

Ludmiła ŁOPACIŃSKA

Institute for Sustainable Technologies – National Research Institute, Radom

MULTI-LEVEL EVALUATION ENHANCING EFFECTIVE MANAGEMENT OF STRATEGIC RESEARCH PROGRAMMES

Key words

Formal evaluation, factual evaluation, strategic research programme, programme effectiveness.

Abstract

In order to improve the effectiveness of strategic research programmes, it is necessary to conduct a systematic and complex evaluation of such programmes. This paper presents an evaluation approach that is adequate for research projects undertaken within strategic research programmes. The approach comprises two dimensions, formal evaluation and factual evaluation, in order to provide the appropriate completion of the research projects and the efficient implementation of their results to the market. The evaluation approach focuses particularly on the possibilities of introducing changes in the research projects; if such changes are required in order to improve the effectiveness of the realisation of the whole strategic research programme.

Introduction

In order to ensure the competitiveness of the national economy, many initiatives are undertaken, among which strategic research programmes can be distinguished. They are mostly financed from state funds (in case of Europe also

from the European funds). Such programmes are characterised by an abundance of levels, a multitude of objectives, and a high financing scale; therefore, it is necessary to systematically evaluate them.

Evaluation of strategic research programmes is not an easy process, mostly due to a time factor that causes that not everything which was planned before the start of the programme is valid during and after its realisation.

In such a case, the following questions come to mind: What should be done when any obstacles appear during the realisation of the programme? Should the individual projects undertaken in a strategic research programme be continued, changed or terminated? How can we improve the effectiveness of the realisation of a programme? In literature there are many evaluation approaches [1–8] that can be used for the needs of strategic research programmes; however, none of them contains a methodology which allows for the assessment starting from the launch of a programme until some years after its termination.

In order to make proper decisions, it is necessary to conduct a detailed evaluation of the programme. The evaluation process should relate to all levels of a strategic programme, e.g. the project, the project group and the thematic group levels and it should be dynamic, which means that a programme should be assessed at different times (*ex-ante*, *on-going*, *mid-term*, *ex-post*, *follow-up*) of the realisation.

The author designed an evaluation methodology relevant to a strategic research programme with the static (the structure of the programme) and the dynamic (time) elements taken into consideration (see Figure 1) [9].

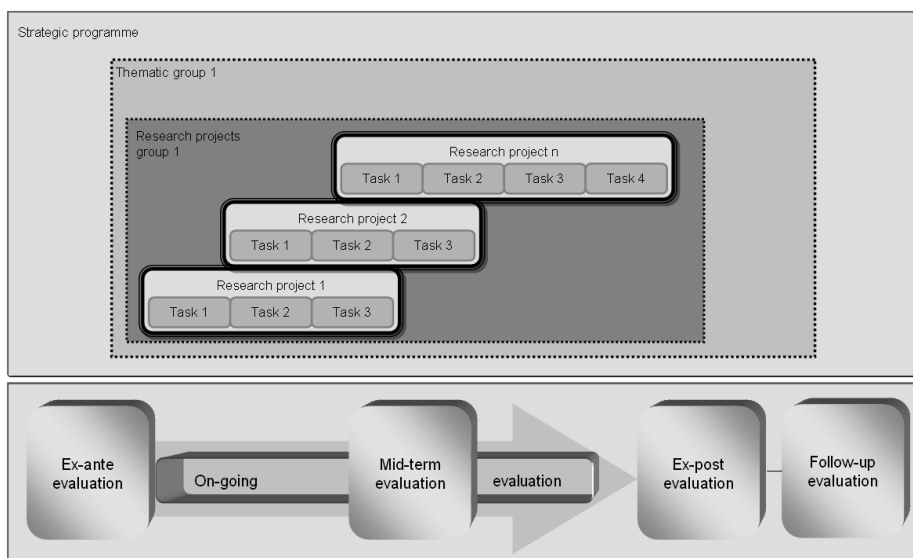


Fig. 1. The static and the dynamic elements included in the evaluation methodology
Source: Author.

