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A Comparison of the Project Management Methodologies PRINCE2 and PMBOK in Managing Repetitive Construction Projects

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Abstract: Nowadays, companies employ various project management (PM) methodologies to ensure that their projects are effective and successful. It is worth knowing that differences in principles and processes of PM methodologies influence the use of different PMs in managing non-repetitive and repetitive construction projects. This paper presents the selection and application of a rational construction PM methodology to a repetitive construction project after a comparison of two PM methodologies, namely Project Management Body of Knowledge (PMBOK) and Projects IN Controlled Environments (PRINCE2). The object of this study is a repetitive anti-corrosion works project for steel structures conducted at Company X. The research was carried out in two steps. First, a quantitative survey of the respondents from companies involved in the management and execution of construction projects was conducted with the aim to identify a rational approach to construction PM. The questionnaire consisted of fourteen closed-ended questions, six of which were generic and eight were PMBOK- and PRINCE2-specific questions. Companies that took part in the quantitative study identified the PRINCE2 project management approach as the most suitable for managing a repetitive construction project. Using the PRINCE2 PM methodology, the repetitive construction project would aim to provide as much information as possible to the project participants, form a team and assign team leaders responsible for the phases, establish a financial plan, a detailed timetable for the execution of the works, a quality control plan, and a plan of responsible persons, and detail the technological sequencing of the works. Second, a quantitative study on the selection of a rational construction project management approach for a repetitive construction project was pursued, and a qualitative assessment of construction project monitoring trends and actions was conducted. The qualitative research was performed using a structured interview method and asking the representatives of different companies X, Y, and Z the same 15 questions. The results of the qualitative research showed that a successful PM depends on the size of the project team, the PM tools and methodologies used, the PM philosophy, and the frequency of monitoring and discussing the project progress.

Keywords: project management methodologies; PRINCE2; PMBOK; repetitive construction projects

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1. Introduction

Why do construction projects take longer to implement than they should? Why do they fail to deliver the desired results on time and to ensure sustainability? The analysis of project management (PM) experience from different sectors has revealed such aspects as mistakes made by project team members, changes in law, unclear roles and responsibilities, ineffective communication, problems with suppliers, and the sustainability of the

results. These factors do not really answer the questions raised above. Apparently, there are general laws of PM and challenges that project managers (PJMs) have to handle.

In the digital economy, business and governmental organisations design and implement projects of all types and sizes. However, not all project activities run smoothly. Despite the availability of financial resources and competent PM teams, projects are not always completed on time, they often exceed the budget, they do not meet quality and time requirements, and they fail to meet sustainability goals. What does this mean? If a PJM sets a deadline, the staff usually report the work carried out when the deadline comes, even if the work was finished earlier. What are the factors behind this? The project team may try to avoid additional tasks because next time new tasks may have shorter deadlines and less-inspired staff members may be late in completing the planned goals. Poor planning and high urgency can lead to project failure or the need for additional resources due to the changes in scope, lack of quality, and weak sustainability. Project planning is a crucial stage. It is inappropriate to start implementing ideas without a good-quality plan.

The benefits of a good PM methodology include the easy handling and distribution of project reports, transparent management practices, successful risk management, effective problem-solving, easy measurement of the completion percentage, improved control and command of the project, regulated stakeholder inventories, the measurement of accomplishments against plans, improved estimation for future planning, and identifying objectives that cannot be met or will be exceeded [1]. PM is employed to ensure the efficient and effective organisation of a project from its initiation to its completion [2–5]. It also encompasses all strategies and activities that ensure the project's success based on the quality, cost, and timeliness triangle. In this case, standard PM frameworks that include PMBOK (Project Management Body of Knowledge), PRINCE2 (Projects IN Controlled Environments), and the international standard ISO 21500:2012 are used for project management [6,7]. Both the PMBOK and the PRINCE2 PM methodologies have positive and improvable areas. According to popularity in regions, the PMBOK PM methodology is more widespread in North America, while the PRINCE2 management methodology is more popular in Europe, as it originated in the United Kingdom [4,5]. The PMBOK methodology represents the collective knowledge that is widely accepted as best practice in the field of PM, while PRINCE2 is focused on the business aspects of the project and emphasises a structured organisational approach to PM with an emphasis on dividing the project into manageable stages and a product-oriented approach to planning [8,9]. The above-mentioned standard PM frameworks are popular with scientists who explore non-repetitive construction projects.

Repetitive construction projects refer to projects that involve the construction of recurring units, where each unit consists of the same group of sequential activities. These projects often occur in the construction industry, such as building multiple identical houses, constructing similar sections of a highway, or conducting similar anti-corrosion works for steel structures. The repetitive nature of these projects offers several advantages including significant time and cost savings. By working on similar units with the same sequence of activities, construction crews and resources can maintain continuity and efficiency. Once they become familiar with the process, they can work more quickly and effectively, reducing the overall construction time [10–12]. Maintaining work continuity in repetitive construction projects is crucial for achieving time and cost savings, and it can be achieved through various means:

- By keeping a consistent workforce throughout the project, there is no need for the frequent hiring and firing of labour. This reduces recruitment and training costs as well as the time required to onboard new workers. Skilled workers who are familiar with the project's requirements can continue working on subsequent units, ensuring higher productivity and efficiency.
- In repetitive projects, skilled labour becomes more proficient and experienced over time. By retaining these skilled workers, their expertise and knowledge are preserved, leading to improved performance and quality. They become familiar with the

project's specific requirements and can work more efficiently, minimising errors and rework.

- In repetitive projects, the use of equipment can be optimised since the same activities are repeated. By maintaining work continuity, equipment idle time is minimised as well. Equipment can be kept operational and utilised efficiently without long periods of downtime between units. This reduces equipment-related costs and increases overall productivity.
- As workers become more experienced with the sequential activities involved in the project, they can perform their tasks more quickly and accurately. This leads to improved productivity and reduced construction time with each successive unit.

On the other hand, maintaining work continuity in repetitive projects indeed presents an additional constraint that traditional scheduling and planning tools and techniques struggle to address effectively [13–15]. The following negative aspects can be mentioned:

- Traditional scheduling tools are often rigid and not well-suited to adapt to the specific requirements of repetitive projects. These methods typically assume a high level of task variability, making it difficult to account for the repetitive nature of the project and the streamlined workflow it entails.
- Repetitive projects demand efficient resource allocation and management to maintain work continuity. However, traditional tools may not adequately account for the optimisation of crew allocation, equipment utilisation, and material flow. This can lead to suboptimal resource allocation, increased idle time, and reduced productivity.
- Traditional planning and scheduling techniques often overlook or underestimate the learning effect, resulting in unrealistic timelines and cost projections.
- While repetitive projects consist of recurring units, there may still be variations in design, site conditions, or other factors. Traditional tools may struggle to handle these variations effectively, leading to challenges in maintaining the desired work continuity and achieving accurate project planning.

The purpose of standard PM frameworks is to establish clear project objectives, prioritise quality, enhance communication, and provide professionals with the necessary project management tools. As a result, it is not clear which PM methodology—PRINCE2 or PMBOK—would be the most rational and efficient for implementing repetitive construction projects. Therefore, the purpose of this study is to determine which PM methodology is more effective for repetitive construction projects. In order to identify a rational methodology for construction PM, an analytical quantitative survey of respondents from companies involved in the management and execution of construction projects was conducted. In addition, a descriptive qualitative study was performed in order to identify the trends and actions of monitoring the progress of construction projects.

2. Background

It is known that PM combines knowledge, skills, tools, and techniques to efficiently manage project activities and meet stakeholders' expectations [1]. It involves nine knowledge areas and enables project PJMs to ensure that projects are conducted rationally and efficiently. PM techniques are primarily applied in the planning and control of time, cost, and quality to achieve success in different projects. However, there is a lack of precision in distinguishing between the P and PM. The overlapping definitions of the two can potentially impact their relationship. Therefore, understanding the difference between the P and the PM can increase the likelihood of a project's success, as concluded by the authors of [9].

The rising stakeholder expectations demand for integrating all PM activities within an organisation. This integration is known as organisational project management (OPM), which combines organisation and PM. The foundation of organisation theory is based on

organisational structure, forms, and the concept of integration. PM is linked to organisations through the use of projects as platforms for improving business, implementing changes, fostering innovation, and gaining a competitive edge, as explained by the authors of [16]. In their research, Aubry et al. [17] highlighted a growing interest in social perspectives that take politics, organisational dynamics, paradoxes, and pluralism into consideration. This presents an opportunity for PM scholars to contribute to management and organisational theory. The premise of the authors of [18] is that the project management office (PMO) is an integral part of a complex network that connects strategy, projects, and structures. Thus, it provides a point of entry to the organisation for studying the fundamentals of OPM. The proposed theoretical framework refers to three complementary fields, namely innovation, sociology, and organisational theory, to provide a novel understanding of the PMO and OPM. Other researchers [19] suggest that robust management structures, particularly PMOs, can enhance the oversight capabilities of contractors when implementing sustainable procurement management (SPM) processes.

Numerous projects may encounter significant delays that exceed their initial time and cost estimates. Construction delays can be attributed to various parties including the owner, contractor, and other involved parties. Thus, it is crucial to identify the responsibility for delays among these parties, and it is necessary to understand the causes and types of delays [20–26]. In this case, different approaches have been offered by scientists to decrease the likelihood of delays in construction [24,25,27]. An important aspect of the construction industry is the implementation of PM success methods. The authors of [28–32] in their research identified factors that influence a construction project's success. A summary of studies that analyse the causes of delays in construction projects, approaches to decrease the likelihood of delays in construction, and the success of PM implementation methodologies is presented in Table 1.

Table 1. Summary of studies that analyse the causes of delays in construction projects, approaches to decrease the likelihood of delays in construction, and the success of PM implementation methodologies.

Authors	Major Aspects
	Causes of delays in construction projects
Aubry et al. [21]	Relationship between organisational culture and the extent of delays.
Sweis et al. [22]	Financial difficulties experienced by the contractor and excessive change orders requested by the owner.
Arditi and Pattanakitchamroon [23]	Availability of scheduling data, analyst's familiarity with the project software capabilities, clear specifications in the contract regarding concurrent delays, and float ownership.
Kim et al. [24]	Insufficient consideration of concurrent delays and inadequate consideration of time-compressed activities.
Gunduz et al. [25]	Quantification of the likelihood of delays in construction projects before the bidding stage.
Mahamid [26]	Payment delays, poor labour productivity, lack of skilled personnel, frequent change orders, and rework.
Arantes and Ferreira [33]	Late progress payments by the owner to the contractor, slow decision-making by the owner, owner interference, increase in the scope of the works, modifications of orders, inappropriate planning and scheduling, errors and discrepancies in drawings, contractors' financial difficulties, late delivery of materials, changes to the specifications of materials during construction, late procurement of materials, bidding and contract award process, impracticable schedule and specifications in the contract, deficient communication between parties, disputes and negotiations between the parties, and late permits from authorities.
	Approaches to decrease the likelihood of delay in construction
Kim et al. [24]	Delay Analysis Method Using Delay Section (DAMUDS).
Gunduz et al. [25]	Relative Importance Index (RII) methodology with fuzzy logic integrated.

