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The Efficiency of Time Management During the Design Process for Residential Buildings to Achieve Sustainable Project Management

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ABSTRACT

The process of sustainable design involves creating structures with environmentally friendly techniques and resource-efficient materials, influencing various stages of a project's lifespan, particularly architectural design. Although time management, performance, and quality are critical aspects of construction projects, existing methods often fall short of fully integrating the principles of sustainable project management. Recognizing the growing importance of both time management and sustainable development in the construction industry, this study delves into their interconnected roles in effectively managing project time, quality, and cost throughout the project lifecycle.

The study centers on a case study of residential projects in the United Kingdom, examining the requirements of sustainable design. Simultaneously, it explores the current state of sustainable construction practices in Egypt, aiming to develop a specialized time management program for these projects during the design phase. By investigating the real-time project management processes in residential complex projects, the study seeks to understand their impact on sustainable project management and identify solutions that align with sustainability principles.

The objective is not only to analyze and utilize sustainable management systems and methods as tools for meeting sustainability requirements but also to provide recommendations for the implementation of sustainable project management in Egypt. Ultimately, the study envisions a comprehensive understanding of the

relationship between time management and sustainable development, strengthening regulatory frameworks for governments to continually update regulatory frameworks to incentivize and mandate sustainable design practices. This includes revising building codes, zoning laws, and environmental regulations to keep pace with the latest developments in green building.

Keywords:

Sustainable Design, Sustainable Construction, Green Architecture, Time Management, Sustainable Project Management

1. INTRODUCTION

In recent times, organizations have grappled with increasingly intricate challenges spanning social, economic, and environmental domains. These challenges compel them to seek innovation, adapt to change, and adopt novel approaches to confront these multifaceted issues. In this context, organizations aspire to achieve a high level of excellence by formulating strategies to mitigate the adverse social and environmental repercussions they may cause.

Sustainability is centered on the fusion of social responsibility, environmental mindfulness, and economic viability. Its core objective is to facilitate the prudent utilization of existing resources while ensuring a sustainable quality of life for future generations. Consequently, sustainability is progressively acknowledged as an indispensable framework for comprehending the interwoven social, economic, and environmental consequences linked to projects.

Projects assume a pivotal role in advancing endeavors aimed at a more sustainable future, given that a substantial portion of the global Gross Domestic Product (GDP) derives from project-related activities. This underscores the significant potential for creating a positive impact by incorporating sustainability principles into project management methodologies. Moreover, the essence of sustainable development strongly implies profound ramifications for project management procedures and practices.

Nonetheless, prevailing project management standards have frequently fallen short of adequately addressing the most critical sustainability imperatives. A compelling need exists to transition from conventional project management approaches toward sustainable project management. This shift necessitates the

integration of the three dimensions of sustainability—social, economic, and environmental into the operational framework of project management stages.
In view of these imperatives, the role of project managers assumes paramount importance. They serve as catalysts for change within organizations, wielding substantial influence over the sustainability orientation of both organizations and their projects. This shift toward sustainable project management is considered indispensable for effectively addressing the challenges posed by contemporary sustainability requirements.

The effort to incorporate sustainability principles into project management will trigger substantial changes in how project management processes operate and the responsibilities of project managers. The importance of this research becomes evident when considering the crucial role projects play in driving change and promoting the development of a sustainable project management approach. Additionally, the study seeks to emphasize the critical need to prioritize sustainability by advocating for a transition from traditional project management to the management of sustainable projects. To achieve this goal, the study employs a descriptive-analytical approach, leveraging a thorough examination of a wide range of literature related to project management and sustainable development.

2. RESEARCH PROBLEM

The adoption of sustainable development principles in developing countries, including Egypt, faces challenges. Despite the country's traditional use of "green architecture" due to its hot and arid climate, there's a notable gap between theoretical studies and practical implementation. Limited environmental awareness among architects and design firms, combined with partial or ignored application of sustainable concepts, results in inefficient and unsustainable buildings with long-term negative impacts.
Architectural organizations encounter challenges in incorporating sustainability due to uncertainties about their role, client requirements, financial constraints, limited contractor awareness, and inadequate regulatory frameworks. To overcome these challenges, the author suggests the need for a clear code of practice, specific regulations, and tools that architects can use.

