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THE EFFECTIVE PROJECT MANAGEMENT APPROACH TOWARDS MINIMISING ENVIRONMENTAL IMPACTS IN THE CONSTRUCTION INDUSTRY

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ABSTRACT

One factor in a nation's successful economic growth and social well-being is the construction industry. Regrettably, the construction industry is also associated with a range of environmental impacts, including air pollution, noise pollution, soil contamination, and other related problems. The construction activities will have a detrimental environmental effect, significantly impacting the comfort and quality of life of individuals, particularly in urban regions like Klang Valley, Malaysia, where the pace of development is very rapid. However, project management approaches in construction projects can efficiently reduce adverse environmental impacts. Nevertheless, the adoption of project management approaches in construction projects, particularly in medium to small scale ones, remains significantly low. Although the use of project management has numerous advantages, it also presents significant hurdles for construction professionals in efficiently incorporating it into their professions,

particularly in Klang Valley. Therefore, this research study aims to assess the level of comprehension among construction industry players in the Klang Valley regarding the environmental impact of construction activities. It also seeks to identify the challenges they face in implementing effective project management in construction projects and determine the most efficient approach to implement project management from the pre-construction stage to the post-construction stage, with the goal of minimising environmental impacts. Interviews were conducted with seven experienced experts who specialise in diverse construction projects. The findings indicated that they are aware of the advantages, but they faced major hurdles in putting those advantages into action. Despite their awareness of the advantages, they were unable to successfully implement them.

Keywords: Project Management Approach, Effective, Environmental Impacts, Challenges, Construction Industry

INTRODUCTION

The construction industry plays a crucial role due to the increased need for buildings and other amenities associated with rapid economic growth. The construction industry provides the essential living circumstances necessary for the sustenance and development of human life on Earth. Due to a growing population, environmental strain, and expanding economic activity, there is a significant demand for construction projects, resulting in increased activity in many countries. Moreover, these efforts and projects strive to encourage sustainable economic growth and cultivate robust economic linkages. Dehdasht et al. (2022) conducted a study that reveals Malaysia's construction industry has witnessed substantial expansion. The government's substantial investment in infrastructure development has provided strong support to the construction industry and resulted in significant progress in Malaysia over the past few decades. To ensure the successful completion of these projects and achieve their intended goals within the designated timeframe, it is imperative to employ an efficient project management approach that encompasses all stages from planning to project handover (Haron et al., 2018).

According to a study conducted in residential areas in Malaysia by Khairul et al. (2018), construction activities emerge as the primary source of air pollution. Guan (2018) stated that the construction of an urban rail transit system in Wuhan, China, has resulted in various negative impacts on the environment and surrounding areas. These include water and soil pollution, destruction of vegetation, disruption of agricultural ecology, land subsidence, water and air pollution, generation of solid waste, noise and vibration pollution, alteration of urban landscape, and potential effects on population health. Construction activity is a widespread cause of environmental contamination, both in Malaysia and worldwide. Therefore, it is imperative to find a solution that can effectively reduce the environmental impact of construction projects.

Project management models such as Agile do offer a way of reducing environmental impact due to construction activity (Sertyesilisik, 2014). Most industry players are well aware of the construction implications of the rapid construction that is currently happening in the Klang Valley. However, they have also been facing multiple challenges in order to effectively implement a project management approach in their project, especially for those in small to medium scale project. This research attempts

to identify the main challenges and the most effective approaches to implement project management in construction in order to minimise environmental impact.

LITERATURE REVIEW

Construction is unquestionably the most complicated and significant industry sector, with the majority of other sectors increasingly project based as well (Adeleke et al., 2018). Other project-based industries include management consulting, information technology, and other areas of the construction industry. Project based industry sectors, particularly construction projects, widely acknowledge the value of contractors and project managers (Adeleke et al., 2019). As a result, researchers have extensively studied the performance of project managers and contractors in relation to their clients. These investigations collectively support an updated awareness of current knowledge among contractors and project managers, as well as more general project management.

Adeleke et al. (2019) conducted a study to investigate how project management effectiveness affected the success of construction projects in Malaysia. According to the study, project management effectiveness significantly contributes to project success in Malaysia's construction sector. Project management techniques, including project planning, scheduling, risk management, cost management, quality management, and communication management, are crucial to the success of a project. Project managers in Malaysia also identified several other challenges, such as of funding, poor stakeholder coordination and communication, a scarcity of qualified workers, and inadequate tools and technology.

