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Leveraging Contemporary Project Management Techniques and Technology for Sustainable Telecommunications Advancement in Yemen

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Abstract

The digital techniques and technology have transformed formal project management field dramatically by enhancing communication, resource management and efficiency. This study aims to evaluate the efficacy of contemporary project management methodologies in promoting and facilitating sustainable development within the telecommunications sector in Yemen. Situated within the broader discourse on achieving the United Nations Sustainable Development Goals, the research employs a mixed methods approach to gather both quantitative and qualitative data. Quantitative data was collected through a survey of 150 professionals across major telecommunications firms in Yemen. The survey examined familiarity and application of techniques and technology such as waterfall, agile, six sigma, and lean. Qualitative insights were derived from 22 in-depth interviews with project managers and stakeholders. The findings of the study indicate that there is a narrow scope for integrating sustainability in Yemen's telecommunications sector projects. Despite the research indicating a considerable level of awareness and utilization of contemporary methodologies, the integration of sustainability objectives varies considerably between projects. While numerous projects adopt environmental sustainability strategies, such as enhancing energy efficiency to reduce environmental impact and minimize carbon emissions, they lack comprehensive sustainability strategies that encompass economic, social, and environmental aspects in an integrated manner. The qualitative interviews yielded insights into the significant challenges to sustainable implementation, including insufficient training, organizational obstacles, and the effects of the ongoing conflict. In light of these findings, the paper addresses these challenges and provides recommendations and effective strategies to overcome them.

Article Info

Keywords:

Agile Project Management (APM), Code Division Multiple Access (CDMA), Lean Thinking Concept , Modern project management methodologies, SIX SIGMA MODEL,Sustainable Development,Telecommunications sector

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1. INTRODUCTION

Given the complex global challenges of climate change, population growth, and political instability, developing sustainable strategies has become imperative. Sustainable development ensures consideration of impacts on future generations and responsible stewardship of resources. As emphasized in seminal reports like the Brundtland Commission and Rio Earth Summit, organizations must contribute to equitable and sustainable development.

The UN Sustainable Development Goals call for companies to adopt sustainable business models through investment and solutions. Project management (PM) represents an approach to address complex problems, having emerged in the early 20th century and continuously evolving. The appropriate PM methodology depends on the problem and complexity.

Effective PM aids organizations in minimizing time-to-market, optimizing resources, managing technology, satisfying stakeholders, and enhancing competitiveness.

For Yemen, telecommunications is significant as national infrastructure supporting economic growth and social connectivity. However, ongoing conflict resulted in 4.1 billion in losses from 2015-2019, greatly impacting sector performance due to fuel shortages, divisions, and financial disputes.

Currently facing pivotal change, the sector must shift PM approaches and strategies to adapt to technological and socioeconomic transformations. Integrating sustainable PM methodologies is paramount to overcoming challenges and contributing to Yemen's SDGs through the sector. This research thus evaluates how PM methodologies can facilitate sustainable development under complex conditions in Yemen's telecommunications industry.

The telecommunications and information technology sector in Yemen is a vital component of the country's infrastructure, and it plays an important role in economic growth. It is also one of the most important sources of revenue for the state, especially in acquiring hard currency. The sector was second only to the oil and gas sector in generating public financial revenues and foreign currency. Between 2015 and 2018, the telecommunications and information technology sector contributed around 7% to Yemen's real gross domestic product (GDP). (Central Statistical Organization,2017). The sector provides employment opportunities directly and indirectly through linkages with other parts of the economy that depend on it [1]

- According to an estimate by the Ministry of Telecommunications and Information Technology in Sana'a, the total wartime losses of the telecommunications sector as of March 2020 are estimated at $4.1 billion due to the damage or destruction of infrastructure, including facilities, telecommunications towers and stations, telephone centrals; confiscation of equipment arriving at Yemen's ports; and the inability to utilize some of the international internet cables due to the ongoing conflict*.
- A review of the existing literature reveals a clear knowledge gap regarding the lack of studies that have analyzed the potential contribution of modern project management methodologies to sustainable development in the telecommunications sector. The present study aims to address this gap in the literature and provide a robust theoretical foundation for further research, thereby enhancing the strength of its arguments and conclusions and contributing new scientific insights to the field. A substantial body of research has been conducted on the concepts of sustainability and project management as discrete entities [2].
- The findings of Herzing's study, [3] indicate that contemporary project management methodologies, particularly those associated with agile project management and the effective utilization of project management methodologies, are of paramount importance in achieving sustainable development. aligning these methodologies with organizational strategies, organizations can enhance project success and contribute significantly to the achievement of the Sustainable Development Goals (SDGs).
- The Agile Project Management (APM) methodology is an effective tool for organizational leaders seeking to enhance project success. The application of agile methods is particularly well suited to environments characterized by uncertainty and ambiguity, as it facilitates the flexibility required in rapidly changing projects. The overarching objective of agile methodologies is to deliver the greatest possible value to the customer while maintaining a sustainable pace. This approach optimizes the utilization of resources and ensures the long-term sustainability of projects. This is of particular importance in contexts characterized by resource constraints and rapid change. [4].
- Six Sigma is a methodology that enables organizations to address challenges and issues by improving processes, analyzing data and developing effective operational strategies that focus on customer needs and business sustainability [5].

* Since 2014, the Republic of Yemen is going through a civil and regional war which it consequently effects all companies in the country.

- A review of the literature on the application of Lean in this sector reveals that tangible improvements can be achieved in reducing waste and improving delivery times and service decisions. These improvements have a positive impact on customer satisfaction and reduce operational costs. They also enable organizations to better adapt to unforeseen circumstances and market volatility. This adaptability is a critical factor in the success and sustainability of industries that are subject to rapid changes, such as telecommunications [6].

