

Selected Sources for Financing Research Based on the Railway Research Institute's Activity: a Case Study

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Summary

The problem of financing research in Poland is a multifaceted, complex, and still current topic. This article attempts to approach the issue from the perspective of institutions benefiting from the funds allocated for research and development, such as the Railway Research Institute. The research methods used in the article are the analysis of source materials and a case study.

Keywords: research institutes, research funds, projects, research and development

1. Introduction

The level and quality of financing research and development activities depends on the given country's policy in terms of science and innovation. After Poland's accession to the European Union, and even during the pre-accession period, new opportunities opened up for the Polish research and development sector. One of the most important legal acts that regulated the rules of financing back then was the Law of 8 October 2004 on the Principles of Financing Science [10]. According to its provisions, decisions concerning the granting of financial funds were taken by the minister competent for science, which meant full centralization of the decision-making process [10]. There was no executive agency – a state-owned legal person that would transfer the funds allocated in the budget for science directly to particular projects or entities carrying out research and development. This resulted in the process of investing public funds in research and development being carried out within the limitations of public administration. Consequently, the efficiency of this system of financing was low. Additionally, the system made Poland stand out negatively against other European countries that had a high innovation index. In highly-developed countries, R&D activity is predominantly financed with non-public funds, mainly by business entities.

In 2000, under the Law of 9 November 2000, the Polish Agency for Enterprise Development (PARP), a government agency subordinated to the minister

competent for the economy, was established. The goal of PARP is to manage state and EU funds assigned for supporting entrepreneurship and innovation and the development of human resources. The contests organized by PARP are addressed to entrepreneurs as beneficiaries. Most projects are designed in such a way that research organizations participate in them as partners or subcontractors. The mission of PARP is to create favorable conditions for the sustainable development of the Polish economy, to support innovation and international activity of enterprises, and to promote environmentally-friendly forms of production and consumption. The purpose of the Agency's operations is to implement programs that make the economy grow and support the activities of SMEs in terms of research and innovation, as well as regional development, the growth of export, development of human resources, and use of new technologies [16].

In 2006, the government started a reform of the system of scientific research in Poland. The new approach assumed splitting the functions of developing and implementing the policy in terms of science, which until then had been centralized in the Ministry of Science and Higher Education. In 2007, the National Center for Research and Development was established as an executive agency of the Ministry of Science and Higher Education, the purpose of which, in accordance with the Law of 27 August 2009 on Public Finance (Journal of Laws of 2017, item 2077, as amended), is to carry out tasks in terms of the state policy concerning science, technology, and

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innovation. At the moment of its establishment, it was a platform for efficient dialog between science and business. Today, it functions under the Law of 30 April 2010 on the National Center for Research and Development [9].

The reform of science introduced in the fall of 2010 provided the Center with more freedom in terms of utilizing financial funds for the purpose of the strategic research program. Additionally, on 1 January 2011, the Center expanded the scope of its operations to include new initiatives and opportunities. Taking over the function of an Intermediate Body for operational programs from the Ministry of Science and Higher Education, the Center became one of the largest entities supporting innovation in Poland. The operations of the Center are financed from the State Treasury and EU funds. Its task is to support Polish research entities and enterprises in developing their capacity to create and utilize solutions based on the results of research in order to spark development in the economy, with benefits for society.

The main goal of the National Center for Research and Development is to manage and implement strategic research and development programs that directly translate to the development of innovation. The tasks of the Center also include supporting commercialization and other forms of transferring the results of research to the economy, managing applied research programs, and carrying out projects in terms of defense and security. The Center also ensures good conditions for the development of scientific personnel, carrying out international mobility programs, among others. Particular emphasis is put on involving young scientists in research programs. They are assisted in improving their qualifications in terms of entrepreneurship, managing intellectual property, and commercializing research results. At the same time, through the initiatives it carries out, the Center promotes the need to raise the awareness of R&D personnel in terms of the importance of industrial property protection within the process of commercializing modern solutions, as well as the possibility of research entities receiving international patent protection [14].

