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## Success factors and success criteria for research and R&D projects

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### ABSTRACT

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The topic literature of the success in research and R&D projects, their success factors, or success criteria is not very extensive. Although a few items on this topic can be found, they often do not distinguish between types of projects in the research area between research projects and R&D projects. The aim of the paper is to present the success factors and success criteria of research and R&D projects and their importance for these types of projects. In order to achieve the aim of the study, the following research methods were used: a literature review and a survey analysis using correlations. The research was conducted on a sample of 200 organizations in Poland that run research and R&D projects. Based on the conducted quantitative research, the importance of individual success factors and success criteria of research projects and R&D projects was determined. The research results show that the importance of success factors and criteria for research and R&D projects varies.

**Keywords:** project success, success factors, success criteria, research projects, R&D projects

**JEL Classification:** O320, M210, C000

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## Introduction

In the project management field, there is no common approach in defining the term 'success'. Some authors prefer equating the success of a project with the fulfilment of its objectives, the achievement of its benefits [Shenhar, Wideman, 1996]. Success understood in this way can be measured after project completion [Cooke-Davies, 2002]. Others define the term 'project management success' [Munns, Bjeirmi, 1996] as an outcome that can be measured during the course of the project, e.g. by meeting the budget, schedule, or achieving the required quality. 'Project success' is equated with the effectiveness in achieving results, 'project management success' is related to the efficiency of the implementation of the project [Jugdev et al., 2001; Nicholas, Hidding, 2010; Serra, Kunc, 2015]. In order to be able to determine whether a project has actually been successful, it is required to identify ways of measuring it. Here it is important to distinguish between two processes: predicting the success of a project (before or during its implementation) or assessing a project already completed (or its individual stages). In the case of predicting success, it is useful to use so-called project success factors (SF). For assessing a project or its phases, project success criteria (SC) are used. The topic literature of the success of research and R&D projects, their success factors, or success criteria is not very extensive. Although a few items on this topic can be found, they often do not distinguish between types of projects in the research area between research projects and R&D projects (see the section on the literature review).

The aim of the paper is to present the success factors and success criteria of research and R&D projects and their importance for these types of projects. In order to achieve the aim of the study, the following research methods were used: a literature review and a survey analysis using correlations. Based on the conducted quantitative research, the importance of individual success factors and success criteria of research and R&D projects was determined. The results were analyzed in terms of the size of the organization carrying out the research or R&D projects, the age of the respondent and the respondent's role in the research area within the organization. Predicting the success of a project (based on success factors) is crucial when deciding whether to undertake or continue a project, while assessing success (based on success criteria) provides information on whether projects in an organization are successful or not and what the organization can do to improve its project management activities in the future.

To achieve the intended aim, 3 research questions were asked.

1<sup>st</sup> part of the research process: Literature review

- (i) Should we distinguish types of projects in research areas in organizations?
- (ii) How is project success defined and measured in research and R&D projects and are there identified success factors and success criteria for these types of projects?

2<sup>nd</sup> part of the research process: Quantitative research

- (iii) Which success factors and success criteria are important for research and R&D projects?

3<sup>rd</sup> part of the research process: Conclusions

This paper consists of three sections. The first one shortly presents a literature review: information from the subject literature in the context of research and R&D projects (i), the concept of project success and its measurement in research and R&D projects, success factors and success criteria for these types of projects (ii). The second section describes the research sample, the data collection process, and the analysis of the results of the quantitative research (iii). The third section ends the paper with conclusions.

## Literature review

The literature research conducted for this paper was a typical literature review. The authors considered those publications that were within the scope of this paper and related to research and R&D projects.

