PROJECT MONITORING BASED ON VIEW OF ALL PROJECT PARTNERS AT DIGITAL PROJECT MANAGEMENT PLATFORMS

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Abstract: In the dynamic landscape of digital project management, effective project monitoring is critical for successful project outcomes. The emergence of digital project management platforms has revolutionized the way projects are monitored, enabling real-time collaboration and data-driven decision-making. Periodic site visits and gathering input from all project stakeholders are crucial for ensuring clear understanding of project progress by states institutional. With digital project management systems, on-site progress should be monitored in real-time and inclusive of all project stakeholders. The research investigates how collaborative monitoring fosters project progress of transparency and active engagement among project partners. By providing real-time visibility into project progress, tasks, and milestones, these platforms empower stakeholders with up-to-date information, enabling agile decision-making and prompt risk mitigation. This study explores how digital project management platforms integrate site monitoring evaluations and reporting tools, providing valuable data-driven insights into project performance. By considering periodic analytics, project partners can improve resource allocation, decision making process against possible bottlenecks at construction stages and boost productivity and inform states institutional to monitor project progress closely. Furthermore, the research examines the influence of these platforms on communication dynamics, promoting communication and efficient information exchange among project partners. Such enhanced communication capabilities result in improved team cohesion and collaboration, driving the project forward with synchronized efforts. In this study, the focus lies on tracking the progress of contractual agreements through digital platforms, enabling all stakeholders to monitor advancements. Specifically, the investigation centers on how the designated contractor responsible for project execution and the consulting firm appointed by the project owner can effectively track project progress on a periodic basis using digital platforms. In the context of transportation projects in Türkiye, a digital project tracking system has been developed for the Ministry of Transport and Infrastructure, through which data obtained from on-site visits and consultant opinions regarding project advancements are shared with the Ministry. Subsequently, the responsible contracting authority, guided by the consultant's feedback, can respond and evaluate progress accordingly. This approach ensures that project advancements are accurately monitored by all stakeholders of the project. To do so, this study investigates the utilization of the prepared digital platform to facilitate rapid and precise contract monitoring by all project stakeholders, encompassing the opening information and assessment evaluations based on stakeholders' perspectives.

Keywords: Project management, Project monitoring, Digital project management

1. Introduction

The project management process is a structured and systematic approach to planning, executing, and closing projects, made possible by the coordinated efforts of diverse project partners. The process commences with project initiation, where objectives, scope, and stakeholders are defined. Traditional project management process composes of simply consultants, owners, and contractors. Effective collaboration and communication of them are essential in the project process. Consultants play a crucial role at the project initiation stage, conducting feasibility studies, defining project scopes, and providing expert guidance on the project's strategic direction. Consultants' technical guidance and insights contribute to the project's success

and quality. Owners, as project sponsors, provide the vision and resources required to drive the project forward. Their involvement throughout the project lifecycle, from inception to closure, ensures that the project aligns with strategic goals and meets expectations. If public projects' construction process is taken into account, the owner, as an institution, serves as the driving force and ultimate decision-maker in the project management process. Their clear vision, effective resource allocation, and active engagement are vital in ensuring the project's success and aligning it with the institution's strategic objectives. Once the project is greenlit, constructors step in, taking charge of construction activities. They work closely with architects and engineers to ensure the design is translated into

reality while adhering to quality and safety standards. Throughout this dynamic process, effective communication and collaboration among all partners are vital to address challenges, make informed decisions, and meet project milestones. Ultimately, successful project management hinges on the collective efforts of these partners, harmoniously working together to bring projects to fruition on time, within budget, and to the highest standards of excellence.

While these project management processes suit projects with clear requirements and predictable outcomes, they may lack the flexibility to address complex and rapidly changing endeavors. Close contact with project partners is essential during the project duration, especially in the face of unexpected conditions or challenges. Maintaining open and effective communication with all stakeholders, including consultants, contractors, suppliers, and the project owner, allows for prompt identification and response to unforeseen issues. When unexpected conditions arise, such as changes in project scope, unforeseen risks, or resource constraints, close contact ensures that relevant parties are informed promptly. This enables collaborative problem-solving, where partners can collectively assess the situation, brainstorm solutions, and make informed decisions to adapt to the changing circumstances. Regular updates and close coordination foster a sense of teamwork, enhancing the project partners' ability to work cohesively and proactively address any obstacles that may arise. By staying in close contact, project partners can swiftly adjust project plans, reallocate resources, and modify strategies to keep the project on track and achieve successful outcomes despite unexpected challenges. Consequently, more adaptive and iterative methodologies have emerged, prioritizing collaboration, adaptability, and customer feedback to better handle dynamic and uncertain project environments.

