



# Performance measurement of complex project: framework and means supporting management of project-based organizations

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## **Abstract:**

Performance management and measurement enable to improve strategy implementation and increase organizational competitiveness. The literature review and desk research confirm that the design of a performance system is an issue because of the redefinition of project environment conditions and complexity of 4P. The system should be continuously developed during exploitation. Main objectives of the paper are to propose a framework of project performance measurement and a set of measures that could be applied in project-based organizations. The assessment proposal is the result of a literature review and qualitative empirical studies, interviews, and participatory observations. The framework considers performance assessment of the project and its context, including benefits occurring outside the project – on the program, project portfolio, and project-based organization levels – but being the result of project execution. The framework incorporates in project performance assessment the simultaneous and supplementary utilization of quantitative and qualitative measures, financial and non-financial measures that describe various fields of evaluation: finance, production, procurement, product quality, social, marketing of a product, legal, natural environment, client, and other stakeholders' satisfaction.

## **Keywords:**

project; performance; measurement; framework; project-based organization; 4P.

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## 1. Introduction

The topics of performance management and measurement have been explored by numerous researchers for years [1]. It is a crucial issue for business practice due to obtaining shareholders satisfaction or managers' target evaluation. One of the most valuable performance definitions points out that it is "the process of quantifying the action (...), leads to performance (...) defined as efficiency and effectiveness of action" [2, p. 81]. Efficiency should be understood as optimization of the relation between outputs and inputs that were utilized to deliver them. Effectiveness is the extent to which the achieved results of an action meet our objectives (plans, expectations, requirements etc.). Amaratunga and Baldry highlight that "performance management provides organizations with the opportunity to refine and improve their development activities" [3, p. 218]. Bititci points out that "the cultural and behavioral routines define how we use the performance measurement system to manage the performance of an organization" [4, p. 29]. Following the presented approach, performance measurement can be defined as the process (or processes) of: setting goals, developing a set of performance measures, monitoring, collecting, analyzing and interpreting data, status reporting, reviewing and acting to enhance performance. It requires from employee more hard skills than the soft ones [5], from organization – more technical solutions such as frameworks, means, or supporting methods, rather than employee empowering or intuitiveness.

Performance management and measurement enable to improve organization competitiveness or adapt entity to changes. They support the translation of business strategy into operational activities [6]. Numerous academic studies in the field are supported by professional organizations, such as Performance Measurement Association (PMA) or European Institute for Advanced Studies in Management (EIASM), International Controller Association (ICA), International Performance Research Institute where knowledge and experience exchange can be observe. Nevertheless, there are still open issues such as exploring the nature of collaboration supporting the achievement of targets, defining the characteristics of performance indicators [7], designing the visual management system that could facilitate performance measurement and review [8]. The crucial aspect related to performance measurement is to design the solution that will follow managers' needs and to consider market conditions e.g. changeability, uncertainty, complexity of organization operations, or the trend related to protection of natural environment. It is still a relevant research problem to follow the assumption that "the leading indicators of business performance cannot be found in financial data alone. Quality, customer satisfaction, innovation, market share-metrics like these often reflect a company's economic condition and growth prospects better than its reported earnings do" [9, p. 131]. The outlined issues are becoming particularly visible in project environment [10] because undertaken activities are more and more complex and stakeholders expect continuous improvement of products. The effect of mentioned environment conditions is the increasing trend of projectization in various sectors of economies [11]. The process should be complemented by performance management and measurement supporting tools that need to be developed, predominately for project-based organization (PBO).

The paper has conceptual character. Its main objectives are to propose a developed framework of project performance measurement and a set of measures that could be applied in the presenting solution. In this context the following research question have been formulated:

- How to consider project indirect inputs and outputs in performance measurement?
- How to combine financial and non-financial measures?
- How to measure the financial and non-financial, project direct and indirect inputs and outputs related to Project Life Cycle?

Indirect inputs and outputs are understood as categories that occur outside the project (on portfolio or permanent organization levels) but are the result of project realization.