Shi et al. [27]	The methodology involves using a series of equations that can be quickly implemented into a computer program and provide rapid access to project delay data and activity contributions.
Arantes and Ferreira [33]	ISM-MICMAC analysis methodology to support the development of delay mitigation measures (DMMs) in construction projects.
	Causes of PM implementation methodologies success
Gudienė et al. [28]	Factors influencing a construction project's success: external factors, institutional factors, project-related factors, PM-/team member-related factors, project-manager-related factors, client-related factors, and contractor-related factors
Radujkovič and Sjekavica [29]	Competent project manager (PJM), a competent team, good coordination between the manager and the team, an adequate organisational structure, culture, atmosphere, and competence, as well as a high usage of PM methodologies, methods, tools, and techniques
Radujkovič and Sjekavica [30]	Continuous development of competencies and improvement of management methodologies
Greenwood and Miller [31]	The organisational components of management activities have to include meeting the initially set deadlines and costs, making more efficient use of resources, adopting an appropriate management style, facilitating communication among the participants, and ensuring stakeholder satisfaction, with a particular focus on the project owner
Ingle and Mahesh [32]	Customer relations, safety, schedule, cost, quality, productivity, finance, communication and collaboration, environment, and stakeholder satisfaction.

The PM process typically involves establishing a business plan for the project, preparing an opportunity statement that aligns with the management's strategy, defining a business model for the project, and identifying potential risks in advance [2–5]. The Project Management Institute has developed the PMBOK methodology as a guide to ensure a standardised set of principles and knowledge in the field of PM [8]. The PMBOK methodology comprises a framework of nine knowledge areas, which are divided into activities across five stages of the project life cycle [8]. It was approved by the American National Standards Institute (ANSI) as early as 1998, and the sixth standard version was released in 2017 [4,5]. Another widely used methodology is PRINCE2, which was developed by the Central Computer and Telecommunications Agency in 1989. PRINCE2 is focused on the business aspects of a project and emphasises a structured organisational approach to PM [8,9]. At the request of the UK government, the PRINCE2 PM methodology was released in 1996, and the sixth version of the methodology was released in 2017, which is applicable to projects to this day [4,5]. The release of the seventh edition of PMBOK in 2021 brought about a significant transformation in the approach to project management [7]. In this latest edition, the previously detailed process and group-based view of project management have been replaced by a comprehensive principle-based perspective. This shift has broadened the applicability of the PMBOK document, making it relevant and adaptable to all types of projects.

Matos et al. [34] explained that while PMBOK defines a project as a temporary endeavour aimed at creating a unique product, service, or result, PRINCE2 defines a project as a management environment created to deliver one or more business products according to a specified business case. In order to provide an integrative approach in respect to business stakeholders and openness on the international scale, the authors of [6] combined the two PM standards (PMBOK and PRINCE2) and proposed a new hybrid approach to PM. A comparative analysis of the controls of PRINCE2 and PMBOK is presented in Table 2.

Table 2. Comparative analysis of controls of PRINCE2 and PMBOK

PRINCE2	PMBOK
Seven principles (continued business justification, learning from experience, defined roles and responsibilities, manage by stages, manage by exception, focus on products, and tailored to the project environment) [3,4,8].	There is no comparative analysis of controls with PRINCE2 [4].
Seven themes (business case, organisation, quality, planning, risk, change, and progress) [3,4,8].	Ten knowledge areas (project integration, scope, time, cost, quality, resources, communication, risks, procurement, and stakeholder management) [2,4].
Seven processes (project initiation, project planning, project control, stage boundaries, product delivery management, project closure, and project monitoring) [3,4,8].	Five process groups (initiating, planning, executing, monitoring and controlling, and closing) [2,4].
Forty-one activities (for example, in the project initiation process, work on the project summary and business case refinement is a repetitive activity, and discussions and document refinement should occur continuously [3,4,8].	Forty-nine processes (grouped by process groups and knowledge areas, such as project integration management and, creating a PM plan in the planning process group) [2,4].
Forty specified tools and techniques [3,4,8].	One hundred and thirty-two specified tools and methodologies [2,4].

While PMBOK and PRINCE2 have similar control definitions, there are many differences between the two PM methodologies. One PM methodology may have a more-detailed process, while another may have a less-detailed one. PMBOK can be identified as a methodology that comprehensively covers such knowledge areas: project integration management, project scope management, project time management, project cost management, project quality management, project resource management, project communication management, project risk management, project procurement management, and project stakeholder management [4]. Meanwhile, the PRINCE2 PM themes cover the following topics: business case, changes, and progress; planning and progress; quality; planning, organization; risk; undefined; organisation [4]. It is seen that the PRINCE2 PM themes cover all the same topics apart from one topic - procurement management, which is not covered by PRINCE2 PM.

Another advantage of the PRINCE2 methodology is the integration of processes with the seven themes. The integration of processes and themes creates a methodology that can be applied widely to manage projects of any type. The author [4] analysed the seven PRINCE2 PM processes and the process model that includes the PMBOK PM methodology. It was stated that the PRINCE2 PM processes cover the following four management levels: corporate or programme management, directing (project board), managing (PJM), and delivering (team manager). Meanwhile, the PMBOK methodology prioritises the level of managing for which the PJM is responsible.

The drawbacks of the PMBOK PM methodology include a lack of responsibility for PM team members and overly detailed descriptions of certain aspects. The PJM plays the main role in the PMBOK methodology, with the primary responsibilities being assigned to them, but the responsibilities of other project team members have been defined ambiguously [4]. The main drawback of the PRINCE2 PM methodology is the limited selection, only 40, of tools and methodologies. Although the PRINCE2 PM methodology does not limit the use of best practice tools and methodologies from external sources, in comparison, PMBOK has 132 integrated tools and methodologies. Additionally, each project team member must know their tasks and responsibilities precisely in the PRINCE2 methodology, and if at least one team member does not follow the PRINCE2 methodology process and flow, the project can become uncontrollable. According to the PBMOK methodology, the schedule baseline serves as a fundamental component of delay analysis in projects [35]. The schedule baseline refers to the authorised project timeline, against which actual

dates and modifications must be compared to assess schedule delays in the project model. When updating the project schedule, it is crucial to retain accurate data on project time performance. Any alteration to the critical path within the schedule baseline results in delays. In their study, the authors of [36] put forward a risk management framework that refers to the PMBOK standards. This framework aims to assist in the selection of appropriate risk response strategies for addressing a specific case study within a construction company. To handle the complexity of the proposed model, different state-of-the-art metaheuristic algorithms were employed. Applying the principles of the PMBOK methodology to identify sources of health, safety, and environmental (HSE) risks and utilising a fuzzy analytic hierarchy process can enhance the accuracy of risk assessments for hazards in construction projects [37]. This comprehensive approach enables a more realistic estimation of the risk index, thereby improving the overall understanding and management of HSE risks in construction projects.

Hence, while project management standards may have their unique features, they generally encompass elements such as terminology, areas of knowledge, an administration system, the project life cycle, and alignment with organisational objectives. These components provide guidance and a common framework for professionals to effectively manage projects [7].

3. Research Object and Methodology

This part presents the project under analysis on anti-corrosion works for steel frames of gas distribution stations at Company X, the description project management model at Company X, the identification of problems related to project management at Company X by conducting repetitive construction projects, and the aim and progress of execution of quantitative and qualitative research.

3.1. The Repetitive Construction Project

The project under analysis was an anti-corrosion works project for steel frames of gas distribution stations. The company that carried out the anti-corrosion work on gas distribution stations and allowed to use of the obtained data for the research was called Company X. The project consisted of abrasive cleaning by sandblasting and anti-corrosion painting of nine gas distribution stations. The total value of the anti-corrosion works for the gas distribution stations was EUR 92.565 including value-added tax.

The planned duration of the project was 23 working days, and the maximum number of staff required during the project was 17. The number of staff depended on the number of gas distribution stations running in parallel. After the welding of the gas distribution stations, the metal structures were transported to the sandblasting chamber, and after the sandblasting, the structures were transported to the anti-corrosive painting chamber. According to the size of the metal structures, the sandblasting work was planned to be carried out within a maximum of 2 working days (4 shifts), and the anti-corrosive painting work was planned to be carried out within 5 working days (10 shifts) in order to meet the specified deadlines. The two-shift front end was more than half of the planned project duration.

Depending on the type of gas distribution station (three different types in total), the metal structures were painted with three to five different anti-corrosive painting systems. The surfaces of the metal structures were painted with the paint systems appropriate for the operating characteristics of the distribution station. Not only did each painting system have different paint dry film thicknesses (ranging from 50 to 150 μm) and several intermediate layers (ranging from 2 to 4) but also colour variants (grey, yellow, or red) depending on the type of gas distribution station (Figure 1).

(**a**) (**b**)

Figure 1. Examples of a steel frame of gas distribution stations: (**a**) station type no.1; (**b**) station type no. 3.

The anti-corrosion coating was subject to high-quality requirements. Before the transportation of the structures, the work carried out for the installation of the equipment was handed over to the FROSIO (nor. Faglig Råd for Opplæring og Sertifisering av Inspektører innen Overflatebehandling) inspector responsible for the condition of the welded metal structures, the surface preparation, and the anti-corrosion coating. At the time of the intermediate acceptance, the FROSIO inspector had to be provided with the gas distribution station's performance documentation, such as measurements of the sub-surface preparation of the metallic structures, dustiness, salt content, and adhesion of the paint coating. In addition, intermediate-temperature and dry-coating measurements had to be carried out in accordance with the requirements of the project's technical specifications.

The sandblasting and anti-corrosive painting works were performed according to technical documents and standards that governed the installation technology. During the sandblasting and painting operations, it was necessary to ensure intermediate quality control by measuring the number of soluble contaminants present on the surface to be sandblasted, ensuring the quality of the abrasive used, ensuring the correct air temperature during sandblasting, anti-corrosive painting, etc. Thus, the project specified the quality requirements, the criteria to be met, and their values. The quality control plan for the anti-corrosion work is presented in Table 3.

Table 3. Quality control plan for anti-corrosion work.

