

An Agile Stakeholder Interface Management Framework for University Infrastructure Projects in Nigeria

Godwin Emeka Nworuh ¹; Oforegbunam Thaddeus Ebiringa ²; Baldwin C. Asiegbu ²; and Ibeawuchi I. Echeme ¹

¹Department of Project Management Technology, Federal University of Technology, Owerri. ² Department of Entrepreneurship and Innovation, Federal University of Technology, Owerri.

Corresponding author: oforegnunam.ebiringa@futo.edu.ng

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Abstract

This paper presents an Agile Stakeholder Interface Management (SIM) framework for university infrastructure projects in the Nigerian university system. Employing a mixed-methods approach (surveys, interviews, system design, and quantitative analytics), 40 university infrastructure project stakeholders were interviewed. The opinions of 150 infrastructure project professionals and practitioners were sought from 10 federal universities and 5 governmental supervision and regulatory Agencies. The result of the analysis of collected data identified project responsibility, interest, and influence as key drivers for the SIM framework developed, underpinning the iterative processes of stakeholder identification, categorization, prioritization, engagement, monitoring, control, evaluation, and debriefing within the university infrastructure project's lifecycle and value creation. Pilot testing of the developed SIM framework on two ongoing infrastructure projects at the Federal University of Technology, Owerri revealed significant impacts on project stakeholder interface management outcomes, notably in openness (19.1%), honesty (9.3%), inclusivity (5.3%), and transparency (3.5%) of project communications. Further, reductions were observed in infrastructure projects' conflicts (17.2%), uncertainties (13.5%), cost overruns (11.2%), time overruns (10.6%), and quality compromises (7.8%). The paper concludes that adopting an Agile SIM framework can substantially enhance infrastructure project information communication effectiveness, collaboration, and inclusivity among stakeholders of a university, thereby supporting the infrastructure projects management system of universities. The paper recommends institutionalization of Agile methodology use for managing infrastructure projects stakeholder interface by Nigeria's universities.

Keywords: Stakeholder Interface Management, Agile Project Management, University Infrastructure, Higher Education, Framework Development, Nigeria.

Introduction

Nigeria has about 275 licensed universities (federal, state, and private) serving more than two million students. However, the universities face major infrastructure deficits, impacting access to quality teaching and research. In 2025, the Nigerian government launched a €38 million Blueprint information communication technology (ICT) development (Blueprint-ICT-Dev) Project, in partnership with the French Agence Française de Développement (AFD), targeting digital transformation across 10 federal universities. This initiative aims to

upgrade ICT infrastructure, enhance campus connectivity, and support staff training to create smart campuses, aligned with the National Universities Commission's strategic revitalisation blueprint (National Universities Commission [NUC], 2025; AFD, 2025). Funding for infrastructure also heavily depends on the Tertiary Education Trust Fund (TETFund), which received over ₦700 billion in 2025 to prioritise rehabilitation and modernization of existing facilities rather than new constructions, ensuring sustained improvement of physical infrastructure across tertiary institutions (TETFund, 2025).

Infrastructure projects often face challenges with respect to schedule and cost overruns as well as substandard delivered quality in most Nigerian public universities. The above challenges are frequently rooted in conflicts, often caused by poor stakeholder interface management. A project stakeholder is an individual, group, or organization whose actions and/or interests can influence, or be influenced by the project, thereby playing a critical role in the project's success or failure (Loftus, 2021; Bourne, 2015). Stakeholder interface management (SIM) refers to the complex, evolving process of managing individual and organizational relationships across multiple levels throughout a project lifecycle (PMI, 2021; Pirozzi, 2020). A stakeholder may be internal or external, depending on the role, responsibility, interest, or influence (Hawrysz & Maj, 2017).