Effective project management requires a diverse range of competencies and skills, such as leadership, communication, problem-solving, negotiation, risk management, and adaptation. Project managers are responsible for overseeing constraints, fostering collaboration, and ensuring that the project meets stakeholder expectations, ultimately leading to enhanced project performance (Giri, 2019). When construction projects are well-managed, they have less of an effect on the environment.

Environmental Impacts

Precisely recognising the key environmental implications associated with construction activities enhances the efficacy of environmental management strategies. Predicting the environmental impacts of buildings in advance can result in improved environmental outcomes for construction projects and their surrounding areas. Identifying noteworthy environmental impacts will facilitate the consideration of diverse local measures to reduce or counteract them (Gangoellis et al., 2011). Construction activities have a significant impact on ecosystems, natural resources, and the general public. The construction process has a substantial detrimental environmental impact on both humans and ecosystems in terms of trash, noise, dust, and hazardous emissions. The significance of development's impact on ecosystems has escalated due to the rising number of newly constructed buildings (Zolfagharian et al., 2012).

Additionally, the construction industry's waste from construction and demolition has a negative impact on the economy (loss of primary resources), the environment (water, soil, and air pollution), and public health (health risks and use of public space). These issues have an adverse impact on numerous external parties. Construction-related ground surface disturbances significantly worsen pollution's impact. Activities like clearing land and digging create soil erosion and sedimentation, which further damage the ecosystem. Furthermore, the conversion of steep mountainous land into arable land exacerbates erosion and sediment issues due to the changes in terrain. Without effective project management and a working environmental management plan, the detrimental effects of the

construction industry on the environment will continue to seriously threaten the globe and (Asnor et al., 2022).

The adoption of sustainable development ideas is getting more and more popular in an effort to mitigate climate change (Asnor et al., 2022). Two of the most essential principles of sustainable development are the improvement of people's health and quality of life, as well as the maintenance of the systems that supply a nation with natural resources. In order to stimulate the application of environmental management plans (EMPs) to construction projects, governments have developed schemes to facilitate their implementation. Identifying the key environmental repercussions caused by construction activities in a more precise manner improves the efficiency of environmental management systems. Predicting the environmental consequences connected with construction activities before the construction stage begins can also enhance the environmental performance of construction projects and sites. This will make it much simpler to take into consideration a wide range of local mitigation strategies (Gangoellis et al., 2011). The identification of important environmental impacts will make this easier. Construction activities impact environmental factors such as ecosystems, natural resources, and the general population as a whole. The construction process continues to have a considerable detrimental impact on the environment, both on people and on ecosystems, through the generation of waste, noise, dust, and hazardous emissions. This is the case in terms of the impact on ecosystems at large. According to Zolfagharian et al. (2012), the role that development plays in ecosystems has become increasingly significant as the number of new structures that are being created has increased.

Project Management Approach

There are a wide variety of techniques for project management, such as waterfall, agile, spiral, hybrid, and critical path methods, that can assist practitioners in successfully managing projects. These approaches consider the requirements of the organisation, the types of projects, and the level of complexity being undertaken while providing systematic methods for planning, executing, and controlling projects.

Waterfall

In the beginning stages of the project's life cycle, the traditional project management technique establishes the project's scope, timeframe, and budget goals. The team manages any modifications to the project's scope with careful consideration. The traditional method of project management focuses on gathering requirements, doing data analysis, and developing projects in advance in order to deliver higher-quality outputs (Reiff et al., 2022). This method aims to reduce the number of modifications that occur throughout the course of the project.

The waterfall method has several drawbacks, though. Because it is sequential, it is less adaptable to shifting requirements because late-stage changes might be time and money-consuming. Additionally, it does not encourage early user participation or feedback, which can result in a discrepancy between the final product and user expectations. In general, projects where the requirements are clear and unlikely to change dramatically during the development process are best suited for the waterfall technique. It offers a well-organised framework for managing projects, providing a smooth transition from one phase to the next. The waterfall methodology contained acknowledged beneficial elements, such as the need for official documentation. Waterfall tends to operate well when team members are dispersed and fluctuate regularly, as well as when system critically is high (Špundak, 2014).

