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MODEL FOR THE HIERARCHIC APPLICATION OF FORESIGHT PROJECT RESULTS

Key words

Innovation policy, advanced technological solutions, foresight, strategic programme.

Summary

The article presents two crucial and correlated issues concerning the hierarchic structure of foresight projects and the practical application of their results. Nowadays, there are weak linkages observed between national foresight projects and foresight projects realised on the sectoral and corporate levels. On the other hand, the range of the practical application of the results of foresight projects remains insufficient. The article presents an outline of the model for the hierarchic application of foresight project results. The model is based on the need of greater interrelations of foresight projects at subsequent hierarchic levels: national, sectoral, and corporate one.

Introduction

Innovativeness and competitiveness of the economy are determined by an effective realisation of R&D strategies at macroeconomic, national, and microeconomic levels, which are the levels of operation of innovative companies and research institutions. The development strategies are largely shaped by the economic situation and global technological development trends. Science, industry, and the government are involved in this process at the

strategic level (macro); whereas, innovative companies and R&D institutions, which are responsible for the development and implementation of advanced technologies in priority, research directions, play an important role as far as the operational (micro) level is concerned. The identification of future research directions and the generation of short- and long-term trends in the development of advanced technologies, conducted within foresight projects at different levels – national, sectoral, and corporate play crucial roles at the time of forming and realising the development strategies. Foresight is understood as “the process involved in systematically attempting to look into the longer-term future of science, technology, the economy, and society with the aim of identifying the areas of strategic research and the emerging generic technologies likely to yield the greatest economic and social benefits” [1]. The determination of the areas of strategic research is of key importance from the perspective of research institutions, because it supports the design of a short-, medium-, and long-term thematic scope and strategy of their R&D activities. Practical application of foresight project results enables research in areas in which a particular institution has appropriate and substantial infrastructure, and financial potential.

The authors of this paper have participated and managed foresight projects at different levels, among others, the National Foresight Programme “Poland 2020,” sectoral foresight “Advanced Industrial and Ecological Technologies for the Sustainable Development of Poland” as well as corporate foresight. Experience obtained and the analyses of foresight project results realised in Poland and other countries indicated that there is a lack of interrelation of foresight executed at the higher level, e.g. the national one, with those executed at lower levels (regional, sectoral, corporate). New foresight projects financed from European structural funds are frequently undertaken in a chaotic way, in many cases without consideration of the results of other and previously executed foresights. To achieve valuable results from the execution of foresight projects at different levels, it is of crucial importance to ensure the hierarchic interrelations between priority research areas generated within national foresight projects and sectoral ones (identification of the research areas of the future and visions for their development) as well as corporate foresights (indication of key technologies to be developed at a research organisation or in an enterprise). However, there is a lack of a consistent methodology of hierarchic mechanisms for the application of foresight results.

1. State-of-the-art

Foresight applied for the creation of medium- and long-term visions of the economic and social development has been in use for a few decades. It has won general acclaim and has been performed on a large scale to direct science, technology, and innovation policies in a number of countries and on many different organisational levels, including supra-national, national, sectoral,

regional, and corporate (used both by public and private organisations) [2, 3, 4]. Foresight facilitates and supports the processes of decision making in the area of future sustainable development. However, as already stated, foresight projects realised at different levels are somewhat independent of one another, without any crucial application of the results at lower levels. Nowadays, there are weak linkages observed between national foresight projects and foresight projects realised at the sectoral and corporate levels [5]. On the other hand, the range of practical applications of the results of foresight projects concerning, for instance, the determination of priority research directions to be financed at the national level, or the introduction of new types of programmes or institutions stimulating the development of the domains of strategic character, remains insufficient.

Often, the effectiveness of the results of implementing foresight projects can only be evaluated from a distant time perspective. Initiatives undertaken in order to evaluate national and transnational foresight projects are focused mainly on the evaluation of the organisational and methodological aspects of the programmes and whether the planned objectives were achieved [6]. Presently, proving and measuring the value and impact of foresight studies has become the critical challenge. The challenge has been recognised by some researchers who have made the effort to develop models and frameworks for the evaluation of foresight projects, including the aspect of foresight impact [7, 8, 9, 10]. The scientific work on foresight evaluation models is still in progress. Knowledge of the aspects of practical implementation of foresight project results is still fragmentary, not widely disseminated, not well indicated in publications, and examples of such implementation activities are rare. Nevertheless, some foresight projects have ended with the practical application of their results, i.e., the recommendations were used in launching new research programmes at the national or regional level [11, 12, 13] or specialised projects for the support of research directions of the future. Additionally, results of foresights were applied to introduce changes in existing R&D financing mechanisms [14, 15, 16, 17].