In today's rapidly evolving technological landscape, the digital project management process has emerged as a paramount strategy to ensure the successful execution of complex endeavors. Integrating cutting-edge digital tools and methodologies, this dynamic process fosters streamlined workflows, enhanced communication, and unparalleled project visibility. At its core, the digital project management process revolves around a series of carefully orchestrated stages, each playing a pivotal role in achieving project objectives. Furthermore, recognizing the significance of collaborative partnerships, this process involves diverse stakeholders working harmoniously to navigate challenges and capitalize on opportunities.

1.1. Studies Related to Digital Project Management

Partnering is considered a vital project management strategy for enhancing project performance by fostering better working relationships (Bennett and Jayes, 1995; Egan, 1998; Bayliss, 2002). In the past ten years, the practice of partnering in construction has significantly enhanced the working relationships between clients and contractors. This approach aims to shift the traditionally adversarial construction culture to one grounded in trust and transparency. To achieve these goals, various partnering tools have been developed, such as workshops, review meetings, team-building exercises, incentives, and social functions. The primary purpose of these tools is to align the objectives of the contracting parties towards a common goal, fostering a more cooperative and effective project team (Bennett and Jayes, 1995). A few research have shown the most important requirements for a successful partnership. These requirements include dedication, confidence, sincerity, common objectives, collaborative tools and processes, participation of appropriate stakeholders, leadership, and continual assessment (Black et al., 2000; Ng et al, 2002). Others look at partnership applications, particularly the use of partnering to eliminate disagreements and foster a more cooperative working atmosphere (Bresnen and Marshall, 2010; Li and Cheng, 2000). There is also a wealth of literature that examines the critical factors of successful partnering (Bennett and Jayes, 1995).

The idea of partnership is now widely seen as a great way to build relationships between organizations in public sector management (Friend, 2006). This arises from the traditional belief that government agencies should collaborate with other governmental bodies, non-profit organizations, or businesses to improve service and goods delivery while optimizing resource utilization. Although the value of collaborative approaches is widely acknowledged, partnerships have a potential to be fail in practice (Jacobson and Choi,2008). Therefore, complexity and ambiguity in defining and measuring project success have been acknowledged as a problem since awareness of success criteria has developed (Jugdev and Muller,2006). Although project management success and deliverable success are not entirely dependent on each other, unsuccessful project management can undermine the success of the deliverables. Therefore, the project and its resulting products cannot be viewed in isolation (Varajao et al, 2021).

With the development of information technologies, the use of software tools in the evaluation project success has increased (Petter and Vaishnavi, 2008). These advancements have made project monitoring more precise and efficient, allowing for real-time tracking and analysis of various project metrics. The success of a project is now more quantifiable, as stakeholders can easily monitor activities, milestones, and progress through sophisticated software solutions. This enhanced visibility ensures that any potential issues are identified and addressed promptly, leading to more informed decision-making and better resource allocation. Consequently, project stakeholders can collaborate more effectively, ensuring that the project's goals are met and that the deliverables are of the highest quality. The integration of information technology in project management has thus become indispensable for achieving and maintaining project success.

In project management, working together with partners is essential for success, but there can be difficulties that slow down the project's progress. With the help of information technologies, technological tools allow project partners to fully understand the detailed complexities of the project's timeline (Fernandes et al, 2021). By using platforms like project management software, communication tools, and task trackers, partners can see project schedules, task assignments, resource distribution, and overall progress in real-time (Marnewick and Marnewick, 2022).