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3. RESEARCH AIMS AND SCOPE

3.1. Aims

To address the aforementioned research inquiries, the investigator established three primary goals for this thesis:

1. Optimal principles of sustainable design practice that can be implemented to facilitate effective project management for sustainable building, incorporating efficient time management strategies.
2. Acquire the necessary components and methodologies for evaluating the levels of accomplishment and forecasting the sustainability aspects of the project.
3. Uncover the barriers and underlying factors contributing to the ineffectiveness in the application of sustainable concepts, namely, the impediments confronted by architects during the design phase.

3.2. SCOPE

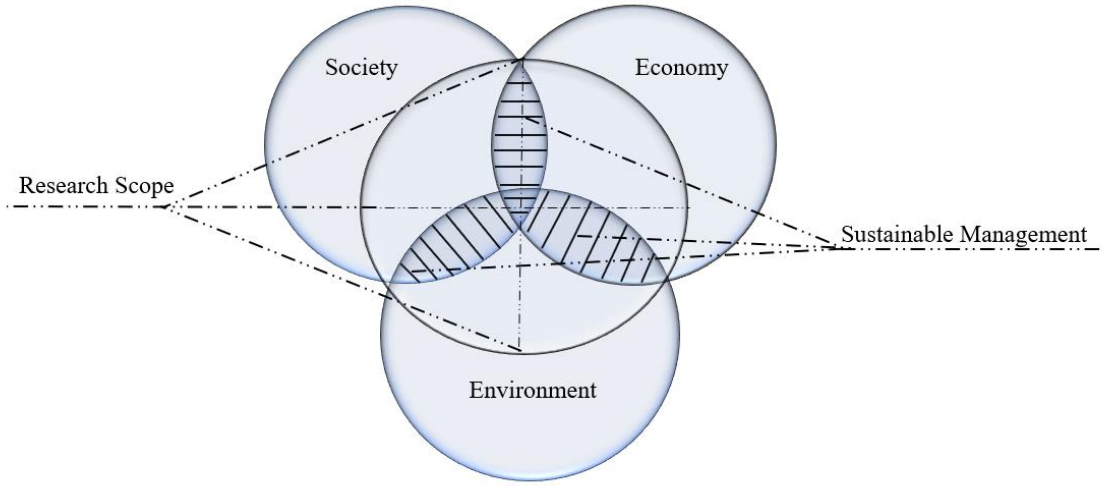

Figure 1-Research Scope

Within this dissertation, the scholar addressed various dimensions encompassing societal, environmental, and economic realms. The objective was to comprehensively grasp the notion of sustainable development, its application, and its interplay with the concept of time management. Given the pivotal role of time, which dictates the timing of implementation and eventual outcomes over an extended period, this exploration delved into these dynamics.

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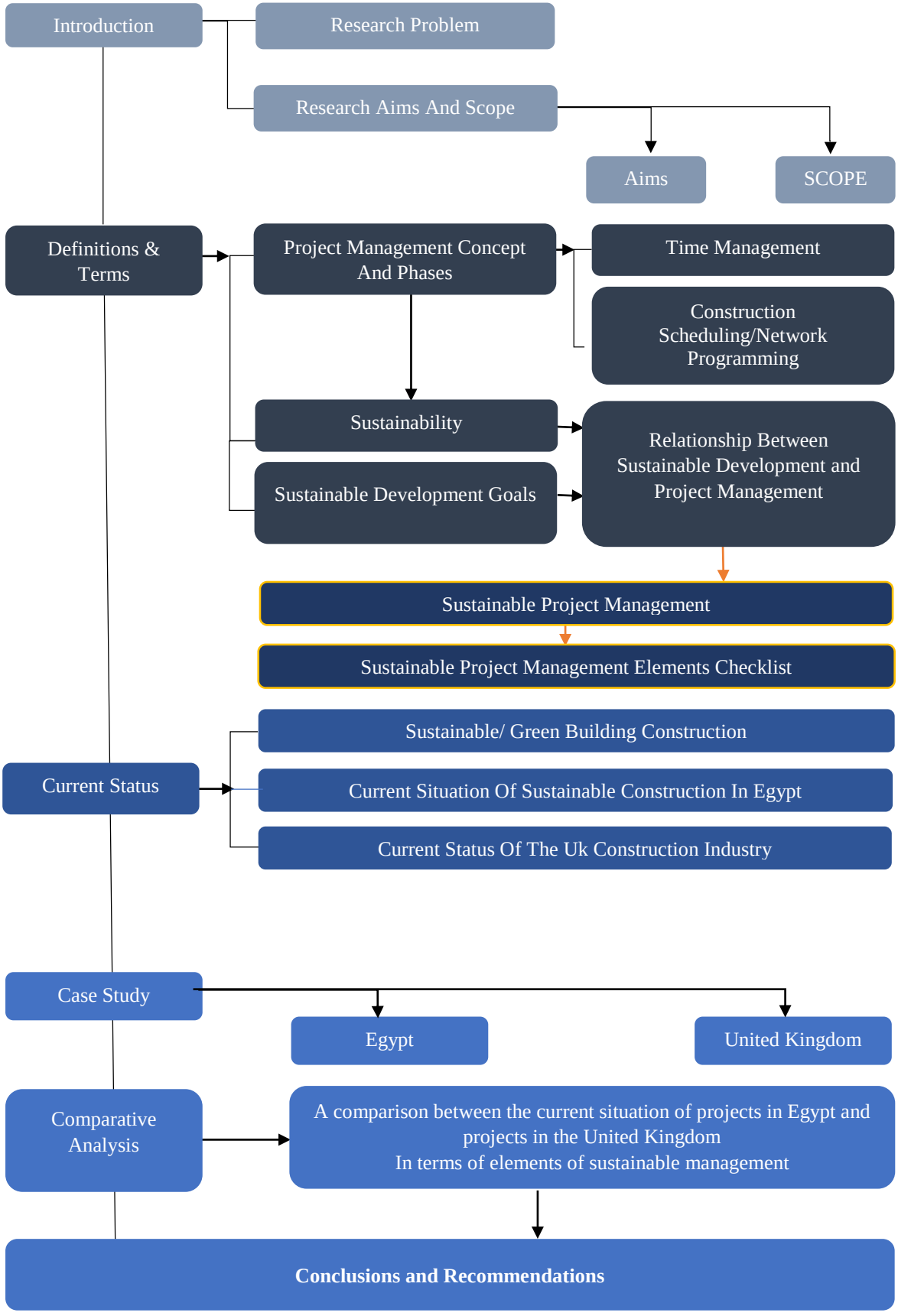
4. METHODOLOGY



