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Artificial Intelligence and the Management of Stakeholders' Relationships in the UAE Construction Industry: A Survey Approach

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Abstract

This study identifies key construction industry stakeholders and defines the UAE's current stakeholder management practices. In addition, it aims to shed light on the potential benefits and challenges of using AI for stakeholder management and propose a framework for using AI in stakeholder management in the construction industry in the UAE. The study employs a mixed-methods approach, utilizing a survey for data collection. A sample of experienced managers with 10-15 years of experience in the UAE construction industry has been chosen for participation in the study. The results reveal that clients, such as real estate developers, drive projects forward, adhering to budget and quality standards. Stakeholder management in the UAE's construction industry emphasizes effective communication as a central practice. Implementing AI for stakeholder management in construction projects presents unique challenges, including ensuring data quality and availability, addressing privacy concerns, and potential inaccuracies. The researcher proposes a framework for integrating AI for stakeholder management based on two main dimensions: the process dimension and the technologies dimension.

Keywords

Artificial Intelligence, Stakeholders, UAE, Construction Industry.

Article history

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1. Introduction

The incorporation of AI technology in stakeholder management has the potential to address different challenges and improve project outcomes (Abioye, 2021). This research project aims to explore the feasibility of using AI technology in stakeholder management in the UAE construction industry and develop a framework for its effective implementation. Trojan Construction Group (TGC), a subsidiary of Alpha Dhabi Holding PJSC, is one of the leading construction companies in the UAE. TGC has a proven track record of completing many significant buildings that have added to the UAE's cosmopolitan skyline. Therefore, this study focuses on TGC and uses a mixed-method approach to collect data from construction experts to investigate the potential benefits and challenges of using AI in stakeholder management. The study will analyze data from TGC employees on the Baniyas North project, a villa compound project constructing 1,365 homes for citizens at 3.2 billion dirhams. The project, represented by Al Dar company and Mott MacDonald, targets local families and investors. The framework aims to guide UAE construction professionals, policymakers, and researchers in utilizing AI for efficient stakeholder management, enhancing project outcomes, promoting sustainable development, and advancing AI knowledge to drive industry growth and sustainability (Pan & Zhang, 2021).

2. Literature Review

2.1. Stakeholder Management in Project Management

Building strong relationships with stakeholders is a fundamental strategy in project management, significantly impacting the success of any business venture (Yang et al., 2009). Project managers must understand stakeholders' interests, impact, and engagement for effective communication and stakeholder analysis, using various tools and methods to provide guidance (Aaltonen et al., 2015). Stakeholders, including company owners, contractors, subcontractors, government, and investors, significantly influence project outcomes and must be involved in every step, especially in construction activities causing disturbances (Winch, 2010). Stakeholders are integral to business success and project completion, and effective engagement improves team collaboration and integrated construction project delivery (Ebekozien et al., 2023; Taimu et al., 2020). Inclusivity in project success involves fostering collaboration among diverse stakeholders, recognizing potential disruptions, and acknowledging the collective efforts of these diverse groups to ensure timely project completion (Elias, 2016).

2.2. Importance of Stakeholder Management in Project Success

Stakeholder relationship management is crucial for project success, as it involves identifying and understanding stakeholders' concerns, addressing their interests throughout the project lifecycle, and elevating this approach to a strategic imperative (Maqbool et al., 2022). Effective communication strategies are crucial in stakeholder

management, minimizing risks, and providing a comprehensive recovery plan throughout the project (Muñoz et al., 2022). This approach transcends mere necessity; it evolves into a powerful catalyst for building confidence, eliciting support, and ultimately fostering satisfaction among stakeholders (Hernández et al., 2017). Stakeholder relationship management, backed by effective communication strategies, is crucial for project success, enabling continuous improvement and stakeholder satisfaction, thereby exceeding expectations (Montenegro et al., 2021).

2.2.1. Methods, Frameworks, and Methodologies used to Manage Stakeholders' Expectations

Project managers use stakeholder involvement to gather data and manage stakeholder relationships, proactively addressing individual needs and concerns to align project expectations (Pan & Zhang, 2021). Models help project managers strategize stakeholder expectations, increasing satisfaction. Pricing methodologies and estimations significantly impact stakeholder relationships, ultimately affecting project success. Companies must employ stable methodologies, follow industry trends, and utilize the PMBoK guideline framework for accurate estimations (Abioye, 2021). The PMBoK guide, published by the Project Management Institute, offers standardized project management practices. It encourages companies to adopt pricing and estimation techniques to meet stakeholder expectations and compete in the market (Winch, 2010). The most vital task is fulfilling client expectations and ensuring their satisfaction, which builds loyalty and ensures fair market representation of goods and services. According to Prebanic and Vukomanovic (2023), AI improves stakeholder communication by tailoring messages to individual preferences and engagement levels, enabling credible and relevant communication. Natural language processing also facilitates the analysis of feedback, enabling informed decision-making and addressing concerns. AI-driven tools improve stakeholder identification, align project goals with interests, streamline communication, and ensure timely information delivery, making them an essential component of multifaceted stakeholder relationship management frameworks.