### Research and R&D projects in the literature

As far back as the 1950s, authors of publications emphasized the specificity of research and R&D projects, which by their nature involve uncertainty [e.g. Finison, 1954]. The systematic review of the literature on research and R&D management can be found in Klaus-Rosińska, [2019]. Many terms related to the conduct of research are used in the literature. One comes across such terms as research project, research and development project (R&D), experimental project, applied research project, etc. Analyzing the definitions presented in the literature, it can be seen that both projects described as research and those called research and development are related to innovation [Kisielnicki, 2014; Machado et al., 2017]. The domain of research projects, on the other hand, is the generation of new knowledge [Forozandeh et al., 2018; Machado et al., 2017], and of R&D projects the creation and improvement of products and services [Kisielnicki, 2014; Vicente-Oliva et al., 2015]. Huljenic, Desic, and Matijasevic introduce a typology of research projects ('research projects with academic-industrial collaboration', 'pure academic research projects', 'research and development projects') and emphasize that they may differ in the way they are planned, implemented, and managed [Huljenic et al., 2005]. In contrast, the OECD defines R&D projects by the execution of research and development activities within them [OECD, 2018]. In summary, 'research projects' will be projects undertaken to acquire/generate new knowledge and can be equated with conducting fundamental research. 'Research and development' projects are those that use the knowledge already accumulated and, in addition, the knowledge generated is directed towards shaping or improving new products or processes [Klaus-Rosińska, 2019].

## Project success, success factors and success criteria for research and R&D projects

As mentioned in the Introduction, in the case of predicting project success it is useful to use success factors (SF). For assessing a project or its phases, project success criteria (SC) are used. In the literature, many authors [Cooke-Davies, 2002; Koutsikouri et al., 2008; Müller, Jugdev, 2012; Rohman et al., 2017; Wateridge, 1998] suggest defining the two terms as follows: ‘success factors’ are factors that, if they interact with a project, increase the probability of its success. In the literature, these are also referred to as critical success factors (CSF), ‘success criteria’ are dimensions for assessing whether a project succeeds or fails. According to Capaldo et al., success criteria can be divided into quantitative and qualitative ones [Capaldo et al., 2021]. The understanding of SF and SC for research and R&D projects is the same as for other types of projects. What, on the other hand, does success of these types of projects mean? The first conclusion is that various stakeholders in research and R&D projects interpret project success differently, the second one is that it can be noted that the success of a research and R&D project is characterized both by the success of the project management (e.g. by indicating success criteria such as ‘closing within the budget and timeframe provided for achieving the goals’) and the success of the project product (by indicating success criteria such as publications, doctorates, or patents) [Klaus-Rosińska, 2019]. It is also possible to find the literature that discusses success factors for projects in the research area, for research projects they are: Barbolla, Corredera [2009]; Ghomi, Barzinpour [2018]; Mahmood et al. [2014]; O’Keefe [1980]; Segalla [1998], for R&D they are: Bartlett et al. [2017]; Durand et al. [2016]; Iams [1955]; Krzos, Szumowski [2017]; Saunders [1990].

### Research sample and data collection

Data were collected from organizations in Poland that run research and R&D projects. 200 organizations registered or operating in Poland from the Central Registration and Information on Businesses (CEIDG) database and the National Court Register (KRS) were selected for the study.

The respondents answered most of the questions in the questionnaire using a seven-point Likert scale (ranging from 1 to 7). These questions concerned the degree of significance of the success factors and the success criteria for research and R&D projects. Due to the fact that the boundaries between research and research and development projects may be blurred, for the purpose of the study, the definition of a research project and a research and development project was included in the questionnaire.

In the research sample of 200 organizations, 32 (16%) were micro-enterprises (employing fewer than 9 employees), 84 (42%) were small enterprises (employing between 10 and 49 employees) and 84 (42%) were medium-sized enterprises (employing over 50 employees).

The projects were divided into research and R&D projects; 132 (66%) of the organizations carried out research projects and 94 (47%) of the organizations carried out R&D projects, yet 26 (13%) of the total number of organizations carried out both types of projects.

The organizations in which the respondents worked represented different types of sectors: 39 (19.5%) organizations operated in services, 48 (24%) in trade, 31 (15.5%) in IT, 26 (13%) in industry, 7 (3.5%) in construction, 27 (13.5%) in science, 18 (9%) in government and local government administration, 4 (2%) in other sectors than those listed in the metric.