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5. PROJECT MANAGEMENT CONCEPT AND PHASES

The rapid expansion of industries and institutions has created a heightened sense of urgency in achieving strategic objectives within shorter timeframes. To ensure the successful attainment of these goals, it is crucial to identify methods of coordination that can effectively consolidate and align the efforts of all involved parties. The key lies in implementing efficient project management practices that guarantee the achievement of targets within optimal timeframes while maintaining the desired level of quality and minimizing costs.

5.1. TIME MANAGEMENT

The term "Time management" is self-explanatory, indicating the effective regulation of time. In the context of a design-build project, the construction team endeavors to establish a well-structured timeline, aiming to efficiently accomplish tasks while maintaining the desired quality standard. In the design-build approach, synchronized collaboration among all contractual stakeholders stands as a pivotal element for its triumph. Organizing tasks chronologically and categorizing the diverse project activities is a captivating yet demanding aspect of this endeavor. (AYRANCI, 2019)

5.2. CONSTRUCTION SCHEDULING/NETWORK PROGRAMMING

Construction scheduling holds paramount importance as it stands among the pivotal components within any construction endeavor. A meticulously structured schedule can be the decisive factor in determining the project's success or downfall. For builders, it could signify the distinction between realizing a profit and incurring substantial losses on the project.

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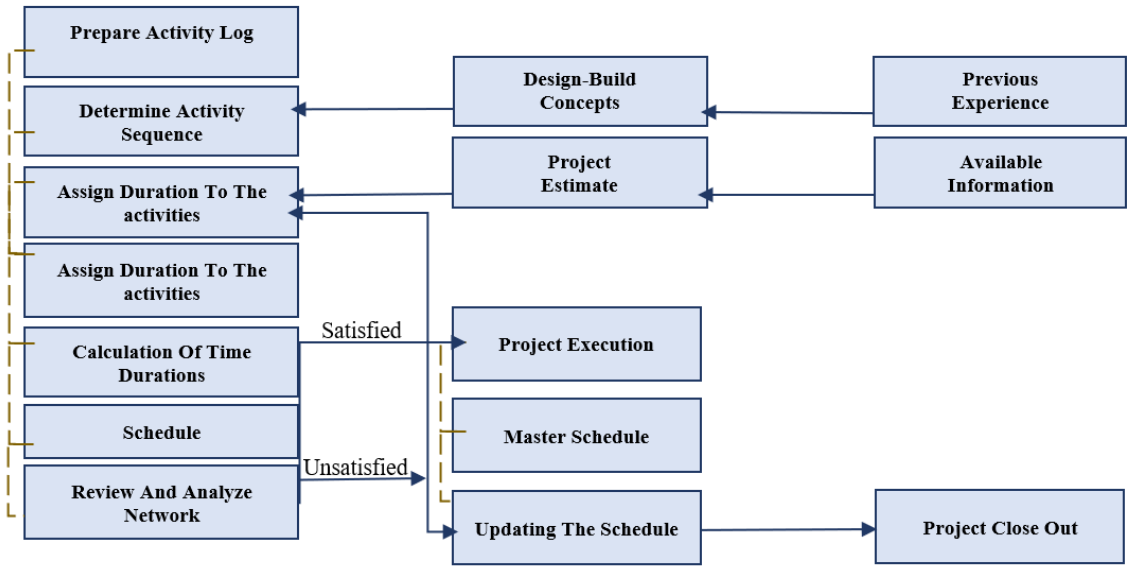

