SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2026
ORGANIZATION AND MANAGEMENT SERIES NO. 249

USE OF PROJECT METRICS IN BUSINESS-BASED R&D PROJECTS

Joanna IWKO[1*], Dorota KUCHTA[2]

[1] Faculty of Management, Wroclaw University of Science and Technology; joanna.iwko@pwr.edu.pl, ORCID: 000-0002-7802-8412
[2] Faculty of Management, Wroclaw University of Science and Technology; dorota.kuchta@pwr.edu.pl, ORCID: 0000-0002-9747-0759
* Correspondence author

Purpose: The purpose of this article is to analyse the use of metrics in R&D projects within business organisations and to formulate recommendations for their practical application.
Design/methodology/approach: First, a literature review was conducted to identify the metrics used in R&D projects within business organisations according to the literature. Subsequently, a multiple holistic case study was employed, with business organisations undertaking research projects serving as the units of analysis. Interviews were carried out with three research project managers. On the basis of the data collected from the respondents, recommendations regarding the use of metrics in business R&D projects were formulated.
Findings: R&D project managers in the business organisations focus primarily on quantitative, easy-to-measure metrics such as cost and schedule variance, and on customer-related metrics. They rarely employ human-centred or more complex metrics, which indicates a need for changes in R&D project management practices.
Research limitations/implications: The research was limited to three case studies. Clearly, additional case studies and a large-sample survey are required to draw definitive conclusions about the use of metrics in the management of R&D projects in business. Nevertheless, the research presented in this paper already demonstrates clearly that metrics-based project management should be further advanced by researchers, with particular consideration for business organisations as the ultimate end users.
Practical implications: Given the well-established importance of metrics in project management generally, and their limited use in the case studies analysed in this paper, R&D project leaders in practice should consider introducing more complex and human-related metrics to improve the success rate of their R&D projects. Appropriate infrastructure and support should also be provided, including training, software, templates, and other adequate resources.
Originality/value: This paper presents the first study in which a comprehensive list of different types of project metrics is compared with the everyday practices of R&D project management in the business sector. The findings indicate that many metrics described in the literature and recognised as valuable remain unused or even unknown in the practical management of R&D projects in business organisations.
Keywords: project metrics, business-based R&D projects, R&D project objectives, R&D project values.
Category of the paper: research paper, case study.

1. Introduction

Metrics in project management are indicators intended to provide selected information about a project's final outcomes as early as possible. They function as an early warning system, enabling the introduction of corrective actions within the project or its environment before it becomes too late to intervene. Metrics-based project management is sometimes compared to regular human health check-ups, whose purpose is to identify signs of illnesses before they fully develop (Kerzner, 2017).

The first fully developed metrics-based project control systems were built on the Earned Value Method (Fleming et al., 2016). In this method, the total cost and duration of the project are systematically re-estimated during project execution on the basis of past and current project information represented by selected metrics. The Earned Value Method has since been expanded to include metrics designed to control aspects of the project beyond time and cost, for example through the Earned Green Value framework (Koke et al., 2017). At the same time, numerous other metrics have been proposed to measure various project dimensions, reflecting the well-established understanding that many diverse factors influence project success (Kerzner, 2017). As the decisive role of people in projects has become increasingly recognised, people-related metrics have also been introduced (Rad et al., 2006). These metrics aim to identify human-related – often intangible – symptoms that may indicate a potential negative impact on project objectives and delivered value in the future.

It is widely acknowledged that metrics-based project management can be extremely beneficial, just as regular health check-ups are beneficial to human well-being. However, much like routine health check-ups, metrics-based project management is seldom applied in practice, both because it is time-consuming and because it is associated with certain psychological apprehensions. The authors' university-based experience suggests that this may also be true for R&D projects, where an R&D project is defined as follows: 'An R&D project consists of a set of R&D activities, is organised and managed for a specific purpose, and has its objectives and expected outcomes. An R&D activity is the sum of actions deliberately undertaken by R&D performers to generate new knowledge' (Eurostat, 2023). This intuition regarding the limited use of metrics in practice was corroborated by the authors' previous study on university-based research projects (Iwko et al., 2025).