This methodology is composed of many procedures, including a procedure for the assessment of research projects, and this procedure seems to be one of the most significant. The procedure enables one to assess research projects from the formal and the factual perspectives. It allows for the organisation realising the strategic research programme on launch, to take the decision on continuation or termination of research projects, if such decision contributes to the improvement of the effectiveness of the whole programme.

1. Analysis of the state-of-the-art

Depending on the objectives of the organisation realising a strategic research programme, different aspects determine the success of a programme. For instance, in most cases the marketability of products is a very important aspect for the successful realisation of a strategic research programme, because the market demand for the products determines the general success of the programme [10, 11]. However, if the results of research projects undertaken are directed to specific beneficiaries, the most significant aspects seem to be the implementation maturity or innovativeness of the results developed in the research projects.

Having analysed 15 case studies of strategic research programmes from Poland, other European countries and non-Europe countries, and literature review [12–18], the author states that there is a lack of a precise division between the two levels of evaluation (formal evaluation and factual evaluation stated above). There is a kind of disorder in the evaluation process due to the mixture of the evaluation criteria and the lack of the assessment of the criteria, which are especially important due to the implementation aspects. There are some strategic research programmes (e.g. CREST – Japan, FinNano – Finland, Voucher for Innovation – Poland) [19–21], in which the sequence in the evaluation is recognised, starting from the criteria of the factual evaluation followed by the assessment of the aspects adequate for the formal evaluation. In the rest of the case studies analysed, the sequence of the evaluation process was not identified.

The lack of the consideration of all evaluation criteria, which are essential for the complexity of the evaluation process, can be the reason that the results of research projects undertaken within strategic research programmes do not often correspond to the needs of the society. As it can be found in literature, the executors of strategic programmes prefer continuing the realisation of the projects which do not bring any significant values and do not have any further perspectives [22, 23]. They want to finish them correctly from the formal point of view, especially to submit a report to the relevant organisation and to start a new programme. They do not often think about the scientific and implementation values of the results.

2. Complex evaluation approach for research projects

In order to implement products successfully into the economy, they have to be assessed from different perspectives, i.e. economic, technological, social and legal. The author's complex evaluation approach contains two types of evaluation: formal (1st step of evaluation) and factual (2nd step of evaluation).

In order to decide if projects should be evaluated positively or negatively, sets of assumptions for both formal and factual evaluations were designed.

2.1. Formal evaluation of the research projects

The basic aim of the formal evaluation is to assess organisational aspects of a research project:

- Goals (the level of the achievement of goals),
- Results (the level of the achievement of results),
- Budget (the level of spending funds), and
- Management style (e.g. the coordination style of the projects, forms of communication between research teams, etc.).

Depending on the evaluation type (*ex-ante*, *on-going*, *mid-term*, *ex-post*, *follow-up*), the elements are assessed in a different way.

The objective of the *ex-ante* evaluation is to verify if the goals, the results and the budget are established and if they are coherent to each other. Moreover, the management style is assessed. (how the projects will be coordinated, what communication styles between people engaged in the realisation of the project will be used, how the efficiency and the effectiveness of the realisation of the projects will be ensured, etc.)

In the *on-going*, the *ex-post* and the *follow-up* evaluations, the level of the achievement of goals and results, the amount of funds spent and a *modus operandi* in the projects will be assessed.

2.2. Factual evaluation of the research projects

The second step of the complex evaluation is the factual evaluation for which the following premises must be fulfilled:

- In the *ex-ante*, the *ex-post* and the *follow-up* evaluations, all elements of the formal evaluation must be positively assessed.
- In the *on-going* evaluation, some elements of the formal evaluation can be negatively assessed.