An Interface Management System (IMS) generally involves an iterative process of 5 steps, namely: interface identification, documentation, transfer, communication, and closure (Shokri et al., 2013). Consequently, as regards infrastructure projects, interface is the connection among construction elements, project phases, or project participants (Papavasiliou & Gorod, 2022), which if not effectively managed leads to poor communications and conflicts among stakeholders (Shokri et al., 2012). A comprehensive IMS clarifies stakeholder roles and responsibilities while enhancing understanding of their interests and influence, highlighting the critical importance of effective stakeholder interface management for university infrastructure projects in Nigeria. The need for an agile stakeholder interface management framework tailored to the complex infrastructure project environment of Nigeria's universities, cannot be overemphasized.

Problem Statement

Infrastructure projects in Nigeria's universities often suffer from delays, cost overruns, poor quality, and stakeholder dissatisfaction. These issues stem primarily from ineffective stakeholder interface management—the coordination and harmonization of diverse stakeholder interests, expectations, and communication throughout the project lifecycle. Nigeria's public universities operate within complex bureaucracies involving multiple stakeholders such as government agencies, contractors, consultants, university management, host communities, donors, students, and faculties. However, current project management approaches are typically rigid, linear, and siloed, ill-suited for managing the dynamic and often conflicting stakeholder interactions. Traditional stakeholder management models used in these projects lack the flexibility and responsiveness to

address emerging challenges and evolving stakeholder needs. Consequently, the absence of a structured yet adaptive stakeholder interface management framework has resulted in trust deficits, misaligned objectives, weak engagement, low stakeholder ownership, and poor project outcomes. This research highlights the urgent need for a context-specific, agile framework to improve collaboration, transparency, and responsiveness, thereby enhancing accountability, inclusiveness, and efficiency in delivering university infrastructure projects in Nigeria.

Aim and Objectives

This paper aims to develop an agile stakeholder interface management framework for enhancing the planning, coordination, and delivery of university infrastructure projects in Nigeria. Consequently, the objectives of this paper include:

1. Critically review the nature, roles, and interface dynamics of key stakeholders involved in university infrastructure projects in Nigeria.
2. Assess the limitations of existing stakeholder management practices in Nigerian university infrastructure delivery.
3. Explore the principles and applicability of agile management approaches to stakeholder interface management in infrastructure projects.
4. Design a context-sensitive agile stakeholder interface management framework suitable for the complexities of Nigerian university infrastructure environments.
5. Validate the proposed framework using expert consultations, stakeholder feedback, and selected case studies of university infrastructure projects in Nigeria.

Research Questions

To achieve the above-stated objectives, this paper sought answers to the following questions:

1. Who are the key stakeholders in Nigerian university infrastructure projects, and how do their roles and interactions affect project performance?
2. What are the major challenges and limitations of current stakeholder management practices in these projects?
3. How can agile principles be applied to improve stakeholder interface management in the context of Nigerian university infrastructure delivery?
4. What are the key components and operational mechanisms of an agile stakeholder interface management framework suitable for this context?
5. How effective and feasible is the proposed framework in addressing stakeholder-related challenges and improving project outcomes in Nigerian university infrastructure projects?

Significance and Structure of the Paper

The significance of this paper is that it addresses the need for a sustainable, evidence-based stakeholder interface management system for university infrastructure projects in Nigeria.

It proposes an integrative framework that systematically identifies, classifies, prioritizes, engages, controls, and debriefs critical stakeholders using a systems thinking approach (Ebiringa, 2011). The framework responds to gaps in knowledge about stakeholder interface drivers, priority grouping, and integration, especially in environments characterized by limited openness and information sharing, which often breed mistrust and conflict. Ultimately, the Agile SIM framework is designed to overcome challenges that have hindered the effective delivery of essential infrastructure in Nigerian universities.

The paper is structured as follows: the introduction sets the context, outlines the problem, states the objectives, presents research questions, and significance. The second section reviews relevant literature. The third describes the methodology. The fourth presents findings and discussion, and the final section offers conclusions and policy implications.