No.	Name of Quality-Related Activity	Relevant Standard	Satisfactory Criterion/Value
1. Before sandblasting			
1.1	Steel surface preparation (welds and imperfections).	ISO 8501-3:2006 [38]	P2
1.2	Determination of the presence of soluble contaminants on the surface.	ISO 8502-6:2020 [39]/ISO 8503-5:2017 [40]	3 µg/cm
2. During sandblasting			
2.1	Quality of the surface to be cleaned before sandblasting.	SSPC-SP1 [41]	Oil- and grease-free surface.
2.2	Blast cleaning abrasives control: conductivity and lubricant contamination.	ASTM D4940-15:2020 [42]	<250 µS/cm at 20 °C temp.
2.3	Quality of supply air.	-	Oil-, water-, and moisture-free.
2.4	Environmental conditions during sandblasting: air temperature; relative humidity; dew point; and surface temperature.	ISO 8502-4:2017 [43]	Air and surface temperatures according to the material's tech-

			nical data sheet; relative humidity not exceeding 85%; and difference from the dew point greater than 3 °C.
2.5	Air compressor blotter test.	ASTM D4285:2018 [44]	Free of oil and moisture.
3. Before anti-corrosive painting			
3.1	Visual inspection of the sandblasted carbon steel surface.	ISO 8501-1:2007 [45]	SA 2.5
3.2	Determination of dustiness on the surface.	ISO 8502-3:2017 [46]	Maximum quantity—2, size—2.
3.3	Roughness check on the surface of carbon steel.	ISO 8503-2:2012 [47]/ISO 8503-5:2017 [40]	Medium (45–75 μm).
4. During anti-corrosive painting			
4.1	Environmental conditions during painting: air temperature; relative humidity; dew point; and steel surface temperature.	ISO 8502-4:2017 [43]	Air and surface temperatures according to the material's technical data sheet; relative humidity not exceeding 85%; and difference from the dew point greater than 3 °C.
4.2	Dry film thickness check.	-	Before each layer, according to the specified dry film thickness of each layer.
4.3	Layered painting.	-	Before every layer of paint.
5. After anti-corrosive painting			
5.1	Adhesion measurement (adhesion to coating) test.	ISO 4624:2016 [48]	A value greater than 6 MPa; Performed on SDS >200 μm

If the values did not meet the intended criteria, e.g., the SA 2.5 cleanliness class was not achieved during the sandblasting according to the ISO 8501-1:2007 standard [45], these areas were re-sandblasted to ensure the cleanliness class specified in the design.

3.2. Project Management Model at Company X

The PM in Company X was based on a customised model developed internally. The responsibilities and duties of the project team were defined in the project implementation process so that each member of the project team had a clear understanding of his/her tasks. The project initiation phase involved the appointment of a PJM, an understanding of the project purpose and expectations, the phasing and scheduling of the project, a review of contractual requirements for additional documentation (e.g., site access permits), a risk assessment, and the creation of the project initiation documents, namely the appointment letter, the order, and the site file.

The standard PM organisational structure in Company X included the following personnel: project director, PJM, works manager, works organisation manager, engineer, delivery manager, works supervisor, and workers. As one of the key criteria of the project was to complete the work on time, the technical director was also involved in the PM organisational structure. The responsibilities of the project team are broken down by function below (Table 4).

Table 4. Responsibilities of the project team by function at Company X.

Function	Project Responsibilities
Technical director	Advises the project team on technological matters and assists the PJM in making decisions; participates in project discussions and provides support in resolving project-related issues.

Project director	Supervises the PJM, organises regular project meetings, and assists in managing project issues; may also arrange additional meetings with the technical director, project director, works organisation manager, and PJM as needed; implements PMT and signs and approves project contracts.
Works organisation manager	Ensures an adequate number of contractors and workers, plans human resources and manages their employment and allocation in projects; organises construction documents based on client needs, including assignments, permits, orders, and instructions, which are provided alongside the site file; is responsible for monitoring compliance with safety requirements.
Project manager	Estimates and submits commercial proposals to clients, clarifies technical and commercial issues, and negotiates contracts; organises project team meetings, provides project briefings to contractors, monitors work execution, and hands over the site file containing relevant documents; plans initial equipment requirements, facilitates material procurement and equipment delivery, and coordinates construction permits with the client; establishes project control principles, oversees contractor and subcontractor work, monitors project progress, and makes necessary adjustments; ensures quality execution through periodic checks, approves statements and invoices, manages project costs, and participates in project discussions.
Supply manager	Ensures the availability of necessary tools as per the list provided by the PJM and contractor; arranges for equipment hire or purchase and its delivery to the site; is responsible for purchasing services, seeking and reserving accommodation, assembling and inspecting the specified equipment, and ensuring its readiness for use; also handles transport arrangements and reports any discrepancies as needed.
Warehouseman	Carries out delegated tasks from the delivery manager, arranges necessary equipment based on the provided list by the PJM and contractor, and ensures that the issued equipment for the project is in good working condition.
Engineer	Performs assigned tasks by the PJM, prepares construction documents such as assignment permits and orders, and compiles the site file; registers reports submitted by the contractor in the system, and provides plan-invoice outputs to the PJM, works organisation manager, and contractor weekly; also handles forms F2/F3 and internal acts.
Works supervisor	Formulates tasks for employees, monitors the progress and quality of work throughout the project; updates the equipment list as needed, signs construction documents including assignment permits, orders, and briefings based on customer requirements, and maintains object files; also submits the completed work to the PJM.

3.3. Problems Related to Project Management at Company X

The problems that related to project management at Company X were identified by the project team conducting repetitive anti-corrosion work projects for steel frames of gas distribution stations. The following problems were identified during the repetitive construction PM:

- Increased design quantities that were not paid for by the contract;
- The technological solutions for the project were only adjusted during the project;
- Lack of quality control of the project and poor quality of the anti-corrosion work carried out on certain steel structures;
- Failure to assign the responsible works managers to the relevant work operations;
- Works not foreseen in the project (installation of elevation aids, coating of steel structures before painting, and repeating the same operation twice);
- Delays in the agreed work schedule;
- Exceeded material resources.

The project foresaw the execution of 1360 m^2 of anti-corrosive painting, but the actual quantities were higher, i.e., 1653 m^2 (21.54% increase), and the contract did not provide payment for additional works. As the actual quantities were not in line with the projected quantities, the cost of the project increased, requiring more man-hours, materials, and machinery to complete the project. During the project, the observed over-quantities led to additional orders for materials, which were transported directly from the paint supplier,

resulting in higher project costs. The following cost increases were identified: the wage bill increased by 37.68%, the number of materials used increased by 38.69%, and the cost of machinery increased by 68.47%. But the direct and other costs decreased by 7.66%.

Increased design quantities, technological complexity, and continuous work in several shifts were identified as PM weaknesses, which had a major impact on the overall project's result. This shows that the above-mentioned management areas have to be improved to seek good project results. In this case, it was decided to apply two PM methodologies, PMBOK and PRINCE2, to improve the management areas in conducting repetitive construction projects at Company X.

3.4. Methodologies

Analytical quantitative research in the form of a survey and qualitative research using a structured interview method were carried out by the researchers. To enhance the validity and reliability of research results, it is crucial to integrate quantitative and qualitative approaches in the research design and data collection. By adopting a mixed-methods research approach, researchers can strengthen their ability to derive trustworthy and compelling conclusions from empirical research [49].

3.4.1. The Analytical Quantitative Study

In order to help Company X to solve the problems related to the project management of their repetitive anti-corrosion work projects, analytical quantitative research was carried out in the form of a survey. By employing this technique, researchers can create an appealing and well-structured questionnaire with a suitable introduction, clear instructions, and a thoughtfully arranged set of questions with aligned response alternatives that aim to facilitate ease of response for the respondents [50]. The researchers developed a survey questionnaire to assess the perceptions of the respondents of construction PM and execution companies of the application importance of two PM methodologies, PMBOK and PRINCE2, for repetitive construction projects. Not only did it aim to extract general information about the respondents (age, experience in the construction sector, etc.) but also their knowledge of PM methodologies. The survey analysed two PM methodologies, PMBOK and PRINCE2, which were discussed in the literature review section above. The survey results were used to determine which of the two PM approaches would be more suitable for a repetitive construction project.

The questionnaire for the quantitative study on the selection of a rational construction PM approach for the repetitive process consisted of fourteen closed-ended questions, six of which were generic and eight were PMBOK- and PRINCE2-specific questions. The six general questions were related to gender, age group, educational background, work experience, position in the company, and scope of the company activities. Each of the eight questions on project management had two possible answer options, one related to PMBOK and the other to the PRINCE2 methodology. The respondents, by choosing the answer options, could consider what methodology would be more suitable for managing repetitive construction projects. The questions given to the respondents are discussed in Section 4.1. A repetitive construction project involving the abrasive cleaning and anti-corrosive coating of steel structures of gas distribution stations was presented for the case study. In addition, it was highlighted that the project was subject to stringent requirements in terms of the budget, the quantities of materials, and relatively short lead times.

The quantitative research was carried out over two weeks, from 22 November to 5 December 2021, targeting the respondents from construction PM and execution companies. The survey was conducted online using the Google Forms platform. Construction companies with recurring construction projects in Lithuania were surveyed. The survey link was distributed via email and the LinkedIn platform. The respondents were randomly selected if their job title was related to project management in the company. Based on the findings of the researchers [22], the selection of a simple random sampling method

ensured that every element within the population had an equal opportunity to be included in the sample. A total of 104 respondents took part in the quantitative study over a two-week period. Responses to the questionnaire were then collected and analysed.

3.4.2. The Descriptive Qualitative Study

To identify trends and actions related to monitoring the progress of construction projects, a descriptive qualitative study was conducted. In qualitative research, structured interviews serve as a prevalent method for data collection. It is worth noting that the effectiveness of the study results is fundamentally influenced by the quality of the interview guide [51]. To collect the needed information, the qualitative research was carried out using a structured interview method, asking representatives of different companies, X, Y, and Z, the same 15 questions. The qualitative study involved three different-sized companies dealing with construction PM and implementations. In the analysis of the replies received, the companies were identified as Company X, Company Y, and Company Z.

The descriptive qualitative study aimed to obtain information about the structure of the company, the tools, methods, and methodologies used to improve PM, project progress monitoring, progress indicators monitored in the report, additional report information, and other relevant issues, as listed in Table 5. Author [52] in his work provided a working knowledge of the whole building industry, i.e. the technical skills required to manage a construction project from conception through occupancy. The useful information provided helped to prepare the questionnaire for the descriptive qualitative study.