Agile development methods, which emphasize adaptability and iterative development, are sometimes compared with the waterfall method. Traditional methodologies, commonly referred to as waterfall, are linear approaches to development that have distinct project life cycle phases that are completed in order, assume events affecting the project are predictable, assume all tools and activities are understood, and emphasise the significance of upfront requirements gathering (Hass, 2007).

Agile

Agile project management, initially used in the software development sector, has since been embraced by various industries, including the construction industry. According to Casteren (2014), a fundamental tenet of agile project management in construction is ongoing customer interaction. Throughout the project, clients are actively involved, taking part in frequent meetings, giving input, and making decisions. The project will be in line with the client's developing demands and expectations, thanks to this degree of commitment. Construction teams can deliver a product that meets or exceeds the client's expectations by maintaining a close working connection. Agile project management values flexibility and priority. Agile teams prioritise work based on value rather than strictly following preset plans, and they modify their plans as necessary.

Agile project management in the construction industry frequently uses daily stand-up meetings, also referred to as daily scrums. Team members can coordinate their work, talk about their success, deal with problems, and plan their daily activities at these brief sessions. Daily stand-ups help team members stay in tune with one another and concentrate on the objectives of the project by encouraging good communication and coordination (Bennison, 2008). Agile project management in the construction industry is fundamentally based on continuous improvement. Teams often review their procedures, results, and lessons learned. This reflective technique enables the team to maximise performance and provide better results in subsequent iterations. Furthermore, it allows for the improvement and refinement of project management methods.

Transparency and communication are vital to agile project management within construction companies. The success of a project depends on the team and stakeholders having open and honest communication. Regular status updates, visual management tools, and clear documentation keep all stakeholders informed and involved throughout the project lifecycle. These elements also build shared knowledge and enable effective decision-making. Agile project management in construction incorporates ongoing testing and quality control. Regular testing and quality checks ensure that the built elements adhere to the necessary requirements. Continuous evaluation and verification of the work allows us to find and fix issues early, reducing rework and improving overall quality. Concentrating on quality assurance enables the production of a high-quality end product that meets or surpasses client expectations.

Hybrid

Reiff et al. (2022) propose that hybrid project management integrates methods from both traditional and agile project management. The idea is to make use of each approach's advantages while avoiding its drawbacks. Comprehending the differences or similarities between techniques, as well as the benefits or drawbacks of the hybrid approach in general, is challenging due to the range of hybrid methodologies presented in the interim. Furthermore, information on the requirements and success criteria for successfully implementing hybrid project management in businesses is only partially available.

According to Hassani et al. (2018), the project team assumes a variety of roles in the Waterfall-Agile framework. The project manager organises and supervises the work in traditionally shaped projects to ensure the project's goals are met and it is effectively completed. The project manager ensures that defined workflows are followed, achieves the requirements established at the start of the project within budget and time constraints, and supervises the work in traditionally shaped projects to ensure the project's goal are effectively met and completed. The tester evaluates the product and ensures that quality goals are met. The waterfall and agile techniques are distinct in that they do not explicitly define where, when, or the process by which traditional planning gives way to agile implementation. Project teams can make this decision on a project-by-project basis. Additionally, it is possible to create and plan the project using an agile methodology before later developing and implementing it using conventional methods.

Spiral

Barry Boehm first put forth the spiral model in 1986, according to Doshi et al. (2021), an essential model for the software development life cycle. It combines the models of waterfall, evolution, and prototyping. Many organisations commonly use the spiral model to handle projects that are too big, expensive, or complex. The spiral model's capacity to manage risks sets it apart from other mathematical models. The number of loops in the spiral model is totally arbitrary and dependent on the project. The angular rate governs the success of the continuous phase as wind speed and project payload increase. Development firms and clients widely use the spiral model in the coding industry because it supports the development process with reduced risk. Spiral models are typically utilised in projects that have a medium to high level of risk, compound needs, and projects in which risk assessment is crucial yet there is a financial limitation.