The advancement of Artificial Intelligence (AI) has created new opportunities for the construction industry. It has the potential to increase annual productivity growth from 0.8% to 1.4%, and by 2030, the global construction market is expected to expand by 85%, reaching a value of USD 15.5 trillion (Regona et al, 2022). AI technologies such as automation, machine learning, and predictive analytics can significantly revolutionize the construction sector by enhancing project efficiency, reducing waste, and optimizing resource management. AI technologies, including automation, machine learning, and predictive analytics, have the potential to completely transform the construction industry by increasing project efficiency, cutting waste, and improving resource allocation (Darko et al, 2020).

This transparency helps prevent delays by enabling quick decision-making, identifying challenges early, and efficiently allocating resources (Tam et al,2020). AI also facilitates access to online training materials, enhancing skills and accelerating project completion (Pan and Zhang, 2021). Building Information Modeling (BIM), a 3D model-based approach, provides valuable insights for planning, designing, constructing, and managing infrastructure in engineering, construction, and architecture (Regona et al, 2022). The industry is exploring machine learning techniques to identify and resolve conflicts among various design models during the planning phase, thereby minimizing rework (Blanco et al, 2018). Additionally, machine learning generates optimized 3D models of plumbing, electrical, and mechanical systems to ensure they integrate seamlessly with the structural design. Nevertheless, the construction industry lacks adequate cybersecurity awareness, which makes it highly vulnerable to cyberattacks that can result in project delays, financial setbacks, and other serious negative impacts (Parks,2021). Although cybersecurity standards specific to the construction industry have not been established, many countries are addressing these challenges by adopting existing frameworks such as the National Institute of Standards and Technology (NIST), General Data Protection Regulation (GDPR), ISO/IEC 27000, and Center for Internet Security (CIS) Controls. These frameworks provide structured approaches for managing cybersecurity risks and mitigating potential threats (Yao and Sato, 2024). Throughout the project, clients or end-users stay involved, giving feedback and approving deliverables. This client-centered approach,

supported by digital tools, ensures the project meets expectations and reduces misunderstandings. Additionally, stakeholders from regulatory bodies or other organizations may join to ensure compliance with industry standards, emphasizing the need for a clear and accessible view of the project's timeline and details (Sallinen et al,2011). In this complex network of partnerships, each participant's role is crucial, working together to ensure the project's success. Digital tools used in modern project management enhance this collaborative environment, minimizing bottlenecks that could delay the project and keeping it streamlined and responsive to the demands of today's projects.

2. Materials and Methods

In Türkiye, there are 14 institutions under the Ministry of Transportation and Infrastructure. Under the auspices of the Ministry of Transportation and Infrastructure, there are approximately 3000 contracts in progress, overseen by these institutions that provide services in all sectors such as highways and railways. The activities carried out by the institutions affiliated with the ministry are regularly monitored and informed by the central units of the ministry throughout the process. The Ministry of Transport and Infrastructure has been followed the projects of its responsibility as shown in Figure 1.

All developments in the project are reported by the consultant and the contractor to the responsible Minister's members to control and approve the developments in field. These developments are detail-reported to the region and Minister Head Departments to follow the field's cost and physical performance progress. In traditional project management methods, all these information transfer about project progress is done not only via mail or in word/excel type of documents. It has become necessary in the digitalized world to monitor many planned, ongoing and completed infrastructure projects, especially with today's technologies. To implement new technologies in infrastructure projects and increase the project management knowledge within the changes in the digital world, digital project management system (DPMS) has been implemented by the Minister of Transportation and Infrastructure in Türkiye since 2020. Within this system, the Ministry is able to have close knowledge about ongoing projects and can monitor significant projects for the country's future through one system, involving all stakeholders.

DPMS provides an efficient and user-friendly platform by digitizing the data of ongoing transportation projects. DPMS not only provides an excellent monitoring environment for conditions, costs and general activities which apply to the transportation projects, it also allows users to view geographical based information such as locations and the routes of the linear transportation webs. This comprehensive system also lets users see upcoming and past ceremonies for completed transportation lines.

2.1. Ecosystem of DPMS

DPMS is a system in which all project stakeholders are

involved, so contractors and consultancy firms have been a part of the system. System data entry is expected from consultancy firms. If there is no consultancy firm on project, Minister's members are duty to give data to system. They must periodically enter data related to performance (physical and cost progress) planning, reports, and photos.