Furthermore, although not common, some examples of applying national foresight results at lower levels can be indicated. Such a situation can be observed in Russia, where a system of technology forecasting has been created that focused on ensuring the future needs of the manufacturing sector of the national economy, including the development of key industrial technologies [18]. Beneficiaries of foresight results include the following: state departments responsible for forming S&T policies, regional authorities developing regional R&D strategies, high-tech companies, and research organisations.

In Germany, interest in practical application of foresight results also exists with numerous organisations, not only national administration, including regional administrations, companies, associations, research and consulting organisations [19]. A focus on the dissemination and implementation of national foresight results to the business community, especially SMEs, as well as on the

regional level, is also observed in United Kingdom [11]. In China, technology foresight results are used by key organisations (including local government, the Chinese Academy of Sciences) in the course of their strategy constructs [20].

In Poland, foresight activities are fragmented among many actors and the linkages between different levels are weak. On the national level, the first foresight initiative was the National Foresight Programme “Poland 2020” ordered by the Ministry of Science and Higher Education (2006–2008), which was followed by the National Foresight Programme “Poland 2020” – results implementation (2011–2015). So far, ca 40 sectoral and regional foresight projects have been executed in Poland. Few of them derive from the continuation of other foresight initiatives, including national and sectoral foresight [21]. However, a trend is observed that the latest foresight projects undertaken in Poland represent a more complex approach to the interconnection of the scope and results of foresight initiatives at different levels – national, sectoral, regional, and corporate.

Summing up, although not numerous, some examples of the practical application of foresight project results and the implementation of the hierarchic approach to the generation of new scientific directions and future technologies are known. However, the hierarchic structure of applying project results has not been popularly used or knowledge on this issue has not been sufficiently disseminated.

2. Methodology

The authors of the article proposed a model for the hierarchic application of foresight project results concerning technological solutions in the field of technical support for sustainable development. The proposed model assumes that the priority directions are determined by national economic and scientific development strategies incorporating the results of foresight programmes (at national or sectoral levels). Priority research topics selected at the macro level within the national foresight, which are typically undertaken every 10–15 years, and sectoral foresight projects, which are typically undertaken every 5 years, are directed at the determination of key R&D directions and the visions for their development. The directions that are strategic for the country are verified and detailed within sectoral foresight projects and implemented in corporate foresight projects realised cyclically, not rarer than every 3 years. They target the generation of innovative technologies that condition the functioning of the R&D institutions or the enterprises. Research directions conducted at research organisations are determined, on the one hand, by the results of foresight projects at different levels and, on the other hand, by national strategies of scientific and economic development (Fig. 1).