2. RELATED WORK

Over the last decade, the global telecommunications sector has excelled, mainly due to technological advancements and the growing trend of smartphone usage. Significant investments from successful telecom giants like Orascom, Etisalat, Telenor, China Mobile, and Singtel support this perception. As mobile and telecom technologies rapidly advance, the lifecycle of personal communication is evolving. The concept of accessing utilities on any device, anywhere, through any network is gaining momentum. In the next ten years, the use of GSM and internet-enabled tablets and other mobile devices is expected to increase significantly [7]. The telecommunications and information technology sector in Yemen is a crucial component of the country's infrastructure and plays a significant role in economic growth. Beginning

in 2001 and accelerating between 2013 and 2014, the sector saw substantial investments from both the private sector and the government. Telecommunications towers and infrastructure were installed across much of the nation, enabling access to telecommunications services in most Yemeni cities and villages, and leading to a rapid spread of mobile phones and internet services. Prior to 2001, cellular services were provided through the analog network of TeleYemen, a publicly owned sole mobile operator. The sector is immensely important for economic development, social progress, and human capital, connecting people, communities, and businesses through the exchange of information in an increasingly interconnected global economy. It is also one of the state's most significant sources of revenue, especially in acquiring hard currency. Before the conflict, the sector was second only to the oil and gas industry in generating public financial revenues and foreign currency. ORGANIZATIONAL AND INSTITUTIONAL STRUCTURE OF THE SECTOR The Ministry of Telecommunications and Information Technology serves as the governmental authority tasked with enforcing state-enacted laws that regulate various components of the sector, such as landline telephones, mobile phones, internet services, and postal services. Its responsibilities include approving new bylaws, formulating sector policies and plans, managing the frequency spectrum for mobile broadband services, granting licenses for the establishment and operation of private or public networks, maintaining the national numbering plan, and approving pricing policies for telecommunications services. The telecommunications sector is exclusively regulated by Telecommunications Law No. 38 of 1991 Pertaining to Wired and Wireless Telecommunications, as amended by Law No. 33 of 1996 . However, it does not serve as the legal reference point for mobile telecommunications and internet companies and their services in Yemen. Instead, these companies—which began operating several years after the technology-specific laws were enacted (internet service providers started in 1996 and mobile phone operators in 2001) are regulated by the licensing agreements established between the government and each network operator [8]. The main concern is not so much whether these individual license agreements are standardized in terms of their conditions, costs, and procurement processes, but rather that relying on outdated legislation and fragmented regulations undermines the legal framework governing the sector and discourages private investment. The Public Telecom Corporation under the Ministry of Telecommunications and Information Technology is the sole provider of landline services and one of the key internet service providers, alongside the Yemen International Telecommunications Company (TeleYemen), which also offers international calling and mobile satellite services. To help manage the high investment and operational expenses of mobile phone companies and to enhance the private sector's role in the economy, the government has encouraged private investment in the telecommunications sector by implementing a variety of structural reforms. For example, in 1997, the Yemeni government launched an economic reform program in collaboration with the World Bank and the International Monetary Fund (IMF). This initiative aimed to reduce the state's involvement in the economy and to boost the private sector's participation. Additionally, as part of the government's incentives, some operators have entered into exclusivity agreements with the government for durations of up to four years [9]. As a result, the private sector has played an active role in telecommunications since 2001. To date, the government has issued three operating licenses to private companies for the operation of Global System for Mobile Communications (GSM) networks, specifically Sabafon, YOU, and HiTS Unitel, which operates under the trade name Y Telecom. Additionally, the government, through the Public Telecom Corporation, established a fourth company, Yemen Mobile, which runs a Code Division Multiple Access (CDMA) network. According to Central Statistical Organization (CSO), in 2016 .

Table 1

Table 1. Institutional structure of the telecommunications sector in Yemen

Company	Ownership	Activity
Public Telecom Corporation	Government	Oversees landline telecommunication network, provides services throughout Yemen, including phone, internet and data transmission.
TeleYemen	Government	Provides international telecommunications services, analogue mobile phones, and internet.
Sabafon	Private Sector	Provides GSM services.
MTN Yemen Currently known as YOU	Private Sector	Provides GSM services.
Yemen Mobile	Government	Provides CDMA services.
Y Telecom	Private Sector	Provides GSM services.

Source: National Information Center, https://yemen-nic.info/sectors/information/(2020).

- **Sustainable Development**

Sustainability has become a popular topic among the scientific community, businesses, financial markets, and other stakeholders. Growing awareness stems not only from environmental challenges but also from economic and social issues. In response, Corporate Social Responsibility (CSR) strategies have been introduced, although many companies view them as a cost rather than an investment. However, companies recognize the importance of innovation for long-term growth. As a result, the scientific community is addressing this through sustainable innovation, a comprehensive approach that combines innovation, environmental protection, and economic performance. There is a growing recognition of the need to develop methods, tools, and techniques to in-

corporate sustainability criteria into project management [10]. This development inherently involves an innovative process that must appeal to organizations by ensuring efficiency, meeting quality standards, and achieving sustainability, all without sacrificing economic returns. Sustainability has garnered increasing attention (Lélé, 1991) for several key reasons: scarce and valuable natural resources are being gradually depleted, and the growing global population places excessive demands on these limited resources. Additionally, human activities are leading to negative and often irreversible consequences—such as environmental pollution, overuse of resources, and greenhouse gas emissions—resulting in even more serious challenges. In light of this, ensuring sustainable development is a responsibility that should be embraced by everyone, not only for the present but also for future generations. Similarly, the World Commission on Environment and Development (1987) defines sustainability as"meeting the needs of the present without compromising the ability of future generations to meet theirs". However, it is generally acknowledged that there is no single, definitive definition of sustainable development. This suggests that individuals or organizations may interpret the concept of sustainable development according to their own interests or depending on the specific circumstances in which they operate [11]. According the book Becoming a sustainable organization by Khol, [12], The concept of sustainability is defined as considering both the short- and long-term environmental, social, and economic impacts of organizational decisions and actions. This holistic approach includes elements such as greenhouse gas emissions, product stewardship, regulatory compliance, and supply chain management, while also addressing community impacts, employee health and safety, and workforce diversity. Central to many interpretations of sustainability is the idea that sustainable development involves advancing economic prosperity, environmental protection, and social equity. Progress in one area should not come at the expense of the others. For instance, economic growth should not harm the environment, and societal tensions, like the 2011 Arab revolutions, can negatively affect both the economy and the environment (as seen with the 2010 waste crisis in Naples). Therefore, when companies, NGOs, or politicians aim to implement changes, they must consider the impact on all three dimensions, striving for a balance or harmony between economic, environmental, and social perspectives.The TBL concept is crucial in this context as it extends project management to include environmental, social, and economic dimensions of sustainability. The theory discusses how TBL principles can be incorporated into project management practices to ensure comprehensive sustainable outcomes [11].

Project Management:

The Project Management Institute defines a project as a temporary effort undertaken to create a distinct product, service, or result. The project life cycle generally progresses through four stages in sequence: defining, planning, executing, and delivering. The project begins as soon as it is approved, with the work starting gradually, peaking in intensity, and then tapering off until the final delivery to the customer.