The spiral model enables ongoing risk assessment and mitigation in risk management as the project moves forward. It also makes it easier for project designs to change to accommodate changing client demands and environmental factors. Complex and large-scale projects can utilise the concept to enable the division of the project into manageable stages. Other benefits include client and stakeholder collaboration, resource efficiency, quality assurance, and effective cost management. Additionally, it supports monitoring progress amid uncertainty, adapts to changing regulatory needs, and promotes rigorous recording and reporting. According to Dorshi et al. (2021), a project management team with experience and the ability to handle changing objectives, budget constraints, and schedule limitations is essential for the successful implementation of the spiral model in the construction industry.

Critical Path Method (CPM)

The Critical Path Method (CPM) is a project management methodology that is frequently utilised in the construction industry in the United States. For the purpose of effectively planning, scheduling, and managing difficult construction projects, it serves as an essential tool. The primary objective of the project is to determine the sequence of tasks that, if delayed, will delay project completion (Baki, 1998).

The initial step in utilising CPM is to identify all the critical jobs for the construction project. These actions must have clear dependencies, be well-defined, and be measurable. The project manager determines the logical sequence for completing these tasks after identifying the activities. In order to go on to the next step, it is necessary to finish the activities that are dependent on the previous one. It is crucial to gauge how long each task will take. These time predictions should be as accurate as possible,

frequently using past data, professional opinions, or other tested estimation methods. Then use the activity list, dependencies, and time projections to create a project network diagram. Goksu (2017) explains that this diagram, typically presented as a flowchart or network diagram, visually represents the project's execution and its interrelationships.

The Critical Path Method ensures that projects in the building industry are completed on schedule and within budget. It enables efficient resource allocation and schedule management by giving project managers a clear grasp of the order of tasks essential to the project's success. Concentrating on the key path allows project managers to complete construction projects quickly and with minimal risk of delays and cost overruns (Goksu, 2017). The project management approach in construction ensures project completion within the budget, time, and scope as stated in the contract.

RESEARCH METHODOLOGY

This study used a qualitative research approach to collect and analyse the data. This is because qualitative research focuses on analysing individuals' subjective interpretations of their real-life experiences as expressed through their own thoughts and words (Horton, et al., 2004). Language and concepts commonly used in everyday life often exemplify this knowledge. Qualitative research is distinct from quantitative research as it centres on the subjective perceptions of researchers and often employs specialised scientific language. As a result, qualitative research adopts unique ways of problem-solving compared to other research strategies. This study will focus on individuals as the unit of analysis, namely professionals with over 5 years of industry experience. The underlying principle is that each person, especially knowledgeable individuals who contribute as respondents, should develop their own distinct understanding by incorporating their own ideas and opinions about the nature of the material, as everyone's perception of reality varies (Rahman, 2016).

Grundmeyer (2013) stated that enlisting qualified and capable informants as participants in a study is essential for gathering fruitful and valuable data. The respondents for this study are professionals with more than 5 years of experience working in the construction industry, preferably in a senior manager position, who have vast on-site and managerial experience in the industry. Conducting in-depth interviews is the most effective way to learn about individuals' histories, perspectives, and experiences, particularly when addressing sensitive topics. As with interviewees, this occurs during information gathering. Data collection is therefore both subjective and thorough (Rahman, 2016). This study was carried out in Malaysia, focusing specifically on industry players in the Klang Valley. Researchers acquire primary data information from sources like structured open-ended questionnaires and interviews with a specified goal for a given topic (Hox and Boeije, 2005).

RESULT AND DISCUSSION

Respondent Profile

Table 1 below shows the background of all the respondents. The respondents involved in this study were based on the criteria of professionals with at least 5 years of experience in the construction industry in Klang Valley and a senior position who can make a decision in their respective organisation. Respondents consisted of architect, civil and structure engineer, electrical and mechanical engineer, site supervisor, contractor, and project manager.

Table 1

Respondent Background

Items Respondent	Age (Year)	Position	Experience (Year)	Company Background	Company Size	Type of Project Involved
A	50	Director	22	Civil & Structure	> 10 employees	- Building - Infrastructure - Oil & Gas
B	42	Project Director	18	Construction	> 25 employees	- Building
C	30	Site Supervisor	5	Design and Build & Architecture	> 10 employees	- Building - Interior
D	38	Project Director	12	Electrical & Mechanical	> 10 employees	- Building - Infrastructure - Renewable Energy
E	36	Project Manager	10	Architecture	<10 employees	- Building - Interior
F	51	Director	23	Construction	> 25 employees	- Infrastructure - Oil & Gas
G	31	Project Designer	6	Town Planning & Landscape Architecture	> 10 employees	- Building - Landscape - Infrastructure

Respondent A is a director for a civil and structural engineering consulting firm that has more than ten workers. Respondent A is fifty years old and has already worked in the construction industry for twenty-two years. The company is an industry leader in the provision of consulting services in the fields of civil and structural engineering for a wide range of construction projects. Respondent A has been involved in a wide variety of projects throughout the course of his 22 years of expertise. These projects include those linked to oil and gas, infrastructure, and construction projects.