The aim of the present paper was to replicate that research, but this time in the context of business-based R&D projects. More specifically, the objective was to determine whether, and to what extent, metrics-based project management is used in R&D projects within business organisations, and to develop recommendations for project managers in this sector. A secondary objective was to compare the situation across the university and business sectors.

To achieve the research objectives, a literature review was combined with a multiple holistic case study, with business organisations conducting R&D projects serving as the units of analysis (Yin, 2015). In-depth interviews were conducted with three research project managers from business organisations. The literature review provided the basis for developing a list of potential metrics, which was subsequently used during the interviews. Based on the data collected from the respondents, the extent of the use of project metrics in business-based R&D projects was established and recommendations were formulated. Finally, the results were juxtaposed with those from our earlier study concerning universities (Iwko et al., 2025).

2. R&D projects in business – literature review

A research and development (R&D) project in business involves investigating new ideas and transforming them into innovative products, services, or processes. Its purpose is to enhance a company's competitiveness by exploring and implementing emerging technologies, improving existing solutions, or creating entirely new offerings. Such projects typically include market analysis, experimentation, prototype development, and testing (Tidd et al., 2020).

The primary objective of project management is to deliver the required product, service, or process while meeting defined goals. In addition, as noted by Kerzner (2011), it has recently been recognised that the fundamental objective of every project is to deliver the values expected by its stakeholders. Metrics in project management are indicators used throughout the project lifecycle to help monitor its trajectory and to forecast potential problems as early as possible (Iwko et al., 2023; Kerzner, 2022) – where problems refer to situations in which the project fails to achieve the desired objectives or values. For this reason, the literature review conducted here focused on the objectives of business R&D projects, the values they are expected to deliver, and the metrics used to assess the likelihood of achieving these objectives and values.

2.1. Primary goals, objectives and values to be achieved in R&D projects in business

The primary goals of R&D projects in business include developing new products and services (Groen et al., 2011), enhancing existing solutions, and creating customer-specific offerings (Kreimeyer, 2010). Additional goals comprise the commercialisation of research results and the formation of new start-ups (Tung et al., 2013), increasing profitability (Kotlar et al., 2014), and investing in innovation (Ge et al., 2025). R&D projects also aim to initiate new strategic collaborations (Gamal et al., 2025), support talent development (Zhu et al., 2022), enhance economic and social welfare (Hariharan et al., 2024), and strengthen sustainability (Wiratmadja et al., 2025). Operational objectives include prototype development, feasibility studies and proof-of-concept activities, knowledge creation and documentation, and process optimisation (Tidd et al., 2020).

The values that stakeholders of business R&D projects expect to achieve include sustainable growth, infrastructure development, and the reduction of inequalities (Maddaloni et al., 2024; Thabrew et al., 2009), as well as improvements in human well-being (Picolli et al., 2024). Stakeholders also seek learning opportunities, career progression, recognition, and various user-specific benefits (Elias et al., 2002).

2.2. Metrics used in R&D projects in business

Metrics used in R&D project management, as described in the literature, are largely those that can be applied either as end-of-project or end-product metrics – after project completion – or during the project in the form of predicted values. These include metrics such as ROI, NPV, revenues, R&D intensity (R&D cost as a percentage of revenue), market share, product quality, stakeholder satisfaction, customer impact, environmental impact, time-to-market, and knowledge creation (He et al., 2023; Mack Institute for Innovation Management, 2020; Schwarz et al., 2011).

However, metrics that can be applied during project implementation and are based not only on forecasts but also on current values are equally important (Kerzner, 2022). They may possess strong early-warning potential, as they are often more objective – being grounded in current rather than predicted information. According to the literature, such metrics are not frequently employed by business organisations. Among the few that are used, we find the speed of new product development (Mallick et al., 2005); schedule and budget adherence (Mallick et al., 2005; Hughes et al., 2004; Shields et al., 2003); the effectiveness of project management and team productivity (Gün et al., 2020); resource allocation, milestone achievement, and continuous feedback (Lazzarotti, 2009; Rodríguez Gutiérrez et al., 2012). Research-specific metrics are also noted in the literature, such as the number of publications and patents (Munari et al., 2024).

Table 1 links these metrics to the relevant objectives and values.

