

## **BUDGETING OF PROJECTS IMPLEMENTED BY SCIENTIFIC AND INDUSTRIAL CONSORTIA – ANALYSIS FROM THE POINT OF VIEW OF ENTERPRISES**

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**Purpose:** The purpose of this study was to identify and evaluate the elements of projects implemented by scientific and industrial consortia that were managed and then assess the use of IT systems and tools for managing these elements, with particular emphasis on the project budgeting process.

**Design/methodology/approach:** This paper presents partial results of mixed research involving preliminary qualitative research in the form of unstructured interviews with managers of projects implemented as part of scientific and industrial consortia, followed by quantitative research conducted using a questionnaire survey among representatives of companies from a group of this type of consortium.

**Findings:** The research identified key elements of the projects from a business perspective and determined the usefulness of IT tools/systems for project management, with a particular focus on project budgeting functionalities.

**Practical implications:** The research results will contribute to a better understanding of the project management process within scientific and industrial consortia and enhance the absorptive capacity of consortia consisting of private enterprises and public higher education institutions. They may also increase the use of IT tools/systems in project management processes, including project budgeting.

**Originality/value:** Literature studies and the results of our own research conducted among enterprises indicate the complexity of the cost budgeting process in projects carried out by consortia consisting of public higher education institutions and private enterprises. They also highlight the significant role of using IT systems/tools in cost management.

**Keywords:** budgeting, consortia, enterprises, universities, project management.

**Category of the paper:** Research paper.

## **1. Introduction**

The development of innovative economies is supported by the transfer of modern solutions from the world of science to industry. This is made possible through the collaboration between higher education institutions and enterprises. Such cooperation is widely supported by external funds, including EU funds. The acquisition of external funds usually occurs through the formation of a scientific and industrial consortium and the joint preparation of a project in response to announced funding competitions. Joint project implementation enables achieving a synergy effect based on the diverse resources and competencies of the consortium members. However, it also increases the risk of failure as it requires coordination of work at the level of multiple entities.

The budgeting process for projects implemented in consortia involves the need to consider the specific conditions of individual partners. This arises on one hand from the nature of their financing, and on the other from the constraints resulting from the competition conditions of various public institutions providing funding for such initiatives. Typically, scientific and industrial consortia comprise public higher education institutions and private enterprises, although other entities may also participate in their implementation. The complexity of the budgeting process within projects implemented by scientific and industrial consortia was the primary reason for choosing this topic.

Public higher education institutions, as part of the public sector, are subject to public finance regulations, with their main source of funding being public funds. When applying for funding, they are in a privileged position as they can receive up to 100% funding for eligible costs.

Private enterprises, on the other hand, have more flexibility in managing their financial resources, but when applying for public funding, they must adhere to limits on public aid and always secure funds for their own contribution to the project. As a result, the project budget in a consortium varies in the level of funding among the different partners.

## **2. Cooperation between higher education institutions and enterprises in joint research and development projects**

The aim of this chapter is to provide a concise presentation of the motives for establishing cooperation between higher education institutions and enterprises, as well as the implications of this cooperation. Increasing the innovativeness of enterprises requires collaboration with research institutions. One of the factors stimulating this cooperation is the possibility of obtaining external financial resources. There are two forms of research funding in the public sector – institutional funding and project funding (Prucia, 2017). Institutional funding pertains

to, among others, public higher education institutions, which receive subsidies for maintaining and developing their educational and research potential. Both public higher education institutions and private enterprises can apply for public research funds through scientific and industrial consortia, by participating in competitions announced by public funding institutions.

As noted by I. Sobańska (2011), consortia represent a mixed organisational form combining market and hierarchical elements. She also highlights the need to expand the organisational boundaries of the accounting system in interorganisational relationships. E. Bracci (2023) emphasises the key role of accounting in managing organisational boundaries to support an appropriate level of control and accountability. He argues that accounting must transition from a hierarchical approach to coordination and vertical information flows to a more horizontal approach to coordination with lateral information management.

According to Bernal, Carree, and Lokshin (2022), the primary motive for innovative enterprises to seek collaboration is access to knowledge resources. They stress that R&D collaboration plays a crucial role in creating innovation. It can facilitate access to resources that firms do not possess internally and enable consortium partners to share costs and risks within R&D projects. Additionally, Aksoy, Pulizzotto, and Beaudry (2022) indicate that universities can act as accelerators of innovation and regional economic growth.