The other executive agency is the National Science Center in Kraków. It is an agency of the Ministry of Science and Higher Education, established to support scientific activities in terms of fundamental research, i.e. experimental and theoretical research undertaken primarily in order to acquire new knowledge about fundamental phenomena and observable facts, without putting practical application or use first. The tasks of the Center include the financing of fundamental research in the form of research projects, doctoral scholarships, and placements after the completion of one's Ph.D., research projects for experienced scientists to carry out pioneering research that is impor-

tant for the development of science, and projects that remain outside the scope of the research financed by the National Center for Research and Development. The National Science Center also supervises the process of carrying out the above research. Additionally, the agency is involved in international cooperation in terms of financing fundamental research, dissemination in the scientific world of information concerning the contests organized by the Center, and inspiring and monitoring the financing of fundamental research using funds from sources other than the state budget. Furthermore, the Center carries out other tasks commissioned by the Ministry of Science and Higher Education, including the development of research programs important for national culture [15].

The establishment of these two agencies was intended to reduce the bureaucracy of and the political influence over the process of distributing public funds to finance R&D. The competence to decide about the granting of funds to particular research entities and projects was shifted from the ministry to executive agencies.

Another important institution involved in the implementation of the plans of the Ministry of Science and Higher Education is the Center for Information Processing. Since 2007, as a Managing Institution, it has been involved in the distribution of EU funds and funds from the Polish-Norwegian Research Fund.

Bank Gospodarstwa Krajowego also takes part in supporting innovation and R&D. The Bank's offer is addressed primarily to small and medium enterprises. They may apply for a technological loan from the Bank. The Technological Loans Fund is co-financed from the European Regional Development Fund as part of the Operational Program Innovative Economy 2007–2013.

Currently, funds for R&D are available from the Operational Program Smart Development. This program is the EU's largest initiative concerning the development of research and innovation. The areas and types of projects supported within the 2014–2020 time frame are specified in the program itself and in the description of its particular priorities. As part of the priority axes and activities into which the program is divided, the following areas and types of undertakings have been defined:

- support for R&D activities carried out by enterprises,
- support for the surroundings and the potential of enterprises in terms of R&D&I,
- intensifying cooperation within the national innovation system,
- supporting innovation in enterprises,
- increasing research and development potential,
- development of modern research infrastructure for the science sector.

Today, science is financed on the basis of the Law of 20 July 2018 on Science and Higher Education [8]. The minister competent for science plans and provides financing to research entities, higher education institutions, and other entities as the administrator of certain budget funds and the intermediate body in some operational programs. The main areas covered with financing include:

- strategic research and development managed by the National Center for Research and Development and other tasks carried out by the Center,
- statutory activities of research entities, including their own research and the maintenance of special research instruments,
- investments intended to support research and development,
- scientific cooperation with foreign entities,
- activities that support research (tasks intended to support the development, promotion, and practical use of science),
- programs or undertakings defined by the minister competent for science.

The level of financing research organizations is strictly related to the national policy in terms of science and innovation and is a result of long-term development strategies. The economic conditions for the development of this sector are specified in the successive national development plans: the National Cohesion Strategy 2007–2013 [5], the National Development Strategy 2007–2015 [7], and the Strategy for Responsible Development Until 2020 [6].

2. Financing of research institutes in Poland

Research institutes receive financial funds from various sources:

- the national statutory subsidy for carrying out its statutory tasks, including for infrastructure and research equipment; the entity granting budget funds to research institutes is the Ministry of Science and Higher Education,
- funds received following participation in contests for national projects that are financed by the National Center for Research and Development and the National Science Center,
- European funds (participation in EU framework projects, structural funds) at the central and regional levels,
- subsidies from the Ministry of Science and Higher Education,
- contracts with enterprises (commissioned projects),
- revenue from licenses and patents,
- multi-annual programs,

- projects financed or co-financed by public administration,
- projects financed by local governments,
- the National Health Fund (medical projects),
- revenue from the commercialization of research (license fees, sale of know-how, etc.),
- revenue from manufacturing unique materials and products.