In order to assess the projects in details from the factual point of view, the author proposes a set of indicators to be used that are relevant to the assessment of the products developed within the projects assessed. The selection of the indicators depends on which aspects are the most important in the evaluation for the institution commissioning the evaluation. For instance, if the commercial

potential aspect [24] is dominant, the author designed a set of indicators grouped according to the following areas: technological, financial, social, and legal. The examples of those indicators are the following:

- Technological area – attainability of full process parameters, attainability of ecological rules (ecological risk);
- Financial area – production cost-effectiveness, financing of the research from state funds or the European funds;
- Social area – market demand; and,
- Legal area – political regulations influencing the production of the products.

There are different sets of indicators for other assessment aspects, e.g. for the innovativeness level or the implementation-maturity level [25].

2.3. Assumptions for the complex evaluations of the research projects

In the case of formal evaluation, it is assumed that the negative assessment of one of the following elements should cause that the results of the formal evaluation are negative: goals, results, budget, management style. However, even if the formal evaluation turns out to be negative, the author indicated variants in which factual evaluation can be positive. Such variants were possible to design only for the *on-going* stage, because only at this stage there are opportunities to introduce “improvement” actions. In the *ex-ante*, the *ex-post* and the *follow-up* evaluations such actions are not possible to undertake.

W is a variant in which formal evaluation is negative, but factual evaluation may be positive.

$$W(W_x)$$

$$W_x \in \{W1, W2, W3, W4, W5\},$$

where:

0 – unfulfilled indicator = negative

1 – fulfilled indicator = positive

k – real variant

Five variants were assumed in which formal evaluation at the *on-going* stage may be negative; however, factual evaluation may still be positive.

W [goals, results, budget, management]

W1 [0, 0, 1, 1]

W2 [0, 0, 0, 1]

W3 [1, 1, 1, 0]

W4 [1, 1, 0, 1]

W5 [0, 0, 1, 0]

$$\{x \in X: W_x - k = 0\} \neq \emptyset$$

The assumptions for the factual evaluation are different, depending on which aspects are the most significant for the organisation realising the strategic

research programme. As an example, consider the assumptions for the factual evaluation in the case when the commercial potential is the most important issue to be assessed:

$$I(I_w) = \begin{cases} 0 & \text{– unfulfilled indicator = negative} \\ 1 & \text{– fulfilled indicator = positive} \end{cases}$$

I – area

$w \in \{l, f, s, t\}$

l – legal area

f – financial area

s – social area

t – technological area

$$I(W) = I_l \times I_f \times I_s + 0,5I_t$$

It is assumed that, in the case of the lack of the fulfilment of any indicators from the legal, financial, or social areas, the factual evaluation of the research project should be definitely negative. In the case of the lack of the fulfilment of the indicators from the technological area, there is an opportunity to undertake correction activities in order to continue the research project.

The algorithm for the complex (formal and factual) assessment of research projects realised within a strategic programme is presented in Figure 2.

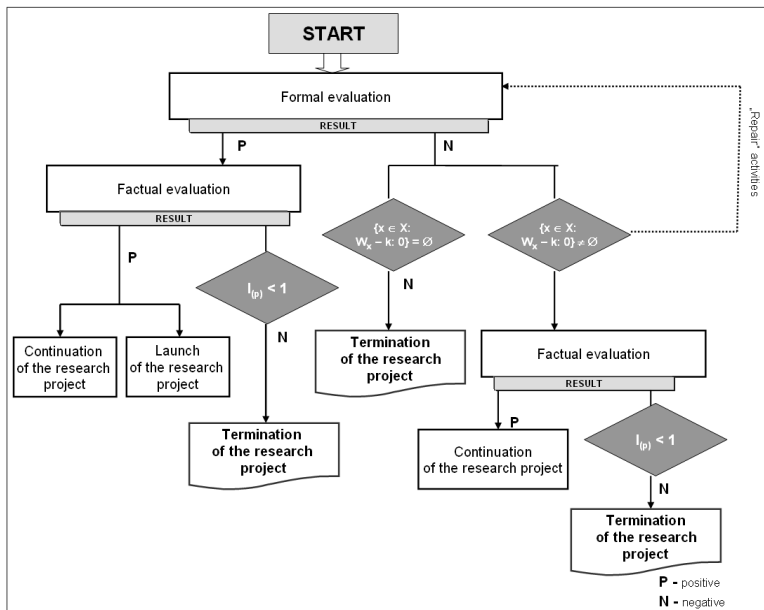


Fig. 2. The algorithm for the detailed assessment of research projects realised within a strategic programme

Source: Author.