Numerous studies on collaboration between academic institutions and industry focus on how such partnerships develop and what benefits they bring (Attour, Lazaric, 2020; Compagnucci, Spigarelli, 2020; De Silva et al., 2020; Rajalo, Vadi, 2017). Interesting findings regarding the processes underlying the evolution of collaboration between higher education institution and industry were presented by Patnaik, Pereira and Temouri. Their case study involved collaboration between a university and a large company, which later evolved into a three-way partnership with the entry of a health organisation (Patnaik et al., 2022). This case illustrates the potential offered by cooperation between higher education institutions and enterprises in executing joint R&D projects funded by EU grants distributed by intermediary institutions (e.g. the National Centre for Research and Development in Poland or the European Commission for Horizon projects).

If a joint venture succeeds, there is a high likelihood that companies will pursue further R&D collaborations with new partners (Belderbos et al., 2018). With their previous experience, these companies find it easier to establish new partnerships and are more inclined to apply for external funds. The knowledge gained from the application process and previous successes increases the probability of securing funding in future competitions.

Considering the diverse goals of universities and enterprises, they present significant management challenges that require overcoming many barriers in joint project execution (Meissner et al., 2022). One such barrier is defining mechanisms that allow proper preparation of the project budget to minimise the risk of incurring non-eligible costs that consortium members would need to cover from their own funds during the project execution stage.

### 3. The essence of budgeting for joint projects between higher education institutions and companies

The purpose of this chapter is to provide an overview of the current state of knowledge regarding the budgeting of projects carried out within scientific and research consortia. Budgeting involves a set of actions that allow the most efficient use of financial resources available to an organisation (Żaba-Nieroda, 2018). When considered as a process, budgeting is defined as a series of actions related to the preparation of assumptions, development, approval, and control of the budget (Świdarska, 2010). There are significant differences in the budgeting process between public higher education institutions and private enterprises. These differences also affect the process of preparing project budgets during the application for funds, as well as during the implementation and settlement of received funding. Dziadek (2020) points out that enterprises use acquired funding for investments in machinery, equipment, and modern technologies. This increases their innovative potential, enabling them to introduce new products and offer new technological solutions. Thanks to EU funds, they can develop, thereby positively influencing the labour market by creating new jobs and enhancing the overall innovativeness of the national economy. Universities, on the other hand, participate in the process of applying for funding to obtain resources for conducting research and subsequent commercialisation.

The differences in the budgeting process between public higher education institutions and enterprises stem from various factors. The key ones are presented in Table 1.

**Table 1.**

*Comparison of the budgeting process in public higher education institutions and private enterprises*

No.	Criterion	Public higher education institution	Private enterprise
1	Time horizon	Annual, based on a material and financial plan	Multiannual
2	Revenue structure	Predominantly public funds received from the state budget (subsidy)	Predominantly private funds, public funds constitute a small percentage
3	Cost structure	Dominated by fixed costs of maintaining personnel and infrastructure	Varied depending on the type of activity
4	Budget planning and implementation process	Regulated by law	Determined internally by the entity's authorities

Source: own elaboration based on Urbanek, 2015.

The differences indicated in Table 1 are reflected in the preparation of the project budget. Sarnowski (2019) points to a two-level planning system in projects:

1. Overall project plan – general in nature, setting the framework for the project.
2. Stage plan – detailed, indicating the sequence of actions.

Preparing a budget for a funding application requires detailed task planning and precise cost estimation. This is due to the constraints of public funds, especially EU funds. According to these constraints, expenses not included in the project's budget and schedule cannot be

considered eligible. Intermediary institutions enable budget changes, but this usually requires approval and contract amendment, which is a time-consuming process fraught with the risk of denial. Furthermore, it should be noted that the categories of costs eligible for funding are also limited. This means not all project costs can be financed by the funding. The catalogue of eligible costs is published with each call for proposals.