2.3. Stakeholder Management in the Construction Industry

The effective management of construction projects involves a nuanced understanding of the various stakeholders, both internal and external, and the intricacies of their interests (Yang et al., 2009). The role of stakeholder management in construction projects has been widely studied, with a focus on critical success factors for stakeholder management (Yang et al., 2009). Inadequate stakeholder engagement, unclear management objectives, and communication issues are common issues in construction projects. Emotional intelligence significantly impacts project success, emphasizing the importance of internal and external stakeholder relationships (Montenegro et al., 2021). Additionally, the management of external stakeholders in construction projects includes local communities affected by the projects, the public, and government organizations (Ruwanpura & Perera, 2022). This emphasizes the importance of gaining a full grasp of the various external stakeholders engaged in

construction projects. Furthermore, examining stakeholder engagement during internal early preparation has highlighted the significance of early-stage stakeholder engagement for infrastructure projects (Baharuddin et al., 2022).

The management of stakeholders in construction projects is a complex task due to the involvement of various parties such as clients, suppliers, contractors, designers, governmental bodies, landowners, and non-governmental organizations (NGOs) (Diogo & Carvalho, 2022). NGOs, in particular, can introduce additional layers of complexity by intervening in projects, leading to delays that require adept negotiation and communication strategies (Ruwanpura & Perera, 2022). Project managers must balance stakeholder expectations, ensuring timely and budget-conscious project execution to satisfy all parties involved and align company objectives with their needs. Stakeholder management in construction projects requires a systematic approach, as recommended by industry best practices (Aaltonen et al., 2015). This method involves examining stakeholder positions, identifying internal and external parties, understanding their interests, and assessing their perspectives on project success (Aaltonen et al., 2015). This nuanced understanding of stakeholder dynamics is fundamental for successful project management in the construction industry, guiding strategies that promote collaboration, mitigate conflicts, and ensure the timely and efficient completion of projects (Ray & Miller, 2017).

2.4. AI in Project Management

AI is revolutionizing project management by simulating human intelligence processes, offering new opportunities to enhance outcomes and revolutionize traditional practices (Odeh, 2023). The role of AI in project management is multifaceted and impactful. AI plays a crucial role in talent management, organizational management, and decision-making processes, thereby significantly influencing project management practices (Liu et al., 2021). Furthermore, AI has the potential to augment the project management profession across various knowledge areas, as defined in the Project Management Body of Knowledge (PMBOK) of the Project Management Institute (PMI) (Friðgeirsson et al., 2021). AI can contribute to improving project management practices and outcomes by leveraging its capabilities in data analysis, predictive modelling, and decision support. It is a crucial driver of innovation and productivity in project management, enhancing decision-making, resource allocation, and streamlining processes for the successful execution of construction projects (Gao et al., 2023).

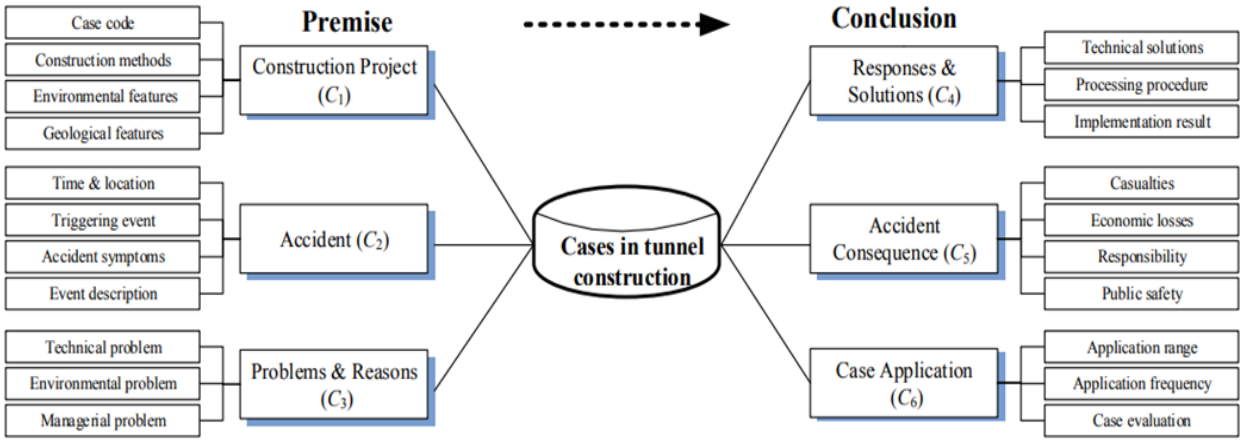
AI's potential in project management extends beyond traditional execution to specialized areas like fire safety management in buildings, enhancing safety and risk management in construction projects (Xu et al., 2023). AI is also being developed as a decision-making support tool for innovation project management, demonstrating its diverse applications in project management (Fernández et al., 2022). AI is being utilized in human resource management to improve talent acquisition, performance evaluation, and workforce optimization, particularly in the agricultural sector, showcasing its versatility across various industries (Evseeva et al., 2021). AI is also

utilized in project risk assessment and complexity management, particularly in construction projects, to effectively manage complex, uncertain, and vulnerable cost-risk networks (Afzal et al., 2019). Additionally, ethical considerations and the success factors of AI projects are essential aspects that require attention to ensure the responsible and effective application of AI in project management (Miller, 2022).

2.4.1. Frameworks for Introducing and Using AI in Stakeholder Management

AI tools and techniques are crucial in construction project management (Chenya et al., 2022). AI implementation methodologies utilize statistical and mathematical algorithms to make inferences and utilize data effectively, offering unique features and applications across various domains (Borrmann et al., 2018). Construction Engineering Management (CEM) highlights AI applications like fuzzy logic, expert systems, machine learning, statistical models, and process mining for optimizing project and risk management processes (Zicari et al., 2021). The user interface facilitates interaction with the expert system, allowing data exchange and input/output. The inference engine retrieves knowledge to generate answers and solutions (Pan & Zhang, 2021). Expert system techniques, introduced in 1965, have been widely used by professionals due to their adaptability and effectiveness, significantly impacting various disciplines in the field of AI (Pan & Zhang, 2021).