Literature Review

Stakeholder Interface Management (SIM) is an essential dimension of project stakeholder management, involving the systematic identification, categorization, prioritization, engagement, and eventual debriefing of stakeholders throughout a project's lifecycle (Pirozzi, 2020). This process ensures that diverse stakeholder interests, roles, and interdependencies are effectively coordinated to enhance project outcomes. Central to effective SIM is stakeholder requirement engineering, which involves gathering and analyzing stakeholder needs and expectations by navigating complex interpersonal and organizational dynamics (Bourne, 2015). Mixed-method approaches such as surveys, interviews, and expert consultations are commonly employed to capture comprehensive stakeholder attributes including roles, responsibilities, interests, and influence (Eskafi, Hashemi, Hashemi, & Tabatabaeian, 2019; Ogunsanya & Govender, 2020). Furthermore, snowball sampling techniques support identifying unique stakeholder groups and mitigating redundancy in data collection (Mwanzia, 2014).

To evaluate and prioritize these stakeholder groups, strategic frameworks like SWOT analysis are frequently utilized, aiding in highlighting strengths, weaknesses, opportunities, and threats relevant to various stakeholder clusters (Khan, Rahman, & Hussain, 2019). Stakeholder categorization often employs the multiple classification grid model, which assesses stakeholders based on two key dimensions: interest and power (Aki & Haapasalo, 2014; Khan et al., 2019). This 2x2 matrix helps classify stakeholders for appropriate management strategies such as monitoring, informing, satisfying, or closely managing critical players (Roeder, 2013; Ogunsanya & Govender, 2020).

Beyond power and interest, stakeholders are also classified by their functional roles in the project ecosystem (such as customers, contractors, sponsors, host communities, non-governmental organizations (NGOs), and government agencies) thus enhancing tailor-made management approaches that maximize project value (Aki & Haapasalo, 2014). Requirement engineering, a systematic and iterative process, ensures the documentation of stakeholder needs that are clear, complete, consistent, and traceable. This improves

communication, supports decision-making, and fosters value creation across the project lifecycle (Bourne, 2015; Ebiringa & Lasiz, 2014).

Primary stakeholders, with direct project interest, differ from secondary stakeholders who hold indirect stakes or are affected indirectly by the project (Roeder, 2013; Ogunsanya & Govender, 2020). Bourne (2015) further recommends evaluating stakeholders by power (ability to influence), proximity (closeness to project activities), and urgency (priority of their concerns), often using quantitative scales to refine prioritization. Effective stakeholder engagement requires assigning roles and responsibilities based on this prioritization, supplemented by ongoing communication management throughout the project. Continuous monitoring ensures stakeholders uphold their commitments, with formal debriefing performed when participation concludes to close relationships professionally (Pirozzi, 2020).

Summary of Theoretical and Practical Gaps

Current stakeholder management theories in infrastructure projects primarily utilize rigid, linear models that inadequately capture the complex and evolving interactions among stakeholders, particularly within public university contexts. These models tend to emphasize stakeholder identification while neglecting the dynamic relationships, communication patterns, and conflict points that arise throughout the project lifecycle (Freeman et al., 2010; Yang, Shen, Ho, Drew, & Xue, 2011). Furthermore, existing frameworks often lack integration of agile principles such as flexibility, iteration, and responsiveness, which are essential for effective stakeholder management in complex environments (Highsmith, 2009; Conforto, Salum, Amaral, da Silva, & de Almeida, 2016). Most models are also derived from contexts that do not adequately reflect the socio-political and institutional realities of Nigerian public universities (Ogunlana & Promkuntong, 1996; Eze, Chinedu-Eze, & Bello, 2020).