Research institutes, as one of the three types of entities operating in the R&D sector, receive a so-called statutory subsidy (today referred to as a subvention) from the state budget. The amount of the subsidy depends on the scientific category into which the given institute is classified by the Scientific Evaluation Committee [1]. Most funds come from market agreements and the services provided to the companies operating in the given industry. According to the experience of European countries, a statutory subsidy should provide the institutes with financial stabilization, allowing them to pursue their own research policy and prepare an offer in which enterprises could be interested.

Funds related to participation in EU and national projects are also a strong source of support. Thanks to such projects, in recent years, it was possible to purchase modern and unique research infrastructure and equipment for a number of laboratories. Already at the end of 1999, Polish R&D entities were allowed to take part in the Fifth Framework Program of the European Community for Research, Technological Development and Demonstration Activities (FP5); however, their participation was rather insignificant. In the following years, when FP6 started, there was some improvement in this respect. In 2005, Polish research institutes taking part in FP6 made up 3% of all program participants and Poland came 10th among all EU Member States. The Polish presence was much more impressive in the Seventh Framework Program, which started in 2007. The time frame of the program covered seven years (2007–2013) and its mechanism of financing and shaping research at the European level was the largest ever, with a budget of nearly EUR 54 billion. Currently, the Horizon 2020 program is coming to an end. This is the largest program of financing research and innovation in the history of the EU. Its budget between 2014 and 2020 amounted to nearly EUR 80 billion. The participation of Polish research institutes in Horizon 2020 is significant, although insufficient when compared with other European countries. Approx. 1 % of the entire budget spent so far has gone to Poland. Poland is the leader in Central and Eastern Europe, but still far behind the leaders: the UK, Germany, Spain, and Italy. The highest numbers of Polish participants carry out projects as part of the Marie Curie program,

programs in terms of information and communication technologies, energy, research infrastructure, and transport, and the SME instrument. Most applications for funds under the Horizon 2020 program are submitted, in descending order, by: Polish higher education institutions and research institutes and the Polish Academy of Sciences, business entities (mainly small and medium enterprises), and public and local administration [12].

3. The Railway Research Institute and its activity in terms of obtaining funds for research and development

The Railway Research Institute functions under the Law of 30 April 2010 on Research Institutes and is entered into the National Court Register. As a research and development entity, the Institute has been striving for years to have an impact on the development of innovation policy in Poland in terms of railway transport, taking an active part in it. As an entity subordinated directly to the Ministry of Infrastructure and cooperating with the Railway Transport Office, it has the possibility to, at least indirectly, influence government actions in terms of developing modern, safe, and passenger-friendly railway transport. The scope of the Institute's activities covers all technical issues in the area of railway transport. For 68 years now, the Institute has been connected to the Polish State Railways (a part of which it was until 2000) and the Ministry of Transport. The output, unique competences, and specialist laboratories and research facilities are a basis for creating and supporting innovation.

The areas in which research is carried out include railroads, urban railway transport, railway vehicles, the transport of passengers and cargo, logistics and analysis of the transport market, command, control, and signaling and automation, telecommunications and ICT, traction networks, powering of electrical traction and non-traction devices and systems, materials and elements of systems and structures used in railway transport, protection of the natural environment and availability of railway transport to the disabled, public and technical safety in railway transport, use of railway transport for defense purposes, economic analyses in terms of railway transport, and modeling railway transport systems and processes. Thanks to its research facilities, the Railway Research Institute plays a special role in the economy. Innovative solutions in terms of systems and devices, as developed by the industry, may be tested at the Institute. Unique research and development equipment allows manufacturers to use a "common" national pool of research facilities owned by a state research entity.