The algorithm assumes a two-level evaluation: formal evaluation and factual evaluation. In the case of a positive formal evaluation, the next step is to conduct the factual evaluation. In the case of negative formal evaluation, it is possible to conduct the factual evaluation, but only if the variant indicated in the assumptions for the formal evaluation is fulfilled (the variants can only be developed for the *on-going* stage). If not, the rejection of a project application (*ex-ante* evaluation) or the termination of a research project (*on-going* evaluation) takes place. In the case of the factual evaluation, if it is positive, the launch or the continuation of a research project takes place. If it is negative, the project is terminated.

This approach enables decisions to be taken at launch, continuation, or termination of research projects.

3. The usage of the complex evaluation approach

The importance of the application of the proposed approach for the assessment of research projects results from the fact that the correct realisation of all tasks, that were planned in the project, does not always mean that the final evaluation must also be positive. Moreover, *vice versa*, the incorrect realisation of some of the planned tasks does not cause that the final evaluation of the project must be negative [26]. The essence of this evaluation is that this process is not a simple summing of evaluation results but, which is most important, a process of the assessment of the aspects which are significant for the executors of the programme, e.g. the real relevance of the project subject-matter with the market needs and market environment and the national strategic R&D priorities.

The set of possible evaluation results of a research project, with the complex evaluation approach taken into consideration, are presented in Table 1.

Table 1. Juxtaposition of the results of the evaluation of research projects within a strategic programme

Case	Formal evaluation of the project	Factual evaluation of the project	Final evaluation result
1	Positive	Positive	Positive
2	Positive	Negative	Negative
3	Negative	Positive	Positive
4	Negative	Negative	Negative

Source: Author.

Let us focus on cases No. 2 and No. 3 from Table 1. Case No. 2 is presented in Figure 3. From the formal point of view, the research project is realised correctly, but from the factual point of view, it does not correspond to the needs of the industry.