Figure 1: Expert System for Tunnel Construction (Source: Pan & Zhang, 2021)



Fuzzy logic, an AI method developed in the 1960s, addresses ambiguity in human language, enabling flexibility in decision-making by handling unclear, partial, or inaccurate input data (Zhao et al., 2021). Additionally, fuzzy inference carries out the computational process to determine whether the fuzzy inputs and rules match (Le et al., 2019). Fuzzy logic, a mathematically sound method used in expert systems, is a popular and easily understood method for capturing uncertain information (Zhao et al., 2021). It is a potent instrument for managing construction projects more wisely and effectively (Marsden, 2019). Hidden Markov models, based on Markov chains, enable managers to assess visibility and hiddenness, enabling them to implement preventive measures against potential risks (Tong & Wang, 2021). ARIMA models are commonly used for long-term forecasting, primarily for short-term forecasts that impact allocation or resourcing, ultimately affecting stakeholder expectations of project performance

(Fesenko, 2022). An AI method called machine learning enables computers to learn from data without explicit programming (LeCun et al., 2015). Machines use unsupervised learning to identify patterns in large data sets, while supervised learning uses labelled data for future task predictions (Tong & Wang, 2021).

2.4.2. Advantages and Disadvantages of Using AI in Project Management

Marsden (2019) emphasizes that AI enhances project management efficiency and decision-making by enabling quick data analysis, providing insights into project progress and issues, and saving time for project managers. Smith (2018) also shows that AI-driven project reporting can enhance project management efficiency, including streamlining reporting processes and freeing project managers to focus on more essential tasks. Brown (2016) also emphasizes that AI-enabled devices can assist project managers in making informed decisions by offering valuable insights and analysis, leading to improved project results.

2.4.3. Gaps in AI Applications for Stakeholder Management in the Construction Industry

Some stakeholders fear AI in construction could lead to inaccurate information, while others believe it improves efficiency, productivity, and cost savings. It is crucial to clarify how AI replaces human workers and creates a more comfortable work environment (Araya & Sierra, 2021). AI's effectiveness in the construction field is hindered by the inadequacy and outdated nature of the data, which can be a significant challenge (Yang & Shen, 2015). Lack of standardization in construction creates barriers to the implementation of AI technologies because of the fear of delays and errors in decision-making (Smith, 2018). AI programs struggle to handle shop drawings, images, and text documents, requiring high budgets for construction project planning. Larger companies like Trojan can invest in AI technology (Chenya et al., 2022).

3. Research Methodology

This research aims to explore AI's role in stakeholder management in the UAE construction industry. Using a mixed-method approach, it explored stakeholders' perspectives, experiences, and practices throughout the project life cycle. Data was collected using nonmetric (qualitative) and metric (quantitative) scales, categorizing differences and measuring variables using interval and ratio scales. Therefore, the questions of this study can be reviewed as follows:

RQ1: What are the expectations and needs of key stakeholders in the construction industry in the UAE?

RQ2: What are the current stakeholder management practices in the UAE construction industry?

RQ3: What are the potential benefits and challenges of using AI for stakeholder management in the construction industry in the UAE?

RQ4: What are the key dimensions of the proposed framework for using AI in stakeholder management in the construction industry in the UAE?

3.1. Research Method

The main goal of this research is to investigate the use of artificial intelligence (AI) in stakeholder management in the construction industry, specifically in the United Arab Emirates (UAE). The research employed a mixed-method approach to gain in-depth insights into stakeholders' perspectives, experiences, and practices throughout the project life cycle. The data collected is classified into two categories: nonmetric (qualitative) and metric (quantitative) data. Nonmetric data uses nominal and ordinal scales to categorize differences, while metric data uses interval and ratio scales to measure variables.

3.2. Data and Sample Collection

This study used a carefully selected sample of 25-30 experienced managers with 10-15 years of experience in the UAE construction industry. The chosen sample size ensures a thorough understanding of the research objectives and maintains a manageable number of participants. These managers possess deep knowledge and vision, making them important respondents in the study. The sample plan aims to provide a balanced and diverse group of stakeholders in the construction and engineering sectors in the UAE, ensuring a comprehensive and inclusive approach to the subject matter.

3.3. Survey Design, Execution, and Questions

The recruitment process involved WhatsApp messages in the district, allowing participants to interact. Participants were directed to an online survey created using Google Forms, accessible to TGC and its sister firms within the Royal Group of IHC. The survey consists of two parts: pre-screening questions based on respondents' professions and ten open-ended questions. The pre-screening questions categorize participants and align the sample with research objectives. The open-ended questions cover topics like identifying key stakeholders, current stakeholder management approaches, obstacles, technology impact on project partnering, AI software implications, and integration framework challenges. Participants are required to provide concise answers. Here are the 10 main questions that the participant needs to answer one by one through the online survey:

1- Who are the key stakeholders in the UAE construction industry, particularly in TGC projects, and what are their typical expectations?
2- Can you describe TGC's current methods for managing relationships with its stakeholders in construction projects?
3- What are the main challenges you have encountered when managing stakeholder relationships in the construction industry in the UAE?