The Institutions of Ministry do sustainability of the system. The data entrance process of the system depends on the hierarchy of the institution and if the institution

coordinator approves the entered data, system will launch the information. This helps control the data and allows it to be corrected in case of a possible error, before it is reported to the Ministry. When each data entry process is completed, information is provided from the system as mail or pop-ups for the approval and control of the relevant units. This data-driven system can be easily connected from anywhere with internet access. Figure 2. represents the data-driven DPMS working principles between all stakeholders.
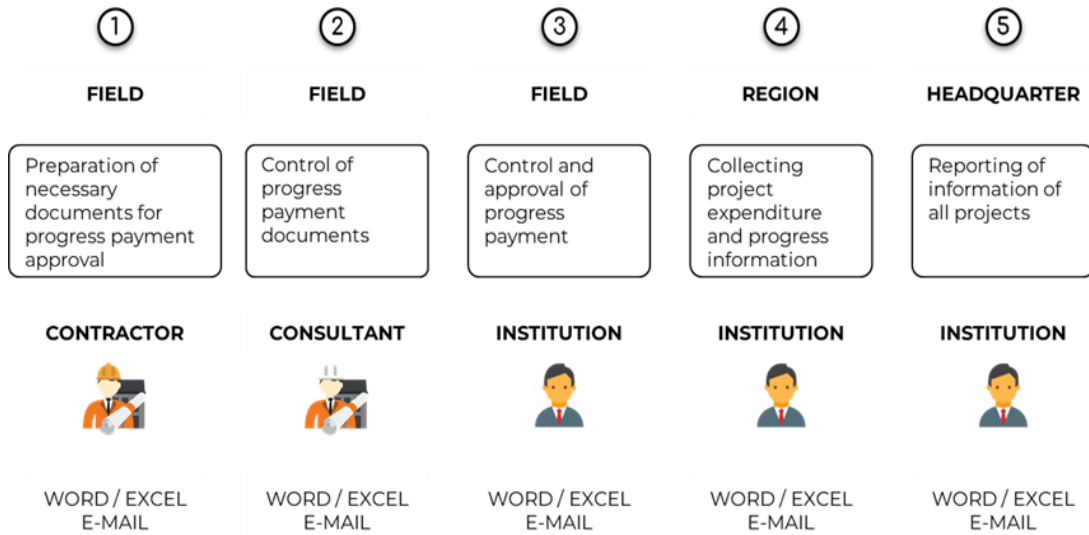

Figure 1. Change of organizational relations - project reporting process-traditional methodology.
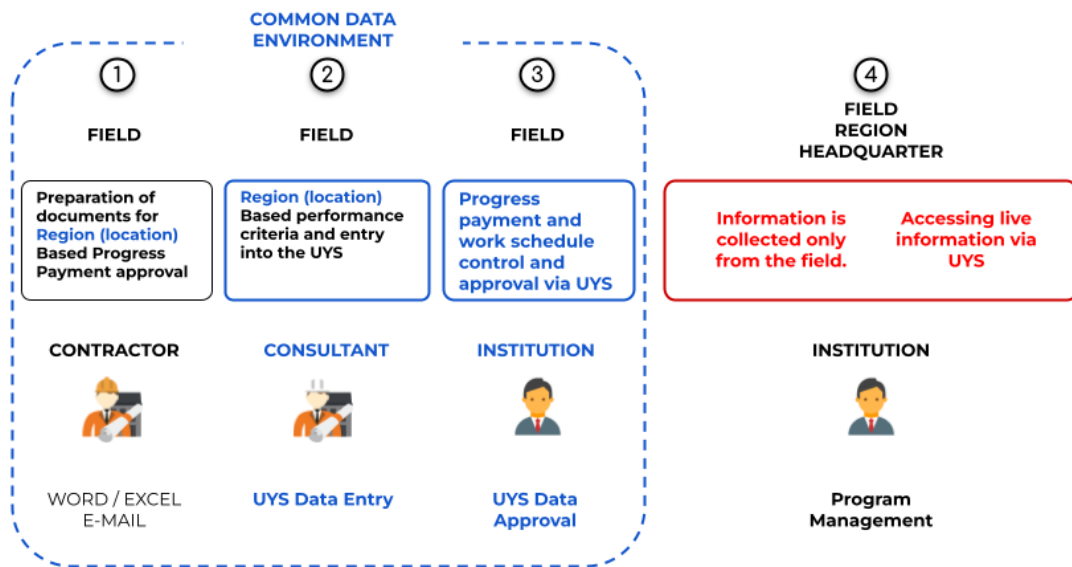

Figure 2. Change of organizational relations of project monitoring process with DPMS methodology.