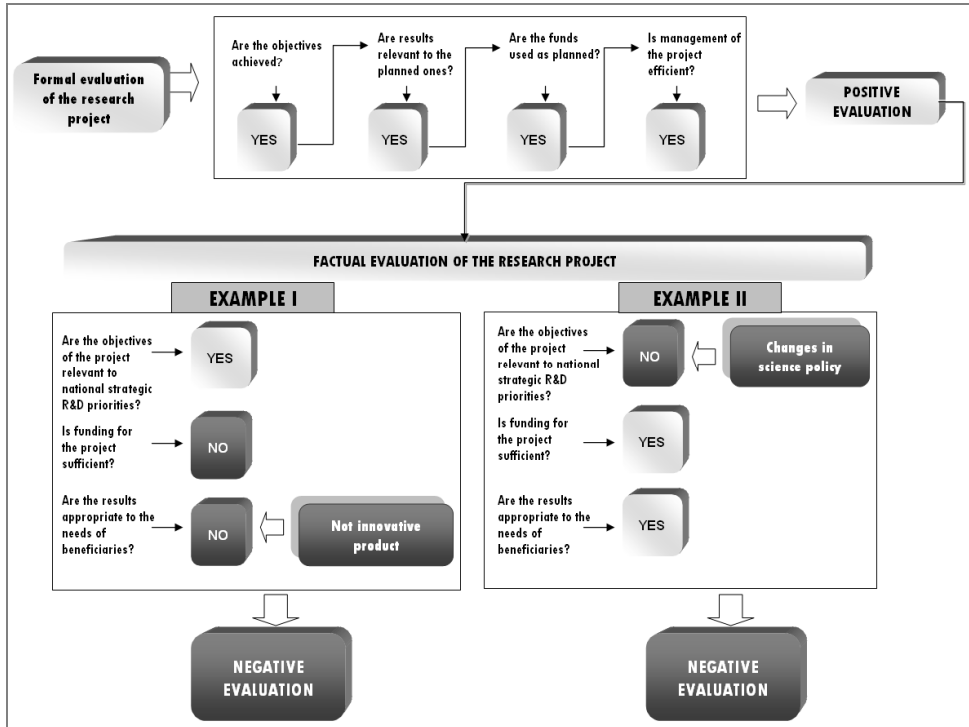


Fig. 3. Situations of negative final evaluations of the projects undertaken within a strategic research programme

Source: Author.

The first example of the negative factual evaluation of the project refers to the situation in which the innovativeness of the products developed within the research project is missing. This lack of innovativeness can cause that, e.g., the product is no longer interesting for the end users. Maybe more innovative and cost-effective products have appeared on the market, so that the beneficiaries do not want to use the originally envisioned product anymore.

The second example refers to the situation in which the content of the research project is not relevant to the national strategic R&D priorities (e.g. due to changes in national science policy), so that there is a lack of perspectives for further successful development of the products.

However, the approach proposed considers the continuation of some research projects that are not fully realised in a correct way from the factual point of view, e.g. the budget allocated was too low for the realisation, which makes the development of the planned products impossible, but the project results are still expected on the market (see Figure 4).

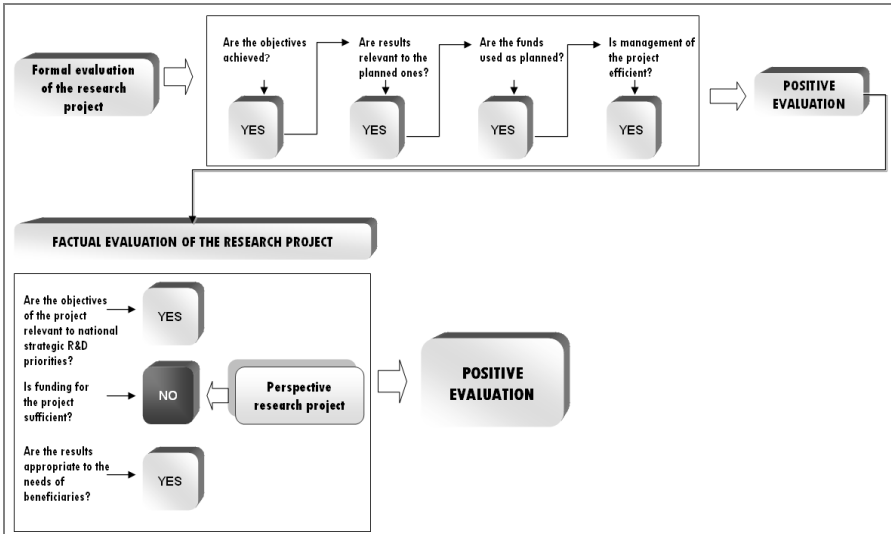


Fig. 4. Positive factual evaluation of the research project despite a negative assessment of one of the criteria
Source: Author.

In this case, there is the possibility to make a contribution to the research project with the funds coming from other research projects in which, e.g. the costs of the development of products are lower than planned in advance, or the opposite, the costs of the development of products with the comparison of potential benefits achieved from these products by the beneficiaries are too high (see Figure 5).