The study proceeds as follows. The first part presents the critical analysis of current research related to project performance management and measurement. Next, the assumptions for framework design and framework proposals of project performance measurement are described.

## 2. Project performance management and measurement: theoretical background

### 2.1 Project management performance and project performance

Performance in project environment can be divided into two various research objects - project performance and project management performance. Bryde demonstrated the differences between them in the context of quality. Quality of management process is the leading attribute of project management performance while the quality of the end product delivered by the project is associated with project performance [12]. Both categories are close interlinked.

Development of project management processes is commonly related to the increase in the project management maturity levels of PBO [13] that enhances the competitiveness of organizations [14]. Bryde demonstrated that project management performance is driven by: project management leadership, project management staff, project management policy and strategy, project management partnerships and resources, project management life cycle process, and project management key performance indicators [12]. The mentioned elements were utilized in PMPA model, a well-known project management performance evaluation framework that was created basing on EFQM Excellence Model [12, 15]. Numerous studies present the close relation between project management performance and project success, such as project efficiency, impact on the customer, impact on the project team, business success, preparing for the future or general stakeholders satisfaction [16]. The presented findings overlap the assumptions of project management factor research school [17] that indicates project success factors (drivers) as vital methods accomplishing project success. Concluding, project management performance is the mega process consisting of planning, monitoring, control, and support for decision making that is focused mainly on people behaviors, organization of work, existing or desirable regulations, efficient utilization of resources. The assessment of project management performance aims at answering the question 'how to deliver the product?'

Project performance describes outputs related to product. They can be a product in progress or a final/completed product. Traditional approach associates project performance with evaluation of scope, quality, and cost [18]. Contemporary research proposes the focus on management of: benefits, requirements, scope and configuration, value, quality, organization, schedule, cost, resources, risk, health and safety, and environment [18-19]. The monitored elements should be measurable, which enables to plan and control them in the selected time range. Well-known project performance evaluation methods are EVM (Earned Value Management) [20-21], KPI (Key Performance Indicators), or Balance Scorecard [22]. In this context the analysis of project performance is "the process of comparing actual project cost and schedule performance to the performance measurement baseline for the purpose of analyzing the current status of a project" [23, p. 55]. Significant added value can be supplemented by various methods of project completion calculation [24]. It delivers the information required for invoices issuing and revenue recognition. Evaluation of completed project performance supports establishing benchmarks of high performance projects for cross-learning and identify inefficiencies [25].

Evaluation of project performance should be conducted from various contexts, direct project oriented outcomes (e.g. scope, quality) and indirect effects (e.g. natural environment). Such an approach is presented in Prince2 methodology where product delivery is a crucial aspect of managing [26]. Industry standard for construction extension proposes monitoring and control in the following areas: design, procurement, expediting, risk evaluation, quality activities, and forecast of future activities related to cost and earned value [27]. The large number of project performance drivers, their nonlinear dependencies and increasing volume and variety of data and information [28] trigger the utilization of project management software. The conducted research perceived that the less-performing projects present significantly lower IT/IS system utilization level than other projects [29-30].

Concluding, project performance is the mega process consisting of planning, monitoring, control, and support for decision making that is focused mainly on product parameters. It controls the fulfillment the requirements related to product: accepting a work package, executing a work package, and delivering a work package [26]. In the light of presented research findings and business practice performance project management should be treated as project performance driver (figure 1). It is one of the complex project success factors that directly and indirectly affects product

delivery in all stages of project life cycle. The framework of measurement of indirect project benefits is still an open issue.