In total, 200 respondents were invited to participate in the survey. Most of them were between 25 and 34 years old (n=101; 50.5%); 25 (12.5%) respondents were up to 24 years old; 52 (26%) respondents were between 35 and 44 years old; 19 (9.5%) respondents were between the ages of 45 and 54 years old, and only 3 (1.5%) respondents were over 55 years old. 81 (40.%) respondents were women, 117 (58.5%) respondents were men, 3 (1.5%) respondents did not indicate their gender. Among the respondents who took part in the survey, 125 (62.5%) were members of the project team, 70 (35%) were project managers, 5 (2.5%) of the respondents performed other roles in the project than those listed in the metric.

In the further part of the study, the results of the research on success factors and project success criteria will be presented, divided into research and R&D projects<sup>1</sup> in the surveyed organizations.

## Results

### Success factors of research and R&D projects: predicting success of this type of projects

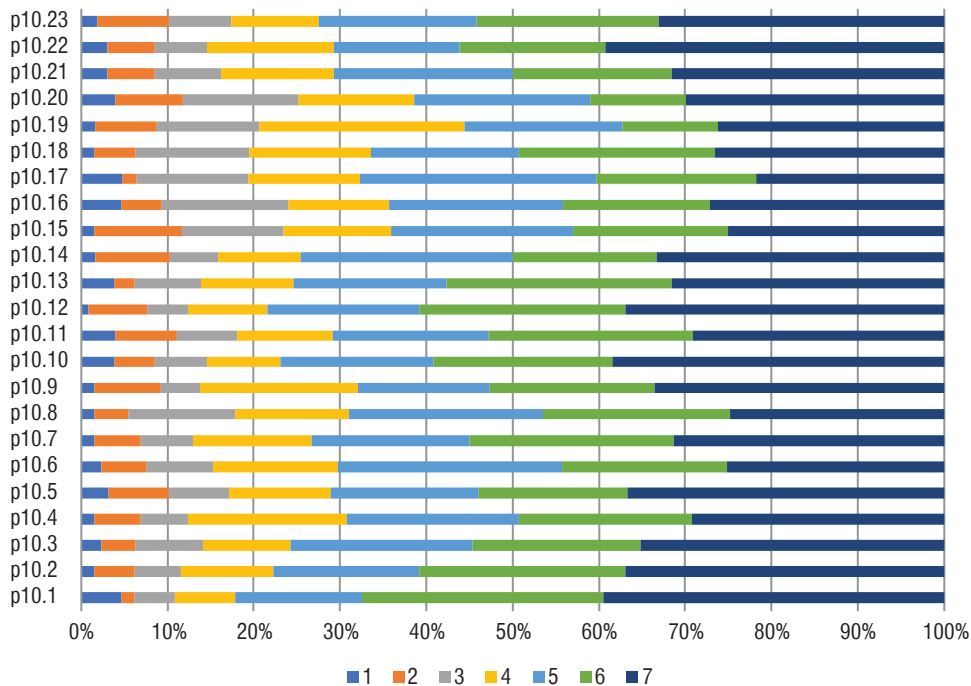
A questionnaire was prepared to carry out a quantitative survey on success factors for research and R&D projects based on the publication by Bartlett et al. [2017]. The full version of this questionnaire is presented in Klaus-Rosińska and Iwko [2023].

Figures 1 and 2 show how significant each of the success factors (p10.1–p10.23) were for the research and R&D projects. The importance of the individual success factors was rated on a scale from 1 to 7 (i.e. very low to very high importance). That is, the higher the weight given by the respondents, the higher the importance of a given factor of the success of research and R&D projects.