4- Have you observed how technology and analytical skills have impacted the way we work with project partners on construction projects, and how these changes have impacted the way people collaborate and work together?
5- How familiar are you with the concept of using AI for stakeholder management in construction?
6- What do you see as the potential benefits of integrating AI into stakeholder management processes in the construction industry?
7- What challenges or obstacles do you anticipate when implementing AI for stakeholder management in TGC or the broader industry?
8- What elements do you believe should be included in a framework for the effective implementation of AI in stakeholder management?
9- Factors like safety, quality, and budget can significantly impact a construction project's workflow and progress. Can you provide examples of how these factors have acted as challenges in the past and how AI can address or mitigate these weaknesses throughout the project lifecycle?
10- AI influences stakeholder management in the UAE's construction industry. What insights and suggestions would you provide to construction companies as they explore AI's potential impacts on stakeholder engagement?

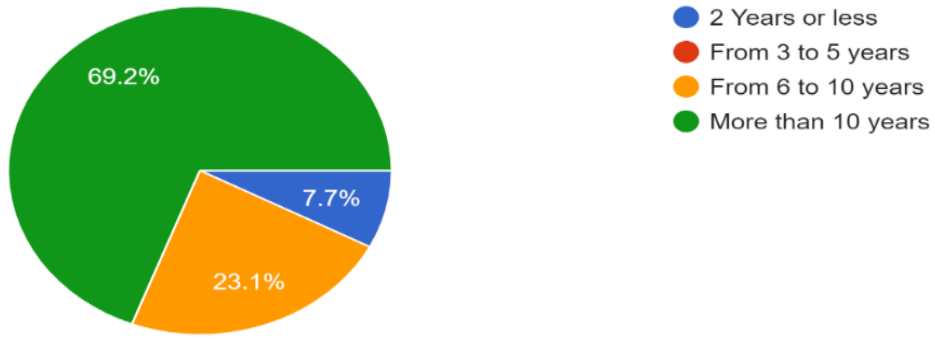
4. Results and Discussion

This survey explores the perceptions and experiences of 26 participants in the UAE's construction industry regarding the use of AI in stakeholder management. It explores the challenges faced by the industry and its readiness and attitude towards AI applications. The analysis provides insights into current trends and practices, as well as the implications of AI on reshaping stakeholder relationships and management strategies in the UAE construction industry. The survey offers a rich perspective on AI's potential in this dynamic field.

4.1. Demographic Analysis

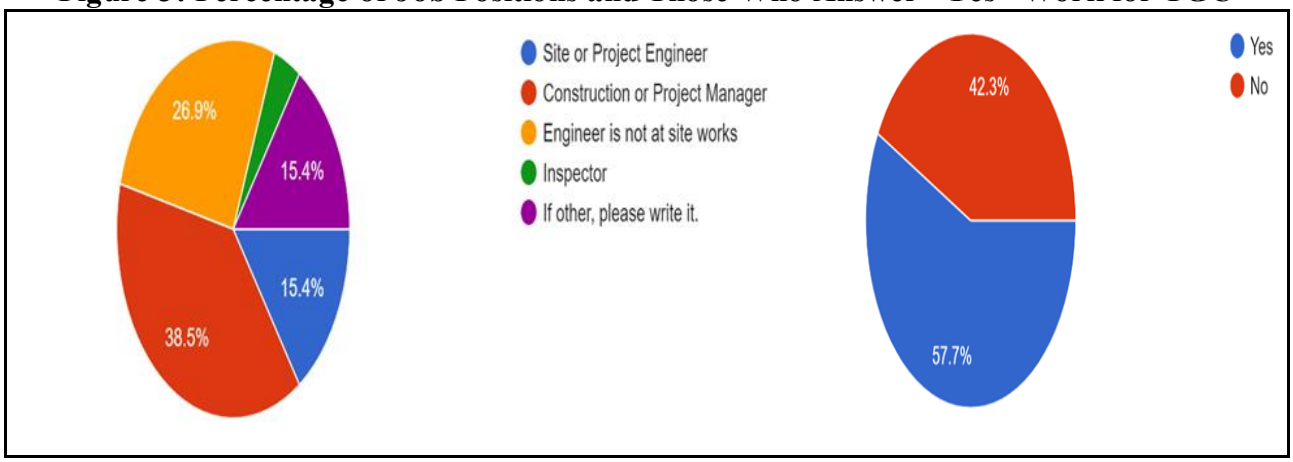
The subsequent data focuses primarily on the demographic characteristics of the survey respondents. By examining the initial six inquiries, the initial section attempts to elucidate the professionalism of the respondents within the construction industry of the UAE. Most participants, 69.2%, or 18 out of 26 respondents, have over ten years of experience in the UAE, indicating a comprehensive understanding of sector-influencing factors and the latest challenges. This level of expertise is crucial as it indicates a strong understanding of the UAE's professional landscape.