Table 1.
Metrics used in R&D projects in business organisations related to objectives and values aimed at in those projects

Objectives / Values	Associated Metrics
Innovation	Time-to-market; Patents; Publications
Commercialization	ROI; NPV; Revenues; Market share
Customer-adopted Solutions	Customer impact; Stakeholder satisfaction; Product quality
Talent Development	Knowledge creation; Continuous feedback; Publications
Sustainability	Environmental impact; Resource use
Operational Excellence	Schedule adherence; Budget adherence; Team productivity
Social Welfare	Customer impact; Environmental impact

Source: own elaboration.

According to the literature, most metrics proposed within general metrics-based project management frameworks (Kerzner, 2022; Rad, 2006) are not widely used in the management of R&D projects in business organisations. Table 1 shows that, for some objectives and values

expected in R&D projects within business settings, no metrics are used at all. The aim of the study presented in the following sections was therefore to examine the current state of practice regarding the use of metrics in business, based on selected case studies.

3. Results of the study of metrics in R&D projects in business organisations

3.1. Research methodology

The aim of the study was to explore project managers' opinions on the use of metrics in research project management in business organisations. A qualitative research strategy – case studies – was employed for this purpose. The study followed a multiple holistic case study design, in which the units of analysis were organisations conducting research projects (Herriott, Firestone, 1983; Yin, 2015).

Three business organisations carrying out research projects were examined. A method typical of qualitative research, namely interviews, was used to collect information on the use of metrics in research project management. Individual structured in-depth interviews were carried out with three research project managers. The case study protocol (questionnaire) was developed on the basis of the literature review and the literature on metrics-based project management (Rad et al., 2006; Kerzner et al., 2017). It consisted of questions referring directly to individual metrics from a prepared list (see Table 4) and focused on their use in practice. The moderator clarified the meanings of less obvious metrics to ensure that the interviewees shared a common understanding with the authors of this paper. Each interview lasted approximately one hour and was conducted by a moderator via instant messaging between September and November 2023. All data were anonymised to prevent identification of the interviewees.

The metrics discussed during the interviews with research project managers from business organisations, addressed various aspects of research project management. Based on the literature (Kerzner, 2022; Rad, 2006), thirty-two potential metrics supporting metrics-based project management were identified. These metrics were divided into four groups according to the project areas they address and their level of complexity (Table 4):

1) Quantitative, easily measurable metrics (Group 1).
2) "Soft" or "sensitive" team metrics, fairly easy to determine (Group 2).
3) "Difficult", advanced metrics (Group 3).
4) Customer-related metrics (Group 4).

The above division reflects the different types of metrics. Some of them are easy to understand and should not pose difficulties for respondents when assessing their usefulness. Other metrics may be more challenging to determine, yet they may still be of high importance.

One of the mistakes in practical metrics-based management highlighted by Kerzner (Kerzner, 2022) is the elimination of metrics that are difficult to measure, which reduces the early-warning capacity of the entire system. In this paper, we decided to make the effort to avoid this mistake.

The full list of metrics used in the interviews is given in Table 4.

3.2. Description of the qualitative data analysis procedurę

The study was based on a qualitative approach, utilizing a multiple holistic case study. To achieve the research objective, interviews were conducted with three research project managers from business organisations. Each interview is treated as a separate case embedded in a specific organizational context. Due to the small sample size (n = 3), a strategy of in-depth analysis (within-case analysis) followed by comparative analysis (cross-case analysis) was adopted (Goertz, Mahoney, 2012), with particular emphasis placed on reconstructing the organizational context of each case. This approach enhances the research's insightful value despite the limited sample size.

Using a multiple holistic case study approach, the organizational contexts within-case were analyzed and the convergence cross-case was analyzed using three main dimensions of organizational context (industry and nature of the business, size and structure of the organization, and project management maturity) (Table 2).

Table 2.
Organizational context of the three analyzed case studies

	Project manager 1 (PM1) – Manager of EU projects	**Project manager 2 (PM2) – Manager of projects combining business with science**	**Project manager 3 (PM3) – Manager of projects conducted in the Design Thinking methodology**
Industry and nature of business	The respondent operates in a highly institutionalized environment, associated with the implementation of projects financed from public funds (EU funds). The organization operates at the intersection of various sectors (including industry, fashion, and manufacturing), which requires adapting to the specific needs of its clients, but the core of its operations remains unchanged – compliance with regulations and procedures.	The respondent operates in a hybrid environment— at the intersection of academic organizations and businesses. Projects are research and development in nature and are often co-financed by public funds, but their implementation requires collaboration between entities with different operational logics.	The respondent operates in an environment with a high level of flexibility, including projects implemented for private companies, public institutions and organisations from various industries (e.g. education, HR, medical sector).

