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The role of project management in achieving the sustainable development of smart cities

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A B S T R A C T

Integrating project management (PM) and sustainable development (SD) is not merely an option but a necessity for smart cities (SC) to secure a prosperous future for the next generations. Also, useful PM plays a vital role in fostering sustainable growth within SC, as it enhances the quality of life, conserves natural resources, and encourages technological creation. Therefore, this study aimed to examine the significance of PM in advancing the SD of SC. Randomly 189 questionnaires were distributed to possible respondents working in PM by email, hardcopy mailings, and web-collection apps. The statistical analysis was carried out using SPSS version 25, by using a quantitative research approach. The results showed that all study variables (smart technologies company policies, resource management, and organizational culture) positively impacted smart cities' SD. Therefore, the study recommends enhancing the incorporation of PM and SD in SC by implementing effective processes and technologies that connect harmoniously with technological advancement and environmental and social sustainability.

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1. Introduction

Project management (PM) plays a crucial role in securing the long-term success of SC by enabling the careful planning, execution, and monitoring of initiatives with a priority on sustainability. SC strive to enhance the well-being of its residents by integrating new technologies across sectors such as transport, energy, and healthcare (Ababneh et al., 2024). However, knowing these goals primarily hinges on the performance of efficient PM techniques that can effectively reconcile technological innovation with environmental, and sustainability (Schipper & Silvius, 2018). Via the application of established protocols and the adoption of innovative instruments, PM can aid SC initiatives in reaching their sustainability goals. The incorporation of sustainability principles across the whole project lifecycle, from initial planning to implementation and closure, carries significant significance in PM for SC (Blasi et al., 2022). Therefore, project managers are responsible for ensuring that sustainability is factored into project objectives, help funding, threat management, and stakeholder engagement processes (Alawneh et al., 2024). This approach allows them to underestimate the environmental influence of SC initiatives, advance social equity, and provide financial viability. In addition, PM strategies play a part in enhancing project outcomes and managing help to advance sustainability over the project's time (Selim et al., 2018). Sustainable PM involves integrating sustainability principles related to the climate, and economy, forming the basis for projects that meet existing conditions while

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protecting the claims of coming generations. Moreover, in line with economic sustainability principles, construction projects should promote economic progress without adverse effects on society, achievable through more intimate collaboration with the government and local economy (Ershadi & Goodarzi, 2021).

Therefore, the integration of PM with SD is a major topic among academics. As a result, integrating sustainability into PM means a new school of thought. Economic, social, and environmental aspects are linked with the project's deliverables, delivery method, and ethical organization in PM (Rozman et al., 2015). The relevance of adding sustainability measures and variables into PM is recognized at both the corporate and project levels. To improve the PM level, efforts have been made to facilitate PM maturity and competence, PM training, management of environmental policies and standards, and education for SD. These measures strengthen the organization's capability, which will contribute to future projects (Xue et al., 2018). However, with the quick building of numerous infrastructures, researchers increasingly realized the negative impact it had on the natural environment, resulting in punishment for the whole population. As a result, whether infrastructure projects intend to clean cities from the outset of the project lifespan is critical. It will have an impact on the end product's usability and operability, as well as on the environment and society (Martens & Carvalho, 2017). Because of this, creating sustainable infrastructure has become essential to the building, engineering, and architecture sectors. Raising the degree of lifetime PM is one way to achieve infrastructure sustainability. To increase the success of building projects, several experts have suggested integrating sustainability into PM techniques (Krajangsri & Pongpeng, 2017). Sustainability should be taken into consideration as a new standard for project success as it becomes a more important concern on a global scale (Gharaibeh et al., 2024). The disciplined application of information, skills, tools, and processes to project operations to meet project requirements is referred to as PM, and it is a critical facilitator of project success (Silvius, 2017).