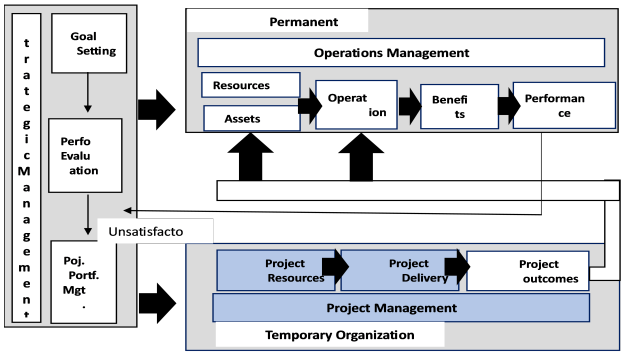
Defining Stage: In this phase, the project's specifications are outlined, objectives are set, teams are assembled, and key responsibilities are assigned.

Planning Stage: During this phase, effort increases as detailed plans are developed. These plans outline what the project will involve, its schedule, its beneficiaries, the quality standards to be maintained, and the budget required.

Executing Stage: This is where the bulk of the work happens—both physical and intellectual. The actual product, whether a bridge, report, or software program, is created. Controls are put in place to monitor time, cost, and specifications. Is the project on schedule, within budget, and meeting its specifications? What adjustments or changes are needed to stay on track?

Closing Stage: This final phase involves three key activities: delivering the finished product to the customer, reassigning project resources, and conducting a post-project review. Delivery may include customer training and handing over necessary documentation. Resource redeployment typically involves releasing equipment and materials for use in other projects and assigning team members to new tasks. The post-project review assesses the project's performance and documents lessons learned. The growth of new knowledge has led to an increase in the complexity of projects, as they now incorporate the latest advancements. For example, building a road 30 years ago was relatively straightforward, but today, every aspect—materials, specifications, codes, aesthetics, equipment, and required specialists—has become more complex. Similarly, in today's digital and electronic age, it is difficult to find a new product that does not contain at least one microchip. This increasing complexity has created a greater need to integrate diverse technologies, making project management an essential discipline to achieve this integration. Moreover, the threat of global warming has brought sustainable business practices to the forefront. Companies can no longer focus solely on profit at the expense of the environment and society. Efforts to reduce carbon footprints and use renewable resources are being realized through effective project management. This shift towards sustainability is reflected in the changes in both the objectives and methods used to complete projects. The rise in competition has heightened the importance of customer satisfaction. Customers are

no longer content with generic products and services; they now seek personalized solutions that meet their specific needs. This shift requires a much closer working relationship between providers and customers. Account executives and sales representatives are increasingly taking on the role of project managers, collaborating with their teams to meet the unique demands of clients. This focus on customer satisfaction has also led to the creation of more tailored products and services. For instance, 15 years ago, purchasing a set of golf clubs was a straightforward task simply choosing a set based on price and preference. Today, golf clubs are available for tall players, short players, those who slice the ball, and those who hook it. There are also high-tech clubs featuring the latest metallurgical innovations designed to increase distance, among other options. Project management plays a vital role in both the development of these customized products and services and in maintaining profitable relationships with customers [13]. According Silvius. G. [14] related the concept of sustainability to the project life cycle and developed a maturity model to assess the level of consideration of sustainability in projects, focusing his approach on levels of sustainability in resources, processes, business models and products/services. Sustainable Project Management (SPM) involves incorporating social and environmental considerations into project management activities to enhance project performance. A Sustainable Business Model fig1 refers to the approach an organization uses to generate benefits while ensuring that future generations can meet their own needs without compromise. Silvius, who emphasizes a significant transition from a traditional approach focused on technical tasks to more holistic approach that



Author based on Silvius, G., Schipper, R., Planko, J., van den Brink, J., & Köhler, A. (2012). Sustainability in project management.

Figure 1

includes the management of organizational change. This transformation is highlighted through different phases and historical milestones: Early development: Project management initially developed as a discipline primarily concerned with technical and mechanical tasks. This phase was characterized by the use of structured, mathematical techniques to optimize design, construction and production processes. Adoption of information technology: With the advent of information technology, project management began to permeate all industries and sectors, leading to a shift in its nature and scope. Shift to a soft paradigm: a transition from a rigid mathematical approach to a softer paradigm, where project management focuses more on social interactions than purely mathematical optimization. This shift acknowledges that project goals, methods, expectations, solutions, outcomes, and success are less predictable and are more significantly shaped by human factors. Research trends: A study by Kloppenborg and Opfer, [15] traced the evolution of project management research, noting a shift in focus from large defense-related projects in the 1960s to topics such as team building, quality and knowledge management in the 1990s. This reflected broader interest the human resource and organizational change aspects of project management. Modern View of Project Management: Today, is seen as management of project-organized change across different organizational functions. Projects are seen as temporary organizations designed to achieve specific results that are aligned with an organization's strategy, using specified resources and budgets. Complex Project Management: concept has emerged address the limitations of traditional project management in dealing with the complexity and uncertainty of modern projects. This approach views projects as complex systems that require a holistic management approach, emphasizing the importance of human relationships and adaptability. This evolution reflects the increasing complexity of projects and the need for a more integrated approach that addresses not only the technical aspects but also the broader organizational and human factors. The shift towards managing organizational change and adopting a more flexible, people-centered approach to project management is essential to managing the complexity of modern projects and achieving sustainable success. [16]. Agile Project Management: The Agile methodology provides a flexible and adaptable framework that can effectively address complex challenges, instability, and fragile infrastructure. By focusing on interpersonal interaction, continuous delivery, and effectively managing priorities, the Agile methodology can assist organizations in achieving greater success in challenging environments [17]. As project management entered the new millennium, many professionals realized that a one-size-fits-all approach did not suit their needs. This was especially true for software and product development projects, where the final product is not clearly defined and evolves over time. Such environments demand flexibility and the ability to manage changes as new information emerges and lessons are learned. This