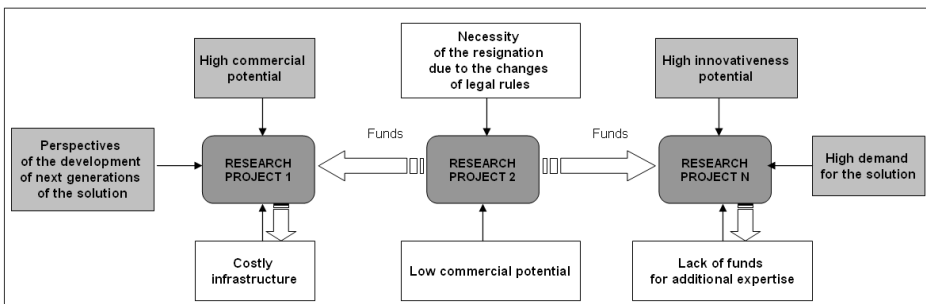


Fig. 5. Example of the modification of finances between research projects realised within strategic research programme
Source: Author.

Figure 5 presents the possibility of the financial support of Project No. 1 and Project No. N. Project No. 1 is characterised by high commercial potential,

and there are perspectives for the development of the next generation of the products; however, the research infrastructure needed for the realisation of the project is very expensive. Project N is characterised by a high innovativeness potential and market interest. However, it is essential for additional assessments to be carried out for which there are insufficient funds. Project 2 has low commercial potential and the product cannot be developed due to the introduction of changes in legal regulations, according to which the manufacture of the product in the planned version is made impossible. The proposed approach assumes the possibility of the transfer of funds from Project 2 to Project 1 and Project N, since they agree with the needs of the industry. At the same time, the realisation of Project 2 is terminated.

In case No. 3 from Table 2, the situation is the opposite. The project results are relevant to the economy; however, the project is not realised correctly from the formal point of view (see Figure 6).

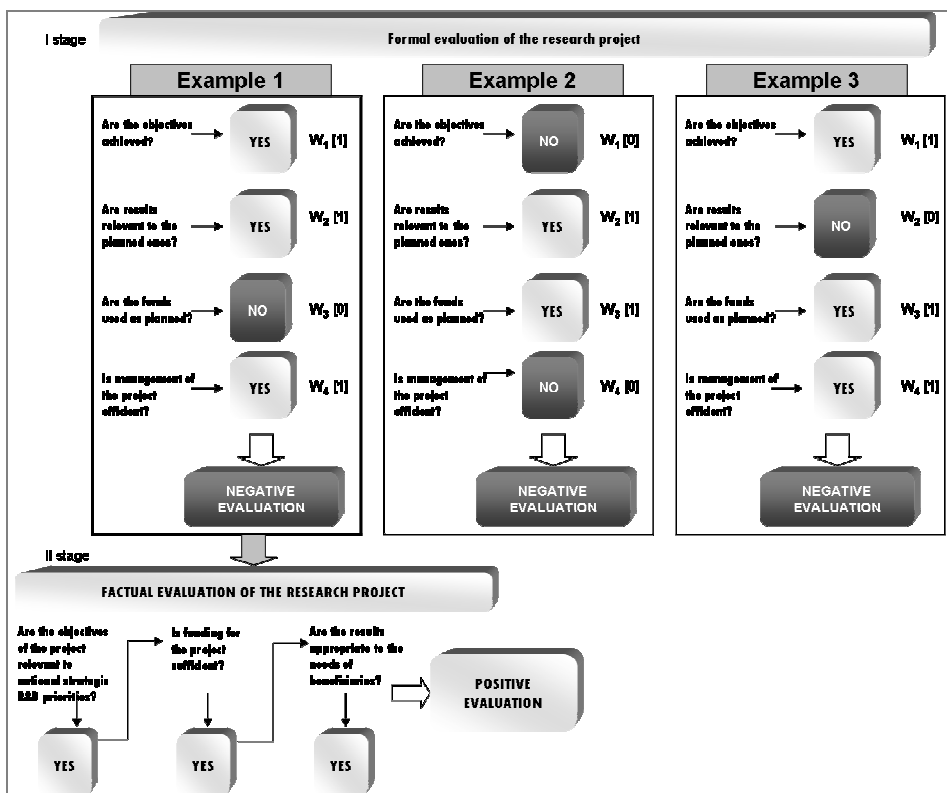


Fig. 6. Negative formal evaluation vs. positive factual evaluation of the research project realised within the strategic programme

Source: Author.

