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INTEGRATED MANAGEMENT AND EVALUATION SYSTEM FOR STRATEGIC RESEARCH PROGRAMMES

Key words

Evaluation, management system, strategic research programme, evaluation system, evaluation methodology.

Summary

The development of the knowledge-based economy requires undertaking many initiatives that contribute to the increase in the competitiveness of enterprises through the development and the implementation of innovative products. Such initiatives include, among others, strategic research programmes, which are characterised by a great number of levels, a multitude of objectives and results, and high budgets. It causes that the subject of strategic research programmes must be generated or fully accepted by national authorities responsible for this sphere. Therefore, it is necessary to develop a complex and effectiveness management and evaluation system dedicated to strategic research programmes. The authors present the concept and the structure of the system, and particular attention is paid to the evaluation, which enables systematic improvement of the effectiveness and the efficiency of a strategic research programme and research projects undertaken within such a programme.

The system designed is currently verified within *Innovative Systems of Technical Support for Sustainable Development of Economy* Strategic Programme executed in the Institute for Sustainable Technologies – National Research Institute in Radom (Poland).

Introduction

The R&D management is defined in the literature as “the use and the application of knowledge, skills, tools and techniques in the management area in the context of fulfilling the objectives in order the execution of the programme to contribute to the improvement of the value of the organisation in a measurable way” [3]. Moreover, the R&D management is “the process, taking into consideration in the organisation, for the achievement of profits and avoiding risk and loss” [3]. This definition does not consider the nature of management of a strategic programme, which is characterising by interdisciplinary character and high budget. A strategic research programme results from scientific and innovative policy of a country. It is executed in a long-term perspective, and it aims at the improvement of the competitiveness of a national economy through the development of innovative products and services and the execution of R&D activities enabling ways to solve scientific, technical, and social problems [28]. The important elements of a strategic research programme include the identification of the projects and the measurement of a programme results in order to ensure the greatest benefits for the organisation. Therefore, it is necessary to pay special attention to the evaluation understood as the study on the programme characteristics, with assessment criteria taken into consideration in order to analyse and interpret the achieved results and to make decisions on the launch of the programme, the way of its execution, the continuation of the whole programme or its individual elements, or termination [28].

1. Management system for strategic research programmes

Strategic programme management is a part of the project management area. According to the methodology designed by the American Project Management Institute [22], there are the following phases in the project or the programme management: launch, planning, execution, termination, and control during the project execution.

According to the *European Guide to the Evaluation of Socio-Economic Development* [11], the project or the programme management process includes the following phases: programming, identification, formulation, *ex-ante* evaluation, execution and monitoring, project termination, and *ex-post* evaluation of the final results. These phases are also considered by other authors, among others, by Mingus [20], Lewis [17], Kerzner [15], and Kanda [13].

The state-of-the-art concerning management systems for strategic research programmes¹ enabled the identification of the following basic management

¹ National Program of Research Infrastructure (Denmark), Advanced Technologies for Energy Acquisition (Poland), GRAF-TECH (Poland), Core Research for Evolutional Science and Technology (Japan), Industrial R&D Program (Korea), Small Business Innovation Research (United States), Solar Chemistry/Hydrogen (Switzerland), Telecommunications Electronics

phases: programming, planning, formulation, *ex-ante* evaluation, execution, and closure (Fig. 1).

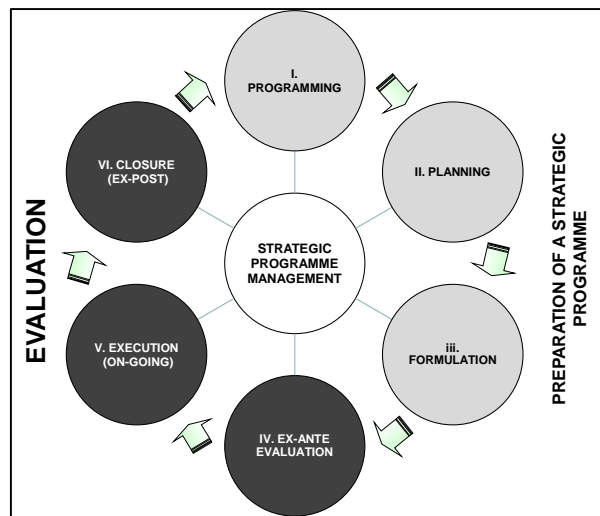


Fig. 1. The identified phases of a strategic research programme management

These phases form *the life cycle of a strategic research programme*. The phases enable the identification of the launch and the closure of a programme as well as indicating the timeframe needed for the execution of individual research tasks within a programme:

- Programming (detailed analysis of strategic documents at national or European levels, analysis of research directions, which are interesting for those supporting programme funding);
- Planning (identification of needs, which are the basis for the launch of a new strategic programme, analysis of potential problems, detailed description of programme objectives, preliminary estimation of the timeframe and the budget of a programme, identification of the results planned to be achieved);
- Formulation (analysis of the programme feasibility, design of the plan, how to use the results in a long-term perspective, detailed description of elements designed in the planning phase);
- *Ex-ante* evaluation of the proposal submitted by potential beneficiary;

(Finland), Exploratory Research for Advanced Technology (Japan), Danish Strategic Environmental Research Program, Systems Technology and Methodology for Development of Complex Technical Systems (Sweden), PINTA – Clear Surfaces (Finland), Superfund Innovative Technology Evaluation Program (United States) and Nutek-Vinnova Programme in Complex Technical Systems (Sweden).

- Execution (leadership of research teams, monitoring and *on-going* evaluation of the programme); and,
- Closure (formal closure of the programme and *ex-post* evaluation; the use of the evaluation results for the launch of future strategic research programme).

The most important conclusions coming from the analysis are the following:

1. The management phases of a strategic research programme, which were identified in the literature, are characterised by different level of detail. It means, for instance, that, in analysed strategic research programmes, the planning phase is very expanded; whereas, the closure phase is very general or even omitted.
2. *Ex-ante* evaluation phase is usually of an external character, which means that it is conducted by the experts, who are not engaged in the execution of a strategic research programme. In most cases, the internal evaluation was not identified, but it seems to be an important element of the management, as it contributes to the decrease of the risk of the rejection of the programme proposal.
3. The closure phase does not concern the formal closure of a programme but mainly the *ex-post* evaluation of the achieved results.
4. The phase of analysis and the use of the results aiming at the launch of a new programme were not identified.

All management phases for a strategic research programme are significant; however, as the analysis shows, the evaluation is particularly important, because it can be perceived in three management phases: preliminary phase (*ex-ante* evaluation), execution phase, and closure phase.

2. Evaluation of a strategic research programme

The occurrence of the evaluation in three management phases comes from its objectives: cognitive and instrumental. The cognitive objective enables the detailed presentation of a programme rules, the mechanisms, and the use of gained knowledge to conduct scientific research within a topic relevant for a strategic programme. The instrumental objective aims at the use of the evaluation results in order to make decisions related to the programmes executed [30].

The evaluation is conducted with the use of commonly accepted models, criteria, and research methods.

The literature review conducted revealed four (4) groups of evaluation models.

The groups and models emerging from the aforementioned analysis are as follows:

- 1) Models directed at facilitating the effectiveness of R&D tasks undertaken within research programmes, or aimed at increasing staff responsibilities for the tasks realised: decision model [8], client-centered model [24], accreditation model [26];
- 2) Quasi-evaluation models (directed at finding answers to questions occurring at the time of the evaluation, and they use traditional research methods):

objective-based model [27], accountability model [16], outcome evaluation as value-added assessment model [23], performance testing model [26], experimental model [5], management information model [7], cost-benefit analysis [14], clarification hearing model [29], case study model [4], criticism and connoisseurship model [9], theory-driven model [10], and mixed-methods studies [26];

- 3) Social models (assuming that, apart from the experts and the project management board, beneficiaries of research projects should also participate in their evaluation, because they are the ones to use technologies developed within research programmes in the future): responsive & participatory model [25], constructivism model [26], deliberative and democratic model [12], and, utilisation-focused evaluation model [21];
- 4) Pseudo-evaluation models (concentrating on the positive effects of the programme and neglect any negative aspects of its realisation. They are mainly used by institutions that want to attract beneficiaries and persuade them to participate in the programme or to purchase its material results): public relations model [6], and politically controlled model [26].

Moreover, a state-of-the-art study on evaluation criteria and methods used in strategic research programmes was conducted. The results show that, in most cases, the evaluation only considers the criteria of relevance and effectiveness. The cost-efficiency was verified sporadically. The authors also identified other evaluation criteria, e.g., the impact and the usefulness.

In regarding these methods, mainly document analysis was used. In some cases, detailed documents were analysed, which were the base for the launch of initiatives, among others, in the case of programmes executed by the European Union institutions. The structured and non-structured interviews with beneficiaries and other organs interested in the use of the results were identified. In cases in which the number of beneficiaries was large, the authors also identified surveys – often conducted through Internet. The methods, which were identified more seldom, included workshops during which preliminary or final results were discussed. Some evaluations also included case studies.

The programmes, which were composed of some individual research projects, were analysed in a specific way. Such evaluations contained the analyses of individual projects according to selected criteria, which were later on used in the evaluation of the strategic research programme as a whole. However, such an approach was not used very often.