Figure 2: ***Work Experience Years in the UAE***



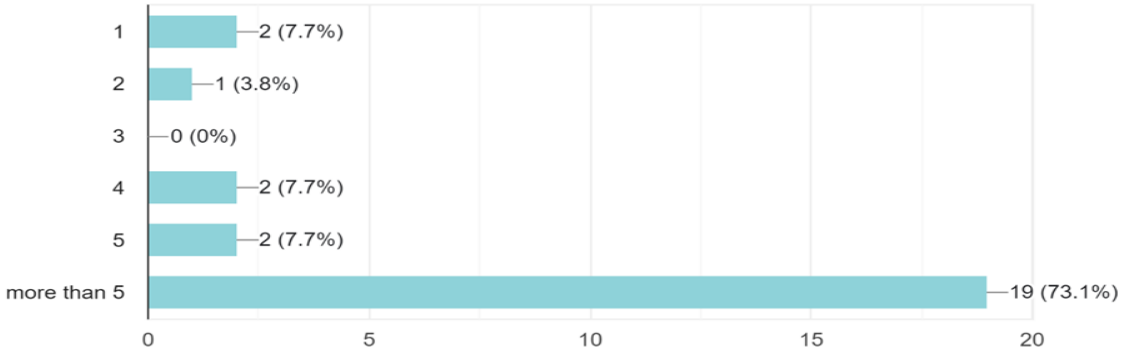
The survey's diversity is attributed to the majority of respondents holding managerial positions, such as those in construction or project management. This diversity offers a wide range of perspectives and opinions, particularly on industry protocols. The survey also includes four site or project engineers and seven engineers not stationed at sites, demonstrating strategic managerial viewpoints and providing crucial insights into the industry's interaction with emerging technologies like AI. Participants in the study identified themselves as "other," highlighting specialized sectors within the industry and their unique perspectives on AI applications in construction. Their experience in multiple projects, often at least five, indicates their practical expertise in the complexities of this undertaking.

Figure 3: Percentage of Job Positions and Those Who Answer "Yes" Work for TGC



A considerable proportion, specifically 19 out of 26, have participated in over five construction projects, indicating a considerable breadth of practical expertise. Comprehending this facet is critical to grasp the practicalities of the construction industry and the potential applications of AI in mitigating those challenges. The study focuses on the diverse company affiliations of respondents, with 57.7% working for TGC. The remaining 11 individuals provide insights from various organizations, with 43.3% not working for a company, which helps to promote a comprehensive and neutral representation of the industry, as additional initiatives may not necessarily include TGC employees.

Figure 4: Construction Projects in the UAE with Participants Involved in Their Career Experiences



This descriptive demographic analysis examines the impact of organizational diversity on AI implementation in construction stakeholder management. The survey, conducted among a diverse group of UAE construction industry professionals, provides a foundation for understanding the industry's preparedness for AI in stakeholder management, highlighting the importance of understanding operational scales and corporate cultures in the construction industry.

4.2. Construction Field Insights Revised with Respondent

The analysis of 26 survey responses on construction experiences and challenges from Q1 to Q4 provides insights into the state of construction in the UAE, identifying key areas of concern and operational challenges, and serves as a basis for discussing AI integration's impact on stakeholders. Budget overruns in construction projects are widely discussed and were raised by approximately half of the respondents (13 of 26). For example, one respondent stated, “Budget overruns are a constant concern, often stemming from unforeseen project complexities,” which suggests that many people believe the industry needs to improve its financial management to become more proactive and predictive. The discussion centered on the challenges of meeting project deadlines, with ten to fifteen respondents sharing their opinions. One participant stated, “Delays are almost inevitable, but their impact on project costs and stakeholder satisfaction can be profound.” Proper time management is crucial in construction projects, as over 15 respondents highlighted the complexity of stakeholder relationship management. Balancing diverse expectations often requires traditional channels, as communication is key to achieving this balance. Overall, effective time management is essential for successful construction projects.

Around 8-12, respondents expressed optimism about AI's potential to transform industry practices, particularly in areas like budgeting, due to its associated benefits. When it comes to the role of AI in budgeting, one respondent described this as envisioning, “AI could revolutionize budgeting by predicting future events based on Level Three thematic raises (Quality, time, and budget) and proactively addressing potential financial risks. This approach could provide new predictive insights and help address financial risks before they escalate.” Another smaller group (5-10 respondents) placed the same level of interest in the role of AI in project management, with some

seeing more adaptive scheduling tools for delays and changes management. The summit survey revealed that industry professionals are ready to embrace AI, with a high awareness of budgeting, project schedule maintenance, and stakeholder management issues. Interest in AI's transformative features has increased, and AI-empowered construction could revolutionize the industry, leading to increased efficiency and stakeholder-centric practices. The table provides an abstract of the main topics and difficulties revealed.

Table 1: Key Themes and Challenges from Survey Analysis - Construction Section

Subject or idea	Key Sentiment or Challenge	Estimated Number of Respondents	Remarks
Budget Management	Concerns over budget overruns due to unforeseen project complexities	13 out of 26	Indicates a need for more dynamic financial management
Project Deadlines	Challenges in adhering to project deadlines, leading to cost and stakeholder issues	10-15 out of 26	Highlights the importance of effective time management
Stakeholder Relationship Management	Balancing diverse expectations and communication challenges	Almost 15 out of 26	Suggests the complexity of managing various stakeholder needs
AI in Budgeting	Optimism about AI revolutionizing budgeting with predictive insights	8-12 out of 26	Reflects interest in AI for proactive financial risk management
AI in Project Management	The potential of AI in providing adaptive scheduling tools for project management	5-10 out of 26	Shows openness to technological solutions for managing project timelines

4.3. AI-Related Findings

Analysis of responses from 26 construction industry practitioners to a survey on the application and perception of AI in stakeholder relationship management. The survey included six critical questions to reveal underlying perspectives regarding the perception of AI and its expected impact on the industry. The level of acquaintance with AI was very different in the surveys. Such statistics imply that nearly 42% of the respondents, or eleven persons, had poor knowledge or none regarding the same, often with quite a brief response, "Not familiar". Another 19% (5 participants) demonstrated a rudimentary knowledge or introductory use of AI, often as an operative procedure for such simple tasks as email messaging. The primitive adoption of AI by this group indicates a budding elementary interest in its potential. On the other hand, 38% (10 respondents) demonstrated a more profound understanding that acknowledges AI as a strategic asset. For instance, one respondent noted “using AI to be able to predict the project outcome based on historical data,” indicating positive perceptions about its predictive ability. Nevertheless, some cautioned, one respondent urged not to “underestimate the hype” that warrants a cautious approach to AI deployment. Regarding possible benefits, the respondents indicated several positive outcomes from incorporating AI in stakeholder management. They observed increased efficiency, communication, and decision-making. For example, a respondent noted that “AI can facilitate an analysis of big data in such a way as to predict potential issues,” thus illustrating the use of this technology for project management. The consensus showed

that AI could result in improved resource utilization, reduction of risk, and better stakeholder involvement.