Figure 6 presents three examples of the negative formal evaluation of a research project realised in a strategic research programme. Having considered all assumptions, it turns out that only the first example, despite the negative outcome of the formal evaluation, can have a positive factual evaluation. The remaining two cases do not fit in the assumption $\{x \in X: W_x - k = 0\} \neq \emptyset$. Therefore, in this case, the factual evaluation is not even conducted.

Conclusions

The proposed evaluation approach is currently applied in a Polish national strategic research programme “*Innovative Systems of Technical Support for Sustainable Development of Economy*” [27], undertaken for the 2010–2014 period and coordinated by the Institute for Sustainable Technologies – National Research Institute (ITeE – PIB). The main advantage of the multi-level evaluation approach is that it can be a tool for supporting the decision-making of organisations undertaking strategic research programmes. It can be used to indicate what steps should be taken to ensure the highest effectiveness of the whole programme.

The approach proposed has some useful implications for the management staff of research organisations and evaluators who are interested in effective and efficient realisation of strategic research programmes. The usage of the proposed evaluation approach enables the organisation to increase the effectiveness and efficiency of works undertaken within strategic programmes through supporting decisions on introducing changes in the programme. These include the following:

- Termination of research projects with little perspective;
- Continuing the realisation of the research projects whose realisation does not fully comply with what was planned but are realised correctly from a factual point of view;
- The transfer of funds to perspective research projects from other projects in which, e.g., the costs of the development of solutions are lower than was assumed; and,
- The launch new projects if they are innovative and perspective, with the use of funds coming from projects that were terminated.

The strong need to assess research projects, both from the formal and factual points of view, should be stressed, because this assessment contributes to the improvement of the effectiveness of the realisation of the whole strategic research programme.

References

1. Patton M.: *Utilisation-focused evaluation – the New Century Text*. Sage Publications, 1997.
2. King J.A.: *Participatory evaluation*, [in]: Mathison S. (ed.): *Encyclopaedia of Evaluation*, Sage Publications, Thousand Oaks – London 2005.
3. Sana E.A.: *Teaching and Learning in the Health Sciences*, Philippines 2010.
4. Scriven M.: *Pros and cons about goal-free evaluation*, [in]: Glass G.V (ed.): *Evaluation Studies Review Annual*, Vol. 1, Sage Publications, Beverly Hills 1976.
5. Stufflebeam D.L., Madaus G.F., Kellaghan T.: *Evaluation models: viewpoints on educational and human services evaluation*, Massachusetts 2000.
6. Stronge J.H., Tucker P.D.: *Handbook on teacher evaluation: assessing and improving performance*, New York 2003.
7. Stufflebeam D.L., Shinkfield A.J.: *Evaluation theory, models, and applications*. San Francisco: Jossey-Bass 2007.
8. Chen H.T.: *Theory-Driven Evaluations*, [in]: Mathison S. (ed.): *Encyclopaedia of evaluation*, Sage Publications, Thousand Oaks-London 2005.
9. Łopacińska L.: *Model procesu ewaluacji strategicznych programów badawczych w obszarze innowacji technicznych (praca doktorska w przygotowaniu)*, Radom 2012.
10. Chifos C., Jain R.K.: *A comprehensive methodology for evaluating the commercial potential of technologies: the strategic technology evaluation method*. *International Journal of Industrial Engineering*, 1997, Vol. 4, no 4, pp. 220–235.
11. Jain R.K., Martyniuk A.O., Harris M.M., Niemann R.E., Woldmann K.: *Evaluating the commercial potential of emerging Technologies*, *International Journal Technology Transfer and Commercialisation*, 2003, Vol. 2, no 1, pp. 32–50.
12. Kneller G.: *Goal-free evaluation: Evaluation comment*. *The Journal of Educational Evaluation*, 1972, Vol. 3, no 4: 13–15.
13. Marsh J.: *The goal-oriented approach to evaluation: Critique and case study from drug abuse treatment*. *Evaluation and Program Planning*, 1978, Vol. 1, no 1, pp. 41–49.
14. Scriven M.: *Prose and cons about goal-free evaluation*. *American Journal of Evaluation*, 1991, Vol. 12, no 1, pp. 55–62.
15. Patton M.Q.: *Utilisation-focused evaluation: the new century text*. Sage Publication, London 1997.