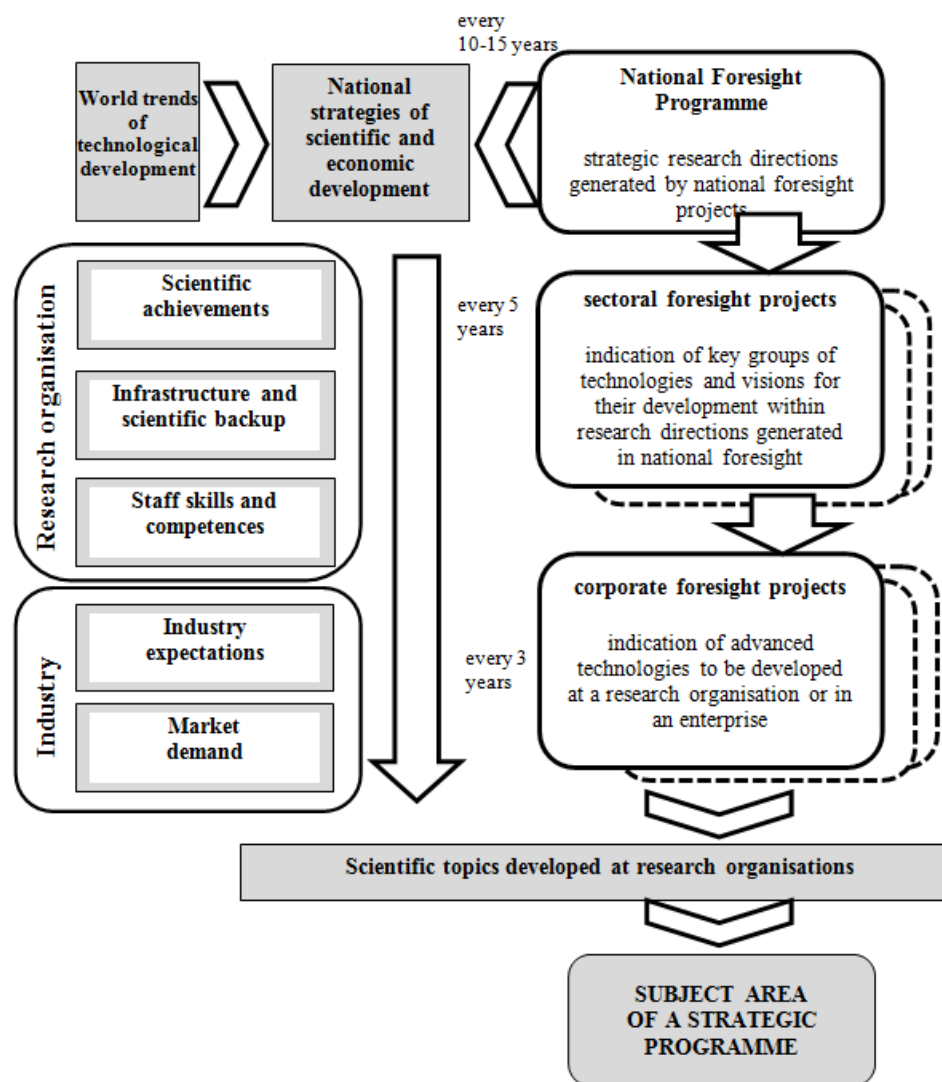


Fig. 1. Hierarchic structure of determining priority research directions conducted at research organisations

Source: Authors.

Indicated priority research directions and incremental and emerging technologies within them are detailed topics that should be incorporated into research projects that have been realised.

Priority research directions are developed within different research programmes out of which the strategic programmes seem to be the most effective. Their subject areas are generated with the consideration of the

priorities included in strategic European and national documents, strategic programmes, and projects previously conducted by R&D institutions, as well as the results of foresight projects at different levels. In practice, these strategic programmes enable the realisation of tasks in directions considered to be of the greatest importance for the development of the economy.

The joint consideration of the results of different kinds of foresight projects (national, sectoral, corporate) and the areas of innovative projects conducted at a research organisation, including those carried out within national research programmes, along with the research organisation's potential and industry's expectations and needs, enable the identification of the thematic areas of strategic research programmes.

3. Findings and interpretation

The presented model has been applied in practice. The National Foresight Poland 2020 [22] realised with significant factual and managerial input of the authors of the article assumed the general characterisation of areas of key importance to national economic growth. The directions indicated within the National Programme were then detailed within the sectoral foresight managed by the authors of the article concerning the technical support for sustainable development of the economy [23] within which research directions of the future were first identified for mechatronic, materials and nanotechnologies, technical and environmental safety, and green technologies, as well as for test and research apparatus. Then priority incremental and breakthrough technologies in these fields were generated and characterised.

Next, the technological institute – Institute for Sustainable Technologies – National Research Institute (ITeE – PIB) in Radom, Poland conducted corporate foresight as far as the aforementioned research areas are concerned. The corporate foresight allowed the identification of priority technologies and their research tasks, which were both closely correlated with the strategic R&D directions generated in the national and sectoral foresight projects and took the research, infrastructure, and financial potential of the organisation into consideration [24].

The hierarchic structure for the realisation of foresight projects and a consistent structure of results obtained are presented in Figure 2. The practical application of the designed model is represented in Table 1, which is based on the example of sectoral foresight with regard to one selected domain – environmental technologies.

