

Received: July 2023  
Accepted: September 2023  
DOI: 10.7862/rz.2023.hss.36

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## THE NON-FINANCIAL RESULTS OF SUPPORTING ENTERPRISES OF THE AVIATION VALLEY USING PUBLIC FUNDS FOR RESEARCH, DEVELOPMENT AND INNOVATION

One of the most important stimulators for the economic situation of enterprises is conducting research, development and innovation activities. However, the costs of running these activities are so high that they exceed the financial capabilities of many enterprises. The financial remedy turns out to be state aid funds, which can bring a number of different benefits. The main purpose of this paper is to determine the non-financial results of supporting the Aviation Valley cluster through public aid for R&D&I. The article is based on a case study of a unit that raises significant funds for these activities. It defines the concepts of research and development and innovation activities, and discusses the development of these activities in Poland in the years 2011–2021. It also characterizes the non-financial results of supporting the Aviation Valley cluster via public aid funds for R&D&I, summarizing the most important achievements of the Aviation Valley.

**Keywords:** Aviation Valley, public funds, research, development, innovation

### 1. INTRODUCTION

The European Union strives for a high level of innovation in the international dimension, wanting to catch up with such economic powers as Japan or the United States. As a result, it allocates huge funds to conduct research, development and innovation (R&D&I) activities. Undoubtedly, an increasing contribution to the development of this type of activity in Poland is made by enterprises. It is thanks to them that specific innovations are created (Prusak, Kardas, 2022) that have an impact on the development and improvement of their economic situation.

Dynamic changes occurring in the environment of each enterprise force the need to constantly adapt and meet the competition. It is no longer enough to just develop – enterprises need to do it more dynamically than the competition.

One of the conditions for increasing the competitive advantage of a unit is conducting R&D&I activity (Baruk, 2022). It is the driving force behind the activity of every company. British economist Ch. Freeman said that a company that does not grow by innovating,

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simply dies. Meanwhile, many entrepreneurs do not have sufficient financial resources to conduct research, development and innovation activities on their own. These barriers are met by public institutions, which provide a number of aid programs that can be used by various entrepreneurs, regardless of the stage of development, size or legal form of the beneficiary. It is worth noting that under the New EU Subsidies 2021–2027 under the Smart Growth Operational Program (SG OP), as much as EUR 8.00 billion of EU Funds has been allocated to activities in the field of innovation and cooperation between science and business (newdodonacjeunijne.eu, 2023).

Public aid, as a solid injection of cash, should improve the financial situation of enterprises. However, it should be considered whether, apart from the impact on the financial statements, it also brings other benefits to enterprises in the form of non-financial results, such as e.g. achieving the position of a leader, the possibility of implementing specific innovations, etc. Therefore, the purpose of this study is to: determine the non-financial results of supporting the Aviation Valley cluster from public aid for research, development and innovation. The article uses the case study method, a diagnostic questionnaire and the statistical method in order to observe the relationships between the studied variables.

## **2. REVIEW OF LITERATURE AND NATIONAL REPORTS**

### **2.1. The essence of research, development and innovation activities**

The terms "innovation" and "research and development activity" are often equated with each other. Some of the authors claim that to some extent they are synonymous concepts, because as a result of research and development works, innovative products and services are most often created (Ostraszewska, Tylec, 2016). Meanwhile, it can be said that conducting research and development activity determines the innovativeness of enterprises, and the largest part of expenditure on innovation consists of expenditure on research and development (Dachs, 2009). In fact, however, the concept of innovation has a much broader scope of interpretation than the concept of research and development activity.

Poland's membership in the European Union obliges the country to unify the applicable standards in the field of science and technology, which are to contribute to greater consistency in the preparation and development of statistical analyzes in the Community countries. Therefore, the main standard for defining concepts and developing the principles of the applied methodology is the publication developed by the OECD (Organisation for Economic Co-operation and Development) – Frascati Manual. It is considered the basis for the scope and methods of data collection, as well as conducting analyzes in the research and development sphere. According to its assumptions, statistics are prepared for the Central Statistical Office in Poland and the statistical office of the European Union (Eurostat). These recommendations are applied in countries associated within the OECD and the European Union (EU). The Central Statistical Office annually conducts a statistical survey entitled "Research and development (R&D) activities", thus wanting to obtain data on creative activities carried out in Poland, which are undertaken in order to increase the stock of knowledge and find new applications for this knowledge. The data obtained in this way give a full picture of Poland's research and development activity compared to other countries (GUS2, 2018).