is where Agile Project Management (Agile PM) comes into play. Rather than trying to plan the entire project upfront, Agile PM uses incremental, iterative development cycles to complete projects. Ken Schwaber illustrates the difference between traditional project management and incremental, iterative development with the analogy of building a house. In a traditional approach, the buyers wouldn't move in until the entire house was finished. In the iterative approach, the house would be built room by room, starting with the most important room (such as the kitchen), and the plumbing, electrical, and infrastructure would be extended as more rooms were completed. After each room is built, both the builders and buyers would assess progress and make necessary adjustments. Buyers might realize they don't need an extra room they initially thought was essential, or they could add features they hadn't considered. Ultimately, the house would be customized to meet the buyers' preferences. Agile PM is well-suited for exploratory projects where requirements are not fully known from the outset and new technologies need to be tested. It emphasizes active collaboration between the project team and customer representatives, breaking projects into small functional segments, and adapting to changing requirements. While the principles of iterative development have been around for a while, agile methodologies have only recently gained significant traction within the project management field. Lean Thinking Concept: The philosophy of "Lean" was developed by the Japanese in the 1950s. Its implementation began in the manufacturing sector, where Japanese companies were producing high-quality products at lower costs compared to their Western counterparts. The Lean methodology focuses heavily on identifying waste and utilizing lean tools to enhance customer satisfaction and improve quality across industries.[18] As explained by Rodriguez, Partanen, Kuvaja, and Ovio, lean thinking is founded on five key principles:

1. **Value:** Defines the customer's needs.
2. **Value Stream:** A series of processes and procedures that deliver value to the customer.
3. **Flow:** Ensures that the value stream operates continuously, allowing for smooth deliveries.
4. Pull: Products or services are delivered only when requested by the customer.
5. **Perfection:** Ongoing improvement to eliminate defects.

According to Khandelwal, M. & Khandelwal, N.[5], In the mid-1980s, Motorola pioneered the development of Six Sigma. Six Sigma is a structured and impactful methodology that relies on data and statistical analysis to measure and enhance a company's operational performance. Its primary focus is on identifying and eliminating "defects" in processes, leading to significant financial gains and improvements across various industries. The Six Sigma methodology, combined with key statistical techniques, ensures continuous quality improvement and reduced defects by setting clear targets and visions.

SIX SIGMA MODEL: The Six Sigma improvement model follows five main phases: Define, Measure, Analyze, Improve, and Control (DMAIC).
Define Phase: In this phase, the Black Belt assembles a team with members from departments affected by the problem. The team clearly defines the problem and quantifies its financial and quality impact on the company. They also identify metrics to assess the problem's past impact and track improvements as it is addressed.
Measure Phase: During the Measure phase, the team investigates the process and related measurements. They create process maps and assess the accuracy and reliability of measurement systems. New metrics are established, and potential causes of the problem are identified using various tools.
Analyze Phase: In this phase, the team focuses on pinpointing the root causes of the problem. They use statistical tools to test hypotheses and experiment with the process. Once the relationship between causes and effects is understood, the team can determine the best approach for improving the process and estimate the benefits of these improvements.
Improve Phase: In the Improve phase, the team implements changes to enhance process performance. Using the previously established metrics, they monitor the process to confirm that the expected improvements are being realized.
Control Phase: In this final phase, the team selects and applies methods to control and manage future variations in the process. These methods may include documented procedures or statistical process control techniques, ensuring that the problem does not reoccur in the future. I have chosen the Complexity Theory in Conflict-Affected Areas and the Fragile States Theory to fit the specific situation in Yemen. These theories provide an appropriate framework for understanding the challenges faced by the telecommunications sector in an environment of complexity and structural conflict. By applying these theories, modern management methods can be adapted to enhance project sustainability and achieve economic and social goals. In this context, the use of Lean, Six Sigma and Agile methodologies will be explored to enhance the telecommunications sector's ability to adapt to continuous change and achieve sustainable development. Complexity Theory in Conflict-Affected Areas: This theory postulates that in complex, conflict-affected environments, traditional linear approaches to development and project management are less efficacious. The theory emphasizes the necessity for strategies that are adaptable and flexible, capable of responding to changing conditions and unforeseen

challenges. [4]. The application of complexity theory to the study of Yemen's telecommunications sector can provide insights into the design and implementation of projects that are tailored to the challenging and complex environment, while taking into account the unique needs and challenges of the region. The Fragile States Theory: The Fragile States Theory posits that states that are particularly susceptible to collapse are those that lack the capacity to cope with a range of internal and external challenges. This theory is concerned with the distinctive challenges and strategies required for development in fragile states, which are characterized by limited institutional capacities and the prevalence of ongoing conflict. The theory of fragile states provides an important dimension to the study of the strategies of modern project management methodologies and their impact on sustainable development in the telecommunications sector in Yemen.

Previous studies:

According [19] as telecommunications companies adapt to rapidly changing market needs, agile project management is crucial. It is noted for its flexibility and ability to meet high demands on service quality and efficiency. The study also mentions the recognition of agile methodologies abroad and aims to explore their implementation in the Russian telecom industry, where agile practices are not yet widely developed. The study "Agile Project Management in Telecommunications Industry" primarily focused on the general application of Agile methodologies in the telecommunications sector and provides examples from global companies like Vodafone Turkey and Telecom Australia to illustrate the implementation and outcomes of Agile methodologies.

The study used a combination of theoretical analysis and case studies to assess the impact of Agile methodologies in the telecommunications industry, along with verifying its applications in companies such as Vodafone Turkey and Telecom Australia. The study on 'Agile Project Management in the Telecommunications Industry' mentioned several examples of global telecommunications companies that have used agile methodologies in project management. These companies include:

TechCore Inc. - This company utilized the Scrum methodology, which is one of the agile project management methods. Within four months, it achieved its goals and improved its prospects.

TelecomAustralia - The Australian telecommunications company that began transitioning to agile to build next-generation billing and ordering capabilities. The teams involved in this project benefited from the flexibility and adaptability provided by the agile approach.

Vodafone Turkey - The Turkish telecommunications company that began its agile transformation journey in 2014. The company established a pilot team and saw significant improvements in productivity, reduced error rates, and customer complaints.