Figure 2- Flow chart sequencing the Schedule programming

6.SUSTAINABILITY: AN OVERVIEW

Sustainable development is a comprehensive concept that encompasses the necessary measures to reduce the environmental impact of new constructions. Embracing a sustainable approach in design and construction necessitates an innovative and extensive learning process. This involves implementing advancements in various areas such as the use of new materials, increasing energy efficiency, reducing waste, and studying the reciprocal impact between societies, cultures, and the environment. Additionally, it requires adapting policies to align with the latest technical knowledge and developments. (Zuo, 2014)

6.1. SUSTAINABLE DEVELOPMENT GOALS

The Global Goals, also known as the Sustainable Development Goals (SDGs), constitute a universal summons for worldwide action, aiming to eliminate poverty, safeguard the environment, and ensure collective well-being, peace, and prosperity. These objectives comprise seventeen distinct categories, which have been built upon the accomplishments of the Millennium Development Goals (2000-2015). They encompass both established triumphs and novel domains like climate change, economic disparity, innovation, sustainable consumption, justice, and peace.

Given the interdependence among these goals, the effectiveness of addressing a specific objective often hinges on tackling associated challenges that are closely interconnected with other objectives. (Organization, 2019)

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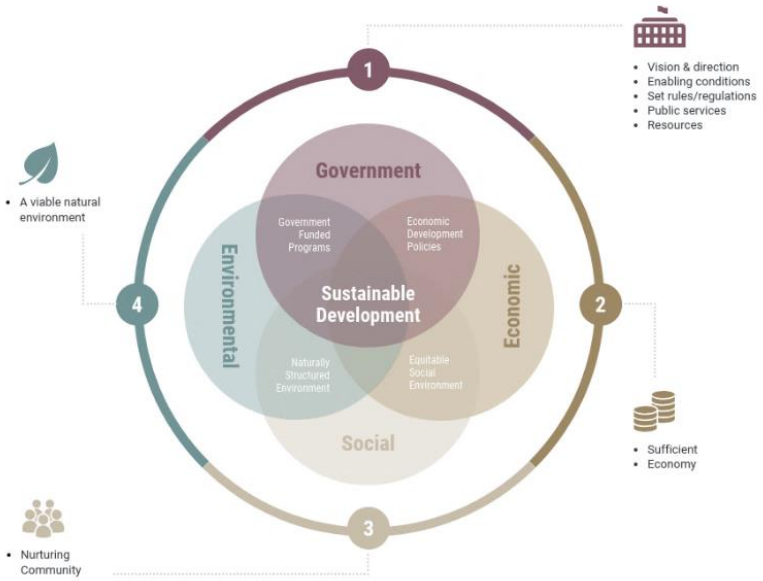

Figure 3- Sustainable Development Goals: A need for relevant indicators. Ecological indicators

In September 2015, world leaders unified their efforts by embracing the 2030 Agenda for Sustainable Development, marking a historic global summit. Over the ensuing fifteen years, nations will labor toward these freshly outlined goals, with the shared recognition that global collaboration is essential for eradicating poverty, confronting inequality, mitigating climate change, and ensuring comprehensive inclusion in these undertakings.

The achievement of the Sustainable Development Goals necessitates cooperative action, executed in a pragmatic manner, to facilitate present-day improvements that endure for future generations. This framework delivers distinct benchmarks and aspirations for all countries to adopt, tailored to their specific priorities, while remaining attuned to the worldwide ecological challenges.