3.1. Financing of the activities of the Railway Research Institute

In recent years, the subvention granted to finance the functioning of the Institute in terms of science constituted approx. 8–9% of its total annual revenue. The development of the research potential of the Institute has been limited since it was separated from the Polish State Railways (2000). Like in the case of many other institutes, financing from European and domestic funds is not enough to guarantee the stability of functioning.

In recent years, the structure of revenues has been relatively good, with the Institute generating a small profit. This increase is predominantly a result of research activities. Other major factors include the amount of the annual statutory subsidy (subvention), facilitations provided by public administration (especially the institutions responsible for domestic projects), and certain legal and fiscal solutions that have encouraged enterprises to use the research offer of the Institute. In view of its expensive equipment that requires modernization, keeping the Institute a going concern requires high market efficiency. There is a paradox as regards the expectations towards the Institute: on the one hand, it is required to make scientific advances, while on the other hand, it has insufficient financial support, which makes it difficult to purchase research equipment and develop in terms of science and research.

3.2. The participation of the Railway Research Institute in R&D, investment, modernization, science popularization, and other projects between 2015 and 2022

The priorities of the Railway Research Institute include subject-matter support for entities, decision-makers, transport organizers, and carriers, investment processes, community law processes, development of competences of the personnel working in the transport sector, and improvement of safety in transport. For many years now, the Institute has been playing a leading role in the research and development of railway transport, carrying out R&D and certification activities in terms of railways and urban railway transport [2].

The Institute's R&D activities are an important element of the development of innovative behaviors and their impact on shaping innovation policies. The number of projects, both domestic and international, in which the Institute is involved is growing year by year [3].

In 2017, the National Center for Research and Development organized a contest as part of the Research and Development in Railway Infrastructure (BRIK)

program. BRIK is a program for supporting research and development in terms of railway infrastructure, financed by the National Center for Research and Development and PKP Polskie Linie Kolejowe S.A. The contest covered five main thematic groups:

- 1) digitization and processing of railway traffic parameters,
- 2) reducing the negative impact of railway transport on the environment,
- 3) increasing the availability and durability of facilities providing services to passengers,
- 4) increasing the resilience of railway infrastructure to climatic factors and third party interference,
- 5) improving the process of maintenance and modernization of railway infrastructure.

There were 30 applications in the contest; 10 of them were deemed innovative and therefore financed. In 5 of the projects, the Railway Research Institute is the leader or a consortium member.

The main purpose of the BRIK Common Undertaking is to increase the innovativeness and competitiveness of railway transport by 2026. Furthermore, program implementation is expected to contribute to increasing R&D activity in terms of railway infrastructure, increasing the number of innovative solutions in this area, improving the efficiency of operation and management of railway infrastructure, and decreasing

the negative impact of railway transport on the environment. Table 1 presents the involvement of the Institute in the BRIK contest organized by the National Center for Research and Development.

Cooperation between Railway Research Institute specialists and Siled Sp. z o.o., Zakład Automatyki i Urządzeń Pomiarowych AREX Sp. z o.o., and ABZ Consulting Sp. z o.o. will consist of developing a system of managing, controlling and monitoring lighting in railway areas. This will allow lighting to be adjusted to actual railway traffic in stations and to the presence of passengers on railway platforms.

Actions in terms of innovative solutions limiting the negative impact of railway transport on people and the environment will be taken by the Warsaw University of Technology, the Railway Research Institute, and the Institute of Environmental Protection in a consortium with Budimex and Tines S.A.

Another interesting project carried out by the Railway Research Institute in cooperation with Neel is the development of a traction network anti-theft system. The purpose of the project is to monitor the track system and if its continuity is interrupted (broken, cut, or stolen contact wires or catenary lines), the services responsible for the protection of railway infrastructure are notified. The new solutions will contribute to ensuring the high reliability of railway transport. As a result, the availability of Polish railway infrastruc-