These study demonstrated how agile project management has been successfully applied in global telecommunications companies, reflecting the positive impact of these methodologies on improving efficiency and responsiveness to market changes. The study, entitled "Agile Project Management and Project Success," [4] Its primary focus is on the concept of Agile Project Management (APM) and its impact on project success within organizational structures. The following is a summary of the theoretical foundations. The framework addresses the complexity and volatility inherent in the contemporary business environment, compelling organizations to reassess their agility in order to respond effectively to changes. The paper presents agile methods as a strategic approach to achieving the necessary organizational agility. This paper examines the interconnections between agile project management, organizational agility, project success and organizational culture. The relationship between agile project management and project success. This section of the framework examines the challenges of implementing agile project management in non-software environments, noting that agile projects frequently employ non-standard measures of project success. This encompasses the objective of meeting customer expectations and achieving a high degree of customer satisfaction, rather than merely adhering to traditional metrics such as time, cost, and scope. The study employs Adaptive Structure Theory (AST) as a theoretical lens to investigate the utilization of agile methodologies. AST focuses on the structures embedded in technology and social processes, which are useful in understanding how organizations leverage agile methods to enhance flexibility and responsiveness to market conditions. These theoretical foundations indicate that the utilization of agile methodologies can facilitate the capacity of organizations to adapt in a more dynamic manner to changes, and to align project outcomes with the evolving business goals and customer needs. According to a more recent study, [20], supported Agile methodologies application in the telecom industry, particularly in the USA, to manage projects involving the deployment of new technologies like 5G networks. Agile practices allow for flexibility in project scopes, accommodating rapid technological changes and iterative testing. The outcomes of using Agile methodologies in telecom projects include increased adaptability to new technologies, improved responsiveness to consumer demands, and enhanced ability to manage complex, multi-faceted projects. Agile enables projects to pivot quickly in response to feedback and emerging challenges, thereby reducing risks and improving project success rates. The study concludes with several key results and overarching conclusions

regarding Telecom Project Management practices, particularly through the lens of experiences in Africa and the USA. Here are the main points: Effective Adaptation of Practices: Both African and American contexts demonstrated successful adaptation of project management practices to their unique challenges and environments, leading to the realization of telecom project goals. Identification of Universal Best Practices: The study was able to identify best practices that are universally applicable across different geographical contexts, such as stakeholder engagement, risk management, and the integration of agile methodologies. Cultural and Regulatory Impact: The analysis confirmed that cultural and regulatory differences significantly impact project management approaches and outcomes, necessitating tailored strategies for different regions. The study concludes that effective Telecom Project Management is contingent upon the ability to adapt methodologies and practices to local contexts while also leveraging global best practices. It highlights the importance of: Cross-cultural collaboration: Enhancing collaboration across different cultural backgrounds can lead to innovative solutions and more effective project outcomes. Continuous adaptation and learning: The telecommunications sector's rapid evolution requires ongoing adaptation and learning to keep pace with technological advances and changing market demands. Strong leadership and communication: Effective leadership and clear communication are pivotal in navigating the complexities of telecom projects and ensuring successful execution despite diverse challenges. The study emphasizes that bridging the gap between diverse experiences in Africa and the USA can provide valuable insights that enhance the effectiveness of project management practices globally. It advocates for a holistic approach that incorporates both local adaptations and insights from global best practices to optimize the management of telecom projects worldwide. [20] On the other hand, Six Sigma methodology has been applied in two Indian companies, Bharti Airtel Pvt. Ltd. and Nokia Siemens Networks Ltd., the author Madhav Khandelwal emphasized through the study that Six Sigma is a very useful process that can help telecom industries adopt best practices for service delivery and enhance overall service quality. It ensures that service improvement activities focus on services that impact customers, thus increasing the impact of quality improvements on the business. Six Sigma helps improve business processes, improve service quality, and maximize returns by finding the best methods of service delivery. The study recommended implementation of Six Sigma in the telecom sector by focusing on operational strategies and customer needs and satisfaction. It stresses the importance of integrating customer feedback into the process improvement phases of Six Sigma. For successful application, it's critical that the implementation considers not just the operational strategies but also customer expectations and satisfaction levels, aligning them with the quality improvement goals. This approach helps in effectively addressing the unique challenges faced by service industries, particularly in the dynamic telecom sector. [5]. Based on Silvius, G's book "Sustainability in Project Management," overcoming obstacles to implementing sustainable practices Adopting International Standards: Implementing internationally recognized standards such as ISO 26000 and ISO 14001 can guide organizations in embedding sustainable practices. These standards provide frameworks for social responsibility and environmental management, helping organizations align their strategies with global best practices .

1. Enhancing Training and Education: It's crucial to increase awareness and knowledge about sustainability among employees at all levels. The book emphasizes the importance of incorporating sustainability principles into business strategies and operations, underscoring the need for continuous education and training programs to develop sustainability competencies.
2. Incorporating Sustainability into Corporate Governance: The book emphasizes the role of organizational governance in driving sustainability. It suggests that integrating sustainability into governance structures ensures that sustainable practices are upheld across all functions and projects, reinforcing accountability and strategic alignment with sustainability goals.
3. Utilizing the Global Reporting Initiative (GRI): This initiative offers a comprehensive sustainability reporting framework that organizations can adopt. By using the GRI framework, companies can transparently report their economic, social, and environmental performance, thus committing to measurable sustainability targets and enhancing stakeholder communication .
4. Engagement with the UN Global Compact: Engaging with global movements like the UN Global Compact can help companies commit to universally accepted principles in areas of human rights, labor, environment, and anti-corruption. Participation in such initiatives not only fosters sustainable practices but also aligns local operations with global sustainability goals.

3. METHODOLOGY

The study employs a mixed-method approach to encompass both the quantitative breadth and qualitative depth necessary for a comprehensive analysis. In terms of quantitative analysis, the research employs survey data to evaluate the prevalence and efficacy of diverse project management strategies across major telecom entities, including the Public Telecommunication Corporation, Sabafon, YOU Telecom, Tele Yemen, and Yemen Mobile, The quantitative component of the study was analyzed us-

ing SPSS software. Reliability testing was conducted using Cronbach's Alpha to assess the reliability of the survey instrument, ensuring internal consistency among items related to the same construct. In terms of qualitative analysis, the research deepens through the use of in-depth interviews and case studies to examine the experiential and contextual factors influencing the adoption and effectiveness of project management strategies. The statistical tools employed in this study include analyses such as frequencies and percentages, calculating the mean and standard deviation, as well as stability and reliability tests such as Cronbach's alpha. The chi-squared test is also employed to examine the statistical relationships between nominal variables. This quantitative analysis enables the estimation of the impact of contemporary project management methodologies on sustainable development goals and the effectiveness of these methodologies in improving organizational performance and overall efficiency. The researcher conducted a preliminary test on a specific sample from the study population using Cronbach's Alpha to derive the reliability coefficient and calculate its value. The tool was applied to a sample of 15 telecommunications workers, representing 10% of the total study sample, with a 15-day interval between the two tests. The reliability was found to be high (0.88), which confirms confidence in the responses of the study participants.