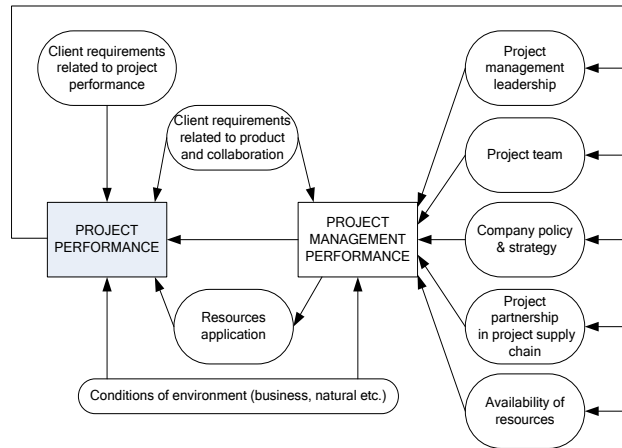


Figure 1. Significant drivers of project performance

## 2.2 Project performance organizational context

Looking at performance in project environment from the theory of organization – that describes project or program as a temporary organization [31-32] – four research subjects can be distinguished: project, program, portfolio, and project-based organization (PBO). The presented list follows traditional classifications of 3P (project, program, portfolio) [33] and supplements it by the fourth element (PBO) that creates the construct of 4P. The relations between the mentioned elements were comprehensively described in literature. Engwall demonstrated that single project cannot be treated as isolated entity [34], but it is affected by the complexity, risk and uncertainty of its context defined by the program, project portfolio and project-based organization of which project is a part [35]. They create one complex management system in organization being a part of its performance management and measurement system (figure 2).

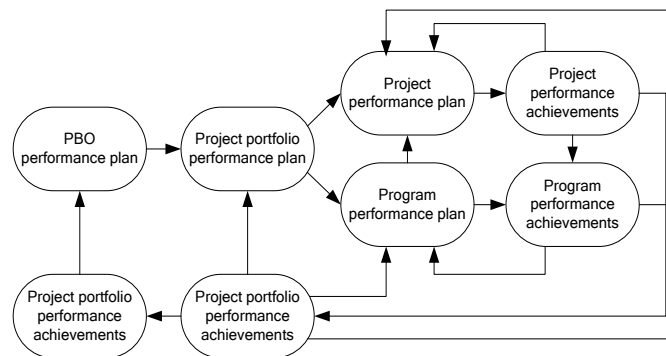


Figure 2. Correlation between 4P performance

Despite that, performance of each of the mentioned elements is driven by diverse factors. Some of them overlap, and others deviate. Next part of the paper describes project performance organizational context related to performance of program, portfolio and PBO.

Program performance is focused on creation of aggregated added value of projects being its part. It is not a simple sum of single project performance and could not been treated as a scale-ups of projects. Project performance monitors and controls results (outputs and inputs) that are direct contribution – in a foreseeable manner of short-term period – to

business success related to project or its product while program performance focuses on broader, fuzzier, and more indirect and far-reaching, long-term results [36]. Program managers are the first supervisors of project managers who control and support their performance. Patanakul and Pinto perceived that program management could be a navigation through political landscapes (especially in the public sector) and performance is limited by formalized communication and collaboration channels that are much more developed than on project level [37]. Project Management Institute defined five program performance domains: strategy-alignment, benefit management, stakeholder engagement, governance, and program life cycle management [38]. In that context the key differences between program and single projects are related mainly to early benefit realization (in some cases the opportunity to achieve benefits from completed projects before program completion), and the need of performance governance of cyclic delivery from various projects [39]. Summarizing, program performance measurement implements project solutions and supplements them by means that are strategy-oriented and empower governance.

Higher strategic level of performance management and measurement is related to project portfolio. By designing the system, it should be considered that group of projects conducted under the sponsorship or/and management of the permanent organization compete for its scarce resources [40-41]. Müller, Martinsuo and Blomquist categorized portfolio performance into four overlapping research areas: the relationship between portfolio management practices and performance, portfolio management performance, portfolio control, contextual factors associated with the relationship between portfolio control and portfolio management performance [35]. First, the presented study confirms that portfolio management performance is a driver of portfolio performance. Second, it emphasizes the crucial role of control functions that have to be supplemented by at least planning and reporting. Much wider approach demonstrated Project Management Institute that described six portfolio performance domains: capacity and capability management, stakeholder engagement, portfolio value management, risk management, strategic management, and governance [42]. The presented domains put attention inter alia on selection of portfolio elements. Its strategy-alignment is positively correlated with achieving permanent organization results [35]. In that context various types of metrics, such as financial and non-financial, should be utilized to present a comprehensive overview of portfolio added value. The researchers still observe existing gap in the fields [22].