Table 5. Company representatives were asked to answer the following questions

No.	Questions
1.	How are projects organised and managed within the company? Please describe the PM structure and responsibilities.
2.	What tools/methods, PM methodologies, or approaches do you use to manage projects?
3.	How do these tools, techniques, PM methodologies, or approaches contribute to improving project delivery?
4.	How do you monitor the progress of construction projects (e.g., human resources, materials and machinery)?
5.	What indicators do you track in project progress?
6.	How often is the project progress monitored?
7.	Does the existing project progress report provide clear and relevant information?
8.	What would you improve in the project progress report?
9.	What decisions does monitoring project progress help you make?
10.	At what frequency is the project progress discussed with the contractors and how is the discussion organised?
11.	Do staff easily assimilate project progress information?
12.	Who in your company takes appropriate action to ensure that the targets are met?
13.	If you see that a project is not going according to the plan, what action do you take? Which units of the company are involved in changing the project plan?
14.	What are the success factors for PM in your opinion?
15.	What are the reasons for project delays in your opinion? What should be avoided in order to deliver the projects on time?

The interviews in the qualitative research were carried out in person and online. The results obtained are analysed in Section 4.3.

4. Results, Discussion, and Recommendations

This part presents the results of the quantitative results, gives recommendations for improvement of the implemented repetitive project management at Company X, presents the results of a descriptive qualitative study, and discusses the sustainability aspect of project management for future studies.

4.1. The Results of the Analytical Quantitative Study

A survey was conducted in order to determine which of the two PM approaches would be more suitable for a repetitive construction project; 104 respondents took part in the quantitative study over a two-week period. The respondents' answers to the questions and the choice of the most appropriate option are presented in Tables 6 and 7. The first six questions were generic and related to gender, age, educational background, working experience, and current position in a company. The answers showed that the majority of the respondents were male (77.0%), aged 25–30 (33.7%), held a Bachelor's degree (61.5%), and had 5–10 years of working experience (39.4%). By position in the company, the majority of the respondents were PJMs (25.0%) and came from companies mainly specialised in construction works (45.2%) (see Table 6).

Table 6. Respondents' characterisation.

No.	Questions	Number of Respondents Who Selected the Answer	Answers as a Percentage
1.	Please indicate your gender.	Men:80	~77.0%
		Women: 24	~23.0%
2.	Please indicate your age group choosing the appropriate option.	18–25 age group: 25	~24.0%
		25–30 age group: 35	~33.7%
		30–40 age group: 31	~29.8%
		40–50 age group: 8	~7.7%
		50+ age group: 5	~4.8%
3.	What is your educational background? Please select the appropriate option.	Secondary education: 5	~4.8%
		Professional education: 5	~4.8%
		Bachelor's degree: 64	~61.5%
		Master's degree: 28	~26.9%
		PhD degree: 2	~1.9%
4.	What is your work experience in the construction sector by year? Please select the appropriate option.	Up to 1 year: 9	~8.7%
		1–5 years: 34	~32.7%
		5–10 years: 41	~39.4%
		10–20 years: 14	~13.5%
		20 years and more: 6	~5.7%
5.	What is your position in the company? Please select the appropriate option.	Assistant manager of projects and works: 20	~19.2%
		Project engineer: 25	~24.0%
		Work manager: 12	~11.5%
		Project manager: 26	~25.0%
		Construction manager: 9	~8.7%
		Head of department: 11	~10.6%
		Head of the company: 1	~1.0%
6.	What is the scope of your company activities? Please select the appropriate option.	General construction contractor: 42	~40.4%
		Specialised construction works: 47	~45.2%
		Real estate development: 15	~14.4%

The remaining eight out of fourteen questions were related to PMBOK and PRINCE2 PM methodologies, and the respondents had to choose an appropriate option from the two presented. The majority of the respondents (see Table 7) chose the answer options related to the PRINCE2 PM methodology, i.e., they considered this methodology to be more suitable for managing repetitive construction projects.

Table 7. Survey responses.

No.	Questions	Number of Respondents Who Selected the Answer	Answers as a Percentage
1.	Which definition of a project do you think is more appropriate for the repetitive construction project? Option 1. Project—a temporary activity designed to create a unique product, service or result. Option 2. Project—a temporary organisation set up to implement one or more products according to a defined business plan.	Option 1 (related to PMBOK): 48 Option 2 (related to PRINCE2): 56	~46.2% ~53.8%
2.	Which PM model do you think is more appropriate for the repetitive construction project? Option 1. The PMBOK PM model consists of 5 groups of management processes: initiation, planning, execution, monitoring and control, and closure. Each stage of each process group is followed by a specific deliverable or feedback. Option 2. The PRINCE2 PM model consists of 7 groups of management processes: project supervision, project inception, project planning, stages boundary management, stages control, product development management and project closure. Each process is reviewed by the PJM and approved by the project board.	Option 1 (PMBOK): 23 Option 2 (PRINCE2)—81	~22.1% ~77.9%
3.	Which definition of the project team's responsibilities do you think is more appropriate for the repetitive construction project? Option 1. PJM is the person responsible for leading a project team to achieve the project objectives. Responsible for completing the tasks assigned to the project team. Project team is a group of people working towards common project goals, under the authority of a PJM. Option 2. PJM is the person whose day-to-day focus is on the project, liaising with the project board throughout the project. Delegates tasks to a team leader (e.g., the works manager or works supervisor). Team Leader—responsible for the execution of the tasks assigned by the PJM and the work performed. Regularly delegates completed work for the PJM. Project staff is subordinate to team leaders to carry out assigned tasks.	Option 1 (related to PMBOK)—40 Option 2 (related to PRINCE2)—64	~38.5% ~61.5%
4.	Which definition do you think is more appropriate for the repetitive construction project? Option 1. The roles and responsibilities of project team members should be discussed and may be specified during the project. Option 2. The roles and responsibilities of the project members must be described, and each participant must have a clear understanding of their roles and responsibilities before the project starts.	Option 1 (related to PMBOK)—18 Option 2 (related to PRINCE2)—86	~17.3% ~82.7%
5.	Do you agree with the statement that the project in question must adhere strictly to the chosen PM methodology?	Agree (related to PRINCE2)—65 Disagree (related to PMBOK)—39	~62.5% ~37.5%

6.	Please choose the statement you think is most appropriate for the repetitive construction project. Option 1. The PM methodology must be descriptive, i.e., it describes processes and knowledge areas but does not specify how they are to be used. Option 2. The PM methodology must be prescriptive, i.e., describing what is to be done and when.	Option 1 (related to PMBOK)—18 Option 2 (related to PRINCE2)—86	~17.3% ~82.7%
7.	Please choose the statement you think is most appropriate for the repetitive construction project. Option 1. The PM methodology must anticipate the tools and techniques that can be applied to the project. Option 2. The PM methodology has less defined tools and techniques but is not limited to the use of best practice tools and techniques from outside the PM methodology.	Option 1 (related to PMBOK)—41 Option 2 (related to PRINCE2)—63	~39.4% ~60.6%
8.	Please choose the statement you think is most appropriate for the repetitive construction project. Option 1. Depending on the progress of the project, a PMO is organised at the request of the PJM or instruction from the project board, involving the project board (e.g., heads of department and company) and the PJM. Option 2. The project board (e.g., head of department and head of the company) must control the work of the PJM and his/her team from project initation to project closure, regardless of the progress of the project.	Option 1 (related to PMBOK)—47 Option 2 (related to PRINCE2)—57	~45.2% ~54.8%

To summarise the results of the quantitative study based on the responses of the 104 respondents, the PRINCE2 PM methodology was more rational for the project under consideration. The answers to the eight questions related to PM methodologies in the quantitative survey showed that the PRINCE2 PM methodology was given a priority. After the conversion of the answers of the one hundred and four respondents to eight questions into points, PMBOK scored 274 points, whereas PRINCE2 scored 558 points (see Figure 2). As a percentage, the PRINCE2 PM methodology accounted for 67% of the total points and the PMBOK methodology for 33%.

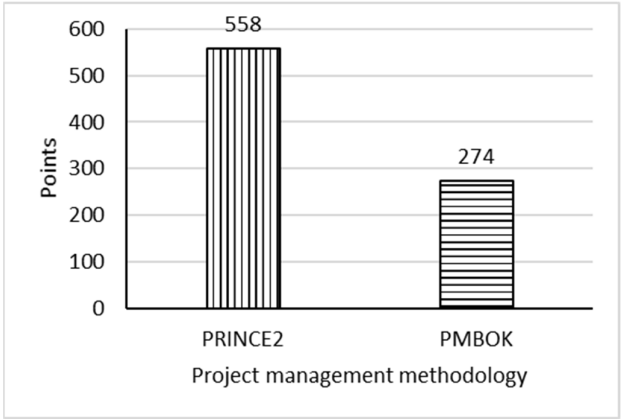

Figure 2. PRINCE2 vs. PMBOK according to quantitative study.

Thus, based on the results of the quantitative study, the PRINCE2 PM methodology was chosen for further development of the repetitive construction project.

One of the principles of the PRINCE2 PM methodology is to learn from experience, so the lessons learnt must be applied to the repetitive project under analysis. The project was integrated through three main elements of PRINCE2: principles, themes, and processes [5]. The business case, organisation, quality, planning, risks, change, and progress are some of the key elements of PRINCE2 PM. In this case, the processes and tasks of the PRINCE2 PM methodology for the repetitive construction project were outlined and compared with the structure of the project in question and the tasks carried out [5]. A comparison of the PM processes using the PRINCE2 project management methodology and standard project management is presented in Table 8.

Table 8. Comparison of the PM processes using the PRINCE2 project management methodology and standard project management.

No.	Project Management Processes	The PRINCE2 Project Management Methodology	Tasks Completed in the Project under Review/Completed by Standard Project Management
1	Project supervision	Regular project meetings with the project board two times a week from the start of the project to the end.	Project discussions/meetings in critical situations separately with managers.
2	Beginning of the project	Preparation of information and plans in accordance with the principles and theorems of PM methodology. Establishment of a site file, an assignment, and a project order with responsible persons.	Preparation of an object file with technological guidelines (painting technology, drawings, and project requirements) and creation of an assignment authorisation and a project order with responsible persons.
3	Planning the project	The PJM approves the documentation set out at the start of the project and adds or assigns a task to add information if the information is missing.	Human resources, equipment, and materials are approved by the PJM.
4	Phase boundary management	The PJM, together with the project board, carefully analyse the phases in progress before providing the PJM with relevant information. If necessary, the project plan is updated.	The project is not phased.
5	Phase control	The PJM designates the persons responsible for the execution and quality of the works for the intermediate control of each phase. In the event of deviations, they inform the PJM, who takes the initiative for project changes and takes decisions. Meetings are organised by the PJM with the project team leaders and/or members.	The project is not phased.
6	Product development management	The PJM carries out a quality control check before the work is delivered to the client. The project board controls communication between the PJM and the project team.	Quality control of the PJM is introduced during the project following the comments made.
7	Closure of the project	Final project documentation is produced, a register of learning from experience is kept, and the results of the project are summarised and evaluated in the company.	Final project documentation, summarising, project results and progress, is presented at the company.