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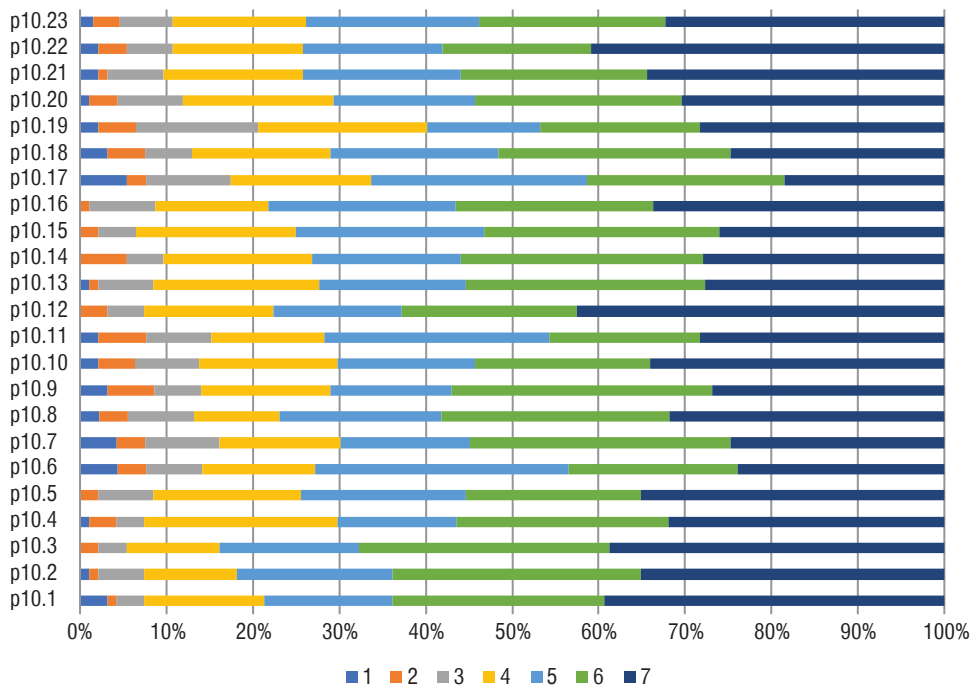
<sup>1</sup> The answers given by the respondents whose organizations conduct both research and R&D projects will not be subject to further analysis due to the small number of respondents (26 people) and in order to determine the differences between the importance of success factors and criteria of research and R&D projects.

Figure 1. Importance of success factors for research projects: distribution of responses



Source: own work.

Figure 2. Importance of success factors for R&D projects: distribution of responses



Source: own work.

For greater clarity, the conclusions from Figures 1 and 2 along with the names and numbers of success factors of research and R&D projects are included in Table 1.

**Table 1. Success factors of research and R&D projects with the importance of 6 or 7**

Factor number	Success factors for research and R&D projects	Percentage of the respondents for whom the success factor was important at the level of 6 or 7	
		Research projects	R&D projects
p10.1	Efficient cooperation in the preliminary phase of the project	65.9	63.8
p10.2	Properly planned project tasks and proper allocation of resources	59.8	63.8
p10.3	Adequate financing, secured research, and equipment facilities	53.0	67.0
p10.4	Involvement of scientists, their cooperation and focus on research	48.5	56.4
p10.5	The team and its substantive skills	52.3	55.3
p10.6	Achieving benefits from research conducted by consortium partners	43.9	42.6
p10.7	Proper selection and involvement of consortium partners	54.5	54.3
p10.8	Choosing the right place for the project and introducing the rules for its implementation	45.5	56.4
p10.9	Leadership and management	52.3	56.4
p10.10	Strong, respectful relationships within the project team	58.3	54.3
p10.11	Equal distribution of the time for research conducted in individual countries	50.8	44.7
p10.12	Effective communication and information flow	59.8	62.8
p10.13	User benefits of the project deliverables	56.8	55.3
p10.14	Flexible project implementation, constant monitoring and reviews	47.7	55.3
p10.15	Invariability of partners in the consortium (no changes among partners involved)	41.7	52.1
p10.16	Properly estimated duration of the project	43.2	55.3
p10.17	The influence of sponsors on the shape of the project	37.9	40.4
p10.18	The implemented project is a subsequent research collaboration	47.7	51.1
p10.19	The implemented project is a continuation of another research	35.6	45.7
p10.20	Adjusting the subject of the project to the development strategy of a given country	39.4	53.2
p10.21	Experience of the project leader in the implementation of projects within the consortium	49.2	55.3
p10.22	Sufficient trust in the team	55.3	57.4
p10.23	Other factors	44.7	37.2

Source: own work.