2.2. Workflow of Project Monitoring at DPMS

All project stakeholders periodically monitor the progress status of the project through the DPMS using the Opening Evaluation module. The tasks assigned by the Ministry for tracking target and vision projects are linked with other modules in the project management system, containing geographical information and contract details, for the works visited during field visits

by the consulting firm. This way helps to see contract routes and construction progress statuses and ensure the monitoring of critical activity follow-ups. The project evaluation process is conducted through the DPMS platform in a transparent and understandable manner for all stakeholders. As shown in Figure 3., the administration first requests input from the consultant and then, based on the consultant's feedback, seeks a

response from the contractor. All parties are given a 15-day period to provide their responses. During this time, evaluations can be documented in the system with accompanying reports and relevant visuals. The request can remain open at the discretion of the administration, or they may require periodic responses at specified intervals.

Evaluation processes begin with creating the "Evaluation Card" and linking the related contract that took part in the DPMS database. After completing this step in the system, an immediate notification will be sent to the issued contacts to inform that an evaluation process has been begun. After completing the further tasks aforementioned, all data and documents will be uploaded to the system. After confirming the uploaded data, completed and checked out, another notification will be sent as previously done.

The Ministry of Transportation and Infrastructure has the leading role for the main purpose of the evaluation module. Always in charge of both the evaluations of consultants and the institutions which operate the projects on site. On behalf of the consultants on duty, the ministry becomes more capable of taking control over these comprehensive projects. Sharing the duty of project management with the consultants, the ministry utilizes the projects more effectively, hand on and objectively which will be served to the public for many years. So the evaluation module gathers opinions of each party in its body for more purposeful data collection. Briefly it gets easier to direct the projects run by institutions under the roof of the ministry.

The ministry serves as the central control unit for projects because ministry is required to manage the process not only on-site but also remotely due to the instructions and responsibilities it provides. Therefore, it should be emphasized that the consultant is responsible for fulfilling field visit and inspection tasks and providing an impartial evaluation of the process based on the instructions and responsibilities given. Since the process is also monitored by the Ministry through the relevant/responsible institution, input from the responsible unit's perspectives and evaluations is necessary, not just relying on the consultant's opinion. The system brings all these partner of the projects together. The observations made by the consulting firm during field visits, the findings generated based on the data collected, and the recommendations for the progress of the work are entered into the system. In line with this, the prepared reports and field visuals are also included in the system. Hence, after conveying and obtaining approval of the consultant's opinions to the Ministry, they are sent to the institution after the consultant approval process to provide information on the consultant's opinions and the status of relevant contracts. Each evaluation will be visible to the institution and with respect to that application, opinions of each party will be reviewed objectively by the ministry. Also this system allows institutions to be more aware of the improvement

of the contracts issued to themselves due to received notifications by other parties. Above all, project management becomes more open, accessible and objective. Notifications are sent to users defined in the system regarding the uploading and approval processes of projects within the system. These notifications can be sent both via e-mail and SMS. The processes with stakeholders and notifications made through the system are carried out as shown in the workflow in Figure 3.

2.2. Data Entering Process of Opening Evaluation Module at DPMS

DPMS incorporates a good deal of categories and modules of categories which connects the collected information between its database. Opening Evaluation, one of the principal services provided by the system, is a module that is designed for tracking the facility openings of the most essential transportation lines marked by the ministry based on the targeted service year.

By using preset geometries of the projects which are linked to their subcontracts, the "Project Openings Module" provides necessary information under a specific layer of the main interface.

