. The constructed model and its subsequent more detailed versions should ensure the implementation of a subsystem of methods that enable permanent improvement of the impact assessment of various studies.

6. Conclusions

The assessment of the social impact of scientific research is a complex and multifaceted problem. The use of a systems approach and praxeology made it possible to build a general model of the assessment system and create a basis for continuing research devoted to the development of new evaluation methods. The presented research results fill the research gap in the use of praxeological theory and the systemic approach for modeling the assessment of the social impact of scientific research. The theoretical considerations signaled now can be the basis for continuing more detailed analyses and empirical research. In particular, the proposed general model for assessing social impact can be a good basis for starting the modeling of information and decision-making processes using approaches consistent with the praxeological theory, R&D project management methodologies, information engineering and knowledge. The effects of this stage of modeling can then be used when constructing a formalized description of the assessment model, in which information and decision-making connections will be used. The use of information and knowledge engineering will make it possible to take into account the functions to be fulfilled by the assessment system and the necessary information and decision-

making processes that also reflect the dynamics of the evaluation decision-making system. The general model can also be the basis for developing a sequential-iterative model based on many repeated (in a feedback loop) sequences in order to implement the process of continuous improvement of the assessment.

The presented research is only preliminary in nature and it is worth checking the implementation possibilities of the proposed solutions and their empirical verification, especially in terms of their usefulness for supporting experts in taking into account qualitative features of difficult-to-measure determinants of praxiological efficaciousness, effectiveness, and efficiency. The terminology used in the case of assessing the social impact of research is ambiguous, which significantly complicates the assessment modeling processes. The approaches recalled in this paper have been known for a long time, but only the systemic approach has seen many practical applications. In the case of the second approach, there are relatively few practical solutions directly based on praxeological criteria, and they are rarely implemented in a direct form. The proposed solutions should be treated as an attempt to extend previously known models, but only the creation of specific formalized descriptions and attempts at empirical verification can help determine their usefulness. It is also possible to consider expanding the scope of research solutions inspired by various scientific trends derived from classical praxeology.

The conducted research is consistent with important trends in the development of methodological research related to impact assessment. There is a need to improve existing methods and models for assessing the social impact of study, but this is accompanied by significant challenges, primarily related to the considerable uncertainty of complex assessment processes, difficulties related to multi-faceted interdisciplinary research in R&D projects, the need to take into account difficult-to-measure quality criteria and problems with diverse stakeholder groups. The research results may also be useful for conducting impact assessments regarding research in the social sciences.

Ethics Declaration

Ethical clearance is not required for the research.

AI Declaration

OpenAI's ChatGPT 4.0 system was used to improve the clarity and readability of some expressions used in the text.

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