The Frascati Manual defines R&D as "creative work undertaken in a methodical way to increase the stock of knowledge – including knowledge about mankind, society and

culture, and to create new applications for existing knowledge” (Frascati Manual, 2018). This definition has been fully implemented by the Central Statistical Office and is reflected in the Act on Financing Science<sup>2</sup>. A definitional analogy can also be found in the Oslo Manual, which is a joint publication of Eurostat and the OECD. This document concerns the principles of collecting and interpreting data on innovation, including the measurement of scientific and technical activities (OECD1, 2008).

The basic features that distinguish research and development activities from other forms of business are: innovative nature, creative properties, unpredictability, methodicality, the ability to transfer or reproduce the results obtained (OECD2, 2018). In addition, the Frascati Manual contains specific examples to guide the correct classification of specific works. The Frascati Manual distinguishes 3 types of research as part of R&D activities – basic, applied and development works.

In turn, the most important definition of innovation can be found in the international methodological manual in the field of innovation statistical research, i.e. the Oslo Manual, which is the third in chronological order in the Frascati Family Manuals series (*Słownik Innowacji*, 2018). The manual defines innovation as “the implementation of a new or significantly improved product (service, product) or process, a new marketing method, or [...] organizational in business practice, workplace organization or relations with the environment” (OECD1, 2008). On the other hand, innovative activity, according to this methodology, is the entirety of scientific, organizational, technical, commercial and financial activities that lead or are to lead to the implementation of innovations. The authors of the handbook emphasize that innovative activities also include research and development activities, but the latter is not related to the creation of a specific innovation.

Undoubtedly, the precursor of the theory of innovation was J. Schumpeter, who, by formulating the definition of innovation in 1912, laid the foundations for further considerations on the issue of innovation. The author understood innovations broadly as the creation of fundamental or radical changes that will cover the transformation of a new idea or technological invention into a market process or a specific product. He argued that the dissemination of innovation is a separate type of change, called imitation. Innovation was considered a unique (one-off) change, while imitative (inventive) changes are continuous and repeatable (*Słownik Innowacji*, 2018; Schumpeter, 1960).

A significant contribution to the definition of innovation was also made by M.E. Porter. According to him, innovation should be defined as the economically successful exploitation of new ideas (Porter, 1990). In this approach, innovations are treated as a continuum of organizational and technical changes. They include both simple modifications of products, processes and services, as well as fundamental changes and the creation of technological innovations.

A summary of the definitions of innovation proposed by contemporary authors can be found in the monograph by A.H. Jasiński (Jasiński, 2014). The author proposes to divide the definition into innovations *sensu stricto* and *sensu largo*. The first group using a narrow definition (*sensu stricto*) includes such authors as: Ch. Freeman, S. Kuznets, E. Mansfield

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<sup>2</sup> Definition according to the Act of 30 April 2010 on the principles of financing science, Journal of Laws of 2018 item 87 as amended, art. 2 reads: “research and development activity – creative activity including scientific research or development work, undertaken in a systematic manner in order to increase knowledge resources and use knowledge resources to create new applications”. Its meaning therefore coincides with the definition contained in the Frascati Manual, but it is not identical.

(Freeman, 1982; Kuznets, 1959; Mansfield, 1968). In this perspective, innovation is defined as a change in manufacturing methods or products, based solely on new, unused knowledge. In a broad sense (*sensu largo*), propagated, among others, by: J.A. Allen, E. Hagen, or Ph. Kotler, an innovation is treated as any novelty or any change in the production process (Allen, 1966; Hagen, 1962; Kotler, 1994).

Nowadays, therefore, a broad approach to the definition of innovation is considered appropriate. The definition used for the purposes of Eurostat, OECD or GUS is largely the same as that of J. Schumpeter.

The definition of the publication prepared by the OECD – The Oslo Manual emphasizes that innovation is created when a product is finally implemented or introduced to the market, and new processes are used in the business. According to many authors, this is of great importance in distinguishing innovation from invention. The latter can become an innovation only at the moment of its practical application. Moreover, a significant proportion of inventions never have to become innovations (OECD1, 2008).