The system frequently employs various colors, shapes, and legends on the main interface map, which change according to the selected layers. Data for this specific submodule is gathered through onsite visits and engineering evaluations based on common planning and cost control disciplines. The Ministry has a dominant leading role in the projects it operates, but many other participants are involved, such as sector-specific agencies, contractors, and subcontractors. Creating objective and well-provided information requires the involvement of all parties. The Investment Planning Monitoring and Program Management project has been providing consultancy services to the ministry since 2020, making the transportation management system available to the institutions in charge. This consultancy organization, operated by the ministry, acts as a catalyst between the ministry and its associated agencies at a whole new level. As a result, this consultancy project becomes the right hand of the ministry, offering on-site and digital project management for all parties. In the Project Openings module, linked to its main module named "Request Tracking Module," consultants start the engineering evaluation for the projects by first visiting the site and documenting the results and visuals from the construction site. Using this submodule's database, consultants request a report with similar criteria from the related party. Projects are reviewed based on the current phase of the project in terms of costs, physical improvement, and assets, the planned date of the facility opening and its comparison with the targeted date determined by the ministry, and evaluating whether the project is reaching the target year. Finally, selecting the appropriate label for this evaluation in the system, such as "Opening is available," "Opening is not available," and "Partial or Conditional Opening is Available," is necessary for the map view.
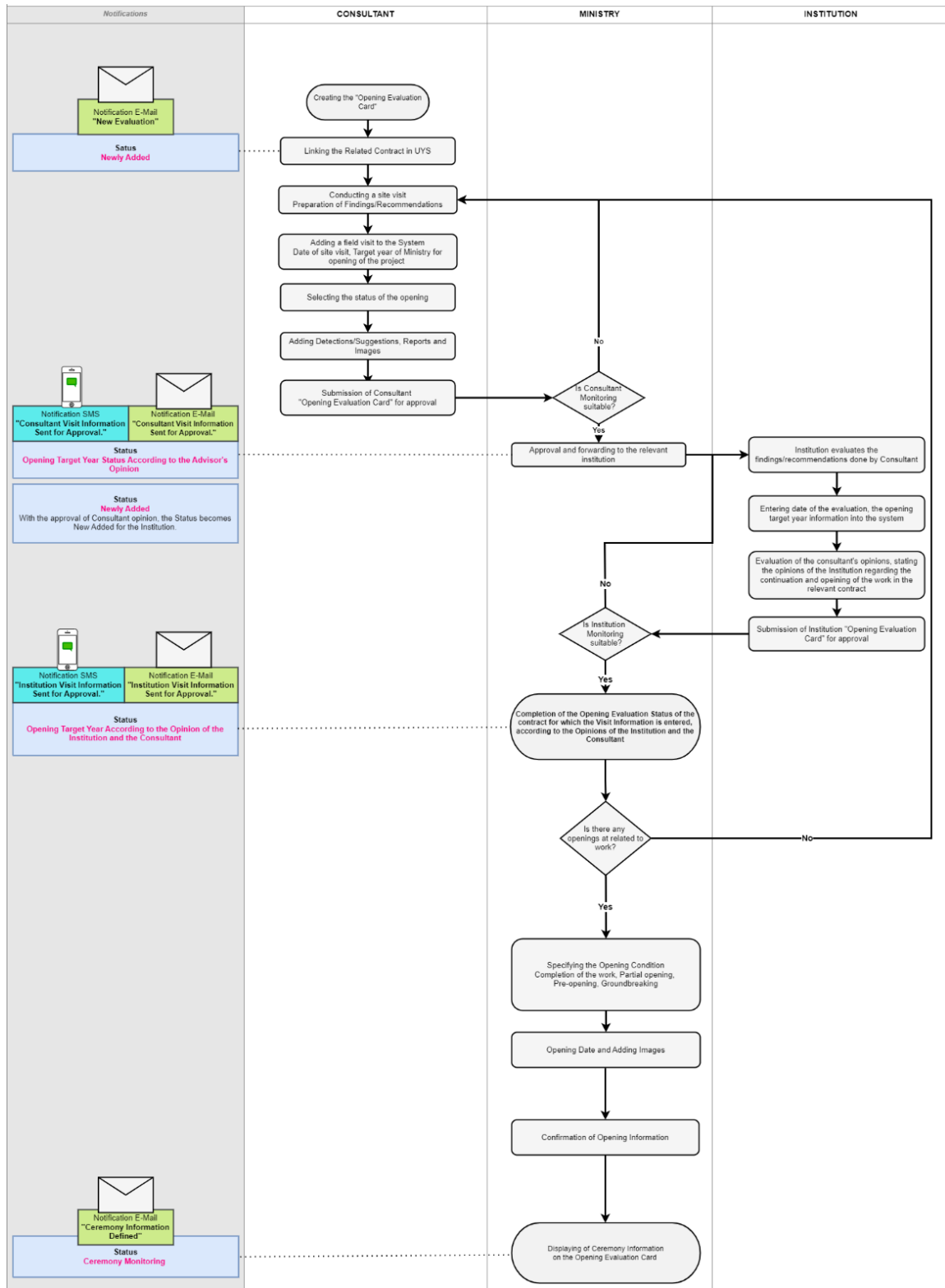
Figure 3. Project openings workflow.