After analyzing the results of the respondents' responses when it comes to the importance of the success factors of research and R&D projects, the following conclusions can be drawn:

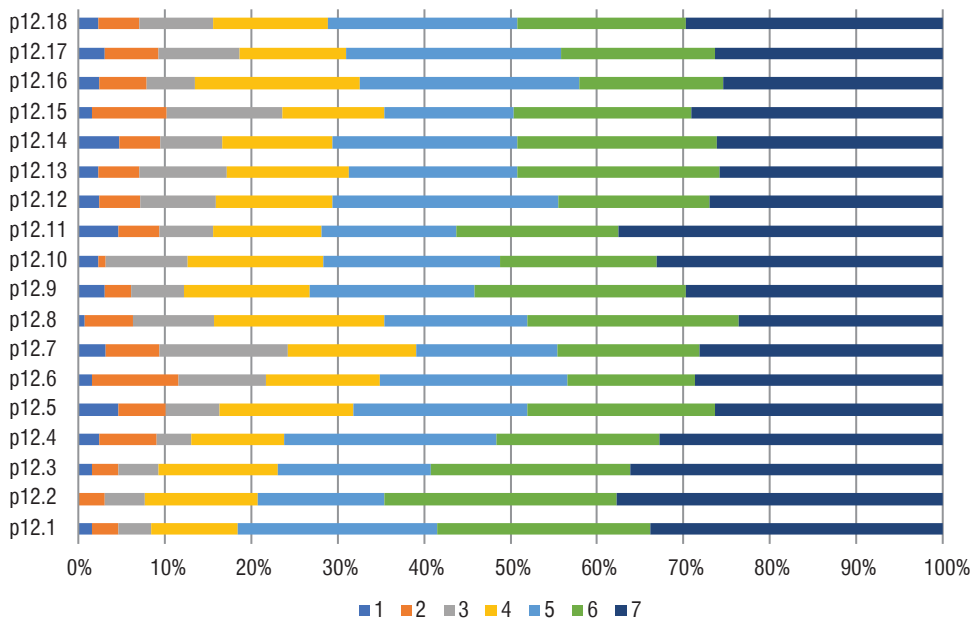
- over 50% of the respondents rated 11 out of 23 success factors as important or very important in research projects,
- more than 50% of the respondents rated 18 out of 23 success factors as important or very important in R&D projects,

- the five most important success factors for research projects turned out to be: Efficient cooperation in the preliminary phase of the project (p10.1), Properly planned project tasks and proper allocation of resources (p10.2), Effective communication and information flow (p10.12), Strong, respectful relationships within the project team (p10.10), User benefits of the project deliverables (p10.13),
- the five most important success factors for R&D projects turned out to be: Adequate financing, secured research and equipment facilities (p10.3), Efficient cooperation in the preliminary phase of the project (p10.1), Properly planned project tasks and proper allocation of resources (p10.2), Effective communication and information flow (p10.12), Sufficient trust in the team (p10.22),
- less than 10% of the respondents rated 20 out of 23 success factors as little or very little important in research projects,
- less than 10% of the respondents rated 18 of the 23 success factors as little or very little important in R&D projects.

### Success criteria of research and R&D projects: assessing success of this type of projects

A questionnaire was prepared to carry out quantitative research into the success criteria of research and R&D projects based on the study described in Klaus-Rosińska [2019]. The full version of this questionnaire is presented in Klaus-Rosińska and Iwko [2023].