Respondent B is serving as the Project Director for a construction company that has more than 25 employees. Respondent B is 42 years old and has 18 years of experience working in the construction industry. In addition to being an expert in construction projects, the company that respondent B is affiliated with is also involved in the development of minor infrastructure.

The respondent C is a Site Supervisor who is thirty years old and has five years of experience working in the construction industry. Respondent C is employed by a design-and-build company that has more than ten total employees. The company's primary focus is on undertaking projects such as the design and construction of buildings as well as the modification of interior spaces.

Respondent D is a 38 years old Project Director for an electrical and mechanical engineering consulting firm with 12 years of experience in the construction industry. With more than 10 employees, the company is an expert in not only mechanical and electrical engineering but also the

renewable energy sector. The company has been involved in various types of projects, such as buildings, infrastructure, and renewable energy plants. Respondent E, at 36 years old, has been involved in the construction industry for more than 10 years and is currently working as Project Manager at an architectural consulting firm with less than 10 employees. The company is involved in various types of construction projects, mainly focusing on the building and interior fields.

Respondent F is 51 years old and the Director of a construction company. Equipped with 23 years of experience in the industry, respondent F has been involved with construction projects that mainly focus on infrastructure construction, such as roads, highways, bridges, oil and gas facilities, and energy and treatment plants. Last but not least, respondent G, at 31 years old and with 6 years of experience as a Project Designer in the construction industry, is attached to a town planning and landscape architectural consultancy firm. The company is involved in a number of projects, such as building, infrastructure, and landscape facilities. Based on the respondents' profiles, it shows that all the respondents fulfil all research criteria and are capable of responding to research questions. With the experience of working with construction companies will contribute to the research.

Challenges in Implementing Project Management Approaches in the Construction Industry

As indicated in Table 2, the interview provided a list of challenges to using project management approaches. The interview also asked respondents to list the challenges they faced when implementing effective project management in their practices and experiences in the construction industry. Then, the respondent's answer will be compared and analysed against the challenges facing project management approach implementation based on the literature review.

Table 2

List of Challenges

Challenges	A	B	C	D	E	F	G
Lack of funding	/					/	
Poor communication and coordination		/	/	/	/		/
Inadequate skill and knowledge	/	/	/	/		/	/
Technology adoption	/					/	
Complexity and uncertainty	/	/	/	/	/	/	/

Even though most of the respondents were aware of the environmental advantages of project management implementation, they did not fully incorporate effective project management into their professional practices in the construction industry. Therefore, this study gathered and examined data on the difficulties each respondent encountered in successfully executing project management. Respondents A and F agreed and stated that a lack of funding is one of the major challenges they face in implementing project management effectively. Both respondents agreed that extra funds are needed to implement a proper and effective project management approach from the early stages of the project until post-construction, especially on medium to small scale projects.

Moreover, respondent A and F are also on the same page that technology adaptation and utilisation of Building Information Modelling (BIM) are more effective and low cost, which can be as good as

project managers in managing small scale projects. Both of them agreed that for a small scale project, utilisation of BIM is adequate and simple enough to be handled and operated by engineer, architect or contractor. Based on their experience of more than 20 years in construction, they believed that using the new technology would improve the performance of construction projects. In Malaysia, implementing new technology and practices takes longer because construction companies avoid it at the beginning.

Next, all respondents, except for respondent A and F, agreed that poor stakeholder coordination and communication in a construction project would become a challenge to implementing effective project management. Without solid coordination and communication between the stakeholders, project managers will face difficulties with multiple expectations, eventually preventing them from implementing the project management approach effectively.

Furthermore, all respondents except respondent E agreed that inadequate skills and knowledge are one of the significant challenges in implementing a project management approach effectively in a construction project. A project manager, engineer, architect or contractor who lacks experience usually faces a number of difficulties in many aspects of a construction project, and without the proper skills and knowledge, certain projects can be delayed or jeopardized.