It should be emphasized that conducting innovative activity gives enterprises unlimited sources of competitive advantages. Entities that are aware of this strive for innovation by generating technological knowledge necessary to create new products and processes or to improve the existing ones. Particularly privileged are those entities which receive public aid for the implementation of research, development and innovation activities. The direct inflow of cash may affect the financial results of these entities, but also the non-financial effects of their operations.

## **2.2. Research, development and innovation activity in Poland in 2011–2021**

The Central Statistical Office (GUS), collecting data on public statistics in various fields, annually publishes reports that are the basis of knowledge about the condition of the Polish economy. In 2021, it published another report: “Research and development activities in Poland in 2021”. Studies in the field of research and development activities are adapted to the methodological recommendations that are used in the European Union and OECD countries in order to ensure consistency with international statistics (GUS1, 2021). The subject of the publication focuses on three main categories that describe research and development activities, i.e. inputs, research and development equipment and personnel employed in research and development activities.

When analyzing expenditures on research and development activities financed from external funds, it can be noticed that in the years 2011–2021 their expenditure initially remained at a similar level, oscillating around PLN 8,000–11,000 million until 2018, and in subsequent years it systematically increased to just over PLN 18,000 million in 2021. The earliest reports found in this regard concerned the year 2011. However, Table 1 does not contain a statement for the years 2011–2012, because the report for the previous years indicated “NO DATA” for this period.

For the last of the analyzed years, detailed information was separated on the share of individual groups: enterprises, government sector, higher education, private non-commercial institutions in the global value of outlays for that year. The breakdown shows that enterprises are the second beneficiaries of expenditure on R&D activities financed from external funds (PLN 5,400.0 million). Whereas PLN 3,011.6 million is obtained from institutions with public funds. The rest are funds from foreign enterprises (GUS1, 2021).

Table 1. Outlays on R&amp;D activities in Poland financed from external sources

| Executive sectors                   |             | Outlays financed from external funds (in PLN million) |   |
|-------------------------------------|-------------|---|---|
|                                     |             | Total   | including from institutions with public funds |
| Total                               | 2013        | 8 727,9   | 6 300,6                                       |
|                                     | 2014        | 9 518,5   | 6 792,2                                       |
|                                     | 2015        | 10 694,2  | 6 993,5                                       |
|                                     | 2016        | 8 037,2   | 6 463,5                                       |
|                                     | 2017        | 9 686,8   | 7 754,1                                       |
|                                     | 2018        | 11 579,1  | 9 774,6                                       |
|                                     | 2019        | 14 811,3  | 11 656,7                                      |
|                                     | 2020        | 15 943,7  | 12 497,5                                      |
|                                     | <b>2021</b> | <b>18 140,5</b>                                       | <b>13 947,7</b>                               |
| Enterprises                         |             | 5 400,0   | 3 011,6                                       |
| Governmental                        |             | 629,6   | 485,7   |
| Higher education                    |             | 12 046,7  | 10 419,7                                      |
| Private non-commercial institutions |             | 64,1  | 30,7  |

Source: GUS1: (*Działalność badawcza i rozwojowa w Polsce w 2021 roku...*).

Table 2 contains a summary of foreign funds financing R&D and budgetary funds for projects co-financed from EU funds.

Table 2. Foreign funds financing R&amp;D and budgetary funds for projects co-financed from EU funds

| Executive sectors  |                | Funds from abroad |                     |              | Budget funds allocated to projects co-financed from EU funds |
|--------------------|----------------|-------------------|---------------------|--------------|--|
|                    |                | total             | Including from      |              |  |
|                    |                |                   | European Commission | enterprises  |  |
| (in PLN million)   |                |                   |                     |              |  |
| Total              | 2013           | 1 892,1           | 1 481,1             | 293,2        | 359,2  |
|                    | 2014           | 2 160,7           | 1 785,7             | 269,0        | 399,8  |
|                    | 2015           | 3 023,8           | 2 629,8             | 228,2        | 482,7  |
|                    | 2016           | 981,1             | 510,2               | 299,5        | 441,6  |
|                    | 2017           | 1 225,1           | 623,4               | 494,6        | 136,2  |
|                    | 2018           | 1 804,5           | 1 035,7             | 646,4        | 253,5  |
|                    | 2019           | 2 134,2           | 1 424,5             | 576,9        | 267,0  |
|                    | 2020           | 2 325,4           | 1 712,3             | 463,8        | 583,3  |
|                    | <b>2021</b>    | <b>3 079,1</b>    | <b>2 391,8</b>      | <b>504,6</b> | <b>528,9</b>   |
| <b>Enterprises</b> | <b>1 896,0</b> | <b>1 346,0</b>    | <b>474,4</b>        | <b>204,3</b> |  |

Source: GUS1: (*Działalność badawcza i rozwojowa w Polsce w 2021 roku...*).