Therefore, although the integration of sustainability into PM has emerged as a promising field, there are still gaps in the current development of sustainable infrastructure, including short-term planning perspectives, inadequate demand fluctuation accounting, maintenance inconvenience during utilization, and so forth. The lack of formal and comprehensive factor systems that support infrastructure sustainability and PM results in limited integration and an inability of PM to assist infrastructure success in training. Project managers in the engineering and construction sectors claim that there is a subtle correlation between executive culture and project outcomes. However, as the organization grows, leadership and organizational culture become linked. Also, leadership styles vary according to organizational cultural features. Furthermore, various leadership styles create distinct management climates, which influence project performance. As a result, explicit step-by-step plans, known as strategy, must be devised before taking action. Generally, the strategy is broken during the PM process. However, poor project outcomes are often caused by inadequate control during the plan design stage. In this context, there is a great need to develop relevant project strategies to ensure optimal implementation and performance.

2. Literature Review

PM has gained popularity as a separate management paradigm used to achieve not just commercial objectives but also economic progress in developing countries. Several programmers in developing countries, such as product production, real estate development, infrastructure development, and event organizing, rely largely on foreign finance from development partners. PM is the discipline of planning, organizing, staffing, coordinating, and managing resources to fulfil specific project objectives and goals (Jarrah et al., 2022). A project is a set of separate, complex, and interwoven activities with a common goal or purpose that must be completed within a particular timetable, budget, and specification. In contrast to daily routines, projects are unique endeavors with specific goals and a defined end. Projects have distinct features such as purpose, life cycle, interconnectedness, and potential conflicts. According to Ramesh et al. (2018), projects involve the allocation of resources to achieve specific objectives, whether it be producing goods, generating profit, or providing community services. Effective stakeholder management is crucial in projects, especially in precision medicine initiatives in smart cities. These projects typically involve various stakeholders, including government agencies, private companies, non-profit organizations, and individuals (Bjørner, 2021). Project managers must engage with stakeholders regularly to understand their needs, expectations, and concerns, by encouraging open communication and cooperation, project managers may promote trust and support for smart city initiatives, which is critical for their long-term success and sustainability (Al Houl, 2024), (Vanlı & Marsap, 2018).

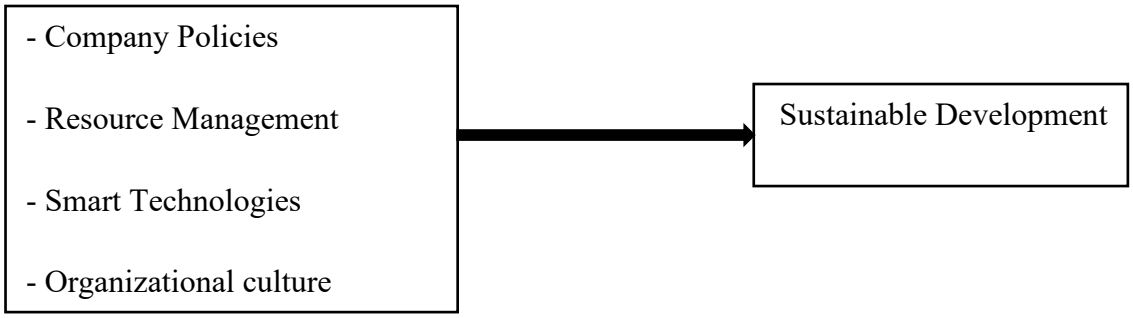
Furthermore, projects play an important part in implementing more sustainable corporate practices, and sustainability has lately been connected to PM (Messarra, 2023). The developing research on this issue indicates that sustainability considerations influence PM methods and practices. However, PM guidelines do not address the sustainability agenda (Silvius and Schipper, 2014). Also, SD has arisen as a paradigm to balance man's developmental demands while ensuring that economic progress is realized without jeopardizing the environment and with adequate regard for delicate social balance (Mousa, 2023). With governments in developing nations pursuing economic growth, public-private partnerships have emerged to execute significant infrastructure projects on schedule, under budget, and according to specifications. A relationship may be shown between sustainable infrastructure development and PM. This will be demonstrated by the requirement to maximize success in infrastructure projects that address integrated social, economic, and environmental problems. To carry out these infrastructure projects, multi-disciplinary teams with particular credentials would need to be recruited (Odedairo et al., 2011).