Cont. table 2.

Size and structure of the organization	The organizational structure is rather formal and hierarchical, and the processes are strongly parameterized by project applications, schedules, budgets, and guidelines of financing institutions.	The organization is characterized by a moderate degree of formalization, high dependence on university procedures, and a dispersed decision-making structure.	The organization is flat and networked, project-based, with high team autonomy, focused on innovation and collaboration.
Project management maturity	The level of project management maturity can be described as high, but it is a "procedural" maturity resulting more from system requirements than from the autonomous development of the organization.	The project management maturity level can be described as medium – tools and procedures are present, but their use is selective and adapted to the situation.	The level of project management maturity is high, but informal – based on experience, team practices and iterative methods, not on formalized standards.

Source: own elaboration

In summary, in research based on a small number of interviews, in-depth contextual and comparative analysis, rather than the number of observations, is crucial. This allows us to capture the mechanisms behind metric selection in business research project management and their correlation with organizational maturity and industry specifics.

Additionally, profiles of the respondents were elaborated (Table 3).

Table 3.
Profiles of respondents from business

	Project manager 1 (PM1)	**Project manager 2 (PM2)**	**Project manager 3 (PM3)**
Description	Project manager of implementation projects in the research services sector	Project manager of high-value commercial projects (multi-million contracts)	Cross-industry project manager with experience in IT and services
Environment	service company implementing research and R&D projects	private technology company	consulting and technology sector
Work style	flexible, utilizing design thinking and agile methods	task-oriented and results-oriented, strongly focused on contract execution and budget control	analytical, but with a strong emphasis on empathy and team communication
Characteristics	creativity, openness to change, strong interpersonal skills	assertiveness, stress resistance, ability to negotiate with clients and partners	reflectiveness, adaptability, and the ability to combine hard and soft management methods
Problems	the need to combine an innovative approach with formal project requirements	maintaining a balance between client expectations and the team's capabilities and financial resources	transferring IT management practices (e.g., Agile) to humanities and organizational projects

Source: own elaboration.

In summary, the interviewed project managers focus primarily on efficiency, timeliness, and risk control. A common thread across all profiles is adaptability and a strong capacity to learn from experience.

4. Results of research on the use of metrics by project managers in business

The application of the protocol (questionnaire) within the multiple holistic case study made it possible to draw the following conclusions regarding the use of metrics in research projects in universities and business organisations, presented across the four metrics groups.

Table 4 summarises the use of metrics by project managers of R&D projects in business organisations, according to their own words.

Table 4.
Usage of metrics by project managers of research projects in business organisations

No	Name of metric	Project manager 1 (PM1)	Project manager 2 (PM2)	Project manager 3 (PM3)
	Group 1: quantitative, easily measurable metrics			
1	Number of resources allocated in relation to planned resources	usually uses, zero-one (are there or are not there)	usually uses	usually uses
2	Quality of allocated resources in relation to planned quality	usually benefits,	does not use, difficult to define	does not use, difficult to define
3	Number of hours (tasks) without human resources allocated	does not benefit	does not benefit	does not benefit
4	Percentage of total overtime worked	does not benefit	does not benefit	does not benefit
5	Cost variance	uses frequently	uses frequently	uses frequently
6	Schedule deviation	uses frequently	uses frequently	uses frequently
7	Number of changes to the project scope	not used, too much volatility	not used, too much volatility	not used, too much volatility
8	The extent to which it has been possible to invoice and obtain payment on time	controlled by an external body (e.g. finance department)	controlled by an external body (e.g. finance department)	controlled by an external body (e.g. finance department)
9	Quality of supplier monitoring (supplier relations)	does not use, difficult to define	does not use, difficult to define	does not use, difficult to define
10	Number of cost adjustments made	not used, too much volatility	not used, too much volatility	not used, too much volatility
11	Quality of implementation of the risk management plan	does not benefit	does not benefit	does not benefit
12	Number of tasks (work packages) completed according to plan	does not benefit	does not benefit	does not benefit
	Group 2: "Soft" or "sensitive" team metrics, fairly easy to determine			
13	Amount of wasted/unproductive time	does not benefit	does not benefit	does not benefit
14	Quality of project management by the project manager	not used, difficult to monitor	does not use, but considers important	not used, difficult to monitor
15	Opportunities for personal and professional development of team members	does not benefit	does not benefit	does not benefit
16	The degree to which the opinions of individual project team members were taken into account	does not benefit	benefits, qualitatively	does not benefit
17	Quality of definition and communication of roles to individual project team members	not used, difficult to monitor	benefits, qualitatively	not used, not understood