All the above mentioned performance management and measurement systems are integrated on PBO level. They are a part of Organizational Project Management (OPM). PBO utilizes well known company performance ratios such as ROS, ROA, EBITDA, market share, brand recognition, and it supplements them by project oriented indicators inter alia project or program success, or portfolio backlog. The comprehensive assessment encompasses tangible and intangible benefits that in many cases are measured by indirect methods [43]. Numerous researchers perceive crucial role of Project Management Office (PMO) in implementation of the task [44-45]. It should support methodological improvement of performance measurement (what and how to measure) and the application of lesson-learned process (collecting and sharing experience, knowledge). PMO should be a unit that designs/redesigns or supports the design/redesign of measurement process and then it consults the project teams in project exploitation stage to ensure comparability of received data. However, few studies in the field of OPM explore the influence of other supporting departments, such as controlling, accounting, procurement or technical, on PBO's organizational effectiveness [see 46-47]. "Through the effective utilization of portfolio, program, and project management, PBO's have the capability to increase their potential to create value and, in some cases, directly increase the effectiveness and efficiency of the value creation itself" [43, p. 16].

### 2.3 *Project performance assessment tools*

The presented knowledge was utilized by researchers in the design of various project performance assessment supporting tools. They can be grouped into:

- Project performance evaluation methods [48-49], including evaluation of environmental or social aspects [50];
- Cost-benefits project assessments, capital investment appraisals or capital budgeting [51-53];
- Project measurement frameworks [54-55], and measures [56];

- Project assessment methods embedded in project management methodologies/methods that present the frameworks of monitoring and control processes, describe the techniques of project performance analysis, focus on fulfillment of the business needs [23, 26-27];
- Project evaluation process fully or partially funded by public institutions [57-58].

The mentioned tools constitute interesting and, in many cases, applicable proposals in business environment. Some of them were positively verified by market entities. However, there is still a gap related mainly to the consideration of indirect project benefits. The presented state of the art was the motivation for further empirical and conceptual studies.

### 3. Research method

The presented literature analysis demonstrates that there are still numerous research issues related to proper definition of project performance that consider environment uncertainty and complexity. In order to bridge the existing gap empirical studies were conducted. First the following methods of data collection were applied:

- Participatory observation of 13 projects (financial, IT, and development) conducted in large PBO operating in Poland (international company), where the observer participated actively as contractor (executor) or ordering party (client) over the last 10 years; the selection of the research sample was targeted and it resulted from a range of researchers' expert activity; during the observations the managers' experience and believes related to project control were collected;
- Unstructured interview that was conducted with 48 persons from large and middle PBO operating in: Germany, Poland, Singapore, the UAE, and the UK; the sample selection was targeted, as the main eligibility criteria were applied in the conjunction of at least one-year experience on the job in project teams and expert knowledge in the key areas for executing projects (planning, tendering, execution, monitoring, control etc.); the requirement of working as a manager was not applied, although it was assumed that the interlocutors should perform at least supervisory and control functions or they should conduct research in project management; the structure of the research sample by sector types was as follows: construction industry 26 persons, consulting sector 12 persons, IT 6 persons, others 4 persons; the goal of the interviews was to collect the managers' experience and believes how to conduct a project assessment, including analysis of project efficiency.

During and after the observations and interviews the notes were made on a regular basis. They included the crucial findings related to conducted business actions and their results, as well as description of interviewee experience, implemented solutions, and ideas. Next the coding using in vivo method was carried out. The codes and subcodes were related primarily to: qualitative and quantitative aspects of performance assessment, final and mid-term project assessment, project portfolio and company performance. The completed steps allowed to create the initial map of project portfolio assessment that was utilized to design a measurement framework and to propose a set of means. Here an academic theorization combined with induction and conceptual modeling processes were applied. They aimed at, inter alia performing taxonomy of main approaches and streams in the issue of efficiency, as well as designing a framework for assessment of project performance.