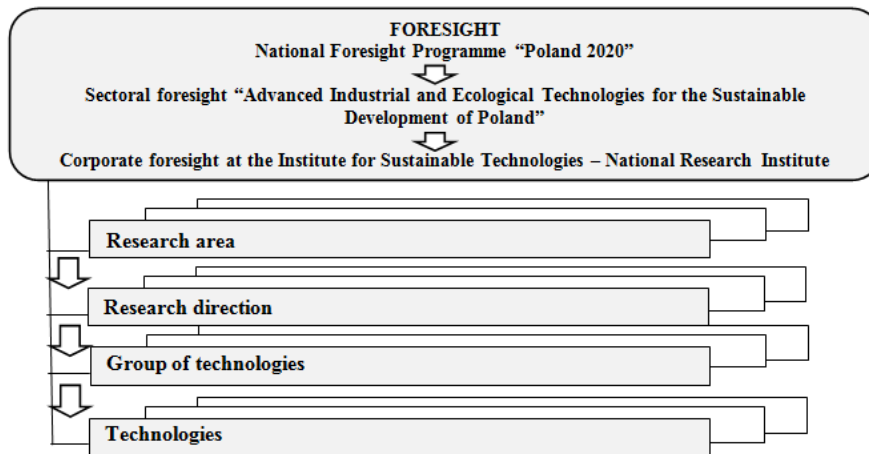


Fig. 2. Hierarchic structure for the realisation of foresight projects and a hierarchic structure of results obtained
Source: Authors.

Table 1. Practical application of the model of the hierarchic structure for the realisation of foresight projects based on the example of the sectoral foresight “Advanced Industrial and Ecological Technologies for the Sustainable Development of Poland”

Research area	Research direction	Group of technologies	Technologies
Environmental technologies	Production technologies for maintenance materials with higher ecological value	Production technologies for biodegradable operating fluids and plastic lubricants	Production technologies for special lubricating materials
			Production technologies for special, ecological operating fluids based on natural and synthetic components
		Technologies of production of bio-components of operating fluids	Production technologies for special, ecological operating fluids based on natural and synthetic components
			Production technologies for special lubricating materials
		New generation of lubricating materials with nanoparticles	...
	Technologies of production of contemporary biopolymer materials, polymers and composites with higher biodegradability	...	
Technologies for the rationalisation of the use of resources	

Source: Authors.

The designed hierarchic model was applied for the creation of the thematic scope of the strategic research programme undertaken at the technological Institute for Sustainable Technologies – National Research Institute (ITeE – PIB) in Radom, Poland. The application of the presented approach resulted in the generation of the currently realised Strategic Programme funded from EU structural funds “Innovative Systems of Technical Support for Sustainable Development of Economy,” 2010–2014, within which technological solutions facilitating sustainable economic growth are developed (Fig. 3).