4. DISCUSSION AND RESULTS

This study makes valuable contributions across theoretical, methodological and applied domains. Theoretically, it addresses notable gaps in integrating project management and sustainability research, advancing understanding of how contemporary approaches can systematically advance sustainable development goals.

Methodologically, the mixed methods research design provides granular empirical insights not captured in prior conceptual studies alone. Quantitative surveys assess sustainability impacts using established metrics according the gender employee as shown in fig 2, while in-depth qualitative case studies offer nuanced perspectives on both challenges and enablers to implementation. At the practical level, as global calls for sustainability intensify under conditions of scarcity and instability, organizations require innovative roadmaps that are supportive of the 2030 Agenda. For Yemen's critically important yet vulnerable telecommunications sector, the timely development of impactful strategies is urgently needed.

By evaluating contemporary project management methodologies through a mixed lens, this research aims to both augment theoretical knowledge and provide practical guidance to facilitate the Yemeni telecom industry's contribution to realizing local and global sustainable development imperatives under complex conditions. It thereby makes an original scholarly contribution with real-world relevance.

The target population for this study comprises all those engaged in the fields of project management, planning, resource management, network operation, and general construction management within the telecommunications sector in Yemen. This extensive community encompasses a diverse range of individuals who play a pivotal role in the implementation and management of projects. This encompasses project managers, who are responsible for overseeing operations; project coordinators, who ensure team cohesion and harmony; executive team members, who carry out day-to-day tasks; senior management, who make important strategic decisions; and technical management, who monitor and track the progress of projects to ensure objectives are met. A total of 150 questionnaires and 22 interviews were conducted to ensure that the sample size size as shown in fig 3, was sufficiently large to encompass a diverse range of participants and to guarantee the reliability of the data collected as showen in fig 4. This exceeds the calculated minimum sample size of 132, thereby enhancing the accuracy of the results. According the first question: Is there sufficient awareness of sustainable development and its importance to the telecom's projects as

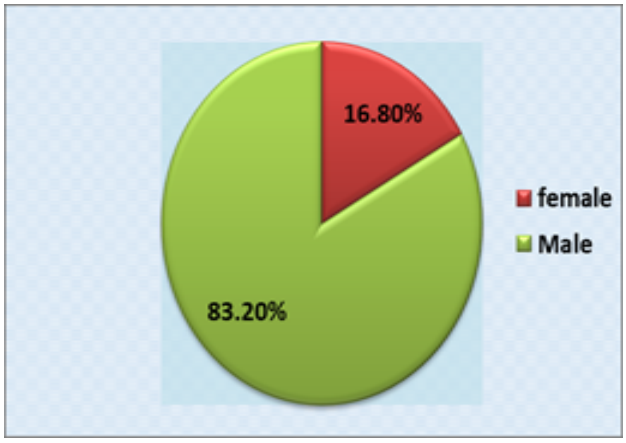


Figure 2

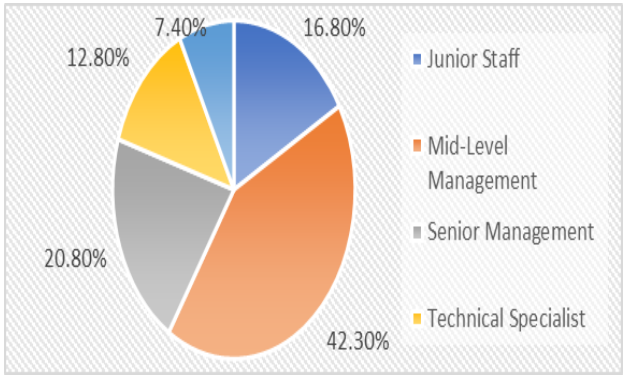


Figure 3

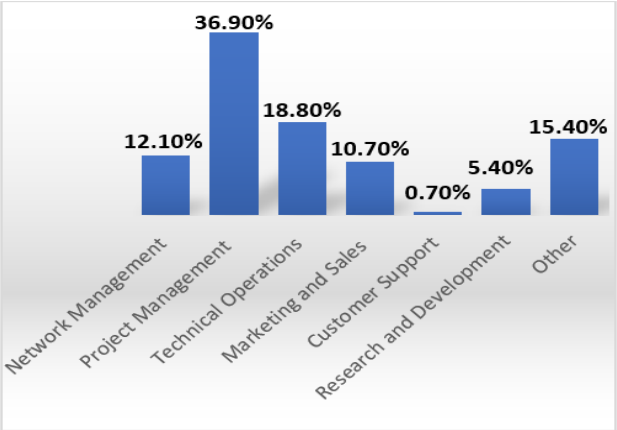


Figure 4

shown fig 5, if so, what are the strategies used in project management to achieve sustainable development in the telecommunication's sector in Yemen? The responses were as follows: The results of Table 2 clarify the extent

Table 2

Response	Percentage
Agree	37.6%
Somewhat Agree	44.3%
Disagree	18.1%
Total	100%

to which the projects within the study sample align with defined sustainability goals. 37.6% of respondents agree that their projects fully align with sustainability objectives. The results of Table No.3 demonstrate the study sample's

Table 3

Response	Percentage
Agree	40.3%
Agree Somewhat	55.0%
Disagree	4.7%
Total	100%

preference for sustainable materials and practices in the implementation of their projects. 40.3% of respondents fully agree with the use of sustainable materials and practices, while The majority, 55.0%, agree somewhat and a small percentage, 4.7%, do not favor sustainable practices at all.