As noted by Dziadek K. (2015), the importance of budgeting has increased in recent years, mainly due to the growing number of EU projects being implemented. Project budgeting is a complex process that requires management to consider numerous conditions for the project's execution (Klinowski, 2017; Kocharński, 2016). Project cost budgeting occurs before its implementation, and control is carried out during or after project completion (Lesniak, 2019; Dziadek, Kotarski, 2016; Łada, Kozarkiewicz, 2007). This means that cost eligibility in funded projects will be assessed not only during the budget evaluation stage but also during its implementation when approving subsequent payment requests, and after project completion when approving the final payment request. It should be noted that in most projects, the recognition of costs as ineligible can also occur after project completion during the sustainability period. Hence, budget execution control plays a crucial role, which allows to identify deviations between planned and actual costs and to take necessary actions (Nita, 2014).

Preparing a project budget is a critical process, as it defines the cost base that integrates the project's scope and quality requirements with the funding limits set by the funding institution. The degree of budget implementation is one of the measures of project progress throughout its life cycle (Xenidis, Stavrakas, 2013). Moreover, the project budget is one of the evaluated elements in the competition procedure. Its preparation thus affects the likelihood of receiving funding and the subsequent recognition of costs as eligible if funding is granted.

Cost budgeting methods differ in terms of complexity and accuracy, but primarily in how they account for contingency reserves in the total budget (Xenidis, Stavrakas, 2013). For projects applying for funding, the aspect of contingency reserves is significantly complicated because the allowable changes in the project budget most often do not permit an increase in funding. This means that any savings realised in the project can be used for additional necessary costs. However, if funds are lacking, their coverage can only be ensured by the consortium members.

#### **4. Research methodology**

The study employed a sequential explanatory model, involving preliminary qualitative research followed by quantitative research on a larger sample. As part of the qualitative research, unstructured interviews were conducted with five project managers involved in such collaborations. These interviews aimed to gather empirical material based on open-ended

questions, allowing respondents to speak freely and directly. The results obtained were used to develop a questionnaire for a survey conducted among individuals managing projects on the enterprise side within consortia comprising at least one public higher education institution and at least one private enterprise. The survey was conducted in 2020-2021 using a mixed-mode method combining CATI and CAWI techniques. The survey focused on a single project.

Random sampling was used. Initially, a database was prepared containing a list of projects carried out since 2014 by consortia consisting of at least one public higher education institution and at least one private enterprise. Then, an invitation to complete the survey was sent to 192 individuals, and 120 fully completed questionnaires were obtained, resulting in a response rate of 62.5%.

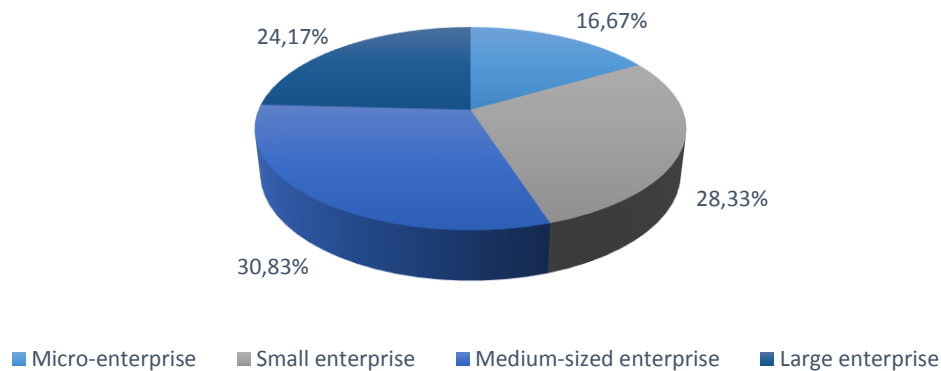
One of the goals of the qualitative research was to identify the elements of project management. The elements identified during the qualitative research and evaluated during the quantitative research included:

1. costs,
2. implementation time,
3. quality,
4. communication,
5. personnel,
6. risk.

In the subsequent part of the quantitative research, respondents were asked to assess the use of IT systems and tools for managing these elements. Respondents in this part of the survey could choose from five responses: definitely useful, rather useful, hard to say, rather not useful, definitely not useful. This scale was also applied to the question regarding the evaluation of the usefulness of budgeting functionalities within IT tools/systems used for project management.