In practice, stakeholder engagement in Nigerian university infrastructure projects is frequently fragmented, bureaucratic, and poorly coordinated. Project teams lack adaptive tools and frameworks capable of managing the fluid expectations, roles, and interdependencies among diverse stakeholders (Adeleke, Oyedele, & Kadiri, 2018; Idoro, 2013). This deficiency contributes to project delays, inefficiencies, and widespread stakeholder dissatisfaction. Additionally, there is a notable absence of feedback mechanisms and iterative learning processes that could enhance project outcomes and foster trust among stakeholders (Bourne, 2015; Pirozzi, 2020). These gaps highlight the urgent need for a context-sensitive, agile stakeholder interface management framework specifically tailored to address the unique challenges of university infrastructure delivery in Nigeria.

Methodology

This study employed a mixed-methods approach for data collection and analysis as shown in Table 1. The research process is grounded in systems modeling (Ezirim, Briggs, Ebiringa

& Maclayton, 2004), facilitating a comprehensive understanding of university infrastructure project environment dynamics and stakeholders' diversity (Papavasiliou & Gorod, 2022).

Table 1: Summary of the research activities

Step	Research Activity	Description
1	Research problem definition	Clearly identify and formulate the key research problem or question focused on stakeholder interface management in Nigerian university infrastructure projects.
2	Literature review	Review existing academic and industry literature on stakeholder management, agile frameworks, and university infrastructure projects to establish background, identify gaps, and refine the research focus.
3	Research objectives development	Based on the problem and literature, formulate a testable clear objectives to guide the inquiry were developed.
4	Methodology design	A mixed method approach combining qualitative (e.g., interviews) and quantitative (e.g., surveys) data collection techniques, specifying sampling strategy, case study selection (the Federal University of Technology, Owerri projects), and data analysis methods.
5	Stakeholders identification and mapping	Key stakeholders involved in university infrastructure projects were identified and their roles and interactions as part of the agile framework focus were analysed.
6	Data collection	Data collection was executed: interviews and surveys with identified stakeholders were conducted, and relevant project data was documentation for triangulation.
7	Data analysis	Qualitative thematic analysis on interview data and quantitative statistical analysis on survey data were performed to draw insights on stakeholder engagement and communication.
8	Agile SIM framework design and development	Insights from analyzed data were used to develop a tailored agile SIM framework suited for universities infrastructure projects in Nigeria.
9	SIM framework validation and refinement	The developed SIM framework was validated through pilot testing and stakeholders' feedback if feasible and refined accordingly.
10	Drawing of conclusions and making recommendations	Findings were synthesized and conclusion on stakeholder management efficacy drawn, and actionable recommendations made for agile practices in university infrastructure projects in Nigeria made.
11	Reporting and disseminating findings	A comprehensive research article written for publications to share results with academia and practitioners.

Table 1 succinctly captures the logical steps of research activities based on the mixed method approach involving extensive data collection secondary and primary sourced data from stakeholders, analysis using both qualitative and quantitative techniques, agile principles application, stakeholder mapping, and framework development to enhance university infrastructure project management. The iterative agile framework development and validation processes form the backbone of the methodology of this research.

Agile SIM Framework Design and Development Process

The Agile process upon which the SIM framework development is grounded is shown in Figure 1. In applying the Agile SIM framework for university infrastructure project development, careful consideration was given to the roles, interests, and influence of multiple stakeholders within the project management system. The System of Systems (SoS) approach facilitated an understanding of the complex interrelationships among different systems and their stakeholders, thus supporting effective stakeholder interface management.