The identified evaluation models do not make it possible to evaluate a strategic research programme in a complex way on its different structural levels (research project level, thematic group level, or the complete strategic research programme level) and only its selected elements. Therefore, after the indept literature analysis, the authors decided to design a complex evaluation system composed of evaluation methodologies and methods, which can be applied from the launch of a strategic programme until its closure as well as some years after the closure.

3. Evaluation system for a strategic research programme

The basic elements of a proposed evaluation system for a strategic research programme include the following [28] (Fig. 2):

- Methodologies enabling the evaluation of a strategic research programme on its different structural levels;
- Standard methods used on each structural level of a strategic programme; and,
- Non-standard methods used for the assessment of products being the results of individual research projects in the area of technical innovation.

The authors designed the key methodologies (3) and the supplementary methodology (1). The key methodologies enable the evaluation of a programme on all of its structural levels and include the following: the assessment methodology for technical products, the evaluation methodology for research projects, and the evaluation and optimisation methodology for the strategic programme as a whole. The supplementary methodology supports the evaluation process and aims at the generation of future research projects and directions.

The assessment methodology for innovative technical products enables the assessment of material results on each stage of their development, which are directed to the implementation into economy or commercialisation. The results of the methodology are later used in the evaluation of research projects.

The evaluation methodology for research projects enables the conduction of formal and content-related evaluation of the project. The formal evaluation aims at the assessment of legal and organisational issues of a research project, among others, the relevance of the project subject to the legal rules and the priorities of national development, the level of the achievement of material and non-material results, and the budget level. The aim of the content-related evaluation is to assess scientific, technical, and application aspects, which are significant for the organisation commissioning the evaluation. The evaluation methodology for research projects is a tool supporting decision making on the continuation or termination of the individual product or project.

The evaluation and optimisation methodology for a strategic research programme is based on the results of the assessment methodology for innovative technical products and the evaluation methodology for research projects. It supports the decision making process on the continuation of works characterising by the highest level of the effectiveness of the research projects and thematic groups or on the continuation or termination of projects or groups characterising the lowest level of the effectiveness.

The supplementary methodology of generating future research projects and directions enables the selection of such directions for the needs of the launch of new projects and programmes, mainly based on the results of the assessment of technical products.