### 4. Performance measurement framework

#### 4.1 Design assumptions and constrains

Before the design stage, having applied literature study and desk research, the following assumptions and constrains related to elaborated framework were made:

- Operational activities of Project-Based Organizations differ from other entities, therefore to increase their effectiveness and efficiency 4P performance system should be developed;
- PBO aims at improving the project maturity level that includes assessment of project and its context at program, portfolio and mother organization levels;

- Project performance measurement should consider various types of inputs and outputs occurring on each 4P levels;
- Set of performance measurement should encompass of financial and non-financial indicators; the presented approach follows the concepts of organization sustainable development which is promoted in the market;
- Measurement process should consider monitoring and control of direct inputs and outputs related to project and indirect inputs and outputs occurring on program, portfolio or permanent organizational levels.

#### 4.2 Framework description

Considering the fulfillment of assumptions and constrains the following major discriminates in the designed framework (figure 3) were set:

- Two-stage performance assessment i.e. division into preparation (planning methodology & targets) and execution (monitoring, measuring, data collection, analysis, comparisons, concluding, and reporting), because the projects are not equal and enable adaptation of contingency approach [59];
- Two-level stage of execution assessment i.e. division into outputs and inputs analysis within the project, project portfolio and company levels, because some project benefits appear with time-lag or have influence directly on PBO, which enables adaptation of governance system.

The first stage of performance assessment is preparation for evaluation. That consists of: defining and prioritizing the assessment criteria and measures, designing methods/techniques of monitoring, measure analysis etc., planning the targets and result interpretation. The presented activities are usually connected with project acquisition (project tender) stage when managers adapt the project strategy into PBO's strategy. However, during the project execution some adaptation or improvement actions could be required. The first stage issue is related to description of means which is presented in the next part of the paper. The second issue is related to the target setting. Means and targets should follow PBO needs (financial and non-financial, direct and indirect) and consider project context – inter alia client requirements, competition level, project novelty, PBO's capacity and capability. The division of project outputs into various groups could support the assessment process. The following fields can be considered: finance, production progress (project completion), procurement, product quality, social, marketing of a product, legal, natural environment, client and other stakeholders satisfaction. All of them influence on project business value that is controlled by performance measurement system.

The second stage of performance assessment is related to project execution. It is divided into two levels – inside the project and outside the project that is related to inputs and outputs occurring in program, project portfolio, and the company. The recognized outcomes and incomes are used for inter alia analyzing the results of project manager's work by portfolio and company managers. However, it is necessary to emphasized that he/she must not maximize performance uncritically because the project context should be considered. Project strategy is a tool for implementing the strategy of the PBO. Therefore, it is important to communicate properly the occurring dependencies among the project, its program, project portfolio, and the company. The proper governance of performance management and measurement process is advocated. Its main role should be the project strategy-alignment to PBO through control of project target achievements and supplement them by inputs and outputs occurring on program, portfolio or company levels. It is called holistic project performance assessment. That consists of completing the assessment from the first level with outputs and inputs that have a dimension of impact wider than just the project. It involves inter alia sharing on time (according to the implementation timetable of the project) the proper: resources (people, equipment, capital etc.), knowledge related to business partners, technology etc., supporting management tools (budgeting, cost accounts, techniques of risk evaluation, information channels etc.), organizational support executed by project management office and other departments, such as accounting, procurement, human resources, research & development etc.