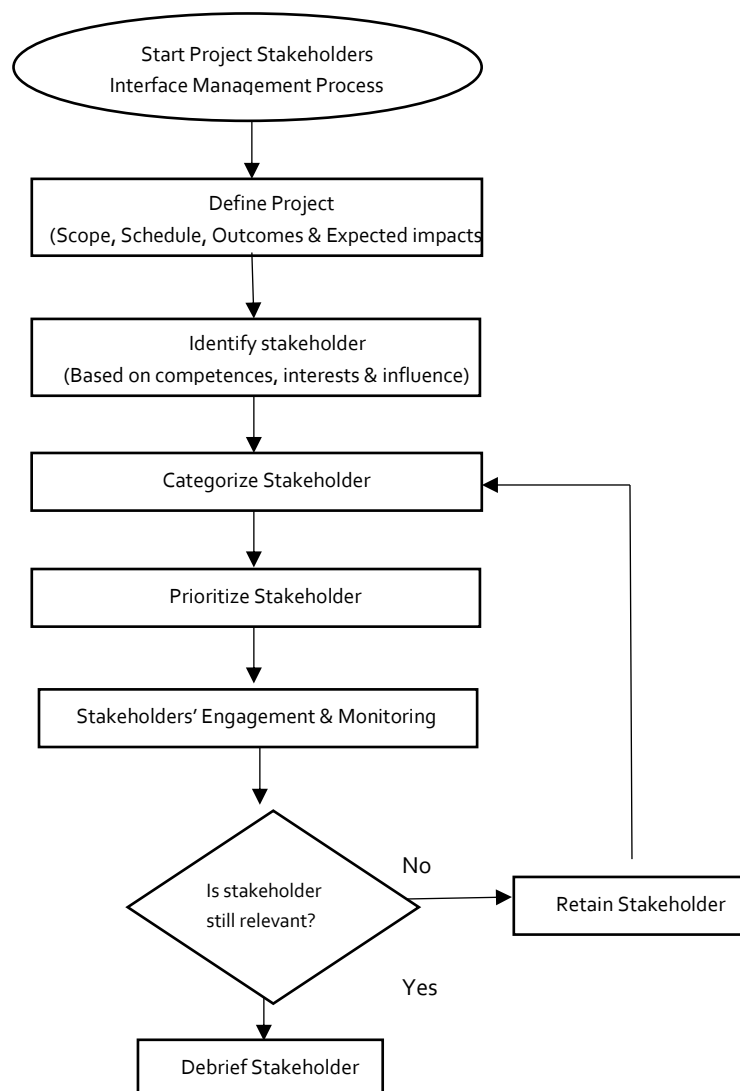


Figure 1: Agile SIM framework development process (Authors' conceptualization)

This paper's SoS approach integrates process engineering (PE) and information systems management (ISM) methodologies to manage the lifecycle of infrastructure projects as interconnected systems. The primary goal is to establish a structured framework for handling the intricate interactions and interdependencies among project stakeholders (Kozma, Dániel, Pál Varga & Larrinaga, 2021).

Sample Size, Recruitment, and Ethical Approvals

Sample size

For the qualitative interviews, the sample consists of 40 key stakeholders of all infrastructure projects development at the Federal University of Technology Owerri. The distribution is as follows:

- Key members of University Tenders Board: Vice Chancellor (1), Registrar (1), Bursar (1), Directors of Works (1), Procurement (1), Physical Planning and Development (1), Internal Control (1), Chairman Committee of Deans (1).
- Key representatives of infrastructure users: Office of University Development (1), Chairman of Academic Staff Union of Universities (1), Chairman of Senior Staff Association of Nigerian Universities (1), Chairman of Non-teaching Staff Association (1), Chairman of National Association of Academic Technologists (1), President, Students Union Government (1).
- Key infrastructure implementation team: main projects' contractors (5), Projects' Consultants (10), Sub-Contractors, Suppliers and Vendors (5), Presidents Generals of University host communities (5), the General Manager, Owerri Capital Development Authority (1).

This sample size is deemed sufficient for saturation of themes in qualitative research.

For the quantitative (survey), the opinions of a larger sample of 150 project practitioners in the Nigerian university system were sought. This included a broader range of individuals involved in university infrastructure projects, such as project engineers, architects, quantity surveyors, and site supervisors drawn from 10 federal universities (University of Agriculture Umudike, University of Port Harcourt, University of Benin, Obafemi Awolowo University Ife, University of Jos, Ahmadu Bello University Zaria, Abubakar Tafawa Balewa University Bauchi, Usmanu Danfodiyo University Sokoto, University of Lagos, and University of Nigeria, Nsukka). Also, some infrastructure projects supervision and monitoring professionals from the Federal Ministry of Education, Tertiary Education Trust Fund, Budget Office, and Accountant General's office were surveyed.