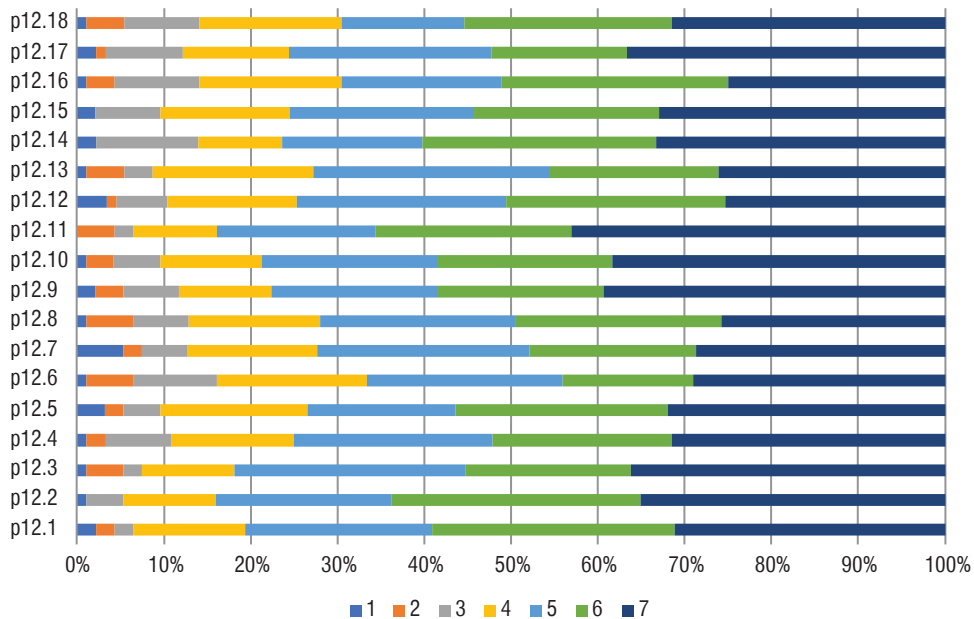
Figure 3. Importance of success criteria for research projects: distribution of responses



Source: own work.



**Figure 4. Importance of success criteria for R&D projects: distribution of responses**



Source: own work.

Figures 3 and 4 show to what extent each of the success criteria (p12.1–p12.18) was relevant for the research and R&D projects. The importance of the individual success criteria was rated on a scale of 1 to 7 (i.e. very low to very high importance). That is, the higher the weight given by the respondents, the higher the importance of a given success criterion of research and R&D projects.

For greater clarity, the conclusions from Figures 3 and 4 along with the names and numbers of success criteria of research and R&D projects are included in Table 2.

**Table 2. Success criteria of research and R&D projects with the importance of 6 or 7**

Criterion number	Success criteria for research and R&D projects	Percentage of the respondents for whom the success criterion was important at the level of 6 or 7	
		Research projects	R&D projects
p12.1	Publication	57.6	58.5
p12.2	Established cooperation	63.6	63.8
p12.3	Project deliverables	58.3	55.3
p12.4	Concept for the next project, generating ideas for the future	47.7	51.1
p12.5	Meeting the needs of end users	47.0	56.4
p12.6	Scientific impact (recognition of the environment, prestige)	42.4	43.6
p12.7	Economic impact (as a result of the commercialization of research results)	43.2	47.9
p12.8	Social and political impact	46.2	48.9
p12.9	Completion of the project on time	53.8	58.5

Criterion number	Success criteria for research and R&D projects	Percentage of the respondents for whom the success criterion was important at the level of 6 or 7	
		Research projects	R&D projects
p12.10	Completion of the project within the set budget	49.2	58.5
p12.11	Achieving the project goal	54.5	64.9
p12.12	Doctoral degrees	42.4	46.8
p12.13	Conference presentations	47.7	44.7
p12.14	Formation of a team thanks to a project	47.0	59.6
p12.15	Manager's satisfaction with the research carried out	47.7	54.3
p12.16	Patents	40.2	50.0
p12.17	Experience gained by scientists	43.2	50.0
p12.18	Substantive and financial settlement of the project, acceptance of the final report	47.7	54.3

Source: own work.

After analysing the results of the respondents' results when it comes to the importance of the success criteria of research and R&D projects, the following conclusions can be drawn:

- over 50% of the respondents rated 5 out of 18 success criteria as important or very important in research projects,
- more than 50% of the respondents rated 11 out of 18 success criteria as important or very important in R&D projects,
- the five most important success criteria for research projects turned out to be: Established cooperation (p12.2), Project deliverables (p12.3), Publication (p12.1), Achieving the project goal (p12.11), Completion of the project on time (p12.9),
- the five most important success criteria for R&D projects turned out to be: Achieving the project goal (p12.11), Established cooperation (p12.2), Formation of a team thanks to a project (p12.14), Completion of the project on time (p12.9), Completion of the project within the set budget (p12.10),
- less than 10% of the respondents rated 17 of the 18 success criteria as little or very little important in research projects,
- less than 10% of the respondents rated all success criteria as little or very little important in R&D projects.