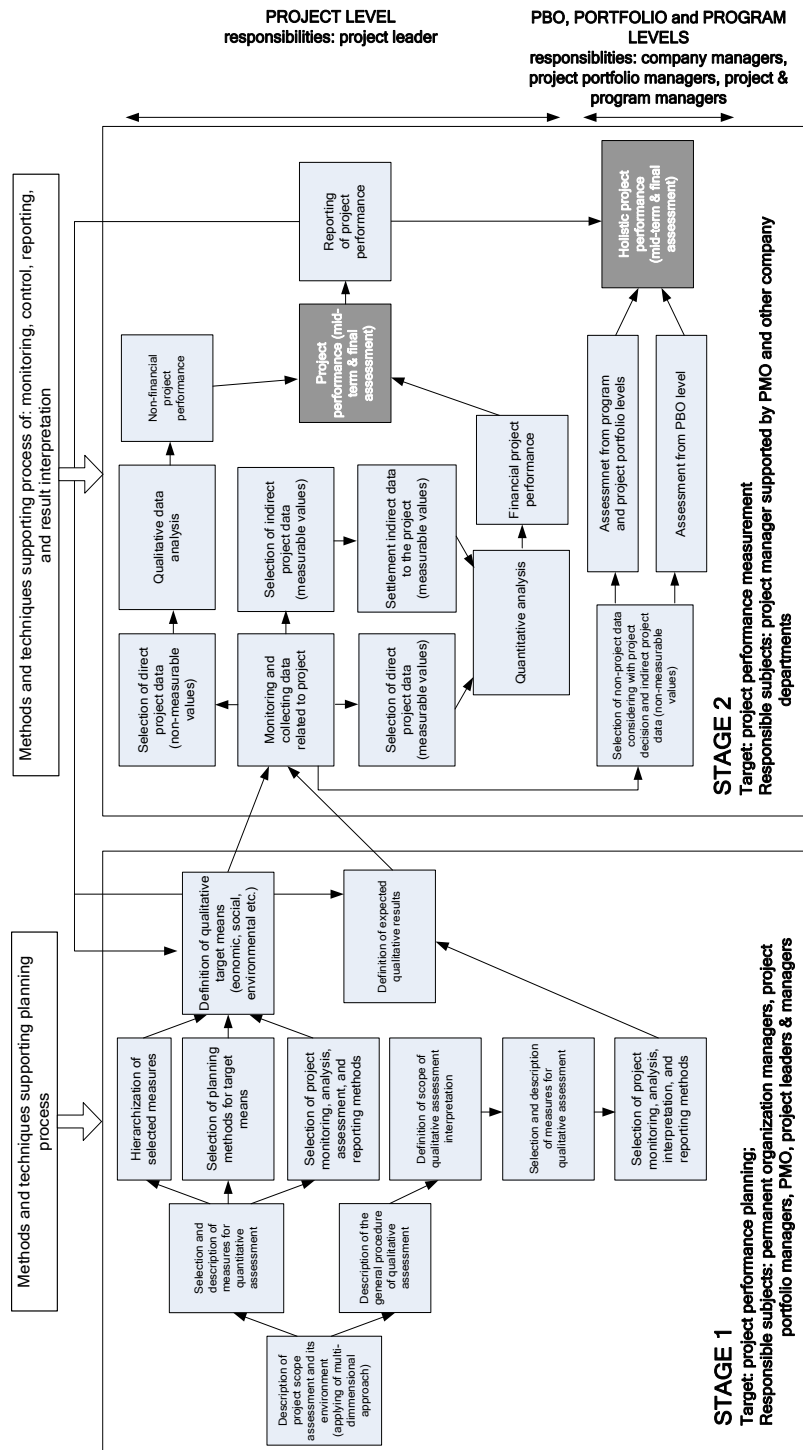


Figure 3. Project performance assessment framework applicable by PBO (based on [61])



The conducted observations indicate that top decision-makers in PBO do not appreciate the supporting role of governance in performance achievement [62]. It is one of the reasons for lack of project success (failing to achieve the expected efficiency level). A holistic assessment of performance involves comparing the achieved outputs (direct or indirect that are recalculated to the project) and the incurred inputs, as well as completing the context of operations and assessment, including the support given by PBO.