## **5. Characteristics of the sample**

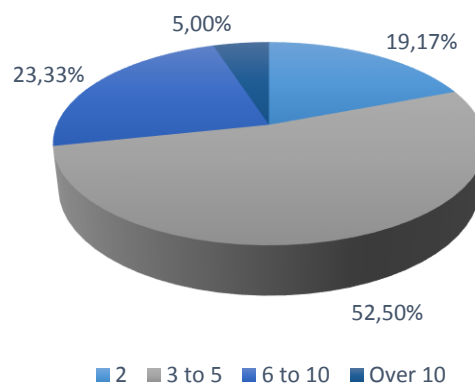
The survey was directed at individuals managing projects on behalf of enterprises within consortia comprising at least one public higher education institution and at least one private enterprise. The largest group of respondents represented medium-sized enterprises (30.83%). The detailed distribution of respondents by enterprise size is shown in Figure 1.



**Figure 1.** Size of surveyed enterprises.

Source: own elaboration based on survey results, N=120.

The number of entities forming the consortium significantly impacts the implementation of projects within the consortium. The distribution of respondents by the number of entities in the consortium is presented in Figure 2.

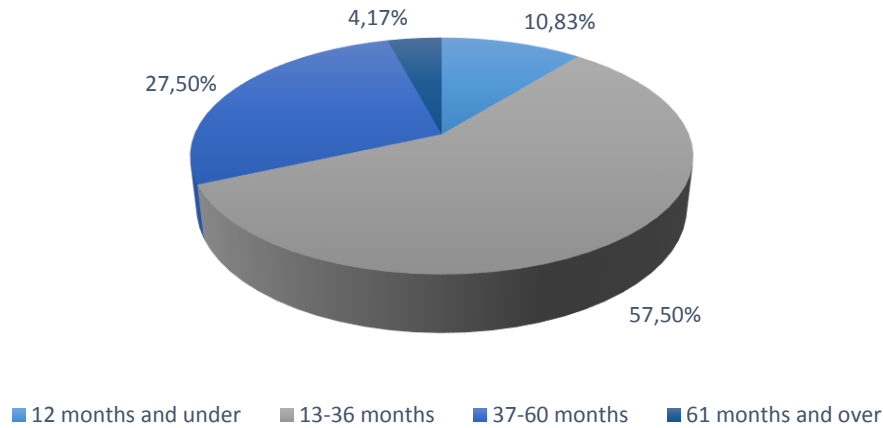


**Figure 2.** Number of entities in the consortium.

Source: own elaboration based on survey results, N = 120.

The majority of the surveyed projects were implemented within consortia consisting of at least three but no more than five entities, suggesting that these were medium-sized consortia formed to jointly implement a project. In addition to public higher education institutions and private enterprises, consortia members also included private higher education institutions and other types of entities.

The duration of the project also significantly affects the cost planning processes, based on the principle that the longer the planning horizon, the greater the associated risk. Figure 3 shows the distribution of respondents by project duration.



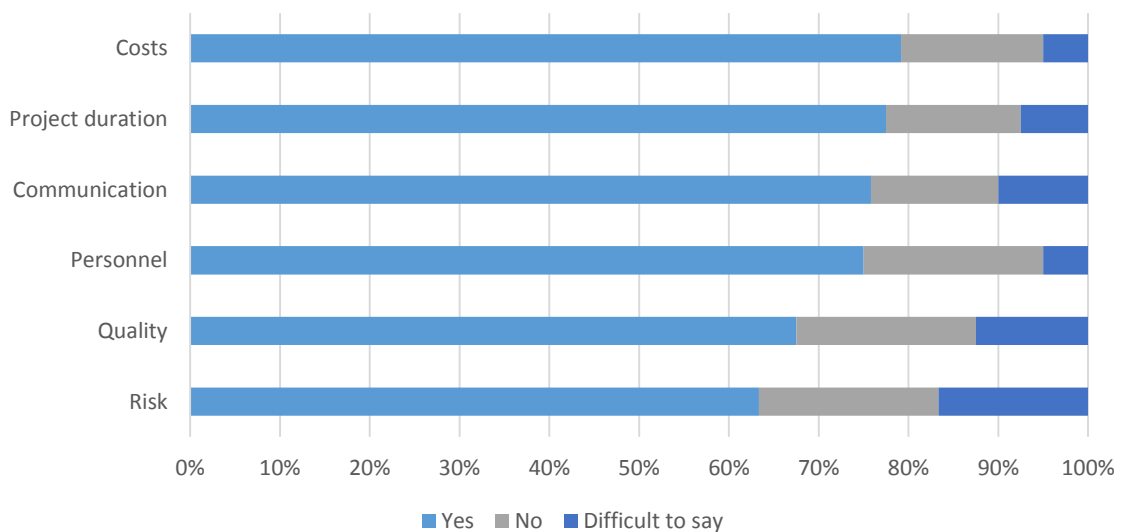
**Figure 3.** Duration of surveyed projects.