Also, technological integration is a distinguishing feature of smart cities, and project managers must overcome the challenges of integrating modern technologies (Hawamdeh, 2023). Therefore, project managers must ensure that these technologies are not only correctly deployed but also in sequence with sustainability objectives (Shah et al., 2023). Adequate practice, collaboration, and constant supervision are crucial to ensure that technological solutions contribute to the general sustainability of the city (Al-Fulaij et al., 2022). Venture supervisors must distinguish potential dangers before the extension and make procedures to offer assistance to them. This includes surveying natural, specialized, and dangers. By proactively overseeing these dangers, extended directors can boost the maintainability of SC businesses. Besides, venture supervisors must make versatile monetary figures that take into account the add-to fetched of the permit, counting care and working costs (Mansell et al., 2019). Moreover, practical project management is essential for the sustained enhancement of SC. Project managers must recognize potential dangers and implement measures to reduce their effect right from the project's start. This involves risk evaluation and all the technical and environmental variables. Based on this, project managers are offered by proactive risk management the power to make sustainable SC industries. Moreover, project managers will need financial forecasts that are not only backed by science but also take into account things such as the cost of licenses plus all associated maintenance and operating costs (Mansell et al., 2019). Another possibility is public-private partnerships whereby SC enterprises can acquire methods that lead to long-term success as well as ownership (Gharaibeh & Ibrahim, 2024). In expansion, the maintainable advancement of SC pivots on whether extended directors are compelling or not. By integrating supportability strategies into improved coordination and performance, involving partners, managing risks, and using cutting-edge technology, project managers can help ensure the success of sustainability ambitions (Uzoigwe et al., 2023). Additionally, educators are increasingly incorporating sustainability into their everyday practices. PM may help total this operation a victory, even though there is less exhortation on how to utilize supportability in individual ventures. Moreover, supportability has gotten to be a basic step, especially in terms of natural effects (Robichaud & Anantatmula, 2011). Moreover, education is progressively trending to consolidate supportability into their day-to-day operations. PM may help make this operation a victory, but there is less counsel on how to apply maintainability to individual ventures. Moreover, supportability has ended up being a basic step, especially in terms of natural effects. In any event, the optimal features for a sustainable project and its administration have yet to be identified (Robichaud & Anantatmula, 2011).

Similarly, the environmental and ecological consequences of building activities have been a significant concern, notably the massive amount of rubbish generated on construction sites. Regulations and increased customer demand for environmental compliance have led contractors to adopt sustainable practices and incorporate them into their operations (Dalaien, 2023). Sustainable procurement management is a feasible method that takes into account the environmental implications of procurement decisions and includes sustainable practices in project procurement to produce positive environmental outcomes (Ershadi et al., 2021). Similarly, sustainability is becoming more important in project delivery as stakeholders expect ethics, environmental friendliness, and economic efficiency throughout the project's life cycle (Kivilä et al., 2017). Also, SD goals are critical components of the SD paradigm. They not only represent the philosophy of economic, social, and environmental concerns in a balanced way, but they also include concrete strategies to achieve them. These measurements are many and varied (Maslova, 2020). As a result, building projects of all sizes and types should strive for integrated sustainable social responsibility, but there must be a comprehensive vision for construction project sustainability. To achieve sustainability within an organized network that works to follow up on and implement SD goals, it is necessary to establish an Arab partnership for construction project sectors, as well as to benefit from the experiences and expertise that governments strive to spread on a large scale. Therefore, the PM may be a tool for positively influencing the integration of sustainability features into projects, which has piqued the interest of professionals and academics in the debate on sustainability in PM, where the idea of sustainability is intertwined with economic, environmental, and social elements (Martens & Carvalho, 2016). Therefore, transforming strategic sustainability objectives into project-specific activities is a complex task. Multidimensional viewpoints on sustainability, such as economic, social, and environmental concerns, along with a lack of organized techniques and information at various hierarchical levels, exacerbate the challenge. Furthermore, sustainability appears to contradict traditional PM, in which practically all elements are based on the investment's economic performance (Marcelino-Sádaba et al., 2015). According to Maslova (2020), public-private partnerships have characteristics that ensure their true contribution to attaining the SD goals. Meanwhile, public-private partnerships should not be seen as the sole method to accomplish the SD goals. The findings of this study by Hwang and Tan (2012) show that, while project cost is a significant barrier to green building construction management, there is no scarcity of sustainable competence in the construction industry. To overcome the cost barrier, government incentives should be broadened to include the usage of green products and technologies. Furthermore, a PM framework for green building construction should be developed to solve the challenges, expanding the usage of sustainable construction in future projects. Martens and Carvalho (2017) identified four key aspects: the sustainable innovation business model, stakeholder management, economic and competitive advantage, and environmental policies and resource savings. Martens and Carvalho (2016) discovered that organizations are concerned about sustainability in PM, however there is a disconnect between perceived significance and actual use in practice. Finally, corporations in the public sector priorities the social component above others. Robichaud and Anantatmula (2011) discovered that greening PM methodologies may provide significant value to a sustainable building project while maintaining costs within reasonable boundaries. A complete analysis using a matrix shows specific alterations to standard PM techniques, with the idea that including a cross-discipline team from the start and throughout the project improves a green project's financial viability. According to Shah et al. (2023), by implementing sustainable techniques and strong PM practices, building projects may achieve success while maintaining environmental responsibility, social equality, and economic feasibility. Silvius and