### Correlation of success factors and success criteria for research and R&D projects

The correlation of success factors was calculated for the three questions from the introductory part of the survey (Demographics): demographics1 (the size of the organization), demographics2 (the age of the respondent) and demographics3 (the responsibility of the respondent). Correlations were analyzed with Spearman's rank correlations. A two-sided p

value of  $<0.05$  was considered statistically significant. All analyses were performed using R version 3.4.4 (R Foundation for Statistical Computing, Vienna, Austria). Correlation analysis was carried out for similar combinations for both the success factors (Table 3a and Table 3b) and the success criteria (Table 4) of research and R&D projects.

Table 3a and Table 3b present the results of the correlation analysis for success factors for research and R&D projects and their conclusions.

**Table 3a. Correlation of success factors for research projects**

Factor number	Success factors	Spearman's rank correlation <sup>2</sup>	Conclusions for research projects
p10.4	Involvement of scientists, their cooperation and focus on research	$r=0.1792$ $p=0.0414$	The "Involvement of scientists, their cooperation and focus on research" factor <b>correlates significantly positively</b> with the size of the organization (the larger the organization, the greater the importance of factor p10.4). <b>Very low correlation</b>
p10.5	The team and its substantive skills	$r=0.1786$ $p=0.0437$	The "The team and its substantive skills" factor <b>correlates significantly positively</b> with the size of the organization (the larger the organization, the greater the importance of factor p10.5). <b>Very low correlation</b>
p10.23	Other factors	$r=0.1977$ $p=0.0413$	Other factors <b>correlate significantly positively</b> with the respondent's responsibility in the examined project (the higher the respondent's responsibility, the greater the importance of factor p10.23). <b>Very low correlation</b>

Source: own work.

**Table 3b. Correlation of success factors for R&D projects**

Factor number	Success factors	Spearman's rank correlation <sup>3</sup>	Conclusions for R&D projects
p10.4	Involvement of scientists, their cooperation and focus on research	$r=0.2268$ $p=0.0279$	The "Involvement of scientists, their cooperation and focus on research" factor <b>correlates significantly positively</b> with the size of the organization (the larger the organization, the greater the importance of factor p10.4). <b>Very low correlation</b>

Source: own work.

After analyzing the correlation regarding the success factors of research and R&D projects, the following conclusions can be drawn:

- only 3 success factors of research projects correlated significantly positively with the responsibility of the respondent or the size of the organization, they were very low correlations,
- the larger the organization, the greater the importance of "Involvement of scientists, their cooperation and focus on research" and "The team and its substantive skills" in research projects,
- the higher the respondent's responsibility, the greater importance of "Other factors" in research projects,
- only 1 success factor of R&D projects correlated significantly positively with the size of organization; it was a very low correlation,

<sup>2</sup> Spearman correlation coefficient;  $p < 0.05$  denotes statistical significance.

<sup>3</sup> Spearman correlation coefficient;  $p < 0.05$  denotes statistical significance.

- the larger the organization, the greater the importance of “Involvement of scientists, their cooperation and focus on research” in R&D projects.

Similarly to success factors, the correlation of success criteria was calculated for the three questions from the introductory part of the survey (Demographics): demographics1 (the size of the organization), demographics2 (the age of the respondent) and demographics3 (the responsibility of the respondent).

Table 4 presents the results of the correlation analysis for success criteria for research and R&D projects and their conclusions.