Table 1

Participation of the Railway Research Institute in BRIK projects

Project name	Carried out by	Start and completion dates	Total financing from the National Center for Research and Development (in PLN)
Development and implementation of elements of railway traction anti-theft systems	Railway Research Institute, Neel Sp. z o.o.	2018/06/01 2021/09/30	444,075
Development of an innovative system of managing lighting infrastructure in the PLK S.A. network	Railway Research Institute, Siled Sp. z o.o., Zakład Automatyki Urządzeń Pomiarowych AREX Sp. z o.o., ABZ Consulting Sp. z o.o	2018/07/01 2020/04/30	416,675
Standardization of selected computer interfaces of command, control, and signaling devices and systems	Railway Research Institute, Rail-Mil Computers Sp. z o.o S.k.	2018/06/01 2021/09/30	1,872,481
Optimization of a system of ultrasonic transducers for discovering internal defects of railway tracks in accordance with the PKP PLK S.A. catalog of defects	Railway Research Institute, Institute of Fundamental Technological Problems of the Polish Academy of Sciences, ZBM ULTRA Sp. z o.o	2018/10/01 2021/09/30	366,938
Innovative solutions in terms of protecting passengers and buildings against railway vibrations (the Railway Research Institute as a consortium member)	Railway Research Institute, Warsaw University of Technology, Budimex, Tines S.A., Institute of Environmental Protection	2018/06/01 2021/05/31	708,256

[The author's own elaboration basing on data from the Railway Research Institute].

ture to passengers will increase and modern information systems and technologies will improve safety.

The “Standardization of selected computer interfaces of command, control, and signaling devices and systems” project will result in the implementation of new, standard interfaces of command, control, and signaling devices and systems, to be used in the railway network managed by PKP PLK S.A. (and other infrastructure administrators), and in drafting documentation containing a description of the standards and guidelines for designing and using these interfaces.

The purpose of the “Optimization of a system of ultrasonic transducers for discovering internal defects of railway tracks in accordance with the PKP PLK S.A. catalog of defects” project is to develop an optimum configuration of ultrasonic transducers for a defect-detecting car and manual measurement devices, allowing a larger number of defects to be discovered, which will increase the safety of traffic. As a result of project implementation, track measurement services will be provided to PKP PLK S.A. and to foreign administrators of railway infrastructure.

The Railway Research Institute is also involved in two research projects as part of contests organized by the National Center for Research and Development with respect to application processes. SIM Factor, in consortium with the Railway Research Institute, has received co-financing for the application of simulation technology in order to build the first Polish railway siding simulation ground. The project was evaluated positively and received support in the form of a special-purpose subsidy. The title of the project is “A simulation training system for drivers of switch engines and employees of sidings and classification yards involved in switching processes, increasing their efficiency and safety.” The purpose of the project is to carry out R&D works that will lead to the development of a simulation training system for the railway sector. Switching maneuvers are a burden that, if possible, should be limited and streamlined, as they generate costs. It is also important to make sure that they are safe (in 2016, there were 120 accidents in sidings, with 5 fatalities). The system will allow the drivers of switch engines and the other personnel involved in the switching process to be trained.

Another project as part of this program in which the Railway Research Institute will be involved concerns **smart CCTV surveillance of containers**. The purpose of the project is to develop a demonstration system and validate technologies that will be used to create an innovative product called the IMW: a smart CCTV surveillance system for railway cars.

The Railway Research Institute is also involved in the Shift2Rail initiative. This program is a European railway initiative (part of the Horizon 2020 program), the purpose of which is to look for the relevant research,

innovations, and market solutions in order to integrate new and existing advanced technologies and develop innovative products that could be implemented in railway transport. The Railway Research Institute takes part in a In2Stempo project called “Innovative solutions for future stations, energy measurements, and power supply.” The project is in line with the main assumptions of the Shift2Rail undertaking and is focused on reducing the costs of a product’s life cycle and improving reliability and punctuality, at the same time increasing throughput and interoperability of railways and increasing passenger satisfaction [11]. As part of the Ministry of Science and Higher Education programs related to the implementation of an international project of research entities within Horizon 2020, the Railway Research Institute received support from the Ministry under the framework program (co-financing for own contributions) and funds to co-finance the engaged scientists (the so-called Bonus on the Horizon).