Schipper (2014) discovered that PM techniques and standards may be improved further to meet the function of projects in promoting SD. Kivilä et al. (2017) discovered that sustainable PM is achieved not just via indicators, but also through a comprehensive control package in which control mechanisms are applied differently to different sustainability elements. Internal project control is reinforced by sustainable project governance, which ties the project to its external stakeholders and needs. The alliance contract encourages partners to explore new opportunities while fostering economic, environmental, and social sustainability. Ershadi et al. (2021) findings explain how PM offices promote sustainability, provide insights into implementing sustainable practices in project acquisitions, and broaden theoretical understanding of PM office ideas. There exists a statistically significant correlation between the study's axes and the site's age; likewise, there is a statistically significant correlation between the study's axes and years of experience; furthermore, an analysis of the relationship between the study's axes and the job title variable reveals a statistically significant relationship wherein grades rise with other jobs and fall with project managers and executive engineers. Based on the above, the study model and hypotheses were developed, as shown below:

The Model of the Study



The Hypotheses of the Study

H_1: *There is a positive relationship between Company Policies and the Sustainable Development of Smart Cities.*

H_2: *There is a positive relationship between Resource Management and the Sustainable Development of Smart Cities.*

H_3: *There is a positive relationship between Smart Technologies and the Sustainable Development of Smart Cities.*

H_4: *There is a positive relationship between Organizational culture and the Sustainable Development of Smart Cities.*

3. Methodology

A practical study was done to collect enough data to analyze crucial elements impacting PM in attaining the SD of SC. A Likert scale with a 5-point threshold was used to collect respondents' ideas from the PM. Given that open-ended questions have a lower response rate than closed-ended questions but are still a good approach to gathering insights from respondents. Pilot research was conducted to ensure the validity and applicability of the designed questions. The original questionnaire was slightly adjusted before mass distribution to reflect the pilot study refinement suggestions. Between April 2022 and May 2023, 189 questionnaires were distributed to possible respondents working in PM by email, hardcopy mailings, and web-collection apps. The statistical analysis was carried out using SPSS version 25.

4. Result

The data shown here highlights the findings of an investigation into the relationship between PM and the SD of SC. The descriptive data and Cronbach's alpha value are shown in Table 1.

Table 1
Means, S.D and alpha for all variables (N=189)

Variables	Mean	S.D	Degree	Alpha
Company Policies	3.81	0.77	high	0.86
Resource Management	4.01	0.49	high	0.81
Smart Technologies	3.88	0.73	high	0.84
Organizational Culture	3.76	0.81	high	0.79
Sustainable Development (SD)	3.79	0.80	high	0.80
Total	**3.84**	**0.75**	**high**	**0.88**