This module is mainly created for examining ongoing projects, but some contracts are detected as completed, or the information obtained by the parties in charge may differ from what is previously known. Such data must also be transferred into the system. In this case, DPMS provides the necessary section under this submodule as a whole new layer tagging the projects under the title of "Ceremonies." These ceremonies typically include laying the foundation ceremony, final face ceremony (often used for tunneling), partial or sectional opening ceremony, and individual opening ceremony. A similar color code is used to define the openings and reviews from executors, but a non-circular shape with a black frame is preferred for identifying openings. Different scenarios are shown with respect to all stakeholders in the Figure 4. The inner circle reflects the consultant's

reviews, while the outer circle shows the institution's opinion. Both openings that have occurred in the project timeline and recent evaluations that have been confirmed will be visible. When a project is completely finished, the

latest unpublished review will be labeled as "Opening is Available" due to its finalized state "Individual Opening" right after the ceremony. This setting for the latest review will also be green.
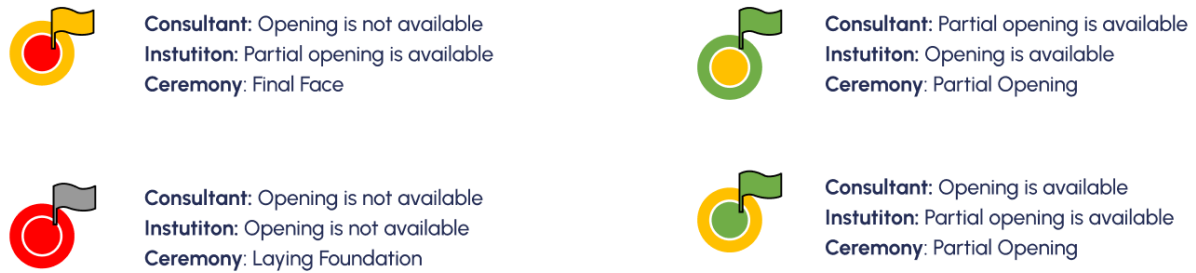

Consultant: Opening is not available
Instutiton: Partial opening is available
Ceremony: Final Face

Consultant: Partial opening is available
Instutiton: Opening is available
Ceremony: Partial Opening

Consultant: Opening is not available
Instutiton: Opening is not available
Ceremony: Laying Foundation

Consultant: Opening is available
Instutiton: Partial opening is available
Ceremony: Partial Opening

Figure 4. Icon combinations on the map view of the evaluation module when an evaluation and a ceremony are added to the linked contract.

3. Results and Discussion

Projects which have been evaluated and ceremony information added will be shown into the "Evaluation card" of the associated contract. DPMS is mainly based on the contracts which summarize projects under the ongoing disciplines. So tying up the related issue with the corresponding contract is crucial.

This point of view is achieved by the examination of ongoing projects as well as the projects executed in the past and it's named as "Project Tree'' by the consultant and the ministry.