Cont. table 4.

	Group 3: "Difficult", advanced metrics			
18	Project complexity index	not used, not understood	not used, not understood	not used, not understood
19	Number of critical restrictions	happened to use	not used, not understood	could benefit from
20	Number of critical assumptions	does not benefit	does not benefit	does not benefit
21	Cost efficiency ratio	benefits in terms of quality	does not benefit	benefits in terms of quality
22	Schedule performance indicator	does not benefit	does not benefit	does not benefit
23	Degree of implementation of health and safety rules	monitored zero-one	not applicable	not applicable
24	Compliance with agreed quality indicators	does not use, difficult to define	does not use, difficult to define	does not use, difficult to define
	Group 4: Customer-related metrics			
25	Level of customer satisfaction with the project outcome	uses regularly	monitors qualitatively	does not benefit
26	Level of customer satisfaction with the project	depends on the customer, uses occasionally	monitors qualitatively	depends on the customer, uses occasionally
27	Level of customer satisfaction with project communication	uses regularly, important	monitors qualitatively	depends on the customer, uses occasionally
28	Number of commitments kept to the customer as a proportion of total commitments	does not benefit	not used, difficult to monitor	does not use, difficult to define
29	Quality of customer expectation management	sometimes used, difficult to define and monitor	not used, difficult to monitor	does not use, difficult to define
30	Level of understanding of the client and their industry by the project team	depends on the customer, uses occasionally	depends on the customer, usually does not use	depends on the customer, uses occasionally
31	The extent to which the project team looked after the client's interests	depends on the customer, uses occasionally	monitors qualitatively	depends on the customer, uses occasionally
32	The extent to which the project has contributed to establishing or strengthening the company's position in the industry (additional opportunity generation)	depends on the customer, uses occasionally	depends on the customer, uses occasionally	depends on the customer, uses occasionally

Source: own elaboration.

The rows highlighted in green indicate the metrics used by all three project managers in their routine practice of R&D project management. The rows highlighted in red represent metrics that are not used by any of the three project managers. The rows highlighted in yellow refer to metrics that are either used occasionally by all three managers or are considered useful or interesting by at least two of them.

5. Discussion of the results

The green and yellow marked metrics in Table 5 are those that are either already used by at least two project managers or are considered important and potentially applicable by at least two respondents. The red marked metrics are not used or considered interesting by any of the three respondents. Metrics without colour are considered useful by only one respondent.

The first striking observation from the results is that, out of the entire list of 32 metrics, only two were reported by all three interviewees as being used in routine project management practice. These are metrics no. 5 and 6 from Group 1 (quantitative, easily measurable metrics): cost variance and schedule deviation. These are very common indicators which, in many cases, provide limited insight into project progress in terms of value creation or the achievement of less traditional project objectives (Kerzner, 2022). Most of the metrics in Group 1 are not used at all, which is surprising given that their practical application is relatively straightforward.

In Group 2 (‘soft’ or ‘sensitive’ team metrics that are relatively easy to determine), there are no green or yellow metrics. This indicates that team-related issues are not monitored systematically in R&D projects, and project managers show limited interest in this area. One respondent noted that monitoring the quality of project management (metric no. 15) would be interesting, and the same respondent uses two metrics (no. 16 and 17) to monitor communication with the team. The other two interviewees stated that they did not use such metrics or believed they were too difficult to apply – although the metrics included in Group 2 are, in fact, not particularly difficult to operationalise.