6.2. RELATIONSHIP BETWEEN SUSTAINABLE DEVELOPMENT AND PROJECT MANAGEMENT

Projects have a central function in streamlining business operations with a focus on sustainability. Approximately one-third of the global output stems from projects, underscoring their substantial capacity to influence and contribute to a more sustainable future by integrating sustainability principles into project management practices.

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6.3. SUSTAINABLE PROJECT MANAGEMENT

"Sustainable project management entails the strategic planning, vigilant monitoring, and adept control of project deliverables and its supportive elements. This entails considering the environmental, economic, and societal dimensions across the entire life cycle of project resources, processes, outcomes, and their impacts. These efforts aim to generate benefits for stakeholders and are conducted in a transparent, equitable, and morally sound manner, incorporating active involvement from relevant stakeholders."

6.4. SUSTAINABLE PROJECT MANAGEMENT ELEMENTS CHECKLIST

Table 1- SUSTAINABLE PROJECT MANAGEMENT ELEMENTS CHECKLIST

No	A Checklist to the Elements of Sustainable Project Management		●	○	Points
1	**Energy Efficiency**	A. Use energy modeling software to predict and quantify the project's energy consumption and identify opportunities for improvement			
		B. Measure the expected energy performance, including energy use intensity (EUI) or energy cost savings, compared to industry benchmarks or project goals.			
2	**Material Selection**	C. Conduct LCAs to assess the environmental impact of materials and product choices over their entire life cycle, from extraction to disposal.			
		D. Measure the percentage of recycled materials used in construction and compare it to sustainability targets			
3	**Water Efficiency**	E. Evaluate water-efficient fixtures and systems to estimate water savings and water consumption compared to baseline standards			
		F. Measure efforts to enhance water quality through stormwater management and treatment.			
4	**Indoor Environmental Quality (IEQ)**	G. Assess indoor air quality through testing for pollutants and monitoring ventilation rates.			
		H. Measure the availability of natural daylight and views for occupants.			
5	**Sustainable Site Planning**	I. Evaluate the project's location in terms of proximity to public transit, walkability, and access to amenities.			
		J. Assess efforts to reduce site disturbance, protect natural habitats, and manage stormwater through sustainable site practices.			
6	**Waste Management**	K. Measure the percentage of construction waste that is diverted from landfills through recycling and reuse.			

7	**Cost and Budget Metrics**	L. the cost-effectiveness of sustainable design strategies, such as evaluating the payback period for energy-efficient systems or sustainable materials.			
		M. Ensure that sustainable design elements align with the project's budget constraints.			
8	**Social and Community Impact**	N. Measure the level of engagement with local communities and stakeholders during the design phase.			
		O. Evaluate efforts to promote social equity, such as ensuring accessibility for people with disabilities or providing affordable housing.			
9	**Resilience and Adaptation**	P. Assess the project's resilience to climate change impacts and extreme weather events.			
		Q. Measure the incorporation of strategies that enhance the project's ability to adapt to changing environmental conditions			
10	**Regulatory and Certification Compliance**	R. Ensure that the project aligns with local building codes, zoning regulations, and sustainability certification requirements (e.g., LEED, BREEAM).			
11	**Stakeholder Satisfaction**	S. Collect stakeholder feedback and satisfaction data regarding the design elements and sustainability features.			
12	**Risk Assessment**	T. Assess potential risks related to sustainability goals, such as supply chain disruptions for sustainable materials.			
13	**Documentation and Reporting**	U. Evaluate the completeness and accuracy of sustainability documentation and reports for third-party verification and certification.			
14	**Resilience Planning**	V. Assess the design's resilience to natural disasters, climate change, and other potential disruptions.			
		W. Measure the incorporation of resilience strategies such as flood protection or climate-responsive design			
15	**Sustainable Land Use Planning**	X. Evaluate land use patterns to optimize density and minimize sprawl			
		Y. Measure the proximity of essential services, amenities, and green spaces to the project site.			
16	**Zero-Waste Design**	Z. Strive for a zero-waste design approach by minimizing waste generation through careful planning and material selection			
		AA. Measure progress toward achieving zero-waste goals.			
17	**Responsible Sourcing and Fair Trade**	BB. Evaluate the use of responsibly sourced materials and products, including those with Fair Trade certifications.			
		CC. Measure the percentage of materials meeting sustainability and ethical criteria			

18	**Sustainable Transportation Planning**	DD. Assess the design's support for sustainable transportation modes, such as biking, walking, and electric vehicle charging infrastructure.			
		EE. Measure the reduction in vehicular emissions through transportation-oriented design.			
19	**Sustainable Landscape Design:**	FF. Consider sustainable landscaping practices, including native plant selection, irrigation efficiency, and water conservation.			
		GG. Measure the reduction in water use and maintenance requirements for landscaping.			
20	**Inclusivity and Universal Design**	HH. Ensure that the design is accessible and inclusive for people of all abilities.			
		II. Measure the mitigation measures and strategies proposed in response to the assessment			

Developing a checklist to assess elements of sustainable project management provides a systematic and consistent method to guarantee that sustainability factors are integrated throughout all aspects of a project.