The largest number of entities financing internal R&D expenditure from foreign funds was in the enterprise sector (83.4% of entities that used this source of financing) (GUS1, 2021). Enterprises were the biggest beneficiaries of foreign funds financing R&D

activities. They acquired as much as 61.58% of the entire pool. The most important source of funds obtained from abroad were the funds of the European Commission, which were used by enterprises in 56.28%. Moreover, in the enterprise sector, one-fourth of the funds from the rest of the world sector, financing research and development, were funds of foreign enterprises.

### **3. OWN RESEARCH**

#### **3.1. Research methodology**

The research in this article is based on a case study of a unit that raises significant funds for research and development and innovation activities, and at the same time is assessed as standing out against the background of the country. It was assumed that entities significant from the point of view of the country's development, characterized by innovation and incurring high expenditures on research and development activities, as well as obtaining significant public funds for the development of this type of activity, constitute an important research sample, and their activities are focused on achieving non-financial results. The Aviation Valley, characterized by clear innovation and constituting the core of the development of south-eastern Poland (Chłodnicka, 2016) predestines it as a suitable research entity. Companies operating within its framework attract more and more new investments, foreign investors, cause the development of cooperation with other aviation centers, as well as promote cooperation with universities, research units and scientific institutes (Barwińska-Małajowicz, Micał, Kozak, 2018). Providing various products and services in the area of the aviation industry requires constant research on their production, implementation of new technical and technological solutions, which involves obtaining public aid funds for their co-financing. And the high importance for the country, twice honored with the title of the National Key Cluster, should be reflected in the non-financial results of obtaining this public aid.

The selection of the research sample was conscious and intentional. Its aim was to find such a group of entities that jointly contributes to the development of innovation. This was then to help identify where they obtain funds for the implementation of their research, development and innovation activities and indicate what non-financial results they achieve in connection with obtaining this aid. The selection of the research sample was made using the funnel method, which enabled the selection of the oldest as well as the most dynamically operating group of entities in the aviation sector, which is the Aviation Valley cluster.

#### **3.2. Research results – Non-financial results of supporting the Aviation Valley from public funds for research, development and innovation**

In order to determine the non-financial results of supporting the Aviation Valley from public funds for research, development and innovation, entrepreneurs were asked about various factors related to the public aid they obtain, including: being perceived as a modern company, implementing innovative products and services, faster modernization of processes and organization methods, staff creativity, obtaining patents, or implementing process and marketing innovations (18 factors in total).

The importance of each non-financial factor was assessed by the surveyed entities on a five-point Likert scale, where “1” meant a completely untrue sentence, and “5” that the statement fully reflected the situation in a given organization.

The factors were related to two groups: competitiveness and innovation. In the context of the article, factors related to innovation in the enterprise will be considered, in sequence:

- Our employees are constantly encouraged to be creative in performing their assigned tasks.
- The management is looking for growth opportunities, taking into account the ideas of employees.
- Our new products/services are perceived by customers as very modern.
- Our management team takes the risk of seeking and exploiting new, sometimes uncertain growth opportunities.
- In 2009-2017, we implemented process innovations.
- In 2009-2017, we implemented product innovations.
- In the years 2009-2017, we employed/we employ employees dedicated to research, development and innovation activities.
- In 2009-2017, we implemented service innovations.
- In the years 2009-2017, our employees published scientific articles related to research, development and innovation activities.
- In the years 2009-2017, we obtained patents thanks to research financed from state aid.
- In 2009-2017, we implemented marketing innovations.

Only those enterprises that answered the question preceding this part in the affirmative were subject to the examination of individual factors: did your organization obtain public aid funds in 2009–2017, hence  $n=60$ .