The respondents also expressed concerns over the difficulties of implementing AI. How much, if any, of the budget should be allocated to adopting AI technology and related expenses was a common theme conveyed in the comments. For example, one respondent noted that "AI systems require high-quality, accurate, and comprehensive data." The survey generated different concepts for the development of an AI framework that would work in the construction industry. The responses also highlighted the need for clarity in objectives, stakeholder analysis, ethical AI use, and strong data privacy. Therefore, one respondent, for instance, noted, "AI solutions should be tailored to specific project requirements," pointing to the crucial nature of bespoke AI implementations. Respondents provided insights based on past experiences with the impact of AI on meeting safety, quality, and budget needs. They noted, for example, the role of AI in addressing issues like construction-related safety and quality control. To sum it up, the survey reveals an industry that is actively researching AI but remains wary of its pitfalls and the essence of careful strategy. The responses provide a holistic view where the optimism of AI in project management and stakeholder engagement is a little bit dampened by the necessity for careful integration, training, and broader environmental considerations.

Table 2: Key Themes and Challenges from Survey Analysis - AI Section

Subject or Idea	Key Sentiment or Challenge	Estimated Number of Respondents	Remarks
Familiarity with AI	Varied levels of AI acquaintance among respondents	11 out of 26 (42%)	Indicates a significant knowledge gap in AI familiarity
	Introductory use of AI, such as for email communication	5 out of 26 (19%)	Suggests a growing but basic interest in AI applications
	In-depth understanding of AI's strategic applications	10 out of 26 (38%)	Reflects a segment with advanced insights into AI's potential
Perceived Benefits of AI	Optimism about AI enhancing efficiency, communication, and decision-making	Not Quantitative data	Recognition of AI's potential for operational effectiveness
Challenges in AI Implementation	Concerns about budget allocation and data quality for AI adoption		Highlights financial and technical considerations in AI adoption
Framework for Effective AI Implementation	Need for customized AI solutions and clear objectives.		Emphasizes AI solutions tailored to project needs
AI's Impact on Safety, Quality, and Budget	AI is seen as a tool to address construction-related safety and quality.		Indicates AI's potential role in enhancing traditional industry issues
AI in Stakeholder Relationship	AI's potential to improve communication and mitigate risks		Showcases AI's role in advancing stakeholder communication and relations

4.4. Analysis of the Results – Conceptual Framework

4.4.1. Key Stakeholders in the UAE Construction Industry

In UAE construction projects, understanding key stakeholders is crucial. Clients, such as real estate developers, drive projects forward, adhering to budget and quality

standards. Consultants prioritize design precision, contractors execute projects, and subcontractors play key roles: clear communication, adherence to scheduling, and timely completion drive project success. Suppliers expect consistent demand, timely payments, and quality compliance. Authorities set regulations and permit requirements, necessitating compliance with building codes and environmental standards. Successful stakeholder management involves understanding expectations and effectively navigating regulatory environments. End-users, the ultimate beneficiaries of any construction project, seek safety and comfort in the completed structures. In a school construction project, for instance, clients expected timely completion to accommodate students for the new school year.

4.4.2. Stakeholder Management Practices in the UAE Construction Industry

Stakeholder management in the UAE's construction industry emphasizes effective communication as a central practice. Early involvement of relevant parties, stakeholder mapping, and consistent updates ensure engagement throughout the project's lifespan. Utilizing stakeholder identification, communication across multiple channels, engagement plans, conflict resolution protocols, and project management software enhances stakeholder involvement and engagement. These integrated strategies acknowledge the importance of proactive engagement, conflict resolution, and leveraging technology for efficient collaboration. Another efficient strategy is the eight-point strategy, covering regular communication, stakeholder engagement plans, conflict resolution mechanisms, client relationship management, subcontractor and supplier management, government regulatory compliance, community engagement activities, and feedback mechanisms. This holistic approach recognizes that stakeholder management extends beyond project teams themselves; it encompasses clients, regulatory bodies, and the broader community as well. Challenges from the excessively manual nature of the process and the absence of intelligent integration can jeopardize stakeholder management. Given these challenges, it is imperative for construction firms to consistently assess and revise their stakeholder management strategies to ensure that they remain in line with technological advancements and industry standards.

4.4.3. Benefits and Challenges of Integrating AI for Stakeholder Management

The integration of AI in stakeholder management processes within the UAE's construction industry holds immense promise, offering numerous advantages while simultaneously creating some challenges that must be carefully addressed. AI can bring tremendous efficiency gains when applied to stakeholder management. AI systems are capable of quickly processing vast quantities of data to detect trends, patterns, and insights that might otherwise be hard for humans to recognize effectively. Construction companies can leverage this ability to streamline processes considerably, optimize workflows extensively, and boost operational efficiency significantly. AI can also provide construction companies with data analytics expertise that enables them to make data-driven decisions with ease. By making smart use of AI algorithms, stakeholders can gain valuable insight into various aspects of project management, ranging from resource allocation and budgeting to risk evaluation and mitigation.