Source: own elaboration based on survey results, N = 120.

Among the surveyed enterprises, the most frequently implemented projects within scientific and industrial consortia lasted from over 1 year to 3 years (57.5% of responses). A significant group also included projects with a duration of 37 to 60 months (27.5% of responses). Thus, it can be concluded that these were predominantly medium-term projects.

## 6. Research results

As part of the study, enterprise representatives were asked to identify the elements managed within the project. This was a closed-ended, single-choice question. The results are presented in Figure 4.



**Figure 4.** Respondents' answers regarding the management of specific project components.

Source: own elaboration based on survey results, N = 120.



One of the key constraints in the implementation of any project is cost. The responses clearly indicate that costs were the main project element managed. Effective cost management in a project should ensure the full eligibility of planned costs.

In externally funded projects, the duration is equally important, as it represents another major constraint. It is defined within the project schedule, and any changes that would extend the project duration require approval from the funding institution. A significant majority of respondents (77.50%) indicated that they managed project duration. Effective time management is essential for ensuring the timely completion of any project.

A similar proportion of responses was related to the management of communication (75.83%) and personnel (75.00%) in the surveyed projects. These are two other crucial and closely related project elements requiring management. In consortia projects, communication management involves not only one organisation but also communication between the various partners.

Quality and risk management received a slightly lower but still significant number of responses. Projects within scientific-industrial consortia are generally aimed at achieving results with commercialisation potential. Therefore, quality management is crucial to ensure the project outcomes find buyers. Research and development projects inherently carry a high risk of failure, hence this aspect of project execution also requires adequate management.

In managing complex projects such as R&D projects implemented within scientific and industrial consortia, it is beneficial to use modern tools and IT systems. In the next subsequent part of the survey, respondents were asked to assess the usefulness of IT tools/systems for managing the specified project elements. This was a closed-ended, single-choice question. For data analysis, the responses were assigned ranks: "definitely useful" was given 5 points, "rather useful" 4 points, "hard to say" 3 points, "rather not useful" 2 points, and "definitely not useful" 1 point. Based on this, basic statistical measures such as median, mode, and standard deviation were calculated. The results, ranked by decreasing mean score, are presented in Table 2.

**Table 2.**

*Evaluation of the usefulness of IT tools/systems for project management*

Item	Mean	Median	Mode	Standard deviation
Costs	4.29	5	5	0.87935
Project duration	4.04	4	4	0.85045
Quality	3.95	4	4	0.90231
Communication	3.72	4	3	0.91454
Personnel	3.69	4	3	0.92912
Risk	3.64	4	4	0.89252

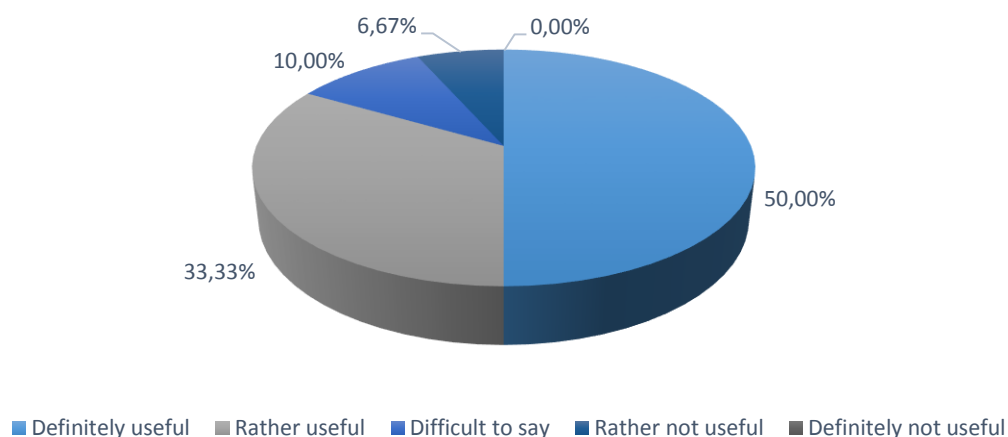
Source: own elaboration based on survey results, N = 120.