**Table 4. Correlation of success criteria for research projects**

Criterion number	Success criteria	Spearman's rank correlation <sup>4</sup>	Conclusions for research projects
p12.2	Established cooperation	$r=0.2118$ $p=0.0156$	The “Established cooperation” criterion <b>correlates significantly positively</b> with the size of the organization (the larger the organization, the greater the importance of criterion p12.2). <b>Very low correlation</b>
p12.7	Economic impact (as a result of commercialization of research results)	$r=0.1793$ $p=0.0429$	The “Economic impact (as a result of commercialization of research results)” criterion <b>correlates significantly positively</b> with the size of the organization (the larger the organization, the greater the importance of criterion p12.7). <b>Very low correlation</b>

Source: own work.

After analyzing the correlation regarding the success criteria of research and R&D projects, the following conclusions can be drawn:

- only 2 success criteria of research projects correlated significantly positively with the size of the organization, they were very low correlations,
- the larger the organization, the greater the importance of “Established cooperation”, “Economic impact (as a result of commercialization of research results)” and “Completion of the project on time”,
- none of the success criteria of R&D projects correlated with the size of the organization, the age and the responsibility of the respondent.

## Summary

In the literature research, the authors of this paper found the answers to research questions (i) and (ii): Should we distinguish types of projects in research areas in organizations? How is project success defined and measured in research and R&D projects and are there identified success factors and success criteria for these types of projects? The main conclusions from the theoretical part include the following points:

<sup>4</sup> Spearman correlation coefficient;  $p < 0.05$  denotes statistical significance.

- the subject literature distinguishes between research and R&D projects,
- stakeholders in research and R&D projects interpret project success differently, success of research and R&D project is characterized both by the success of the project management and the success of the project product,
- the literature demonstrates success factors and success criteria for both research and R&D projects.

Based on the quantitative research, a number of conclusions were drawn, which made it possible to answer the research question (iii): Which success factors and success criteria are important for research and R&D projects?

In the opinion of over 50% of respondents rated 11 out of 23 success factors and 5 out of 18 success criteria as important or very important in research projects. In the opinion of more than 50% respondents rated 18 out of 23 success factors and 11 out of 18 success criteria as important or very important in R&D projects,

The five most important success factors for research projects turned out to be: “Efficient cooperation in the preliminary phase of the project”, “Properly planned project tasks and proper allocation of resources”, “Effective communication and information flow”, “Strong, respectful relationships within the project team”, “User benefits of the project deliverables”, and the five most important success criteria for research projects turned out to be: “Established cooperation”, “Project deliverables”, “Publication”, “Achieving the project goal”, “Completion of the project on time”.

The five most important success factors for R&D projects turned out to be: “Adequate financing, secured research, and equipment facilities”, “Efficient cooperation in the preliminary phase of the project”, “Properly planned project tasks and proper allocation of resources”, “Effective communication and information flow”, “Sufficient trust in the team”, and the five most important success criteria for R&D projects turned out to be: “Achieving the project goal”, “Established cooperation”, “Formation of a team thanks to a project”, “Completion of the project on time”, “Completion of the project within the set budget”.

After conducting the correlation analysis regarding the success factors and the success criteria of research and R&D projects, several general conclusions can be drawn:

- the larger the organization, the greater the importance of the factors: “Involvement of scientists, their cooperation and focus on research” and “The team and its substantive skills” in research projects,
- the larger the organization, the greater the importance of the factor: “Involvement of scientists, their cooperation and focus on research” in R&D projects,
- the larger the organization, the greater the importance of the criterion: “Established cooperation”, “Economic impact (as a result of commercialization of research results)” and “Completion of the project on time” in research projects.

This paper significantly contributes to the state of the art in research and R&D project management. This knowledge provides not only theoretical implications but can be useful to practitioners – project managers, project team members, supervisors.

A project manager can use the research results presented in the article in two ways:

- 1) project success factors can be helpful in predicting whether a project will be successful or not,
- 2) project success criteria can be used to evaluate the success of a project.

Thanks to this research, it is visible which success factors and which success criteria are adequate for research projects and which for R&D projects. The project manager knows the importance of particular factors and success criteria for this type of projects.

However, the survey has a limitation, which is related to the size of the organization. More than 80% of the organizations are medium-sized and large. The results of the survey may be less useful for small organizations (with less than nine employees).

## Acknowledgement

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