AI's ability for personalization can dramatically boost stakeholder engagement. Construction companies that employ sophisticated algorithms that customize communication and services based on individual stakeholder preferences can foster more meaningful and tailored interactions, thus significantly increasing customer satisfaction and collaboration. AI's predictive analytics enable early identification of risks and concerns, enabling proactive measures to be implemented before they worsen. AI-powered systems are crucial for risk mitigation and project success. They are scalable and capable of handling extensive stakeholder interactions simultaneously, making them ideal for managing complex construction projects with multiple stakeholders. AI-powered systems are particularly advantageous in managing complex stakeholder interactions.

Implementing AI for stakeholder management in construction projects presents unique challenges, including ensuring data quality and availability, addressing privacy concerns, and potential inaccuracies. Additionally, new AI technologies require significant adjustments to workflows and processes, potentially leading to disruptions and changes. Employee resistance, job security concerns, and the need for upskilling may also hinder the integration of AI solutions into stakeholder management practices. Therefore, addressing these issues is crucial for the successful implementation of AI in construction projects. Implementing sophisticated AI solutions often presents significant initial costs, creating additional financial barriers for smaller construction firms with limited resources. Investment in advanced AI technology, comprehensive training programs, and modern infrastructure may require careful financial planning and the allocation of appropriate funds.

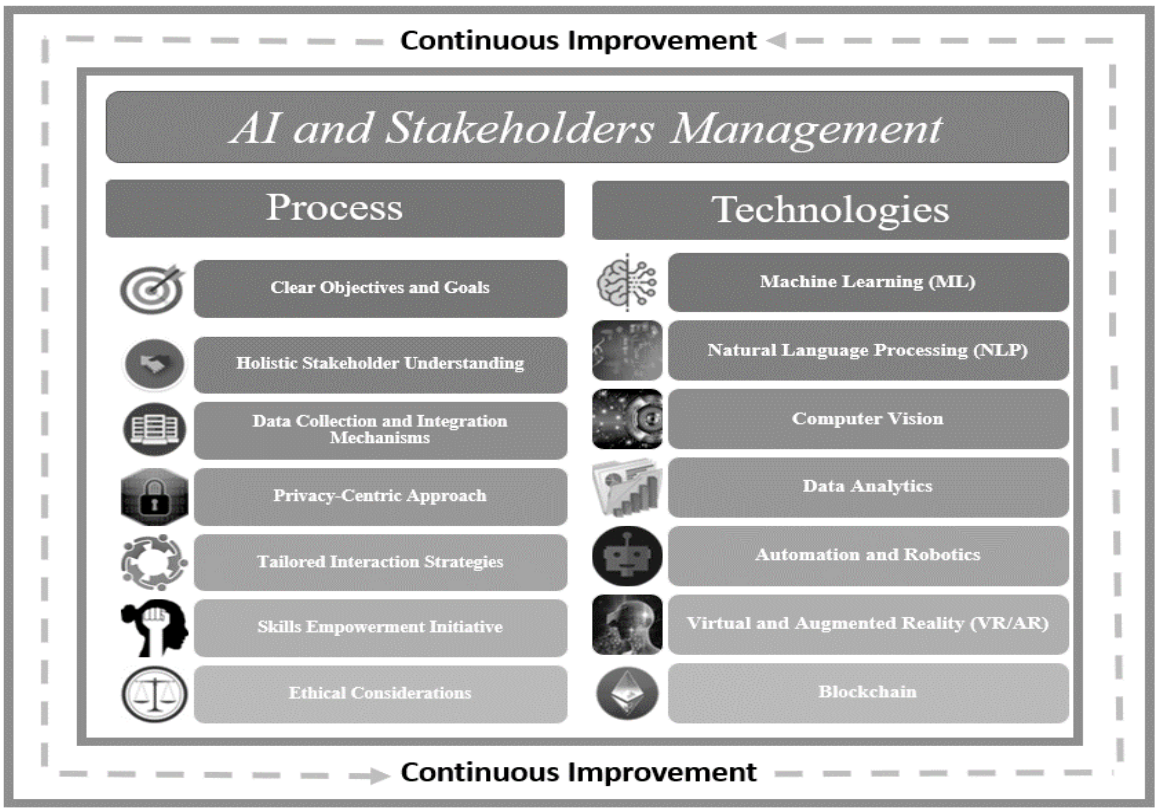
Furthermore, seamless integration into existing stakeholder management systems and processes is vital. Integration issues related to modern AI technologies into legacy projects remain of great concern in terms of compatibility issues, interoperability challenges, and disruptions that might ensue. On the other hand, construction projects often entail sensitive information that must be protected using best practices for cybersecurity and privacy protections. It is thus vitally important that protections against cybersecurity attacks and privacy issues be implemented efficiently on such projects. AI systems must comply strictly with data protection regulations; any perceived lack of security could compromise acceptance and lead to additional challenges. Finally, expertise is crucial to the successful implementation of AI in stakeholder management; professionals with advanced knowledge of AI technologies must be recruited into this industry as soon as possible and retained. The industry's ability to attract, train, and retain such professionals will prove instrumental in meeting long-term challenges head-on.

4.5. AI for Stakeholders Management – A Conceptual Framework

Establishing a practical framework is the cornerstone of successfully utilizing AI in stakeholder management within the UAE construction industry. This industry needs a framework with all the appropriate elements included to aid the integration of AI into stakeholder management practices while reaping maximum benefits and mitigating any

associated challenges efficiently and methodically. Figure 5 presents the conceptual framework that encapsulates two dimensions: the process dimension and the technologies dimension.