Table 8 shows that the fundamental differences between the objectives of the PRINCE2 PM methodology for a repetitive construction project and a completed project are the information flow and different PM processes. For example, a repetitive construction project would introduce phases and phase boundary management, whereas an implemented project is not divided into phases. According to the PRINCE2 PM methodology, a repetitive construction project would aim to provide as much information as possible to the project participants, form a team and assign team leaders responsible for the phases, establish a financial plan, a detailed timetable for the execution of the works, a quality control plan, and a plan of responsible persons, and detail the technological sequencing of the works. These things were not carried out in the project under consideration. In addition, a repetitive project based on the PRINCE2 PM methodology would include a problem register, a risk and action plan, more frequent monitoring of the project progress, and more frequent meetings with the project' team leaders and/or team members.

4.2. Recommendations for Improvement of the Implemented Repetitive Project Management at Company X

Given the results of the quantitative study and the comparison presented in Table 9, the PRINCE2 PM methodology was chosen for improvement of the implemented repetitive project management at Company X. The problems related to project management at Company X are presented in Section 3.3. Some recommendations about how to improve the identified problem areas using the PRINCE2 methodology are given below.

Table 9. The answers of the Company X representative.

Question No.	Summarised Answers to the Questions
1.	PM starts with the signing of the contract. The PJM is fully responsible for the success of the project and manages the team to ensure that the outcome of the project meets the terms of the contract, the detailed and technical designs and the budget. For standard, small-scale projects, the project team is quite simple: a PJM, a works manager, a foreman and an engineer. However, the PJM also uses other people in the organisation, such as the supply manager and the warehouse manager. The PM reports in weekly meetings to his/her line manager (head of the department), who controls basic criteria, i.e., time, scope and budget. The unit manager also approves the essential PM tools (PMT), the project plan, and the project schedule. If the project has a deviation from the plan that affects the budget, the unit manager has to approve the costs in the project change committee, which can include everyone, from the accountant to the company shareholders. Thus, the PJM makes decisions that do not affect the budget and plan and do not impact the business. The role of the unit manager is to oversee the execution of the process at various stages, monitor adherence to the plan, approve essential PMT, and organise changes in the event of a major deviation. Clearly, non-standard projects require additional team members, although the roles of the main actors in the project remain almost unchanged. The PJM is supported by an engineer, a supplier, a works manager, a foreman or more, and the control function is taken over by the PMC (project management committee) rather than the department manager.
2.	Tools need to be user-friendly and standardised so that the PJM can manage the project efficiently and those responsible can monitor the project outcome or deviations. The main tools for PM are the risk management software (which we currently use in MS Excel spreadsheet), the project plan, and the project schedule (MS Project). We also use project progress tracking software, which was specifically developed for our company, since in small-scale projects the most important impact on the budget is the man-hours and the material yield. These indicators need to be monitored on an ongoing basis to be able to manage the result and make the necessary decisions. To monitor the budget, we use a database (Power BI) which allows us to monitor data at different cross-sections, outliers, or comparisons with the plan.

	Project progress and deviations need to be clearly and quickly understood, which is why the traffic light principle is used so that we can quickly see if there is a deviation and if we need to make decisions as soon as the tool is opened.
3.	It is difficult to compete in the market with other organisations if you do not have key advantages (technology you have developed, machinery that your competitors do not have, or the materials you produce yourself), so you have an advantage in PM. The key is to have a standardised project procedure that clearly defines roles, who is responsible for what, who makes decisions and specifies the process and the tools used. As a result, the PJM no longer has to think about what to do or where to go in case of deviations and can therefore be more productive and focused on the outcome of the project.
4.	We can monitor the working hours and materials spent in the previous period for the next day on the traffic light basis. We can see the deviation of one hour and the information is very accurate. The data is also stored to be used for new estimates. We have a unique in-house software for this. We use a tracking program to monitor the machinery where we can see its working hours and fuel consumption rates.
5.	The tools we use are quite effective allowing us to compare the plan of working hours with the fact and the project budget. We can also monitor the result, but it is difficult to understand what decisions are needed in the event of a deviation, so it is most important to monitor the indicators affecting the project result. In our company, the indicators that influence the result the most are man-hours, material yield, and project resources, so we monitor these indicators the most.
6.	It is sufficient to monitor the project result once a month for our projects, as we do not have the possibility to do it more frequently, but the PM has to monitor the indicators that influence the project result on a daily basis to achieve the best project result. And because the tools are user friendly, it takes only 5–10 min a day to review the key indicators.
7.	The traffic-light-based progress tracking software is very user-friendly and time-saving if there is no need for a PJM and a unit manager to go into the figures in detail. Also, it should be standardised. If the traffic light is yellow, the PJM has to make decisions; if it is red, the head of the unit has to find out the reason, and we intend to standardise it in the future.
8.	At the moment, we cannot monitor the direct costs of projects in the current period and compare them with the plan. This can only be conducted at the beginning of the month when the PJM does the material and cost write-off and the accounting department enters the data. If we could monitor this at least every week, we would be able to manage projects more accurately. Clearly, like other indicators, it should give a quick and clear indication of whether there is a deviation and additional time is required.
9.	We do not monitor indicators for the sake of it but to make decisions that will help us manage the outcome of the project. Decisions can take many forms, such as changing the technology or equipment, adjusting the schedule, negotiating extensions, increasing resources, subcontracting, etc., if productivity is not being achieved. If material yields are exceeded, it may be necessary to change materials, order additional quantities, renegotiate with the customer, and arrange a meeting with material and equipment suppliers. It may even be the case that if the indicators show that we will not only be over the budget but also under the cost, the project change committee may decide to cancel the contract.
10.	Usually, if there is no deviation, progress is not discussed with the workers, but this is a bad example, and in any case, progress should be discussed at least once a week. Workers are motivated when they know where they stand. We have tried in the company to send project progress by e-mail, but the figures are not manageable for everyone, so our e-mails get ignored. For larger projects, we use a model where we present the previous day's progress to the lower management, which helps us communicate the problems that are preventing us from achieving the desired result. The project progress meeting should be no longer than 20–30 min, during which indicators are reviewed and problems are mapped. Another meeting is organised to address the problems.
11.	It is important to show the indicators for which they are directly responsible, i.e., labour productivity and material yield. Although we do not hide the financial indicators of the project in our company, the latter would be redundant. The information conveyed must be simple and clear, and the employees must understand what is going on with the project within 5 min of looking at it, which is why coloured boxes and arrows are used.

12.	The PM is always responsible for the outcome of the project, so he is naturally responsible for monitoring and controlling progress, although he may delegate this task to an engineer to inform him of deviations. The PJM takes action when he sees a deviation and delegates tasks to other team members to clarify or correct the deviation depending on the problem. Alternatives should always be applied, taking the costs and foreseeable risks into account to achieve the best or most appropriate result.
13.	The PM is the person who directly influences the outcome of the project and is solely responsible for communication, both internally and externally. The PJM has the ability to decide which line managers he/she needs to support if the redesign results in a change in the final outcome that is either unchanged or insignificant to the project budget. But if, due to deviations or alternatives chosen, the planned budget is insufficient, the PJM has to approach the division manager with the estimated additional budget needed, who (un)allocates the additional budget as far as possible, or summons a project change committee, which decides on the impact on the company's results or on the future business. Modification of the project plan and schedule is mandatory in the case of major deviations.
14.	There are three success factors for PM: Firstly, a standardised and user-friendly project implementation procedure, which is where it all starts. Secondly, the behaviour of the PJM in the preparation phase of the project. The better you prepare the project before it starts, the fewer small problems you have to tackle and can concentrate on the execution phase. The primary tools for project preparation are the project plan, the schedule, and the risk management plan. Thirdly, the PJM's attitude to problems and deviations. If he or she does not feel responsible for the outcome of the project, the outcome will never be good.
15.	The reasons for project delay can be many and varied, e.g., inappropriate choice of materials, insufficient team expertise, inappropriate team structure, poor project preparation, unreliable equipment or suppliers, etc. We can anticipate and prepare for problems in advance and anticipate what we will do if there is a problem. This is a risk management plan.

Increased design quantities. The customer calculated the design quantities using software. However, the actual demand for human resources and the yield of materials was higher than the customer's design calculations. The recalculation of the quantities showed an increase of 21.54% over the projected quantities. Using the PRINCE2 PM methodology, the project initiation process, i.e., the pre-project phase, must clarify and justify the client's expectations and enable a smooth start of the planned project. Therefore, the PJM has to give the task to a team member to check the project quantities internally against the customer's drawings to avoid any misunderstandings during the execution of the project. The implementation of embedded sensors for automated tracking of construction equipment and materials on-site can lead to cost reductions in material expenses [53]. By leveraging this technology, construction projects can achieve improved efficiency and accuracy in managing their resources, resulting in potential savings in material costs.

Technological solutions**.** The technological painting solutions were refined during the project. Initially, the painting process was experimental in order to determine the most rational sequence of coat application. The lack of clarity in the tasks and the allocation of responsibilities in the teams before the start of the project resulted in poor-quality painting and inefficiency, as the work was conducted on the basis of impulsive decision-making. According to PRINCE2 PM principles related to roles and responsibilities and the nature of the organisation, before the start of a project, everyone involved in the project must know their responsibilities and tasks. Also, the PRINCE2 methodology calls for a clearly defined structure and sequence to guide the entire project team. Although the timeframe for the project preparation was shortened, a joint meeting of the project board (technical director, project director, works supervisor, and PJM), with the participation of the works supervisor, was able to find compromises to improve the project.

Lack of quality control. The poor quality of the anti-corrosive painting during the project execution indicated a lack of project control. Prior to approving the next stage of

the project, the PJM must ensure that the work is carried out to the specified requirements and high standards. Failure to ensure the quality led to repeated operations that take as much time as the initial operation. Several factors contributed to this shortcoming, such as the inadequate induction of new works managers and their teams into the project, a lack of feedback from the works managers, and the absence of a coordinating person. A project team is formed with respect to the size and complexity of a project. The standard project team in Company X consisted of a project director, a PJM, a works organisation manager, an engineer, a supply manager, a works manager, and workers. The PRINCE2 methodology places an exceptional emphasis on quality control. Each member of the project team must have a clear understanding of the quality requirements, and the responsible persons (PJM, works manager) must be able to ensure that the work is carried out to a high standard. For example, to manage the project properly, the sandblasting work had to be divided into phases to ensure the quality of the project and to assign the responsible works managers for the sandblasting work. According to the authors of ref. [7], the analysis of stakeholders in a construction project should serve as a foundation for supporting and strengthening team-building activities. These activities encompass various aspects such as strategy development, aligning with project goals, defining members' roles, and managing interfaces between different sections. By leveraging the outputs of stakeholder analysis, team-building efforts can be enhanced and aligned with the needs and expectations of relevant stakeholders involved in the project.