16. Gargani J.: The history of theory-based evaluation: 1909 to 2003. Paper presented at the American Evaluation Association annual conference, Reno, NV, 2003.
17. Weiss C.H.: On theory-based evaluation: Winning friends and influencing people. *The evaluation exchange*, 2004, Vol. IX, no 4, 1–5.
18. Chen H.T.: Theory-driven evaluations, [in]: S. Mathison (ed.), *Encyclopaedia of evaluation*, Sage publications, Thousand Oaks – London 2005, pp. 415–419.
19. Japan Science and Technology Agency: Evaluation of JST strategic basic research programs. The 2nd International Advisory Committee. September 2011.
20. Koponen P., Kalander J.K., Kuursisto M.: FinNano Programme. Intermediate Evaluation. TEKES review 241/2008. Helsinki.
21. Polska Agencja Rozwoju Przedsiębiorczości: Ocena efektywności i skuteczności Programu Bon na Innowacje. Warsaw 2010.
22. Kandel E., Leshchinskii D., Yuklea H.: VC fund's limited horizon as a source of inefficiency. Social Science Research Network, 2004.
23. Bannier Ch.: Heterogeneous multiple bank financing under uncertainty: Does it reduce inefficient credit decisions? Working paper series. Johann-Wolfgang-Goethe-Universität Frankfurt am Main, Fachbereich Wirtschaftswissenschaften: Finance and Accounting, 2005.
24. Łopacińska L.: Ponadstandardowe metody ewaluacji strategicznych programów badawczych. *Problemy Eksploatacji* 3/2011 (82), pp. 33–46.
25. Mazurkiewicz A., Karsznia W., Giesko T., Belina B.: Metodyka oceny stopnia dojrzałości wdrożeniowej innowacji technicznych. *Problemy Eksploatacji* 1/2010, pp. 5–30.
26. Łopacińska L.: Model procesu ewaluacji strategicznych programów badawczych w obszarze innowacji technicznych (praca doktorska w przygotowaniu), Radom 2012.
27. Mazurkiewicz A. (ed.): *Innovative Technological Solutions for Sustainable Development*. ITeE – PIB Radom Shanghai 2010.

Reviewer:

Andrzej KALETA

Wpływ ewaluacji wielopoziomowej na podniesienie efektywności zarządzania strategicznymi programami badawczymi

Słowa kluczowe

Ewaluacja formalna, ewaluacja merytoryczna, strategiczny program badawczy, efektywność programu.

Streszczenie

W artykule zaprezentowano kompleksową procedurę ewaluacji dla projektów badawczych realizowanych w ramach strategicznego programu badawczego, obejmującą dwa wymiary: ewaluację formalną oraz ewaluację merytoryczną. Głównym celem procedury jest zapewnienie prawidłowej realizacji projektów oraz efektywne wdrażanie uzyskanych rezultatów do gospodarki. Zaprezentowana procedura ewaluacji jest narzędziem wspomagającym proces podejmowania decyzji w odniesieniu do programu strategicznego, ukierunkowanym głównie na wprowadzanie modyfikacji do projektów badawczych, jeżeli takie zmiany są niezbędne w celu zwiększenia efektywności realizacji strategicznego programu badawczego.