Chart 1 shows the distribution of individual answers related to the innovativeness of the enterprise.

In enterprises where public aid is obtained, employees are most encouraged to be creative in performing the tasks assigned to them (64.4%). At the same time, the managers of these companies look for growth opportunities, taking into account the ideas of employees (63.3%), what is more, the management staff is willing to take risks and look for new, sometimes uncertain growth opportunities (48.4%). In addition, as the third factor, it was emphasized that the products and/or services of enterprises obtaining public aid are perceived by customers as very modern (66.6%).

Among the individual factors, a wording was randomly placed, to which individual non-financial factors were then related, i.e.: the received funding was sufficient to carry out the assumed research.

Pearson's linear correlation coefficient  $r$  was used to examine the correlation between the answers given. All statistically significant ( $p<0.05$ ) correlations that were confirmed were positive. This means that as the agreement with one of the statements increased, the agreement with the other of the pair of statements increased. The value of the correlation coefficient itself indicated its strength.

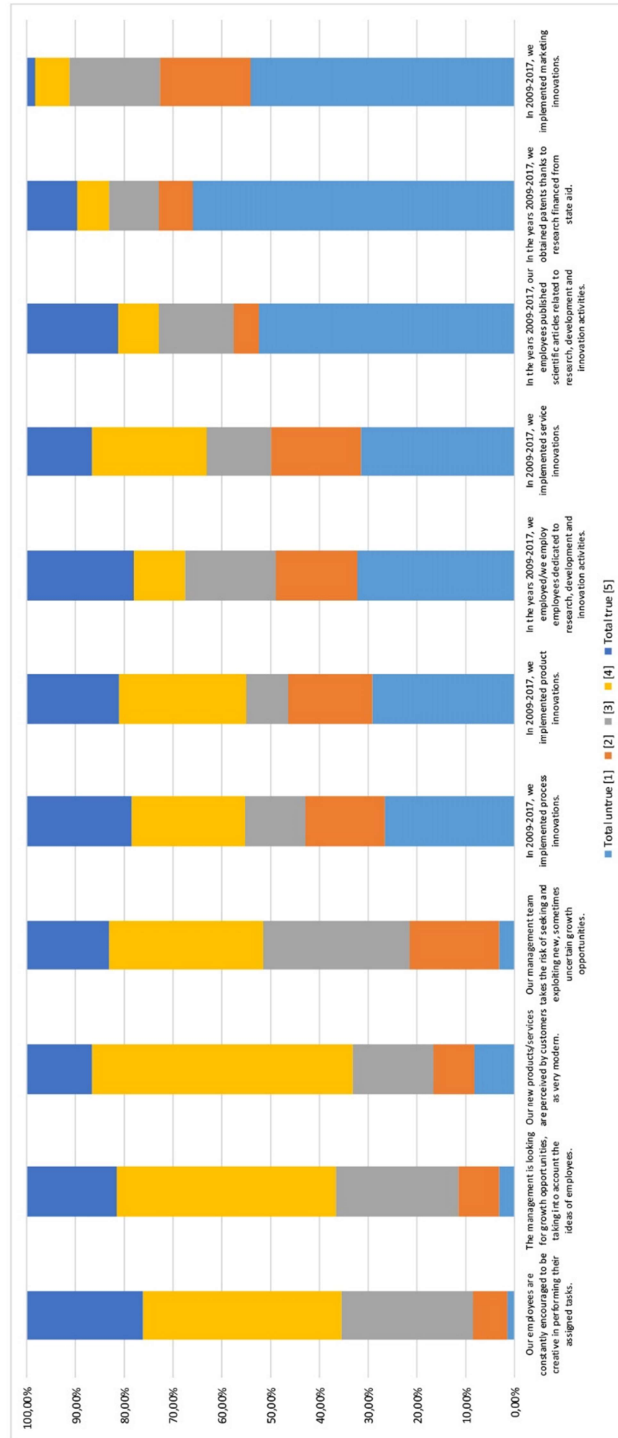


Chart 1. Situation of the surveyed entities in the context of obtained state aid – innovation  
Source: own study, n-60.



Table 3 contains a summary of all obtained correlation coefficients.