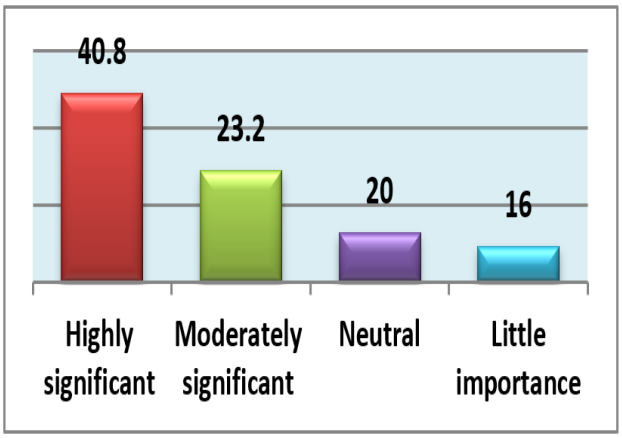


Figure 5. illustrates the significance of methodologies in the sustainable development of projects

Table 4. Illustrates the extent to which sustainability is a fundamental element of telecommunications projects

Response	Percentage
Agree	63.1%
Agree Somewhat	34.2%
Disagree	2.7%
Total	100%

The results presented in Table 4 demonstrate the pivotal role of sustainability as a fundamental aspect in telecommunications projects. A substantial majority (63.1%) of respondents concur that sustainability is a fundamental element, while 34.2% indicate partial agreement and only 2.7% express disagreement. The bar chart shows fig 6 the responses from the study sample to the question about strategies used to integrate sustainability in telecommunications projects. The columns represent the percentage of responses for each strategy. The second question concerns the extent to which sustainable practices are adopted in the sector. If such practices are not yet widespread, this raises the question of what obstacles hinder their adoption. In order to iden-

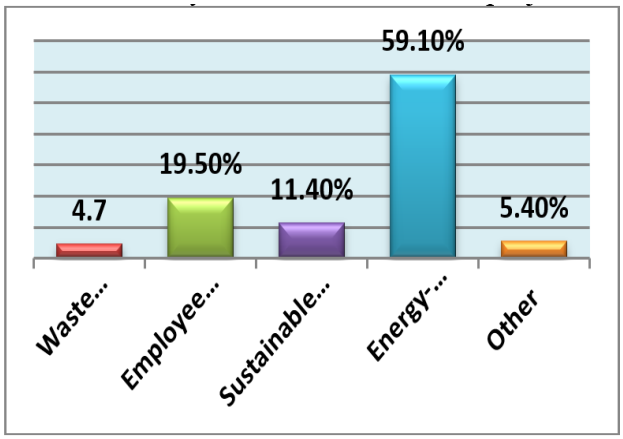


Figure 6. shows the strategies used to integrate sustainability into communications projects

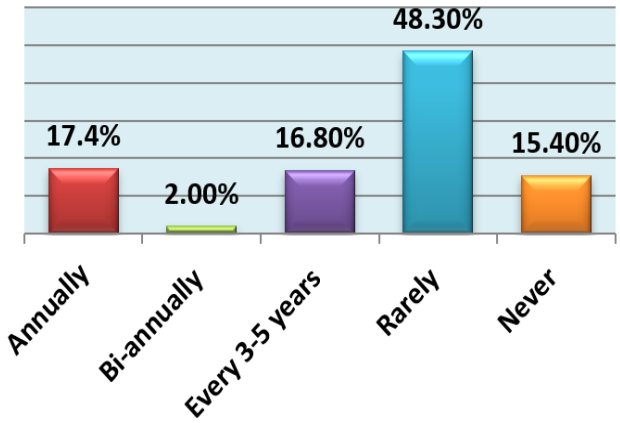


Figure 7. shows how often telecommunications organizations review and update their sustainability policies and practices

tify potential solutions, it is necessary to consider global best practices. The responses are presented below.

Table 5. The extent to which telecommunications sector possess a clear policy on sustainability in project management

Response	%
Agree	17.4
Agree to some extent	49.7
Disagree	32.9
Total	100

The results in table 5 show the extent to which the telecommunications sector has a clear policy on sustainability in project management. 17.4% of respondents confirmed having a clear policy, 49.7% agreed to some extent, while 32.9% of the sample disagreed as shown fig 7. The table's results offer insights into the implementation of sustainability policies in project management within the telecommunications sector. The results show the frequency with which telecom sectors review and update their sustainability policies and practices. The largest group of respondents, 48.3%, indicated that this is done infrequently. The second largest group, 17.4%, indicated that reviews take place annually, followed by 16.8% who indicated that reviews take place every three to five years. 15.4% of respondents said that reviews never take place, and the smallest proportion, 2.0%, said that reviews take place twice a year.

Agree (17.4%): This segment confirms that their institutions actively provide incentives for projects that successfully implement sustainability principles. Somewhat Agree (47.7%): A significant portion feels that while some incentives might exist, they may not be sufficiently impactful or widely implemented. Disagree (34.9%): A

Table 6. Extent to which telecommunications sectors offer incentives for successfully implemented sustainability projects

Response	%
Agree	17.4
Agree to some extent	49.7
Disagree	32.9
Total	100

substantial group perceives a lack of adequate incentives, pointing to a significant gap in the encouragement of sustainable practices within their organizations.

Table 7. Clarity of roles and responsibilities related to sustainability in telecommunications companies

Response	Yes (13.4%)	Neutral (47.7%)	No (38.9%)
Details	A small percentage of respondents affirm that there is clear definition and understanding of sustainability roles and responsibilities in their companies.	A significant portion of the sample does not have a definitive stance, indicating a potential lack of information or uncertainty about the implementation and application of sustainability policies and practices.	A considerable percentage indicates a lack of clarity in roles, highlighting a significant gap in communication and organization concerning sustainability within the sectors.

Table 9 provides a comprehensive view of the hurdles faced by telecommunications projects concerning sustainability, indicating the importance of addressing these challenges to achieve effective and sustainable project implementation

Table 8. Clarity of Accountability Systems for Sustainability Practices in Telecommunications Companies

Response	Yes (8.7%)	Neutral (34.2%)	No (57.0%)
Details	A very small percentage of respondents confirm the presence of a clear accountability system for sustainability practices in their organizations.	A significant portion of the sample is undecided, which may indicate uncertainty or lack of knowledge about the existence or effectiveness of current accountability systems.	The majority indicates the absence of an accountability system, suggesting a significant gap between sustainability aspirations and the systems and policies in place to ensure them.