The Railway Research Institute owns extensive research equipment used to carry out various types of railway research (the particular scopes are a result of the Institute’s structure, which is divided into laboratories with various profiles). As of 2019, the research infrastructure does not fully correspond to market and technological requirements; however, it is being gradually modernized thanks to structural funds. In 2018, the Institute received co-financing from the Mazowieckie Province Regional Program to purchase new research equipment. This covers laboratory and research devices for three divisions of the Institute: the Laboratory for Testing Materials and Structural Elements, the Power Engineering Unit, and the Automation and Telecommunications Laboratory. Modern equipment will make it possible to carry out research tasks concerning strength testing, fire safety of rolling stock elements, railway transport infrastructure, and fire tests. It will also allow research and development to be carried out in terms of electrical traction and power supply. The development of research facilities will also enable specialist EMC and photometric tests. The amount of co-financing for the Railway Research Institute amounted to PLN 4,754,101.50.

In 2017, an agreement was signed by the Railway Research Institute and the National Fund for the Protection of the Environment and Water Management with respect to a comprehensive modernization of the thermal insulation of the buildings at ul. Chłopickiego 50 in Warsaw, with a co-financing of PLN 3,694,408.67. The purpose is to modernize the structural and technical thermal insulation infrastructure of the Railway Research Institute, including seven buildings and a section of the district heating network located on the premises of the applicant. The buildings planned for modernization were built between 1962 and 1965. Table 2 presents the R&D

Table 2

Involvement of the Railway Research Institute in R&D projects (excluding the BRIK initiative, status as of July 2019)

Program name	Title / duration	Type of co-financing
Horizon 2020	In2Stempo Innovative solutions for future stations, energy measurements, and power supply / / 2017/09/01–2022/08/31	European Union
	In2Stempo Innovative solutions for future stations, energy measurements, and power supply / / 2018/03/16–2020/08/31	Ministry of Science and Higher Education, application for funds for participation in a framework program in terms of research and innovation, Bonus on the Horizon
	In2Stempo Application for funds for the implementation of a co-financed international project / / 2018/06/19–2020/08/31	Ministry of Science and Higher Education, national funds, co-financing for the In2Stempo project
Sub-activity 4.1.4: Application projects	A simulation training system for drivers of switch engines and employees of sidings and classification yards involved in switching processes increasing their efficiency and safety	National Center for Research and Development
	Intelligent CCTV surveillance of containers / / 2019/07/01–2021/12/31	National Center for Research and Development

[The author's own elaboration basing on data from the Railway Research Institute].

projects in which the Railway Research Institute is involved (excluding the BRIK initiative).

4. Conclusions

The above analysis of the activities of the Railway Research Institute in terms of obtaining funds for R&D and investments leads to the following conclusions:

- 1) between 2015 and 2019, the Institute's activity in terms of obtaining support visibly increased,
- 2) the National Center for Research and Development has been organizing more contests addressed to R&D consortia,
- 3) the National Center for Research and Development has initiated a so-called common undertaking addressed to the railway sector (a program co-financed by the Center and the Polish State Railways),
- 4) the principles of financial settlements of projects have not improved; excessive bureaucracy continues to be a problem (painstaking procedures in terms of drafting applications, long time of waiting for the results, delayed disbursements of funds that decrease the Institute's liquidity),
- 5) the issue of VAT in R&D projects remains to be solved.

Summarizing, the mission of the Railway Research Institute is to carry out R&D tasks that will increase the efficiency of railway transport and allow,

in a systemic manner, the goals and the vision of the development of the entire sector to be defined, guaranteeing its modernization and resulting in increased competitiveness of railway transport. Funds received thanks to participation in domestic and EU projects are a strong source of support for the Institute. The Railway Research Institute carries out partnership projects with enterprises. In view of the insufficient outlays on research and development, cooperation between business entities and the Institute is an opportunity to jointly generate innovation.

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