Table 3. Evaluation of non-financial results of supporting the Aviation Valley cluster – results of correlation coefficients

| Degree of agreement with the stated statements  | The received funding was sufficient to carry out the assumed research | The obtained public aid contributed to the improvement of our economic situation |
|---|---|--|
| Our organization is a leader in implementing new products/services.   | $r=0,2896$<br>$n=58$<br>$p=0,027$                                     | $r=0,5025$<br>$n=58$<br>$p=0,000$  |
| Our new products/services are perceived by customers as very modern.  | $r=0,3080$<br>$n=58$<br>$p=0,019$                                     | $r=0,6206$<br>$n=58$<br>$p=0,000$  |
| Compared to the competition in 2009-2017, our company implemented more innovative products and services.    | $r=0,4373$<br>$n=58$<br>$p=0,001$                                     | $r=0,7069$<br>$n=58$<br>$p=0,000$  |
| Our new products and services are better and different from competitors' novelties.                         | $r=0,3439$<br>$n=58$<br>$p=0,008$                                     | $r=0,6310$<br>$n=58$<br>$p=0,000$  |
| Our management team takes the risk of seeking and exploiting new, sometimes uncertain growth opportunities. | $r=0,4074$<br>$n=58$<br>$p=0,002$                                     | $r=0,2502$<br>$n=58$<br>$p=0,058$  |
| The management is looking for growth opportunities, taking into account the ideas of employees.             | $r=0,3055$<br>$n=58$<br>$p=0,020$                                     | $r=0,2213$<br>$n=58$<br>$p=0,095$  |
| Currently, the economic situation of our company is better compared to the competition.                     | $r=0,3114$<br>$n=58$<br>$p=0,017$                                     | $r=0,2918$<br>$n=58$<br>$p=0,026$  |
| In the years 2009-2017, we obtained patents thanks to research financed from state aid.                     | $r=0,3915$<br>$n=57$<br>$p=0,003$                                     | $r=0,3415$<br>$n=57$<br>$p=0,009$  |
| In 2009-2017, we implemented product innovations.   | $r=0,3242$<br>$n=58$<br>$p=0,013$                                     | $r=0,5633$<br>$n=58$<br>$p=0,000$  |

Source: own study.

Enterprises, in the opinion of which the public aid received for research, development and innovation was sufficient to carry out the assumed research, also emphasized that:

1. their organization is a leader in implementing new products/services,
2. their products/services are perceived by customers as very modern,
3. the number of implemented innovative products and services compared to the competition in 2009–2017 was higher,
4. their new products and services are better and stand out from the competition's novelties,
5. their management takes the risk of seeking and exploiting new, sometimes uncertain growth opportunities,
6. management looks for growth opportunities, taking employees' ideas into account,
7. their economic situation in relation to the competition is better,

8. obtained patents thanks to research financed from state aid funds,
9. in 2009–2017, they implemented product innovations.

#### 4. CONCLUSIONS AND RECOMMENDATIONS

It should be remembered that non-financial factors significantly determine the economic situation of the audited entity. They are the result of care for the development of the enterprise and show the relationship between public aid and the economic situation.

The conscious and intentional choice of the research subject - the Aviation Valley - allowed to observe interesting relationships. It was assumed that the Aviation Valley, characterized by clear innovation and incurring high expenditures on research and development activities, being a kind of driving force for the development of south-eastern Poland, should achieve non-financial results from the fact of obtaining public R&D&I aid. Enterprises operating within its framework implement various investments, provide various products and services that require constant research on their production, and as a result obtain significant public aid funds for their co-financing.

The article describes the importance of research and development and innovation activities in the development of enterprises. The concepts of research and development and innovation activities were defined. Statistical data in Poland regarding this activity in 2011-2021 are characterized in detail.

Non-financial results of supporting the Aviation Valley cluster from public aid funds for research, development and innovation were also characterized, among which the most important are: achieving a leading position in the implementation of new products/services, convincing customers of the modernity of manufactured products and services, standing out from competitors and implementation of various types of product, process, marketing or service innovations. The most important achievements of the Aviation Valley were summarized, thus emphasizing its high importance on the international arena. The characteristics of the most important achievements of the Aviation Valley showed the key success factors, such as: a strong scientific base, the presence of a highly qualified, educated and experienced workforce associated with the aviation industry for many years. Conclusions and recommendations will be important for the further development of the Aviation Valley.

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