5. CONCLUSION AND FUTURE WORK

From all of the above data, we can conclude from the study sample that: Lack of Knowledge is considered the most significant challenge, as indicated by the highest relative weight of 71.0Regulatory Issues and Availability of Sustainable Resources also pose substantial challenges, highlighting areas where bureaucratic barriers and resource constraints inhibit sustainability efforts. Cost Constraints and Technological Limitations are also notable challenges, with relative weights indicating that financial and technological barriers are significant concerns in implementing sustainable practices. Stakeholder Engagement and Support received the lowest relative weight, suggesting that while it is a challenge, it is less critical compared to others listed. Awareness of Modern and Emerging Methodologies: 24.2% of participants have a high awareness of modern emerging methodologies, while 55.7% are somewhat aware, indicating that most participants are familiar with new developments in this field but at varying levels. Adoption of New Methodologies: About 34.2% of participants have clear strategies to adopt new methodologies in the near future, indicating a readiness to adapt to modern challenges and improve project efficiency. Additionally, 51.7% are considering it, reflecting interest but without a firm commitment. Impact of New Technologies on Sustainability: The vast majority of participants (85.9%) believe that new technologies have not significantly enhanced the sustainability of projects, indicating challenges in effectively leveraging these technologies to support sustainability goals. Policies and Practices Related to Sustainability: Only 17.4% of participants have clear and well-defined policies on project sustainability, while 49.7% have policies to some extent, indicating a need for improvement and clarification of these policies to make them more effective. Incentives for Sustainable Projects: 17.4% of participants offer significant incentives for projects that successfully implement sustainability principles, and 47.7% offer incentives to some extent, indicating some support but possibly not enough or comprehensive enough to encourage widespread adoption of sustainable practices.

6. SUMMARY OF OBSTACLES

1. Lack of Awareness and Commitment to Sustainability: The data shows that while there is some recognition of the importance of sustainability, the lower agreement levels on implementing sustainable development principles (78.4% relative importance) indicate a lack of deep awareness and full commitment across the sector.
2. Insufficient Training and Development: Despite recognizing the importance of training and skill development, the actual provision of sustainability training is limited, with only 10.1% agreeing that it is comprehensively provided. This gap in training can significantly limit the ability of employees to implement sustainable practices effectively.
3. Undefined Roles and Responsibilities: Clarity of roles and responsibilities related to sustainability is lacking, with 38.9% reporting that these are not clearly defined in their organizations. This ambiguity can lead to accountability issues and inefficiencies in implementing sustainability initiatives.
4. Weak Accountability Systems:A major obstacle is the absence of robust accountability systems, with 57% stating that no clear system exists. Without strong accountability, sustaining long-term initiatives becomes challenging, and efforts may not be consistently applied or evaluated.
5. Partial Implementation of Sustainable Practices: While some organizations adopt sustainability practices to some extent, only 11.4% fully adopt them. This partial implementation suggests that sustainable practices are not yet fully integrated into the operational frameworks of most companies.
6. Documentation and Accessibility of

   Sustainability Practices:
   There is a significant gap in how sustainability practices are documented and made accessible to employees, with 44.3% noting that practices are not well-documented or accessible. Proper documentation is crucial for transparency and the dissemination of best practices within the organization. To overcome these obstacles and enhance the adoption of sustainable practices in Yemen's telecommunications sector, several strategic actions are recommended based on global best practices:

   1. Enhanced Sustainability Education and Training: Develop comprehensive training programs that are mandatory for all employees, focusing on the importance of sustainability, practical applications, and benefits to the organization.
   2. Clear Definition of Roles and Enhanced Accountability: Clearly define roles and responsibilities related to sustainability within organizations. Establish robust accountability mech-

Table 9. Main challenges in implementing sustainability in the communications projects of the study sample

Challenge	Extremely Difficult	Significant Challenge	Moderate Challenge	Slight Challenge	Not a Challenge at All	Average Score	Relative Weight
Cost Constraints	(7.4%)	(49.7%)	(22.8%)	(12.8%)	(7.4%)	3.36	67.2%
Lack of Knowledge	(10.7%)	(53.7%)	(20.1%)	(10.7%)	(4.7%)	3.55	71.0%
Technological Limitations	(9.4%)	(43.6%)	(22.8%)	(18.1%)	(6.0%)	3.32	66.4%
Regulatory Issues	(8.7%)	(47.7%)	(26.2%)	(14.1%)	(3.4%)	3.44	68.8%
Availability of Sustainable Resources	(12.8%)	(42.3%)	(26.2%)	(12.8%)	(6.0%)	3.42	68.4%
Stakeholder Engagement and Support	(8.1%)	(39.6%)	(28.9%)	(18.8%)	(4.7%)	3.27	65.4%
Total Responses	149	149	149	149	149		

anisms to ensure that sustainability initiatives are implemented and monitored effectively.

3. Integration of Global Best Practices: Adopt international standards and best practices related to sustainability. This could involve partnerships with global entities and updating internal policies to align with international norms.
4. Full Implementation and Regular Evaluation: Strive for full implementation of sustainable practices, supported by regular evaluations to assess impact and effectiveness. Utilize feedback loops to refine practices continuously.
5. Improving Documentation and Accessibility: Ensure that all sustainability practices are thoroughly documented and readily accessible to all employees. This should include training materials, policy documents, and regular updates on sustainability goals and achievements. These strategies, if adopted and properly implemented, can significantly reduce the barriers to adopting sustainable practices in Yemen's telecommunications sector, thereby aligning with global standards and improving overall sector sustainability.

Results Summary:

The research data shows that the top challenges to implementing sustainability in communications projects are lack of knowledge, regulatory issues, and availability of sustainable resources. Cost constraints and technological limitations also pose notable barriers. Although stakeholder engagement was considered a less important challenge by respondents, it remains a critical element in the success of projects, especially when applying modern methodologies. Most participants have some awareness of modern methodologies but vary in their levels of understanding. About a third have clear strategies to adopt new approaches, while over half are considering it. However, few feel new technologies have significantly enhanced sustainability.

Existing sustainability policies are not well-defined or extensive enough, and incentives for sustainable projects provide partial support. Overall implementation of sustainable practices is limited. Documentation of sustainability work is also incomplete.

Recommendations:

1. **Enhancing Training Programs:** Comprehensive training programs focusing on modern methodologies and sustainability practices should be developed to ensure their effective adoption. These programs should be mandatory for all employees to ensure full adoption of sustainable practices.
2. **Improving** Clear goals, sustainability should be set all stages to ensure achievement, environmental, social, and economic objectives. This requires developing policies and strategies that promote and the application sustainable practices all projects.
3. **Enhancing Stakeholder Involvement:** Stakeholders should be more ensure achievement sustainability. This can be achieved by enhancing communication with them and clarifying the importance of their role in achieving sustainability goals.

4. **Adopting Global Best Practices:** International standards and best practices should be adopted to ensure that project management practices align with global standards. This includes updating internal policies to align with these standards.
5. **Improving Documentation of Sustainable Practices:** All sustainable practices should be comprehensively documented and made available to all employees. This helps enhance transparency and ensure the spread of knowledge about sustainable practices across the organization.

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