7.SUSTAINABLE/ GREEN BUILDING CONSTRUCTION

Green building construction, sustainable construction can refer to the qualities and characteristics of buildings constructed using sustainable construction principles, that is, healthy buildings constructed in a resource efficient manner using ecologically focused principles (Kibert, 2008). Specifically, green building construction is the practice aimed at increasing the efficiency with which buildings use energy, water, and materials and their effectiveness in protecting and restoring human health and environmental quality throughout the life cycle of building, that is, siting, design, construction, operation, maintenance, renovation, and deconstruction (Abdulaziz, 2016b).

7.1. CURRENT SITUATION OF SUSTAINABLE CONSTRUCTION IN EGYPT

The majority of architectural firms in Egypt are managed by architects with academic backgrounds who, alongside their practices, have additional sources of income. Consequently, there are instances were applying their theoretical knowledge or even their teaching in practice can prove challenging. This situation arises partly because educational curricula may, to some extent, become outdated. To retain their client base, these professionals often compartmentalize their roles when dealing with their architectural practices.

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7.2. CURRENT STATUS OF THE UK CONSTRUCTION INDUSTRY

A recent report commissioned by the Department for Business, Innovation, and Skills (BIS) has highlighted the necessity for a sustainable construction strategy that not only boosts the construction industry's contribution to the gross domestic product (GDP) by 8% but also generates employment opportunities for approximately 3 million individuals.

The construction sector has wielded significant influence in the UK market, with statistics from the Department for Business and Regulatory Reform indicating that it constitutes 10% of the UK's GDP, amounting to approximately £100 billion annually. Of this, design activities alone contribute around £3.5 billion per year. (Feria, 2019)

8. CASE STUDY

Table 2- Selected case studies in both Egypt and the United Kingdom

EGYPT	UNITED KINGDOM
 Figure 4- Project "Ahalena 1"	 Figure 5- Project " McGrath Road"
Location: in El-Salam 1 District, Cairo, Egypt	Location: McGrath Road, London, United Kingdom
 Figure 6- Project "El-Mahrousa 1"	 Figure 7- Project "Dujardin Mews"
Location: "El-Mahrousa 1" in El-Nahda, Cairo, Egypt	Location: located in Enfield, London, United Kingdom

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 Figure 8- Project 10th of Ramadan City	 Figure 9 - Project " Kings Crescent Estate Phases 1&2"
Location: in 10th of Ramadan City, Cairo, Egypt.	Location: murrain Road, London, United Kingdom
 *Figure 10 - Project October Gardens City*	 Figure 11- Project “Cherry Court, Bacton Estate"
Location: October, Cairo, Egypt.	Location: 27 Vicar's Rd, London NW5 4NN, UK, United Kingdom

Each of the case studies was analyzed according to the elements of sustainable management and measured on a special evaluation table for these elements and evaluation at the level of the general site, composition and formation of the facades, and sustainable orientation in terms of design and management of the project.

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9. Comparative Analysis

Table 3- Compare the results between Egypt Projects.