In Group 3 (‘difficult’ or advanced metrics), half of the metrics are marked red. One metric, no. 18, was not understood by the interviewed project managers. This refers to the project complexity index, which is defined in various ways in the literature (Kerzner, 2022) based on project duration, size, dependencies in and of the project, number of stakeholders, and similar factors, and is considered an important determinant of project outcomes. Another metric (no. 24) was regarded by all respondents as difficult to define, and none expressed interest in using it. This is surprising, as this metric measures the achieved quality – n aspect that should be central in R&D projects.

Group 4 consists of customer-related metrics, most of which are marked yellow, meaning they are used or perceived as potentially useful by the respondents. The red metric (no. 28) and the uncoloured metric (no. 29) both concern communication with the customer: adherence to commitments and management of customer expectations. All respondents viewed these metrics as difficult to monitor or define, which may indicate that communication with customers is far from fully developed in their project management practice.

In several cases, interviewees provided explanations for not using certain metrics. The reasons included ‘difficult to define or monitor’, ‘too much volatility’, and ‘not understood’. The explanation ‘too much volatility’ is particularly noteworthy:

metrics are designed precisely to control volatility and therefore are inherently linked to it. This reason, alongside the others, highlights the need for training and knowledge sharing on metrics-based project management.

Table 5 provides a comparison between the respondents.

Table 5.
Numbers of metrics used by individual project managers interviewed

	Project manager 1 (PM1)	**Project manager 2 (PM2)**	**Project manager 3 (PM3)**
Nb of metrics used often or occasionally	14	11	9
Nb of metrics not used	16	19	21
Nb of metrics not used, but considered interesting	2	1	1

Source: own elaboration.

Respondent 1 is the most advanced in the use of metrics, whereas Respondent 3 employs the fewest. Overall, however, it must be concluded that the use of metrics seem not widespread among project managers of R&D projects in business organisations. This is surprising, given the profiles described by the respondents in the interviews (Table 3), which would suggest a much greater openness to non-traditional management methods.

6. Conclusions and Implications

The only two metrics consistently used by project managers in business organisations are schedule and cost variances, reflecting traditional project management practices. However, relying on only two metrics is far too modest even within a classical project management approach, where aspects such as quality and risk should also be systematically monitored. More advanced metrics – or those related to soft aspects, such as project management quality or team-related indicators – are not widely used. Yet, as highlighted in the literature, these types of metrics may be particularly valuable for the effective control of all projects, including R&D projects. Customer-related metrics are generally better accepted by project managers in practice, with the exception of a few that are essential for managing customer expectations and satisfaction. These rather limited results appear to stem from a lack of knowledge or understanding of metrics-based project management, as well as of contemporary value-based project management approaches.

R&D projects differ fundamentally from operational or engineering projects: they involve high levels of uncertainty, evolving knowledge, creative problem-solving, and close interaction with customers. They also rely on teams of researchers who have individual goals, ambitions, and personalities. As shown in Section 2, they pursue objectives and values of various types,

For this reason, effective use of metrics in R&D projects in the business sector must extend beyond simple cost–schedule tracking.

To enhance R&D project performance, business organisations should:

- invest in developing project managers' capability to use advanced and qualitative metrics,
- provide clearer guidelines and tools for measuring soft and complex aspects,
- encourage systematic customer and team-related metrics usage,
- integrate both qualitative and quantitative indicators into a balanced scorecard for R&D projects.

Comparing the findings of this study with those presented in the authors' previous publication (Iwko et al., 2025), several similarities and differences in the use of metrics in R&D projects can be observed. In both contexts, the maturity of metrics-based project management practice remains low. Overall, however, business project managers demonstrate a slightly higher level of metrics utilisation. In contrast, university project managers tend to engage with formal metrics more selectively and to a lesser extent, more frequently considering them difficult to define, inappropriate for research environments, or relevant primarily for external reporting obligations rather than for internal project management. This suggests that the recommendations formulated above are relevant for all organisations implementing R&D projects.

This study has several limitations. First, it is based on only three case studies. Therefore, the results are exploratory and interpretative, not representative. A substantially larger sample should be examined in future research, potentially employing additional methods such as surveys. Furthermore, interdependencies among metrics should be considered, as some metrics provide overlapping information. More specifically, coherent sets of metrics should be presented to respondents to allow assessment of the usefulness of an integrated system, rather than of individual metrics in isolation. However, such research should be preceded by a brief training session in which the principles of metrics-based and value-based project management are explained. Further, the reasons should be investigated for which several metrics were perceived as "not understood" or "difficult to define", and cross sector differences should be examined, especially with respect to academia.