Failure to assign responsible works managers. The work was carried out in two shifts (morning and evening), with information being passed from the morning shift to the evening shift by the works managers. However, the evening shift and the morning shift did not meet, and thus the quality of the project was compromised because hard-to-reach areas were inadequately prepared and/or unpainted due to the lack of communication. To avoid quality control errors, it is necessary to assign a person responsible for certain operations, such as the works manager responsible for the quality of the sandblasting work, person X, who identifies and defines the shortcomings of the evening shift and communicates the backlog, highlighting the hard-to-reach spots, and the works manager Y who is responsible for the sandblasting. The PRINCE2 PM methodology helps to avoid such errors by breaking the project down into phases, thereby increasing control over certain operations, such as the first coat of paint. Once the project has been phased, it is necessary to assign responsible persons to ensure the quality of the phase. No further work is to be undertaken until the first phase, the first coat of paint in this case, has been approved. The PJM is responsible for the approval of the phase and may delegate the intermediate control of operations to team leaders.

Works not foreseen in the project. The project in question provided that the customer would supply scaffolding, but due to the poor mobility of the scaffolding, the work was carried out inefficiently, and it was not possible to reach a part of the steel structures. The contractor, therefore, decided to provide a mobile aluminium scaffolding system. Another problem encountered was the need for additional polyethilene film cover for the structures while using different painting systems. The change in the painting sequence necessitated a change in the pre-design solutions and an additional cover of the steel structures to achieve the highest quality. In this case, a detailed project preparation plan would have helped to avoid unforeseen activities or to plan them most efficiently, as emphasised by the PRINCE2 PM principles. Time and resource commitment must be clear, and everyone involved in the project must know in advance what is expected from the product. According to the authors of [54], the increasing adoption of prefabrication, modular construction, and additive manufacturing offers significant benefits in terms of reducing fabrication costs and enabling the timely completion of construction projects. The construction industry can streamline the production process, enhance cost-effectiveness, and improve project delivery timelines.

Delays in the agreed work schedule. Although the project timelines were clearly defined and the timeframe for each gas distribution station was known, the technological

process of the project was only revised during the project, and errors were unavoidable. The painting of the steel structures in different sequences presented technological challenges, resulting in a deteriorated quality of the painting. The increase in project volumes also had an impact on the duration of the work, as the number of workers had to be increased to complete the work on time. The PRINCE2 PM model can be used to overcome such problems by checking the contractual quantities at the start of the project, preparing a detailed project plan, and phasing the work to be carried out in the project, thus eliminating the risks associated with the project delays. According to the authors of [35], by utilising project control software systems, specifically those professionally designed for project time and cost management, PJMs can effectively plan the construction sequence, monitor the progress of project activities, and update the project's overall progress. These software systems enable PJMs to identify and track project delays efficiently.

Exceeding foreseen material resources. The overruns consisted of poor workmanship and work not foreseen in the design. For example, the demand for materials due to substandard work almost doubled as a repainting operation was required. Also, without knowing the exact quantities of the project, it was difficult to predict the exact material resources. This proves once again that in order to manage a project according to the business plan, it is essential to follow PRINCE2 PM principles and processes to avoid mistakes during the project. Firstly, the contractual quantities of the project have to be checked before the project starts. Also, the phases of work to be carried out are to be identified not only for quality control but also for intermediate control of material utilisation.

Thus, by following the PRINCE2 PM methodology, it is possible to avoid the problems that occur in certain phases and processes of PM.

4.3. The Results of a Descriptive Qualitative Study

Three companies of different sizes agreed to take part in the qualitative study. These companies were asked a series of questions (see Table 5), which were answered by company representatives. To ensure the confidentiality of information, the companies participating in the qualitative research were labeled as Company X, Company Y, and Company Z.

Company X was a specialised construction company providing services in constructing and repairing infrastructure, industrial, energy, commercial, and other building projects. Its main activities included anti-corrosion protection (blasting, shot blasting, anti-corrosion painting. and thermal coating), concrete repair and protection, installation of cast-in-place floors, fireproofing, and supply and installation of fire protection products. The company had more than 120 employees. The answers of the Company X representative are given in Table 9.

The second company participating in the qualitative study, labelled as Company Y, was also involved in specialised construction work. The portfolio of work included the design, installation, and assembly of water boreholes, the installation of water supply using hydrophores and frequency converters, the construction of domestic wastewater treatment plants and pumping stations, the restoration of borehole performance, deep grounding, etc. The company had around 90 employees. The answers of the Company Y representative are given in Table 10.

Table 10. The answers of the Company Y representative.

Question No.	Summarised Answers to the Questions
1.	New projects are allocated according to the PJM's workload and the number of projects he manages. From that point on, he/she is responsible for the implementation of the project and for taking decisions to implement it, i.e., from the drafting and modification of the draft contract to the delivery of the project. Surely, the PJM is not responsible for the progress of the work assigned to the work manager, with whom the possible

	solutions are discussed regularly. The PJM has to keep an eye on the progress of the work, as he takes decisions that the work manager will have to implement. In comparison, private-sector projects are much simpler and require less time input compared to legal entity projects, so 'bigger' projects also require extra attention, such as attending the meetings of site construction contractors, constant communication with the construction manager, adjustments to the working design, constant site visits, etc., whereas private-sector projects can be visited up to three or four times if no problems arise. If the project is problematic, if the PJM is unable to resolve the problem or if advice is needed from someone with more expertise, general management meetings are usually held with the participation of the directors of different divisions. A standard project team consists of a PJM, a works manager, a foreman, and workers.
2.	Various tools are used, such as Dalux software and the Electronic Construction Work Log (ECWL). Our company does not have one specific PMT; usually we adapt to the client's requirements (apps, ECWL, etc.) for larger works. Project allocations are usually based on a hierarchical model, i.e., division directors allocate work to lower-level managers according to the staff availability, who in turn allocate it to work managers, who, in turn, allocate it to workers. A project is usually allocated by the PJM according to priorities, contractual obligations, and deadlines.
3.	New technologies are always good, but they also take time to adapt to. Nevertheless, any digitisation or systematisation of mechanical work is appreciated. For example, the ECWL greatly facilitates the description of the work and thus saves precious professional time. Also, the documentation is not lost and is archived immediately. The app is quite new, so mistakes can happen.
4.	We are currently testing trial versions of various applications to find out what the company needs and which will work best. Recently, MS Excel has been used to track human resources, materials, and machinery, and is also used for materials and warehouses.
5.	Project monitoring consists of many components, such as monitoring whether the project is on track, as most estimates are calculated on a project-by-project basis, worker time is calculated based on past projects of a similar nature, and the time taken to complete various tasks. The progress of the work must also be mentioned, as it is rare for everything to run smoothly in construction, and decisions need to be taken as soon as possible if a problem arises. The quantities of materials used and the wear and tear of machinery are also monitored. The financial results of projects are monitored every month.
6.	Project monitoring depends on the complexity of the site, with private-sector sites requiring much less attention as the solutions are not complex, with some exceptions though. Special structures require much more supervision, as they involve more contractors with whom regular communication is required, and the technical solutions are much more complex and need to be coordinated with a greater number of responsible persons. For example, in the private sector, it is usually sufficient to visit a site up to two to three times (depending on the scope of the work), whereas, in larger sites, meetings are usually held two to three times a week until the project is delivered.
7.	The information is really clear, but we would always like to see improvements, as most of the company staff is older in age and it is quite difficult to do so. Our observation is that each PJM uses his methodologies and principles, and of course, it would be ideal if everyone used the same principle. It would be much simpler, which is why we are trying to innovate in the company.
8.	System optimisation, software upgrades, and deployment are required, as with the better flow of information about the facility, the profit estimation is more accurate. It is also worth mentioning that the company employs about 60% older-age workers who would find all this problematic in their day-to-day work, and we believe that additional funding is needed to improve their computer literacy.
9.	Monitoring project progress helps you keep up with on-site activities so that when problems arise, decisions are made more efficiently and quickly. It also shows the number of staff needed to run the site. Time costs are assessed, which also helps to assess the scope and timing of future works, i.e., more accurate pricing in proposals and more precise schedules for the execution of works.
10.	The frequency of project progress tracking depends on the complexity of the project. If the project is simple and on track, the project will be monitored by liaising with the works manager or the executor of the work.

	For larger projects (lasting more than one month), such as general contracts, meetings with the works managers, and contractors, are held at least once a week to discuss the progress of the project while at the same time detailing the work fronts.
11.	Workers working on site are given a technical brief, both digitally and on paper (for older people), which contains only relevant and necessary information about the site so they are not overloaded with excessive information. Financial indicators are not provided to the on-site workers, as this information would be superfluous for them (except for supervisors). Each PJM uses a different methodology to assess the progress of the project.
12.	The appropriate action to ensure the achievement of the targets is taken by the PJM or, in exceptional cases, the project director. All decisions relating to the works are to be taken by the PJM. In the case of delays, the PJM will hold a meeting in the company, listen to the proposals, evaluate them, and take an appropriate or alternative decision.
13.	If the implementation is not going according to the plan, the first step is for the PJM to try to find out the reasons. This is followed by a meeting or simply discussing with the works managers how to optimise the work at the same time as updating the work schedules. The PJM submits proposals to the project director on how to optimise the work or how to allocate additional funds to the project. The PJM is always in contact with the client. Changes to the plan affect all levels, from department heads, who have to approve the changes, to the workers, who recieve new technical tasks included in the new work plan.
14.	A constant interest in the site, and monitoring any problems on site, which may not necessarily be our company's, but may also affect the work we do, so that we can predict and prepare for future problems. Moreover, close cooperation with other companies working on the site, whose help is sometimes very valuable. A good relationship with the client or its representative is essential for the success of the project.
15.	In our case, project delays are mostly caused by production processes, machinery breakdowns, or delays in materials supply. Often it is also the lack of competence of PM or works managers, which leads to unforeseen work. Designers' decisions and adjustments can also contribute to project delays. Although such risks are quite difficult to avoid, they should be managed by choosing reliable design companies (with extensive experience in specialised work). To avoid project delays, the competence of managers must be continuously upgraded and mechanisms updated.

Company Z was a general construction contractor engaged in industrial, residential, public, administrative, and cultural heritage construction and reconstruction, offering advanced, innovative, and sustainable construction solutions to the public and private sectors. The company applied advanced certification systems and international building standards—LEED, BREEAM, BIM, and ISO. The company employed more than 230 people. The answers of the Company Z representative are given in Table 11.

Table 11. The answers of the Company Z representative.