Elements of Evaluation	Egypt			
Social Housing Projects	**"Ahalena 1"**	**"El-Mahrousa 1"**	**10th of Ramadan City**	**October Gardens City**
1. **Sustainable Transportation Planning** 2. **Sustainable Landscape Design:** 3. **Inclusivity and Universal Design** 4. **Indoor Environmental Quality (IEQ)** 5. **Sustainable Site Planning** 6. **Waste Management** 7. **Water Efficiency** 8. **Social and Community Impact** 9. **Resilience and Adaptation** 10. **Regulatory and Certification Compliance** 11. **Material Selection** 12. **Risk Assessment** 13. **Documentation and Reporting** 14. **Resilience Planning** 15. **Sustainable Land Use Planning** 16. **Zero-Waste Design** 17. **Responsible Sourcing and Fair Trade** 18. **Energy Efficiency** 19. **Cost and Budget Metrics** 20. **Stakeholder Satisfaction**	The evaluation context for sustainable project management in Egypt is characterized by a dynamic interplay of environmental, economic, and social factors that reflect the country's unique conditions and priorities. Egypt's predominantly arid climate and environmental challenges, including water scarcity and desertification, underscore the urgent need for sustainability in resource management. Sustainability in housing projects is closely tied to improving water and energy efficiency and mitigating environmental impact. Economically, Egypt's diverse income spectrum and rapid urbanization necessitate a focus on affordable housing solutions. This context brings economic considerations to the forefront, where evaluations emphasize cost-effective sustainable measures that contribute to long-term financial benefits. Regulatory context, guided by building codes and evolving sustainability standards, provides the foundation for assessing project performance. Compliance with these standards shapes the expectations for sustainability in housing projects. The social context in Egypt emphasizes community engagement and the preservation of cultural values, which can influence project design and stakeholder involvement. Government policies and initiatives for sustainable development are central to the context, underlining the importance of sustainability in the country's strategic objectives. The role of the community in decision-making and feedback processes is pivotal, as residents and stakeholders have a vested interest in the success of sustainable housing projects. In sum, the context for evaluating sustainable project management in Egypt is multifaceted and emphasizes the need for tailored, context-specific approaches that address the country's unique environmental, economic, and social challenges and opportunities.			
Result	**21P**	**19P**	**18P**	**17P**

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Table 4- Compare the results between United Kingdom Projects.

Elements of Evaluation	United Kingdom			
Social Housing Projects	**McGrath Road**	**"Dujardin Mews"**	**Kings Crescent Estate Phases 1&2**	**Cherry Court, Bacton Estate**
1. **Sustainable Transportation Planning** 2. **Sustainable Landscape Design:** 3. **Inclusivity and Universal Design** 4. **Indoor Environmental Quality (IEQ)** 5. **Sustainable Site Planning** 6. **Waste Management** 7. **Water Efficiency** 8. **Social and Community Impact** 9. **Resilience and Adaptation** 10. **Regulatory and Certification Compliance** 11. **Material Selection** 12. **Risk Assessment** 13. **Documentation and Reporting** 14. **Resilience Planning** 15. **Sustainable Land Use Planning** 16. **Zero-Waste Design** 17. **Responsible Sourcing and Fair Trade** 18. **Energy Efficiency** 19. **Cost and Budget Metrics** 20. **Stakeholder Satisfaction**	United Kingdom is marked by its distinct environmental, economic, and social parameters. The UK's temperate climate and geographic diversity influence the sustainability measures adopted, focusing on aspects like energy efficiency, insulation, and water conservation. Stringent environmental regulations and adherence to sustainability standards, including BREEAM and Passivhaus, provide the foundation for assessing sustainability achievements in construction and housing projects. The preservation of natural habitats and landscapes is also a priority, affecting project site selection and design. In the economic realm, considerations revolve around the affordability of housing and the long-term financial implications of sustainable features, with evaluations emphasizing return on investment (ROI) linked to energy savings, reduced operational costs, and potential market value increases. The mature construction and real estate markets in the UK encourage innovation in sustainable practices and the adoption of cutting-edge technologies. The social context in the UK entails a commitment to enhancing resident well-being and fostering inclusivity in housing projects. This includes factors like indoor air quality, access to green spaces, and the provision of community amenities. Housing affordability is a significant concern, and social inclusion efforts aim to create diverse and vibrant communities. Stringent health and safety standards contribute to the context, ensuring that housing projects prioritize the well-being of residents. Furthermore, the UK's regulatory landscape, compliance with sustainability regulations and certifications (such as the Code for Sustainable Homes and LEED), and active stakeholder engagement, including local communities, residents, and government bodies, are all integral aspects of the context for evaluating sustainable project management. This multifaceted context sets the stage for the comprehensive assessment of sustainability performance in housing projects, aligning with local regulations, standards, and community aspirations.			
Result	**25P**	**30P**	**28P**	**29P**