Although many infrastructure projects can be defined by few disciplines such as highway projects, some of the larger scaled projects become more and more complicated during the execution. Having numerous new applications that require brand new contracts became the most unwanted problem of project management for the ministry in recent years. The Department of Strategy and Budget follows an alphanumeric identification system containing information of year of the funded project and numbers sorted by previous applications to keep all expenses and funds in track. Congregating similar contracts under similar issues keeps even the smallest data in track since the amount of the expenses might get too many to follow. But this type of application is not compatible with the Transportation Management System. So DPMS has its own way of collecting data of the contracts which is a project tree containing the related subcontracts by their unique ID numbers given. An Evaluation Card which is linked to a specific contract contains two sections. First, a timeline view demonstrating the evaluations and ceremonies second, segments including detailed information such as texts, attached documents and visuals.

Evaluation processes begin with creating the "Evaluation Card" and linking the related contract that took part in the DPMS database. After completing this step in the system, an immediate notification will be sent to the issued contacts to inform that an evaluation process has been begun. After completing the further tasks

aforementioned, all data and documents will be uploaded to the system. After confirming the uploaded data, completed and checked out another notification will be sent as previously done.

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3.1. Potential Drawbacks and Bottlenecks

Despite the clear benefits, several potential problems and challenges could hinder the effective use of digital project management systems. Relying on real-time data entry means all team members need to consistently provide accurate information. Mistakes or delays in data entry can lead to wrong decisions and project delays. Setting up a digital platform requires a lot of technical infrastructure and expertise. Technical issues, like software bugs, network problems, or difficulties in integrating with existing systems, can disrupt project monitoring and management. It's crucial to ensure that all users are well-trained and comfortable with the digital platform. Resistance to change or lack of technical skills among users can slow down adoption and reduce the system's effectiveness. Managing sensitive project data digitally raises concerns about data security and privacy. Robust cybersecurity measures and compliance with data protection regulations are vital to prevent data breaches and unauthorized access. Integrating the digital project management platform with other tools and systems used by different stakeholders can be

challenging. Lack of compatibility can lead to isolated data and hinder smooth communication and collaboration. Using digital platforms effectively requires a significant initial investment in technology and ongoing maintenance costs. Budget constraints and resource allocation issues may pose challenges, especially for smaller organizations. Lastly, while digital platforms can enhance communication, ensuring active and consistent engagement from all stakeholders can be difficult. Variations in commitment levels and responsiveness can impact the overall effectiveness of the project management process.

4. Conclusion

This study highlights the significant role that digital project management platforms play in enhancing project monitoring and collaboration among all stakeholders. By integrating real-time data, these platforms provide up-to-date visibility into project progress, facilitating agile decision-making and prompt risk mitigation. The research demonstrates how collaborative monitoring, supported by digital tools, fosters transparency and active engagement, which are critical for the successful execution of complex projects.

The implementation of the Digital Project Management System (DPMS) by the Ministry of Transportation and Infrastructure in Türkiye serves as a robust example of how digital solutions can transform traditional project management approaches. The system's ability to incorporate real-time data entry, evaluation processes, and geographical information significantly improves project tracking and evaluation. By bringing together contractors, consultants, and ministry officials into a cohesive digital ecosystem, the DPMS enhances communication, ensures accurate monitoring, and promotes effective decision-making. Moreover, the study underscores the importance of periodic site visits and the incorporation of feedback from all project partners in achieving accurate and comprehensive project evaluations. The findings suggest that the integration of digital tools not only streamlines project management processes but also aligns with the strategic objectives of public institutions, ensuring that projects are completed on time, within budget, and to the highest standards. Overall, the adoption of digital project management platforms represents a paradigm shift in project management practices, offering a more efficient, transparent, and collaborative approach to managing large-scale infrastructure projects. Future research should focus on exploring the long-term impacts of these digital tools on project outcomes and the potential for further innovation in this field.

Author Contributions

The percentage of the authors' contributions are below. All authors reviewed and approved the final version of the manuscript.

	H.İ.	E.C.S.
C	60	40
D	60	40
S	60	40
DCP	60	40
DAI	60	40
L	60	40
W	60	40
CR	60	40
SR	60	40

C=Concept, D= design, S= supervision, DCP= data collection, and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision.

Conflict of Interest

The authors declared that there is no conflict of interest.

Ethical Consideration

Ethics committee approval was not required for this study because of there was no study on animals or humans.

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