Question No.	Summarised Answers to the Questions
1.	First and foremost, the life of a project starts with a successful sales process, which is the responsibility of the commercial department. Later, as the project moves into the execution phase, a construction execution team is appointed. A typical construction execution team consists of a PJM, a construction manager, a project engineer, and foremen. Depending on the scope or complexity of the project, the project team may be larger, as one project may have several construction managers, project engineers, or construction managers who divide the work among themselves. The PJM is responsible for the success of the project and makes decisions and gives approvals to the issues during the project.
2.	Successful and effective PM consists of applying tools, techniques, and management philosophies to achieve the project's objectives. The company's PM uses Building Information Modelling (BIM), which helps to monitor and manage the performance of a building throughout its lifetime, avoiding errors that lead to additional time, cost, and material costs. An intelligent cost forecasting and management software has been im-

	plemented. By assessing the purpose of the building, its materials, and other parameters relevant to the project, it allows accurate forecasting of the project costs, opening up the possibility of optimising costs during the project implementation phases. Dalux software is used to record defects and observations, Trimble is used to disseminate information, and MS Project software is used to draw up the project plan, monitor and update the schedule, and draw up the activation plan. In addition, LEAN PM philosophies are widely used in the PM. Visual aids, such as information and accident prevention posters, and a site plan are displayed next to the project to inform the employees. Five Sigma techniques, which are part of the LEAN PM principles, help to organise and control the work in progress, ensure and increase safety on the construction site, avoid repeating mistakes, and promote progress and continuous improvement. These are some of the PM philosophies, tools, and techniques that are applied in PM on different levels of the project team.
3.	The above tools, methodologies, and PM philosophy help to avoid mistakes, save time, costs, and materials, optimise costs during the project phases, plan and control the project, organise and control the project work, prevent accidents, increase safety on site, and promote continuous progress during the project.
4.	The progress of the project in terms of monitoring human resources, materials, and machinery is carried out in several ways—by applying the Asaichi methodology of the LEAN philosophy, which records the objectives and the results of the previous week. The breakdown by work items and the results are recorded in a table. Tracking software is used to monitor the machinery, which indicates the time the equipment is running and the fuel consumed. The progress is also tracked and recorded on the job board on the construction site, and meetings are organised to discuss the project progress.
5.	The PJM monitors labour costs, material, and machinery plans and facts, forecasts project duration, and tracks financial results to derive the overall project outcome.
6.	Construction managers monitor the project progress daily and take appropriate actions if they see that a project is not on track. The financial performance of the project is monitored every month after the write-offs have been made and the subcontractors' invoices have been approved, and the results are discussed with the project board during the meetings.
7.	The project progress report is presented in an informative manner, with relevant information and results. To facilitate the day-to-day monitoring of the project progress, deviations are highlighted in different colours, with positive deviations in green, minor deviations requiring attention in yellow, and negative positions requiring improvement decisions in red. Material yield and machinery deviations are indicated by arrows comparing the plan with the fact.
8.	There is enough information in the daily project report, and there is room for improvement on the financial side of the project results, as accurate conclusions and assumptions can only be drawn one month after the approval of the payroll, the write-offs of materials and machinery, and the confirmation of subcontractors' invoices. But a more detailed tracking of the financial progress should be relevant for projects that are not on track and that deviate significantly from the targets, as the additional processing of the information would put an additional burden on the responsible parties. In such cases, intermediate actuation and cost write-offs should be made.
9.	Tracking the project progress helps in decision making. For example, if the work is behind the schedule, additional staff is involved in the project; if work is slowing down but it is not possible to speed up the work process, an additional agreement is negotiated with the client to extend the deadlines. If, due to technology changes, some works cannot be completed on time, additional funds are agreed upon with the client; if materials or machinery used for the works carried out in the project exceed the planned resources, the use of materials and machinery is reviewed for proper application.
10.	The progress of the project is discussed at a meeting attended by the construction manager, the works managers, and the contractors. The meeting will discuss current outputs, issues and problems, and measures to improve performance. Usually, the meeting is held once a week, but the frequency may be increased or reduced depending on the project. The discussion ensures the transfer of information within the project.
11.	Project progress information is passed on to the contractors, who share the information with their staff, so the last link in the analysis of the project progress information is the contractor. The project progress reports show the most relevant indicators for the contractors, such as deviations in outputs and materials, highlighted by colours and arrows.

12.	The construction manager and the works manager take appropriate action to ensure that the outputs foreseen in the design are achieved and monitor the progress of the works and take measures where necessary. Deviations are communicated to the contractors by the supervisors or, in the absence of such supervisors in the design, by the construction manager. The PM, the construction manager, and the works manager are involved in monitoring the progress of the projects, and the works manager is involved in implementing changes. The progress of the projects is continuously monitored by the PJM, as he is responsible for the overall success and financial performance of the project.
13.	A project plan is a roadmap to help steer a project in the right direction. If the project is not going according to the plan, additional meetings are organised to solve problems and to clarify the issues that need to be addressed here and now. To know what changes are needed, it is necessary to have a risk plan in place so that problems are identified in advance and possible solutions are known. Depending on the situation, the project change plan may involve different people from the construction manager to the commercial director. If the problems are routine and ordinary, they are dealt with within the project team by the PJM, but if the PJM is unable to make decisions and the problems are extraordinary, then the higher levels, such as the construction director or his deputy, the commercial director, are called in.
14.	The success factors for PM consist of external and internal factors. The external success factors include detailed and correct design decisions and the timely delivery of materials and machinery. We cannot change the external circumstances, but we can control the internal circumstances, such as a prompt reaction to changes in the project, good teamwork, timely decisions, communication, and continuous planning (updating the project schedule and plan).
15	The causes of project delays, like success factors, can be both external and internal. External causes of delays include inconsistencies in designers' drawings, delays in additional solutions, lack of communication with builders, etc. Internal causes of delays include lack of communication, miscommunication, human error, chaotic decisions, lack of skills of the project team, and inappropriate structure of the project team. The external causes of delays cannot be directly influenced, but the internal problems can be solved, and communication is the most important tool to eliminate them. To deliver projects on time, it is necessary to keep the project under constant control, to be aware of the problems and to solve them, and if the problems cannot be solved by the PJM, to raise them to a higher level and take the necessary decisions.

The summary of responses provided in Tables 9–11 reveal that construction PJMs are responsible for managing the entire construction project, from the planning and design to execution and completion. Therefore, they have the power to make decisions that can affect the successes and effectiveness of the project.

Comparing the answers given by the representatives of the different companies, some similarities and differences were identified. These are summarised in Table 12.

Table 12. Comparison of responses of the representatives of Companies X, Y and Z.

Criterion	Company X	Company Y	Company Z
Number of employees	100–200 employees.	Up to 100 employees.	More than 200 employees.
Type of construction activity	Specialised construction work.	Specialised construction work.	A general construction contractor.
Standard project team	PJM, works manager, engineer, works executor, and employees.	PJM, works manager, works executor, and employees.	PJM, building construction manager, construction works manager, project engineer, executors, and employees.
Tools, techniques, methodologies, and philosophies used for PM	Risk management using MS Excel, MS Project, Power BI, and bespoke project progress monitoring software.	Dalux and MS Excel software, and Electronic Construction Work Log.	BIM, Dalux, Trimble, MS Project, MS Excel software, smart cost forecasting, and management software. LEAN PM philosophy tools—5S and Asaichi.

Key indicators on project progress	Man-hours, materials and machinery, and human resources.	Duration of work, wear and tear on materials, and machinery.	Man-hours, materials and machinery, and project duration.
Frequency of monitoring project progress	Indicators for ongoing work projects—every day. Financial indicators—every month.	For small-scale projects—depending on the progress of the project. For medium and larger projects—two to three times a week. Monthly discussion of financial results.	Indicators of work in progress—every day. Financial indicators—every month.
Frequency of project progress discussions with the implementers	If there are no deviations, progress is not discussed with the contractors. For larger projects—daily meetings, up to 30 min.	Undefined for small projects (up to 1 month) and at least once a week for larger projects.	Usually once a week, with building construction manager, the construction works manager, and the contractors attending the meeting.
Areas for improvement in the project progress report	Comparison of direct project costs in the current period with the plan every week.	System optimisation, software upgrades, and installation.	Bi-weekly monitoring of the financial performance of projects not on track.
What changes can be made as a result of project progress monitoring?	Changes to work technology or equipment, negotiating work extensions, negotiating unforeseen work, and terminating contracts.	Changes to work schedules, project staffing levels, and cost estimates for subsequent projects.	The number of workers on the project, the agreement with the client on the extension of deadlines, the agreement on additional funds with the client, and the use of materials and machinery.
Action if the project does not go according to the plan	A project change committee is organised, and the PJM contacts the head of the unit with an estimate of the additional budget needed.	The reasons for deviations are identified, a meeting is held to optimise the work, and the project plan and schedule are updated. If an additional budget is needed for a project, the PJM makes proposals to the project director.	Priority problems are addressed, meetings are organised with the project team, and, in the case of extraordinary problems, heads of departments attend the meetings to help take appropriate decisions.
The following PM success factors were identified	Standardised and user-friendly implementation procedure, detailed project preparation, and PJM's handling of problems and deviations.	Focus on the project, tracking and optimising malfunction, communicating closely with collaborating companies, and maintaining good relations with the client.	External factors—detailed and correct design decisions and timely delivery of materials and machinery. Internal factors—self-sustained communication of the project team, good teamwork, and continuous planning.
Identified reasons for project delays	Inadequate materials, lack of team expertise, inappropriate team structure, and poor project preparation.	Machinery failures, delays in material supply, lack of competence of project teams, and designers' decisions.	External factors include inconsistencies and delays in design solutions and a lack of communication with contractors. Internal factors include chaotic decisions, lack of skills of the project team, and inappropriate structure of the project team.

According to Table 12, the standard project teams varied according to the size of the company. In Company Y, the standard project team consisted of a PJM, a works manager, a works supervisor, and workers, while in Company X, an engineer was added, and in

Company Z, in comparison with Company Y, the standard project team included a construction manager, a project engineer, and several works supervisors. This shows that the companies implemented projects of different sizes. Of course, the composition of a project team may vary for certain projects.