A medium agreement degree yields the lowest mean for organizational culture (3.76), whereas a high agreement degree yields the highest mean for resource management (4.01). The research sample was also subjected to Cronbach's alpha to verify the instrument's reliability. In PM, Cronbach's alpha was (0.88), but in SD, it was (0.80). Additionally, organizational culture had

the lowest alpha value (0.79) and company policies had the greatest alpha value (0.86), suggesting dependability acceptance. In Table 2, the Pearson correlation between the variables shows a statistically significant positive correlation between company policies and SD, with a correlation of (0.647). Additionally, there is a statistically significant positive relationship between resource management and SD, with a correlation of (0.614), as well as a statistically significant positive correlation between smart technologies and SD, with a correlation of (0.757). Finally, there is a statistically significant positive correlation between organizational culture and SD, with a correlation of (0.639), as indicated below:

Table 2
Pearson Correlation between Variables (N=189)

Variables	Company Policies	Resource Management	Smart Technologies	Organizational Culture	Sustainable Development
Company Policies	-		0.501**	0.689**	0.647**
Resource Management		-		0.624**	0.614**
Smart Technologies			-		0.757**
Organizational Culture				-	0.639**
Sustainable Development					-

4.1 Normality Testing

The use of SPSS requires that the data be normally distributed, with responses that are close to the mean. Extremely non-normal data makes it difficult to assess the relevance of parameters and confuses multivariate analysis findings (Hair et al., 2011). According to Pallant (2016), the form of the histogram is a stronger indicator of normalcy than the Kolmogorov-Smirnov value. According to George and Mallery (2008), Skewness and Kurtosis values should be considered when analysing normally distributed data, with a range of plus or minus two (±2).

Table 3 shows the values of Skewness and Kurtosis. Skewness goes from -0.246 for trust to -0.893 for sustainable development. The values are smaller than ±2. Furthermore, kurtosis values ranged between 0.838 for hedonic drive and 1.658 for trust. The values are also less than ±2. Kurtosis and Skewness values were less than ±2, indicating that all variables in the research were normally distributed. This leads to the conclusion that all variables follow a normal distribution.

Table 3
Normality Testing

Variable	Skewness	Standard error of Skewness	Kurtosis	Standard error of Kurtosis
Company Policies	-0.657-	0.172	0.838	0.339
Resource Management	-0.893-	0.172	1.101	0.339
Smart Technologies	-0.674-	0.172	1.658	0.349
Organizational Culture	-0.774-	0.172	1.630	0.349
Sustainable Development	-0.246-	0.172	0.867	0.349

4.2 Multicollinearity

Multicollinearity is one of the most important factors to consider when undertaking a multivariate study. When there is a strong correlation between variables, it is assumed that they have a multicollinear issue. Multicollinearity occurs when the Variation Inflation Factor (VIF) is less than 10.0 and the tolerance value exceeds 0.05 (Pallant, 2016). A multicollinearity study was performed using SPPS. Table 4 reveals that the lowest tolerance value is 0.410, while the highest VIF is 1.901. This demonstrates that all tolerance values are greater than 0.05, but the VIF values are less than 10.0. As a consequence, it is determined that there are no multicollinearity difficulties among the variables in this study.

Table 4
Multicollinearity Analysis

Variable	Tolerance	VIF
Company Policies	.410	1.901
Resource Management	.530	2.521
Smart Technologies	.541	1.891
Organizational Culture	.484	2.106

Dependent Variable: Sustainable Development

The study also used multiple regression analysis to investigate the connection between PM and the achievement of the SD of SC. In Table 5, it is evident that the relationship between PM and SD of SC is statistically significant. Among the variables, company policies had the most significant impact, with a "t" value of 18.256 and a significant level of ($\alpha = 0.000$). The achieved (R) value is 0.697, and the (R^2) value is 0.487. Smart technologies followed with a "t" value of 16.120 and a significant level of ($\alpha = 0.000$), achieving an (R) value of 0.783 and an (R^2) value of 0.614. Next is resource management with a "t" value of 14.032 and a significant level of ($\alpha = 0.000$), yielding an (R) value of 0.729 and an (R^2) value of 0.532. Lastly, organizational culture had a "t" value of 12.009 with a significant level of ($\alpha = 0.001$), achieving an (R) value of 0.665 and an (R^2) value of 0.443. All hypotheses were therefore accepted.