Recruitment

Participants for the qualitative interviews were recruited using a purposive sampling strategy, identifying individuals with direct experience and expertise in managing stakeholder interfaces within university infrastructure projects. Initial contact was made

through official university channels and professional networks. Participants for the quantitative survey were recruited using a stratified random sampling approach, ensuring representation across different categories of stakeholders and universities. Online survey platforms were utilized for a broader reach and ease of participation. Links distributed through official university communication channels and relevant professional associations.

The SIM Framework Piloting and Refinement Process

The pilot testing phase was crucial for the iterative development and refinement of the SIM agile framework for stakeholder interface management. Feedback gathered during pilot testing was meticulously analyzed to ensure the SIM framework's practical applicability, clarity, and effectiveness within the Nigerian university infrastructure context. Specifically, the pilot feedback was used in the following ways to refine the SIM framework as developed in this paper:

- Usability and practicality: Feedback on the ease of understanding and implementation of the framework's components (e.g., specific tools, processes, or communication protocols) informed revisions to simplify complex aspects, clarify ambiguous instructions, and integrate more practical examples or templates. Certain steps of the SIM framework development that participants found cumbersome or impractical, were streamlined or redesigned.
- Relevance and contextual fit: Pilot participants' inferred how well the SIM framework addresses the unique challenges and nuances of stakeholder management in Nigerian university infrastructure projects is invaluable. This includes feedback on cultural considerations, regulatory environments, common stakeholder dynamics, and resource limitations. The framework is adjusted to better align with the specific operational realities and socio-political landscape of these projects.
- Clarity and language: Ambiguities in the framework's terminology, definitions, or procedural steps identified during the pilot were addressed. Feedback helped to refine the language to be precise, unambiguous, and easily understood by various project stakeholders, regardless of their technical background.
- Completeness and gaps: Pilot participants identified elements or considerations that were missing from the draft SIM framework but are critical for effective stakeholder interface management. For instance, feedback might highlight the need for more explicit guidance on conflict resolution, risk management related to stakeholders, or specific reporting mechanisms. These identified gaps were incorporated into the refined SIM final framework presented in this paper.
- Effectiveness and desired outcomes: Feedback on whether the SIM framework's proposed methods were perceived to lead to improved communication, enhanced collaboration, and more efficient project delivery was critically evaluated. Certain aspects that were not perceived to achieve the desired agile outcomes, alternative approaches, or modifications were explored and integrated.

The refinement process is iterative, meaning that initial changes based on pilot feedback were further validated through expert review or a second, smaller round of consultation when significant modifications were made, ensuring that the final SIM framework as presented in this paper is robust, validated, and highly applicable.

Tools of Analysis

A combination of descriptive and inferential tools of analysis was applied in the analysis of the data collected. To analyze stakeholder dynamics, the study employed a descriptive analytic tool (the power/predictability matrix), which categorizes stakeholders into four groups: Powerful and predictable, powerful but unpredictable, highly predictable but with low power, and unpredictable with little power.

Additionally, the study referenced the power/interest matrix, which also divides stakeholders into four groups based on their influence and interest. Two key criteria were identified for assigning an entity to a stakeholder group: the entity is (or could be) affected by the system's outcomes, and the entity manages resources (such as expertise, political, or financial assets) utilized by the organization. This distinction led to two main stakeholder groups: the involved (those who can affect the project), and the affected (those who are impacted by the project).

Bourne (2015) further suggested assessing stakeholder salience using a modified impact/probability matrix (see Table 1). In this matrix, the Y-axis represents stakeholder salience (the importance of their claims), and the X-axis indicates the probability of their impact or ability to contribute to the project. The matrix rearranges stakeholder positions to better reflect their salience, emphasizing that a stakeholder must possess at least two attributes to be considered a "key player" or primary team member.