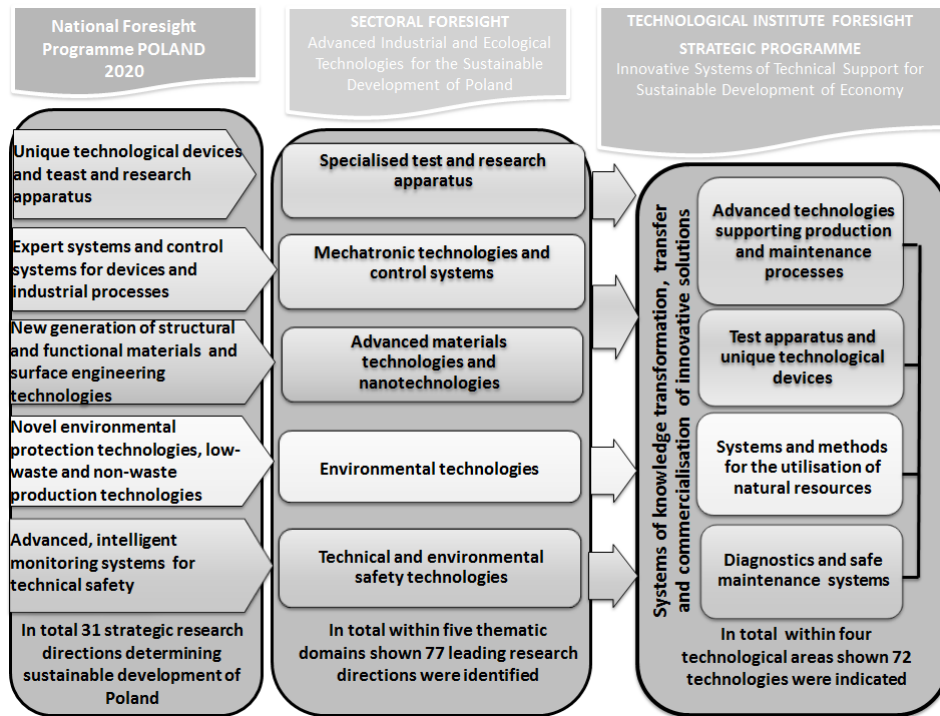


Fig. 3. Generation of the subject area of the Strategic Programme “Innovative Systems of Technical Support for Sustainable Development of Economy”
Source: Authors.

The subject matter of the Strategic Programme has been determined, on the one hand, by the priorities indicated in EU and national strategic documents, thematic areas of governmental programmes of strategic importance, priorities of National Foresight Programme “Poland 2020,” and, on the other hand, by the results of the sectoral foresight project “Advanced Industrial and Ecological Technologies for the Sustainable Development of Poland” [25, 26] and the results of the corporate foresight project, conducted by the authors of the article [27].

The Strategic Programme was submitted within the Innovative Economy Operational Programme co-financed from EU structural funds. It was assessed by an international team of experts, won over other prominent competitors, and was approved for realisation in the 2010–2014 period. The fact that the strategic programme was granted the funds for its realisation strongly confirms that the proposed research directions are of priority to the development of the economy and that the perspective character of research tasks within the indicated directions will positively influence the competitiveness and innovativeness of the economy and primarily the efficiency of modelling hierarchic foresights. The Programme is aimed at the development of both advanced product and process solutions that are ready for practical industrial implementation in the area of manufacturing and maintenance of technical objects and system solutions supporting their application [28, 29].

Conclusions

Foresight results achieved at different levels are useful information in the course of designing research strategies and innovation policies [20]. Foresight provides an overall strategic review of innovation actions at national, regional, sectoral, and corporate levels, and it identifies research and innovation priorities at these levels. Adoption of the hierarchic approach to foresight execution contributes to building common development visions between innovation actors and more focused innovation development in the determined priority areas.

The article presents an outline of the model for the hierarchic application of foresight project results. The model and an example of its practical application are presented. It is important to ensure greater interrelations of foresight projects at different hierarchic levels. The model presented assumes the interrelation of a national, sectoral, and corporate foresight. It would be advisable to widen the scope of the analysis and include the aspect of the relations between the European-level foresight projects and national foresight projects, as well as relations between sectoral and corporate foresight projects. It is important to track the way from the generation of priority research directions at a macro level (European, national) to specific technological solutions developed at a micro level (research organisation, enterprise) and to assess these solutions in terms of their practical application possibilities. Furthermore, the exploration of the possibilities and the effects of the practical application of foresight project results are of crucial importance and should include the evaluation of the effectiveness of foresight projects, analysed both in the hierarchic structure and independently at each level.

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Model hierarchicznego wykorzystania rezultatów projektów foresight

Słowa kluczowe

Polityka innowacyjna, zaawansowane rozwiązania technologiczne, foresight, program strategiczny.

Streszczenie

W artykule zaprezentowano dwa kluczowe i wzajemnie powiązane zagadnienia dotyczące hierarchicznej struktury projektów foresight oraz praktycznego wykorzystania ich rezultatów. Obecnie powiązania między projektami foresight realizowanymi na poziomie krajowym a tymi realizowanymi na poziomie sektorowym czy korporacyjnym należy uznać za niewystarczające. Jednocześnie skala praktycznego wykorzystania rezultatów projektów foresight pozostaje niezadowolająca. W artykule zaprezentowano propozycję modelu hierarchicznego wykorzystania rezultatów projektów foresight. Model zakłada wzajemne powiązanie projektów foresight na kolejnych hierarchicznych poziomach ich realizacji: krajowym, sektorowym i korporacyjnym.