Acknowledgements

The research was funded by the Faculty of Management, Wrocław University of Science and Technology (Poland), as part of the "Mini-Grant WuZetka" competition for the implementation of a single scientific activity entitled "Metrics in research projects - definition and selection".

References

1. Chiesa, V., Frattini, F., Lazzarotti, V., Manzini, R. (2009). Performance measurement in R&D: exploring the interplay between measurement objectives, dimensions of performance and contextual factors. *R&D Management*, *Vol. 39, Iss. 5,* pp. 487-519, doi:10.1111/j.1467-9310.2009.00554.x
2. Elias, M., Cavana, R., Jackson, L. (2002). Stakeholder analysis for R&D project management. *R&D Management*, *Vol. 32, Iss. 4*, pp. 301-310, doi:10.1111/1467-9310.00262
3. Eurostat (2023). *Research and development (R&D*). https://ec.europa.eu/eurostat/cache/metadata/EN/rd_simsbe_ba.htm
4. Fleming, Q.W., Koppelman, J.M. (2016). *Earned value project management* (4th ed.). Project Management Institute.
5. Gamal, H., Saif, S., Alshaarawi, A., Alharbi, A. (2025). Managing R&D projects: Fostering strategic partnerships for innovation and excellence. *SPE Middle East Oil and Gas Show and Conference (MEOS).* Manama, Bahrain, September 2025. https://doi.org/10.2118/227591-MS
6. Ge, T., Wang, M., Dai, D. (2025). R&D investment target setting and enterprise innovation strategy: Substantive or symbolic? *Journal of Innovation and Knowledge*. DOI:10.1016/j.jik.2025.100807
7. Geisler, E. (2002). What do we know about: R&D metrics in technology-driven organizations. *Research–Technology Management*. https://www.researchgate.net/publication/228871609_What_do_we_know_about_RD_metrics_in_technology-driven_organizations
8. Goertz, G., Mahoney, J. (2012). Within-Case versus Cross-Case Causal Analysis. In: *A Tale of Two Cultures: Qualitative and Quantitative Research in the Social Sciences*. Princeton University Press. https://doi.org/10.23943/princeton/9780691149707.003.0007
9. Groen, M., Noyes, J. (2011). Product design: User-centered versus a task-based approach. In: *Human factors and ergonomics in consumer product design: Methods and techniques.* DOI:10.1201/b10950-30
10. Gün, Ö., Yıldız Kumru, P., Aladağ, Z. (2020). Developing a model for measuring project performance with software life cycle process metrics and calculating project success score. *Sakarya University Journal of Science, Vol. 24, Iss. 3,* pp. 543-561, DOI:10.16984/saufenbilder.649588
11. Hariharan, A.N., Biswas, A. (2024). Capturing regional inequality of knowledge-based innovation activities by USA-based multinational enterprises in a globalized world. In: *Neoliberal policies and inequality: Evidence from Asian city regions*. India: Routledge.