The comparison of companies X, Y, and Z in terms of the tools and techniques used for PM, PM approaches, and philosophies revealed significant differences. General contracting Company Z used six different applications for PM such as Building Information Modeling, an intelligent cost forecasting and management program, Dalux, Trimble, and the MS Project software, and it applied LEAN PM philosophies, which helped it to stay on track with project plans. Company X used four different applications for PM such as a unique software that tracks labour hours and material output based on work carried out, MS Excel, MS Project, and Power BI, but it did not identify the PM methodologies and philosophies used. Company Y employed the least number of tools, only three, which were Dalux, an electronic journal of construction works, and MS Excel, and it did not indicate any specific PM methodologies or philosophies but plans to implement additional PM tools shortly. In the future, various technologies such as machine learning, automation, artificial intelligence, the Internet of Things (IoT), data analytics, drone technologies, and robotics will present exciting opportunities for the workplace and, particularly, for the intelligent management of projects [55]. As project managers play a crucial role in implementing these transformative changes, the profession needs to be agile and adaptable to embrace the emerging wave of digitalisation. By embracing these advancements, project managers can effectively leverage the potential benefits and drive successful project outcomes in this rapidly evolving digital landscape.

Among the three companies (X, Y, and Z), the relevant project progress indicators were similar: monitoring man-hours and deviations in terms of materials and machinery used. Company X also focused on the number of human resources in the project, while Company Y additionally monitored the wear and tear of machinery, and Company Z monitored the duration of projects.

The comparison of the monitoring frequency and discussion of the progress of corporate projects revealed both differences and similarities. The companies participating in the qualitative study discussed financial results in monthly meetings. Companies X and Z monitored the progress of ongoing work projects daily, whereas in Company Y, the progress was monitored depending on the progress or size of the project. The notable differences between the companies could be seen in the discussion of the progress of the projects with the contractors. In Company X, no discussion was organised if the project was implemented according to the plan, except for larger projects, in which case the meetings were held every day. In Company Y, there was no defined periodicity of project progress discussion for small projects, but for larger projects, the meetings were held at least once a week. In Company Z, a meeting was held once a week regardless of the project results. Currently, virtual project teams have the advantage of utilising a wide range of technologies and communication tools to facilitate collaboration, even when team members are geographically dispersed, both domestically and internationally [55]. Tools such as Zoom meetings, Slack, FaceTime, Periscope, video conferences, and chat rooms have become invaluable assets for virtual teams. By harnessing these technologies, project teams can effectively bridge the distance and create seamless communication channels enabling efficient collaboration and coordination regardless of physical location.

The areas for improvement in the project progress reports of companies X and Z were the same, with representatives of both companies stating that they would like to see the financial results more often, while the representative of Company Z said that the company would like to systematise everything and introduce additional software, as there was a lack of supporting tools. The monitoring of project progress in companies X, Y, and Z helped to deal with the changes in project schedules and changes in the number of employees. In addition, the decision to terminate a contract may be taken in Company X. The

general contracting Company Z monitored the sustainable use of materials and machinery to ensure their efficient use and to avoid downtime and keep within the planned quantities of materials. By leveraging the power of data analytics, project managers gain the capability to analyse and dissect intricate project data providing valuable insights and real-time predictions [56]. These analytical reports enable project managers to make informed decisions by drawing upon historical data, allowing them to effectively maintain project schedules and adhere to budgetary constraints [57]. This predictive information empowers project managers to proactively address potential challenges, optimise resource allocation, and ensure successful project outcomes.

The companies participating in the qualitative study had different perceptions of the project change plan. Company X organised a project change committee, where problems were identified and solved, while in Company Y, the causes of deviations were first identified, and then a meeting was organised to optimise the project plan, and finally, in Company Z, project changes were solved by the project team with the participation of department managers in meetings if extraordinary problems were encountered.

Successful PM in Company X consisted of a standardised implementation procedure, priority attention to the pre-project phase, and responsiveness of PJMs to problems and deviations. In Company Y, the focus was placed on the project, the optimisation of bottlenecks, and close communication with the customer. Company Z distinguished internal and external success factors in PM. The external success factors were detailed, and correct project decisions and the internal success factors involved timely communication of the project teams and constant planning. To enhance the PM success and improve the overall project results, continuous development of competencies and improvement of management methodologies are highly significant [30]. The authors of [58] examined organisation and management processes, empirically focusing on ontological and epistemological issues related to process research. They present effective methodological strategies for conducting empirical process studies and highlight some unique forms of insight that process research can provide.

It can be argued that the reasons for project delays identified by the companies in the qualitative study were similar. A lack of staff competence, inadequate project team structure, delays in material and machinery supply, breakdowns, and inconsistencies in design solutions were the main reasons for not meeting project deadlines. Leveraging Building Information Modeling and other simulation technologies can result in reduced project delivery time and enhanced cost management, ensuring projects stay within the allocated budget [59]. By utilising these advanced tools, project teams can optimise project planning, streamline coordination among stakeholders, and identify potential issues before they arise. This proactive approach facilitates efficient decision-making, mitigates risks, and improves overall project performance, leading to timely project completion and adherence to budgetary constraints. According to the authors of [60], incorporating design thinking into PM education is necessary to produce more effective PJMs and reduce the occurrence of project failures in the future.

4.4. Sustainability Aspect in Project Management for Future Studies

Construction projects have a significant impact on the environment and the society; therefore, construction project management and sustainability are strongly linked. This means that sustainability in construction project management requires the consideration of the environmental, social, and economic impact of a project throughout its life cycle. A variety of project management methodologies must be used to ensure that the desired sustainability outcomes are achieved. According to the authors of [61], integrating sustainability concepts into construction processes at both the strategic and operational levels has a profound impact on employees, the community, and the environment. Not only does this incorporation of sustainable practices benefit the well-being of employees, it also contributes to the enhancement of the community and the preservation of the environment. By prioritising sustainability in construction, organisations can drive positive

changes and promote a more responsible and environmentally conscious approach to their operations. Embracing sustainable development enables project managers to shift their focus towards various aspects such as value creation, performance enhancement, efficiency improvement, business agility, project excellence, operational quality, paradigm shifts in thinking, flexibility, and more. New questionnaires can be designed based on the sustainable factors that include environmental, social, and economic impacts.

Future studies should also be linked with sustainability in construction PM through energy-efficient building development. One of the things which sustainability in construction PM could adopt is green building practices. These practices involve designing and constructing energy-efficient buildings using renewable resources and minimising waste. Green buildings are designed to reduce the carbon footprint of the building and ensure that the building operates efficiently throughout its life cycle. Given the increasing environmental concerns, reverse logistics also plays a crucial role in promoting sustainability within the construction industry. According to the authors of [62], reverse logistics has the potential to address and mitigate some of the adverse environmental impacts associated with construction activities, but its implementation level in the construction industry is still low. The root barriers to adopting reverse logistics in construction are as follows: the lack of financial incentives to incorporate recycled materials, the lack of knowledge about RL, the lack of technical support, standard codes, and regulations in favour of using recycled materials, the lack of information sharing, cooperation, and coordination among entities of the supply chain, the fact that current buildings have not been designed for deconstruction, and the lack of construction and demolition waste management and recycling infrastructures and markets for the materials resulting from construction and demolition waste.

In the case of PJMs, they have a critical role to play in promoting sustainability in the future. PJMs could also adopt sustainable procurement practices to ensure that the materials used in a construction project are sustainable. Sustainable procurement involves selecting materials that are environmentally friendly, socially responsible, and economically viable. Sustainable procurement practices can reduce the carbon footprint of a construction project, improve working conditions for workers, and support the local economy. In addition, they could promote sustainability through waste reduction and management. Waste reduction involves minimising the amount of waste generated during a construction project, while waste management involves the responsible disposal of waste. By adopting these practices, construction PJMs can minimise the environmental impact of a construction project. According to the authors of [63], inadequate stakeholder engagement, ineffective scope management, subpar schedule management, and insufficient resource management have detrimental effects on project sustainability over time. Moreover, these factors adversely impact employee wellbeing, resulting in decreased productivity, and they undermine the effectiveness of organisational management. The authors of [64] in their study indicated that obstacles such as 'insufficient sub-contractor cooperation,' 'resistance to changes in existing company structure and policy,' and 'the need for additional employee training' pose significant barriers to the successful implementation of environmental management systems in the construction industry. These identified barriers highlight that the primary challenge faced by construction professionals regarding environmental management systems implementation revolves around the level of emphasis placed on effectively communicating environmental concerns.

5. Conclusions

Based on the research conducted, the following conclusions were drawn:

1. The respondents identified the PRINCE2 project management approach as the most suitable for managing a repetitive construction project. According to the PRINCE2 project management methodology, a repetitive construction project would aim to provide as much information as possible to the project participants, to form a team

and assign team leaders responsible for the phases, to establish a financial plan, a detailed timetable for the execution of the works, a quality control plan, and a plan of responsible persons, and to detail the technological sequencing of the works.

2. The rational project management approach PRINCE2 should be integrated into the management of a project under study by applying the seven principles, seven themes, and seven processes. Regular project meetings with the project board should be organised, information and plans should be prepared according to the principles and themes of the project management methodology, the project manager should appoint the persons responsible for the execution of the work, quality, and material control, and the phases should be analysed responsibly with the project board. Before the works are handed over to the client, the project manager should carry out a quality control check, and the project board should control the communication between the project manager and the project team. In the project closure process, a learning-from-experience re-list should be completed, and the project results should be summarised and evaluated.
3. The analysis of the anti-corrosion works project under the PRINCE2 methodology suggested the following areas for improvement: checking the project quantities and describing the technological process before the start of the project to eliminate the risks associated with project delays; periodic control of the quality of the intermediate, understanding of quality requirements, and ensuring that work is carried out to a high standard; clarifying responsibilities and tasks in the teams before the start of the project; breaking the project down into phases to increase control over certain operations (such as the first coat of paint); and preparing a detailed project plan to avoid unforeseen activities (such as an additional cover of the steel structures).
4. The results of the qualitative research and the comparison of the participating companies revealed the following key similarities in project management: monitoring of relevant project progress indicators, project changes based on the project progress report, and the monitoring of project delays. Meanwhile, the main differences in project management among the surveyed companies were the project team size, the tools and methodologies used for project management, the project management philosophy, and the frequency of monitoring and discussing project progress.
5. According to the studied companies, a successful project management should consist of a standardised implementation procedure, priority attention to the pre-project phase and responsiveness of project managers to problems and deviations, focus on the project, optimisation of mistakes and close communication with the customer, detailed and correct project decisions, timely communication of the project teams, and constant planning. Meanwhile, the reasons for project delays were mainly related to the lack of staff competence, inadequate project team structure, delays in materials and machinery supply, breakdowns, and inconsistencies in design solutions.
6. Sustainable construction projects can minimise a project's environmental impact, improve working conditions, and support the local economy by adopting green building practices, sustainable procurement practices, and waste reduction and management practices. By prioritising sustainability development in construction, project managers can shift their focus towards various aspects such as value creation, performance enhancement, efficiency improvement, business agility, project excellence, operational quality, paradigm shifts in thinking, flexibility, and more. Future studies should also be linked with sustainability in construction project management through energy-efficient building development. One of the things which sustainability in construction project management could adopt is green building practices.

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