Assuming the critical factors are those with an average score above 4.0, it can be identified, based on respondents' answers, that the elements for which IT systems are most useful are costs and project duration. According to respondents representing enterprises, IT systems are most

beneficial for managing project costs (mean 4.29, median 5.0, mode 5.0, with a standard deviation of 0.87935). The execution of complex projects always occurs within a specified schedule. Respondents indicated that IT tools/systems could also be useful for managing the project duration (mean 4.04, median 4.0, mode 4.0, with a standard deviation of 0.85045). Notably, the third place is occupied by the quality of project products and outcomes. Since scientific and industrial projects generally aim for the implementation of project results, quality is a crucial aspect of project execution. Respondents considered IT systems/tools useful for quality management (mean 3.95, median 4.0, mode 4.0, with a standard deviation of 0.90231).

Subsequent positions were taken by project elements related to work organisation, i.e. communication and personnel management, which respondents also believed could be supported by IT tools/systems. Risk management ranked last, though the results still indicate the usefulness of IT systems/tools in this area.

Budgeting, which involves defining the revenue and cost plan for both the entire project and individual consortium members, plays a crucial role in project management. Respondents were asked to evaluate the usefulness of the budgeting functionality within IT tools/systems used for project management. This was a closed-ended, single-choice question. The results are presented in Figure 5.



**Figure 4.** Evaluation of the usefulness of IT tools/systems for project management in terms of budgeting functionality.

Source: own elaboration based on survey results, N = 120.

A significant majority of respondents (83.33%) indicated that the budgeting functionality within IT tools/systems used for project management is useful, with 50% of responses stating it is "definitely useful" and 33.33% saying it is "rather useful". For complex projects involving multiple entities, preparing an appropriate financial structure along with specifying funding tranches in accordance with project fund accounting requirements can be significantly automated and streamlined through the use of appropriate IT tools/systems.

## 7. Conclusions

Developing the project budget at the consortium level, as well as for individual partners, is a complex process that is a critical element in preparing a funding application. As one of the evaluation criteria, it influences the likelihood of receiving funds. During the project implementation phase, a correctly constructed budget facilitates settlements between partners and the proper accounting of subsequent funding tranches, ensuring the liquidity of individual consortium members. Since projects funded by external sources often use a cost reimbursement mechanism, consortium members must either provide their own funds or take out loans to finance their work. A properly prepared financial plan allows minimising the time during which own funds are used.

In scientific and industrial consortia, the budgets of individual consortium members differ significantly in terms of funding levels. Public higher education institutions can expect full funding for eligible costs, whereas enterprises must consider public aid limits, meaning they must commit their own resources to cover part of the eligible costs. The allowable level of public aid varies depending on the size of the enterprise. Micro, small, and medium-sized enterprises can expect higher funding levels. Competition regulations may also provide for additional increases in allowable public aid, for instance, for widespread dissemination of project results.

When preparing the budgets for individual partners and aggregating data for the overall project budget, it is necessary to consider the numerous funding conditions stipulated by the competition documentation. Therefore, the use of IT systems/tools can be helpful in budget construction. Their usefulness in cost management was rated very highly by respondents representing private enterprises. Similarly, during the project implementation phase, respondents highly rated the usefulness of the budgeting function within the applied IT systems/tools. These tools undoubtedly play an important role in proper cost management within the project and facilitate data reporting to funding institutions.

Literature studies and the results of our own research conducted among enterprises indicate the complexity of the cost budgeting process in projects carried out by consortia consisting of public higher education institutions and private enterprises. They also highlight the significant role of using IT systems/tools in cost management. Further research requires an assessment by representatives of public higher education institutions, where the budgeting process involves much stricter legal and formal constraints.

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