Finally, all respondents agreed that the main challenges to implementing project management effectively are the complexity and uncertainty of a project. Each construction project will have its own unique properties, needs, deliverables, and challenges. All of those need a certain technique or approach to handle or counter them. Therefore, this situation requires a distinct approach that sets it apart from the previous project.

In summary, it is possible to state that every respondent has encountered at least two of the problems that were described in order to successfully apply project management to their prior construction project. The actors in this industry need to find a way to overcome these hurdles in order to successfully adopt project management and reap environmental benefits.

The Most Effective Project Management Approach in the Construction Industry

The interview has generated a list of project management approaches, as presented in Table 3. All respondents are aware of and have a basic understanding of each approach listed. Consensus among all respondents affirms that employing a robust project management approach throughout the entirety of the construction project enables stakeholders to effectively mitigate environmental consequences. Explicitly mention all deleterious substances prohibited in the contract and include the use of ecologically sustainable items in the specification. Respondent A and respondent F agreed that the waterfall approach is one of the best project management approaches in the construction industry. Spundak (2014) supports this finding by stating that the waterfall approach provides a structured framework for managing projects and enables a seamless changeover between phases. The necessity for official documentation was one of the accepted benefits of the waterfall approach. The waterfall approach is particularly useful in scenarios where team members are geographically dispersed and experience frequent changes, as well as in situations where the system is critically important. In addition to assisting the contractors in meeting the requirements outlined in the contract, this strategy serves to reduce the adverse impacts on the environment. Next, respondent B and respondent F are on the same page to agree that the agile approach is one of the best project management approaches to practice in the construction industry. In construction, agile project management includes constant

testing and quality assurance. Regular testing and quality checks ensure that the produced components meet the relevant specifications. The ability to identify problems early and rectify them reduces rework and improves overall quality through continuous evaluation and verification of the work. Putting a strong emphasis on quality assurance can result in an end product of exceptional quality that meets or exceeds customer expectations.

All respondents, except for respondent A and respondent F, agree that implementing the hybrid approach is the most effective project management approach in construction projects. Reiff et al. (2022) support this finding by explaining that the goal of a hybrid method is to leverage the strengths of each approach while mitigating their weaknesses. Understanding the differences or similarities across strategies, as well as the advantages or disadvantages of hybrid approaches generally, is challenging due to the variety of proposed hybrid approaches. Basically, a hybrid approach combines the benefits of both the waterfall and agile approaches while complementing both approaches to reduce their drawbacks. Implementing a robust project management approach empowers the client to effectively manage the environmental impact by strictly prohibiting the use of any harmful materials during the entire project duration, as stipulated in the contract. In addition to the listed project management approaches and models, respondents B and F also stated that they are most familiar with and have implemented the Critical Path Method (CPM) throughout their experience in the construction industry. They also agree that CPM is the most practical and easy to implement project management approach within the industry. However, in this study, the waterfall-agile approach stands out because it doesn't formally outline how, when, or where traditional planning transitions from traditional planning to agile implementation. After conceiving and creating the project using an agile approach, it is also possible to develop and implement it using conventional techniques.

Table 3

Project Management Approach

Project Management Approach	Waterfall	Agile	Hybrid	CPM
A	/			
B		/	/	/
C			/	
D			/	
E			/	
F	/	/		/
G			/	

CONCLUSION

The implementation of a project management approach depends on the priorities of the companies by absorbing all the challenges such as funding, communication and coordination, skill and knowledge, technology, complexity, and uncertainties. The respondents with more than 20 years of experience working in the construction industry stated that were three challenges: lack of funding, inadequate skill and knowledge, technology adoption, and complexity and uncertainties. The most effective project management approach among the respondents is hybrid. It shows that the combination of project management approaches covers the weaknesses that exist in other approaches. Hybrid became the

most popular choice among the respondents in the construction industry. This study helps to understand and gain awareness of the environmental benefits that a project management approach can provide if implemented effectively, especially within the Klang Valley. Additionally, this research helps professional bodies and government agencies evaluate and understand the difficulties faced by professionals in the construction industry that prevent them from implementing project management in their projects and practices, despite being aware of the environmental advantages and contributions of effective project management.

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