#### 4.3 Project performance measurements

There are crucial issues related to adaptation of the presented framework in business environment. The first one is the consideration and common interpretations of qualitative and quantitative, financial and non-financial measures/factors on each level (project, portfolio, and organization). The second one refers to utilization of separate or aggregated measures applied on various 4P levels. The third encompasses consideration of direct and indirect project outputs and inputs. According to literature review [39-40] and conducted empirical research some measures are recommended:

- In a group of financial means: tender costs, manufacturing costs, overhead costs, financial costs and revenues, decrease in manufacturing costs, incomes from the client and other parties, invoiced work done, not-invoiced work done, various types of results, Net Present Value, Payback Period, incoming and outgoing payments, increase or decrease in asset value, opportunity to use the surplus of project cash flow to another project, covering the organization fix costs by project overheads, etc.;
- In a group of non-financial means related to project level: work done, percentage of completion, development of project team members, procurement results, product quality, client and other project stakeholders satisfaction, etc.;
- In a group of non-financial means occurring on non-project level: work done secured of PBO, resource utilization, volume of contracted works (ending order backlog), effectiveness of tender, client attachment (repetitive collaboration), benefits from marketing activities, result of lawyer's activities, employee development opportunities, employee satisfaction, client references, volume of emissions and produced waste, etc.

The process of selecting the presented measures is a crucial one. It should be executed according to company management system requirements and has to be in line with organization strategy e.g. rather social than financial aspects. However, combining various measures appears to be the dilemma of a common interpretation and consecutive use of qualitative and quantitative measures. It may be limited by applying standardization methods whenever possible (valuation of outputs and inputs in the same unit of measure). However, one must not rigorously pursue transforming qualitative evaluations into quantitative ones, especially when they have a descriptive form. They may be treated as complementary to other evaluations, placing them in the decision-making context. It is vital, since result interpretation usually depends on the perspective, that the analysis is conducted. It is necessary to be aware of it for the evaluator and evaluatee in order to maintain the evaluation impartiality. The interpretation of the evaluation context and combining it with project performance indicators should not be subject to parametrization. One needs to rely on the experience of decision-makers, their business premonition and the ability to predict the future.

Looking into the dilemma of data aggregation, it must be emphasized that there is no need to aim at creating aggregate evaluation of all the tested variables. However, such an activity may and should be undertaken whenever possible. Basing on the conducted observations, one may conclude that the preferred method of indicator aggregation is to create a weighted average or median. Its advantage is the simplicity of use that is particularly important in business activity. However, mid-term assessment is as important as aggregated one. It helps to understand the context of data interpretation and prepare better response actions.

## 5. Conclusion

The literature review indicates that the knowledge in the field of project performance management and measurement is comprehensive but reveals some additional gaps. They are related to new conditions of project environment. The conducted empirical study and designed framework completed the existing knowledge. The presented framework

proposes the simultaneous utilization of quantitative and qualitative measures in assessment of project performance. The qualitative description especially of the outputs enables to understand context of the project. In order to consider both proposals the assessment process was divided into two stages – preparation and active assessment. In both stages monitoring and control on project and non-project levels (program, portfolio, and PBO) are planned and conducted simultaneously and supplementary since project direct and indirect outputs thereof benefits and inputs should be taken into account. Such a process starts since the beginning of tender phase till completion – also in warranty period.

Designing the measurement systems in various fields should be considered. The crucial recognized areas are: finance, production, procurement, product quality, social, marketing of a product, legal, natural environment, client and other stakeholders satisfaction. Financial measures should be aggregated (if possible) from project to PBO levels while non-financial in most cases treated as a context of project delivery. The assessment of the context might change the perception of mid-term or final results.

The presented framework has some limitations. Firstly, PBOs that want to apply the framework should possess high level of company project maturity and endeavour to its increase. This is required because the presented assessment process needs complex standardization that supports collecting reliable data and quality information from various sides of the organization. Secondly, the assessment is not fully parameterized and enables some qualitative evaluations. Highest competences of managers are here required. Thirdly, the proposal was positively verified only in one big construction company and needs further adaptations also in other industries. Fourthly, the proposed framework needs some IS (Information System) support that is crucial driver of organization development [64]. The paper did not discuss the issue.

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