Figure 5: AI and Stakeholders Management – Conceptual Framework



4.5.1. The Process Dimension

First, AI integration requires setting objectives and goals that define its quantitative and qualitative components. Construction companies should outline precisely which outcomes they aim to attain, such as efficiency gains, enhanced communication capabilities, and risk mitigation. Before beginning the AI implementation, all stakeholders must receive an in-depth assessment of their needs and expectations. A framework must include systematic mechanisms for identifying and analyzing stakeholder preferences, requirements, and potential areas of concern relevant to each stakeholder. AI implementation relies on access to high-quality and reliable data, so the framework should include processes for robust data collection, ensuring accuracy, relevance, accessibility, integration with existing management systems, privacy protection, and data security, as this is of utmost importance in construction projects. Strict adherence to relevant data protection regulations is a necessity in this respect.

AI customization represents an invaluable asset in meeting the specific needs of individual stakeholders and adapting communication and services according to their individual preferences. Construction companies should have sufficient tools and guidance available to utilize this form of customization successfully. Empowerment and training programs for staff and stakeholders are also key components. The adoption of AI depends heavily on having access to an adequate pool of expertise within an

organization's ecosystem. So, by investing in necessary training and skill development programs, construction companies can overcome this hurdle more easily. Ethical AI usage is paramount. The framework should emphasize ethical considerations, ensuring that AI applications align with moral and social values. Construction companies should be committed to responsible AI use, avoiding biases, and promoting fairness.

Construction professionals play a crucial role in integrating AI into projects, ensuring its proper use and ethical considerations. They must understand the limitations and blind spots of AI systems, and ensure their use is beneficial for all parties involved. Project managers must identify special needs and prerequisites, choose the right AI technologies, and ensure proper implementation for the benefit of all parties involved. Contractors and clients are essential in training AI models, providing data and feedback for improved performance. They should actively participate in AI development and communicate project goals to managers. Suppliers of AI technologies transport knowledge and skills, supporting employers in problem-solving and informed decisions. Regular meetings, seminars, and workshops are essential for keeping stakeholders informed about the potential of AI technology, fostering understanding, setting realistic expectations, and addressing ethical concerns. Cooperation among stakeholders is essential for the responsible and ethical use of AI, requiring ongoing learning and dialogue.

4.5.2. The Technologies Dimension

The following AI technologies can particularly apply to connecting AI with stakeholder management from a project management perspective in the UAE's dynamic construction industry. Each technology provides distinct advantageous capabilities that meet the industry's complex demands. First, machine learning (ML)-driven predictive analytics represent an invaluable asset to construction companies seeking to anticipate potential trends or issues among complex stakeholder interactions through an in-depth examination of historical data. By employing this capability, construction companies can make more informed strategic decisions to increase project management effectiveness and stakeholder satisfaction substantially. Natural Language Processing (NLP) also provides sentiment analysis capabilities that allow organizations to accurately gauge satisfaction levels among stakeholders while quickly addressing emerging issues and maintaining positive stakeholder relationships.

Computer vision's automated inspection capabilities contribute significantly to streamlining quality control by eliminating manual efforts through automation, thus ensuring strict adherence to quality standards while simultaneously minimizing errors. Additionally, the construction industry generates vast heterogeneous data assets containing invaluable insights. AI-powered big data analytics offers an essential capability for processing and extracting actionable insights from these assets efficiently to improve project management decisions and make well-informed decisions. Robotic Process Automation (RPA) offers another valuable benefit. Automating administrative tasks helps increase focus on strategic priorities while enhancing operational efficiencies for stakeholders. Immersive technologies like virtual and augmented reality enable remote construction progress inspection, improving communication and

transparency in project management. The cooperative entrance in UAE construction aims to enhance AI-related tools and procedures by involving various stakeholders in the process. This approach ensures a practical and technically sound AI integration framework, making it friendly to all parties involved. Successful implementation requires joint experience, ideas, and involvement. Finally, blockchain's immutable and transparent record-keeping abilities are also integral to building trust and accountability between stakeholders, providing an unalterable, auditable record of transactions, agreements, and communications between them.

5. Conclusion

The case study of (TGC) and its integration with AI in stakeholder relationship management within the UAE construction industry highlights the potential benefits and challenges of AI adoption. The study demonstrates that AI, particularly in predictive analytics and decision-making support, can significantly enhance project success in the complex and rapidly evolving UAE market. However, full integration of AI in stakeholder management requires addressing challenges such as data management, privacy, and alignment with organizational goals.

5.1. Recommendations & Implications

Based on the findings, the following recommendations are proposed:

- Customization of AI Solutions: TGC should prioritize the development of custom AI solutions that can be adapted to different project scales, as indicated by survey respondents.
- Investment in Training and Development: Comprehensive training programs should be implemented to improve AI literacy among construction professionals, enabling them to use AI technologies effectively.
- Stringent Data Governance Protocols: Reliable data governance frameworks should be established to ensure data accuracy, security, and stakeholder trust.
- Collaborative Industry Ecosystems: Building collaborative partnerships with technology vendors and academic institutions will drive innovation and standardization of AI applications.

5.2. Recommendations for Future Studies

- Conducting future studies that seek to investigate the role of artificial intelligence in improving stakeholder relationship management in the UAE construction sector.
- Carrying out future studies that deal with the Requirements for implementing artificial intelligence strategies in the construction sector in the United Arab Emirates.

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