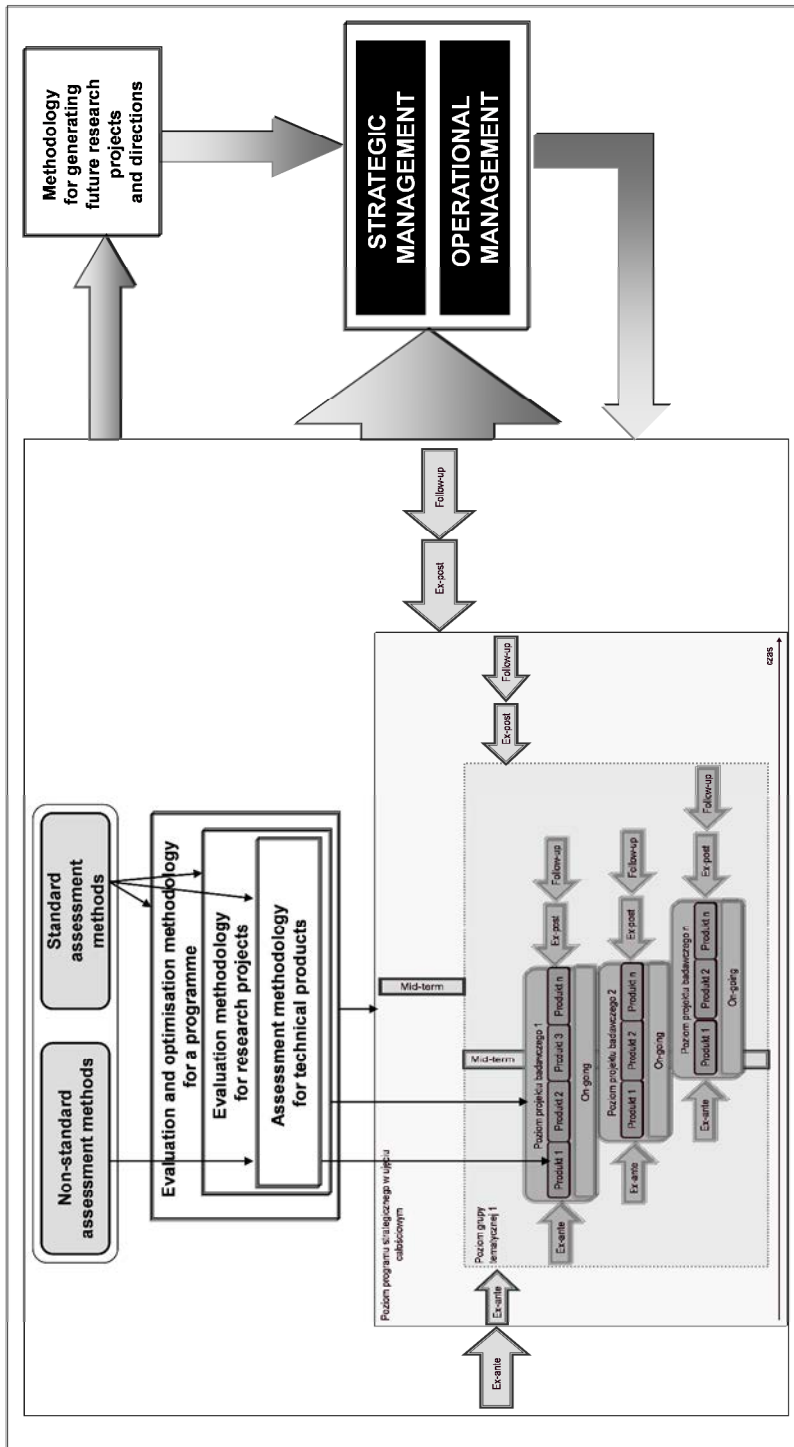


Fig. 2. Evaluation system for strategic research programme in the area of technical innovations

The methodologies designed assume the use of standard methods, commonly used in the evaluation of research projects executed in different thematic areas as well as original non-standard methods for the assessment of technical products, which were developed as a result of the execution of research projects (the technological readiness [19], the risk implementation [18], the commercial potential [1], the innovativeness level [2] assessment methods).

In order to confirm the correctness of the system operation, its verification on the current executed *Innovative Systems of Technical Support for Sustainable Development of Economy* strategic programme was performed. The evaluation of 165 innovative technical products and 30 research projects were conducted. The application of the designed system enabled the identification of technical products and research projects, which are “non-perspective” based on the set of selected assessment criteria, among others, because of low commercial potential, which makes the products impossible to be implemented into economy and “perspective” tasks, which should be continued. Moreover, the results achieved in the evaluation process enabled the researchers to identify and to analyse research directions, which should be the basis for the launch of a new strategic research programme or independent research projects [28].

Conclusions

The designed evaluation system for strategic research programmes in the area of technical products, as an important element of strategic programme management, is an instrument supporting management in a research organisation. The application of designed evaluation methodologies enables the assessment of such types of programmes on different structural levels in selected timeframes of a programme. The evaluation results are going to be used during the next evaluations in order to analyse tendencies and changes, which can take place during its execution. Moreover, considering selected assessment criteria, the evaluation results are going to be used to indicate the subject of new research projects and programmes.

The use of a proposed system enables the conduction of a complex evaluation of a strategic research programme.

Scientific work executed within the Strategic Programme “Innovative Systems of Technical Support for Sustainable Development of Economy” within Innovative Economy Operational Programme.

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Zintegrowany system zarządzania i ewaluacji strategicznych programów badawczych

Słowa kluczowe

Ewaluacja, system zarządzania, strategiczny program badawczy, system ewaluacji, metodyka ewaluacji.

Streszczenie

Rozwój gospodarki opartej na wiedzy wymaga podejmowania inicjatyw mających istotny wpływ na zwiększenie konkurencyjności przedsiębiorstw poprzez tworzenie i wdrażanie rozwiązań innowacyjnych. Do takich inicjatyw można zaliczyć między innymi strategiczne programy badawcze charakteryzujące się wielopoziomowością, mnogością celów oraz uzyskanych rezultatów i wysokim budżetem. Sprawia to, że problematyka strategicznych programów badawczych musi być generowana lub w pełni akceptowana przez odpowiedzialne za tę sferę struktury państwa. Dlatego też konieczne jest

opracowanie kompleksowego systemu zarządzania i ewaluacji w odniesieniu do tego typu programów.

Artykuł dotyczy zintegrowanego systemu zarządzania i ewaluacji dedykowanego strategicznym programom badawczym. Autorzy prezentują koncepcję oraz strukturę systemu, a szczególną uwagę poświęcają ewaluacji umożliwiającej systematyczną poprawę skuteczności i efektywności programu strategicznego oraz prowadzonych w jego ramach projektów badawczych.

Opracowany system zarządzania i ewaluacji jest obecnie weryfikowany w odniesieniu do Programu Strategicznego realizowanego w ITeE – PIB *Innowacyjne Systemy Wspomagania Technicznego Zrównoważonego Rozwoju Gospodarki*.