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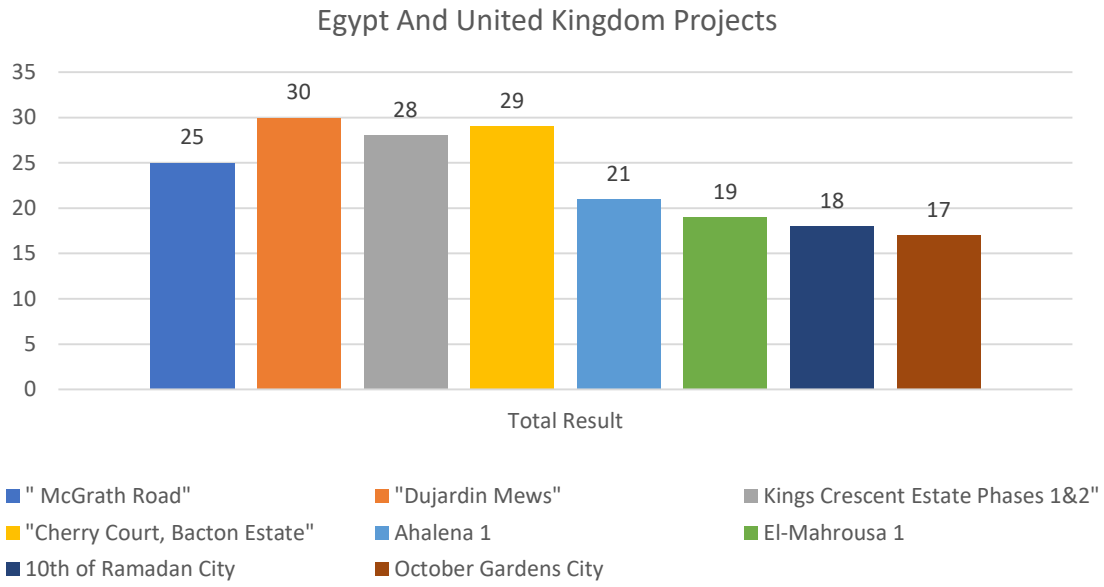

The observed variation in the application of sustainable management elements during the design phase of housing projects in Egypt and the United Kingdom underscores the complex and context-dependent nature of sustainable project management. It results from a multitude of interconnected factors, including diverse contextual backgrounds, regulatory frameworks, resource availability, project-specific constraints, stakeholder priorities, and government support. This variation highlights that sustainable project management is not a one-size-fits-all approach but necessitates tailored strategies to align with the unique circumstances and challenges of each project. The extent of disparity in evaluation scores reflects the dynamic and evolving landscape of sustainability in construction and housing, emphasizing the importance of continuous adaptation and collaboration to further advance sustainable practices in both countries and across the globe.

10. CONCLUSIONS AND RECOMMENDATIONS:

The imperative integration of sustainable design practices into the built environment is a response to contemporary challenges like climate change, resource depletion, and environmental degradation. Governments and professional bodies play crucial roles in propelling this transformation. Governments, through policy formulation, financial incentives, and infrastructure planning, establish regulatory frameworks and provide the necessary drive for sustainable design. Concurrently, professional bodies contribute by setting standards, providing training, and advocating for industry best practices. This collaborative effort cultivates an environment that encourages innovation, raises professional standards, and contributes to the development of a built environment that is ecologically responsible and socially responsive here are some recommendations

- Strengthen Regulatory Frameworks: Governments should continually enhance and update regulatory frameworks to incentivize and mandate sustainable design practices.

This involves revisiting building codes, zoning laws, and environmental regulations to align with the latest advancements in green building.

- Promote Sustainable Practices: Governments should expand and optimize financial incentives to motivate private developers and businesses to embrace sustainable design. This may include tax credits, grants, and subsidies for projects meeting or surpassing established sustainability standards.
- Invest in Research and Development: Governments should allocate funds for research and development initiatives focused on sustainable technologies, materials, and design strategies. This investment will stimulate innovation and make sustainable practices more accessible and cost-effective.
- Support Education and Training: Both governments and professional bodies should invest in educational programs and training initiatives to ensure architects, engineers, and other professionals are equipped with the knowledge and skills required for sustainable design.
- Foster Knowledge Sharing: Professional bodies should create platforms for knowledge sharing among industry professionals, including conferences, workshops, and online forums. These avenues enable practitioners to share insights, challenges, and best practices related to sustainable design.
- Collaboration and Advocacy: Governments and professional bodies should collaborate on advocacy efforts to raise awareness about the significance of sustainable design. This involves engaging with the public, policymakers, and industry stakeholders to build consensus and support for sustainable practices.
- Expand Certification Programs: Professional bodies should expand and promote certification programs recognizing and celebrating sustainable design achievements. This not only validates practitioners' efforts but also establishes a benchmark for excellence in the industry.
- Prioritize Social Sustainability: Sustainable design should not solely concentrate on environmental factors but should also prioritize social sustainability. This involves designing spaces that enhance occupants' well-being, foster community engagement, and contribute to social equity.

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