12. He, M., Pérez Estébanez, R. (2023). Exploring the impact of R&D intensity, human capital, patents, and brand value on business performance in SMEs. *Economic Research–Ekonomska Istraživanja, Vol. 36, Iss. 1*.
13. Herriott R.E., Firestone W.A. (1983). Multisite qualitative policy research: Optimizing description generalizability. *Educational Researcher*, *Vol. 12, Iss. 2,* pp. 14-19. DOI:10.3102/0013189X012002014
14. Hughes, S.W., Tippett, D.D., Thomas, W.K. (2004). Measuring project success in the construction industry. *Engineering Management Journal*, *Vol. 3,* pp. 31-37, https://doi.org/10.1080/10429247.2004.11415255
15. Iwko, J., Kuchta, D., Bezgin, O. (2025). Metrics for measuring the achievement likelihood of values in university R&D projects. *Scientific Papers of Silesian University of Technology, Vol. 215,* pp. 89-106, https://doi.org/10.29119/1641-3466.2025.215.6
16. Iwko, J., Kuchta, D., Yakivets, O. (2023). Metrics based project time management - application of linear programming. *Scientific Papers of Silesian University of Technology*, *Vol. 188*, pp. 243-257, http://dx.doi.org/10.29119/1641-3466.2023.188.14
17. Kerzner, H. (2022). *Project management metrics, KPIs, and dashboards: A guide to measuring and monitoring project performance* (4th ed.). Wiley.
18. Kerzner, H., Saladis, F.P. (2011). *Value-driven project management*. Wiley.
19. Koke, B., Moehler, R. (2017). Earned Green Value management for project management: A systematic review. *Journal of Cleaner Production*, *Vol. 230,* pp. 180-197.
20. Kotlar, J., Fang, H., De Massis, A., Frattini, F. (2014). Profitability goals, control goals, and the R&D investment decisions of family and nonfamily firms. *Journal of Product Innovation Management, Vol. 31, Iss. 6*, pp. 1128-1145.
21. Kreimeyer, A. (2010). Innovation is the key to growth. *Textile Asia*, *Vol. 41, Iss. 2-3*, pp. 64-65.
22. Mack Institute for Innovation Management (2020). *Metrics for Managing Innovation: Lessons From Growth Leaders*, https://mackinstitute.wharton.upenn.edu/2020/metrics-for-managing-innovation/
23. Maddaloni, F.D., Davis, K. (2024). Fostering project social sustainability through stakeholder inclusion. In: *Research handbook on sustainable project management*, pp. 114-131, https://doi.org/10.4337/9781800885455.00017
24. Mallick, D.N., Schroeder, R.G. (2005). An integrated framework for measuring product development performance in high-technology industries. *Production and Operations Management*, *Vol. 14, Iss. 2,* pp. 142-158, https://doi.org/10.1111/j.1937-5956.2005.tb00015.x
25. Munari, F., Leonardelli, E., Menini, S., Righi, H.M., Sobrero, M., Tonelli, S., Toschi, L. (2024). Public research funding and science-based innovation: An analysis of ERC research grants, publications and patents. *Research Evaluation*. https://doi.org/10.1093/reseval/rvae012

26. Pearson, A.W. (1990). Planning and control in research and development. *Omega*, *Vol. 18, Iss. 6,* pp. 573-581.
27. Picolli, I.R.A., Alberton, A., Schmitt, T. (2024). Stakeholder engagement and the impact on promoting social value: A study in businesses with a social mission. *Revista de Gestão Social e Ambiental. RGSA, vol. 18,* p. 3, e07025, https://doi.org/10.24857/rgsa.v18n3-138
28. Rad, P.F., Levin, G. (2006). *Metrics for project management: Formalized approaches*. Management Concepts.
29. Rodríguez Gutiérrez, R.M., Canela, J.M., Ventayol Femenías, T. (2012). Experiences in agile R&D project management for new product design and development in the automotive industry. *Journal of Trends in the Development of Machinery and Associated Technology*, *Vol. 16, Iss. 1,* pp. 83-86.
30. Schwartz, L., Miller, R., Plummer, D., Fusfeld, A. (2011). Measuring the effectiveness of R&D. *Research-Technology Management, Vol. 54,* pp. 29-36.
31. Shields, D.R., Tucker, R.L., Thomas, S.R. (2003). Measurement of construction phase success of projects. *Construction Research Congress: Winds of Change-Integration and Innovation in Construction,* pp. 1-8. 10.1061/40671(2003)28
32. Thabrew, L., Wiek, A., Ries, R. (2009). Environmental decision making in multi-stakeholder contexts: Applicability of life cycle thinking in development planning and implementation. *Journal of Cleaner Production*, *Vol. 17, Iss. 1*, pp. 67-76.
33. Tidd, J., Bessant, J. (2020). *Managing innovation: Integrating technological, market and organizational change* (7th ed.). Wiley.
34. Tung, C.-M., Tseng, T.-Y., Yen, W.-C. (2013). Fostering innovation commercialization at research institutes and universities: Strategy and policy implications. *PICMET 2013 Proceedings*, pp. 928-934.
35. Wiratmadja, I.I., Achmad, F., Rizana, A.F. (2025). Green strategy implementation and innovativeness in SMEs: A pathway towards sustainable development goals. In: *Lecture notes in mechanical engineering,* pp. 305-314.
36. Yin, R.K. (2015). *Case study in research, Design and methods*. Kraków: Jagiellonian University Publishing House.