Table 5
Multiple Regressions test to examine the between PM and achieving the sustainable development of smart cities (N=189)

Independent Variables	β	R	R^2	"t" value	Sig.
Company Policies	0.647	0.697	0.487	18.256	0.000
Resource Management	0.693	0.729	0.532	14.032	0.000
Smart Technologies	0.598	0.783	0.614	16.120	0.000
Organizational Culture	0.6130	0.665	0.443	12.009	0.001

Dependent Variable: Sustainable Development

5. Discussion and Conclusions

PM has gained favor as a separate management paradigm used to perform not just commercial purposes but also economic progress in developing nations (Jarrah et al., 2022). General characteristics of projects include their purpose, life cycle, distinctiveness, interdependence, and competition. Effective stakeholder management is essential for the success of SC initiatives, as highlighted by Bjørner (2021). Furthermore, projects play a vital role in advancing sustainable industry practices, which have recently been linked to PM (Silvius and Schipper, 2014). SC is defined by its integration of technology, giving project managers the challenge of crushing the barriers associated with the incorporation of current technologies (Shah et al., 2023). If they use this as the foundation for project operations, they may fulfil their objectives without jeopardizing the needs of future generations (Ershadi & Goodarzi, 2021). As a result, sustainable infrastructure development has emerged as a key component of the architectural, engineering, and construction industries (Krajangsri & Pongpeng, 2017). As sustainability becomes a more relevant issue internationally, it should be considered a new criterion for project success (Silvius, 2017). To achieve sustainability, meticulous planning, implementation, and administration are required (Schipper & Silvius, 2018). Project managers may also use innovative thinking and rule implementation to assist sectors in meeting their sustainability objectives (Blasi et al., 2022). Furthermore, project management systems increase project results and provide long-term advantages.

Also, SD goals are critical components of the SD paradigm. Therefore, building projects of all types and sizes should strive to achieve integrated sustainable social responsibility, but there must be an integrated vision for construction project sustainability. Therefore, PM may be a tool for positively influencing the integration of sustainability features into projects, which has piqued the interest of professionals and academics in the debate on sustainability in PM, where the idea of sustainability is intertwined with economic, environmental, and social elements (Martens & Carvalho, 2016). According to Maslova (2020), public-private partnerships have characteristics that ensure their true contribution to attaining the SD goals. The findings of this study by Hwang and Tan (2012) show that, while project cost is a significant barrier to green building construction management, there is no scarcity of sustainable competence in the construction industry. Martens and Carvalho (2017) identified four key aspects: the sustainable innovation business model, stakeholder management, economic and competitive advantage, environmental policies, and resource savings. Martens and Carvalho (2016) discovered that organizations are concerned about sustainability in PM, however, there is a disconnect between perceived significance and actual use in practice. Silvius (2017) discovers that sustainability is a new, unique, and emergent school of thought in PM. This sustainability school differentiates itself by looking at projects from a social viewpoint, implementing a Management-for-Stakeholders strategy, using Triple Bottom-Line criteria, and using a Values-based approach to project management. Furthermore, Odedairo et al. (2011) noted that there is an urgent need to capitalize on project management's development potential as a structured profession with a defined educational path, so that project managers may begin to play a role in delivering sustainable infrastructure projects. Robichaud and Anantatmula (2011) discovered that greening PM techniques may provide significant value to a sustainable building project while maintaining costs within reasonable boundaries. Silvius and Schipper (2014) observed that PM methodologies and standards might be enhanced further to better match the role of projects in fostering SD. Ershadi et al. (2021) findings explain how PM offices promote sustainability, provide insights into implementing sustainable practices in project acquisitions, and broaden theoretical understanding of PM office ideas. Furthermore, this study aimed to examine and determine the Role of PM in Achieving the SD of SC. For the current study, a random sample of 189 respondents was selected using the quantitative research methodology. The results of this study showed that Company Policies, Resource Management, Smart Technologies and Organizational culture all positively affected the SD of SC. As a result, the research advises improving the integration of PM and SD in SC by using efficient techniques and technologies that provide a balance between technical advancement and environmental and social sustainability.

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