The matrix also distinguishes between "keep informed" (key supporting participants) and "keep satisfied" (tertiary stakeholders with little personal interest), noting that the former are more likely to influence project outcomes. Stakeholders with only one attribute are categorized as "minimal effort" or "extended stakeholders," and their position may change as their level of impact or contribution evolves. Stakeholder salience refers to the priority managers assign to competing stakeholder claims. It is determined by three attributes:

- Power: The ability of a stakeholder to influence others or project outcomes, often through resources or authority.
- Legitimacy: The perceived appropriateness or validity of a stakeholder's claims within the context of social norms and contractual relationships.
- Urgency: The degree to which a stakeholder's claim requires immediate attention, based on time sensitivity and criticality.

A stakeholder must possess at least one of these attributes to be considered relevant to the project. However, those with more attributes have higher salience and demand greater managerial attention. For example, government agencies may wield formal power, while contractual relationships enhance a stakeholder's legitimacy and influence.

Urgency, though sometimes less compelling than power or legitimacy, is crucial as it drives the dynamics of stakeholder engagement and interaction. In infrastructure projects, urgent claims often arise from the risk of negative consequences, making timely stakeholder management essential.

The level of urgency for each stakeholder was calculated as outlined in Table 1, using a specific equation. Here, "urgency" reflects the need for prompt stakeholder engagement by the project team.

Table 2: Saliency and Probability/Impact Matrix

Saliency and Probability to Impact Matrix								
Saliency								
PTM (0.90)	0.09	0.18	0.36	0.72	0.72	0.36	0.18	0.09
KSP (0.70)	0.07	0.14	0.28	0.56	0.56	0.28	0.14	0.07
TS (0.50)		0.10	0.20	0.40	0.40	0.20	0.10	
ES (0.30)		0.06	0.12	0.24	0.24	0.12	0.06	
	key players (0.10)	keep informed (0.20)	keep satisfied (0.40)	Minimal effort (0.80)	Minimal effort (0.80)	keep satisfied (0.40)	keep informed (0.20)	key players (0.10)

Probability to Impact of the Stakeholders on an objective (e.g., cost, time, scope or quality). Each stakeholder is rated on his/her saliency and probability to impact on the project objective if identified and prioritized.

Key: PTM: Primary Team Members (key players); KSP: Key Supporting Participants (keep informed); TS: Tertiary Stakeholders (keep satisfied) and ES: Extended Stakeholders (minimal effort).

Stakeholders are assessed based on their saliency and likelihood to impact project objectives (e.g., cost, time, scope, or quality) to ensure appropriate identification and prioritization throughout the project lifecycle.

In analysing the impact of the application of the SIM framework proposed in this paper on university infrastructure projects in Nigeria, the inferential Spearman correlation coefficient was applied.

Ethical Approvals

Before any data collection, comprehensive ethical approval was sought from the relevant Research Ethics Committee of the Federal University of Technology, Owerri. The research proposal detailed measures that ensured participant anonymity and confidentiality, informed consent, the right to withdraw at any time without penalty, and the secure storage and handling of all collected data. Participants were provided with a clear information sheet outlining the purpose of the research, data usage, and their rights. Written informed consents were obtained from all participants before their involvement in the research.

Results and Discussion

Agile SIM framework for university infrastructure project development

The agile SIM framework for university infrastructure projects is developed using the thematic analysis of the opinions of key university infrastructure projects practitioners structured into a project management and stakeholders communication system of systems using the flowchart-process flow approach. This method facilitates the rapid identification, classification, and requirements engineering of stakeholders, especially during the early stages of a project. By systematically identifying and engaging stakeholders who can significantly influence project success, the SIM framework supports the formation of integrated, multi-level project teams from the outset.

The primary goal of the SIM framework is to maximize value creation throughout the project lifecycle. It achieves this by combining best practices in stakeholder management with robust requirements engineering, as illustrated in Figure 2.

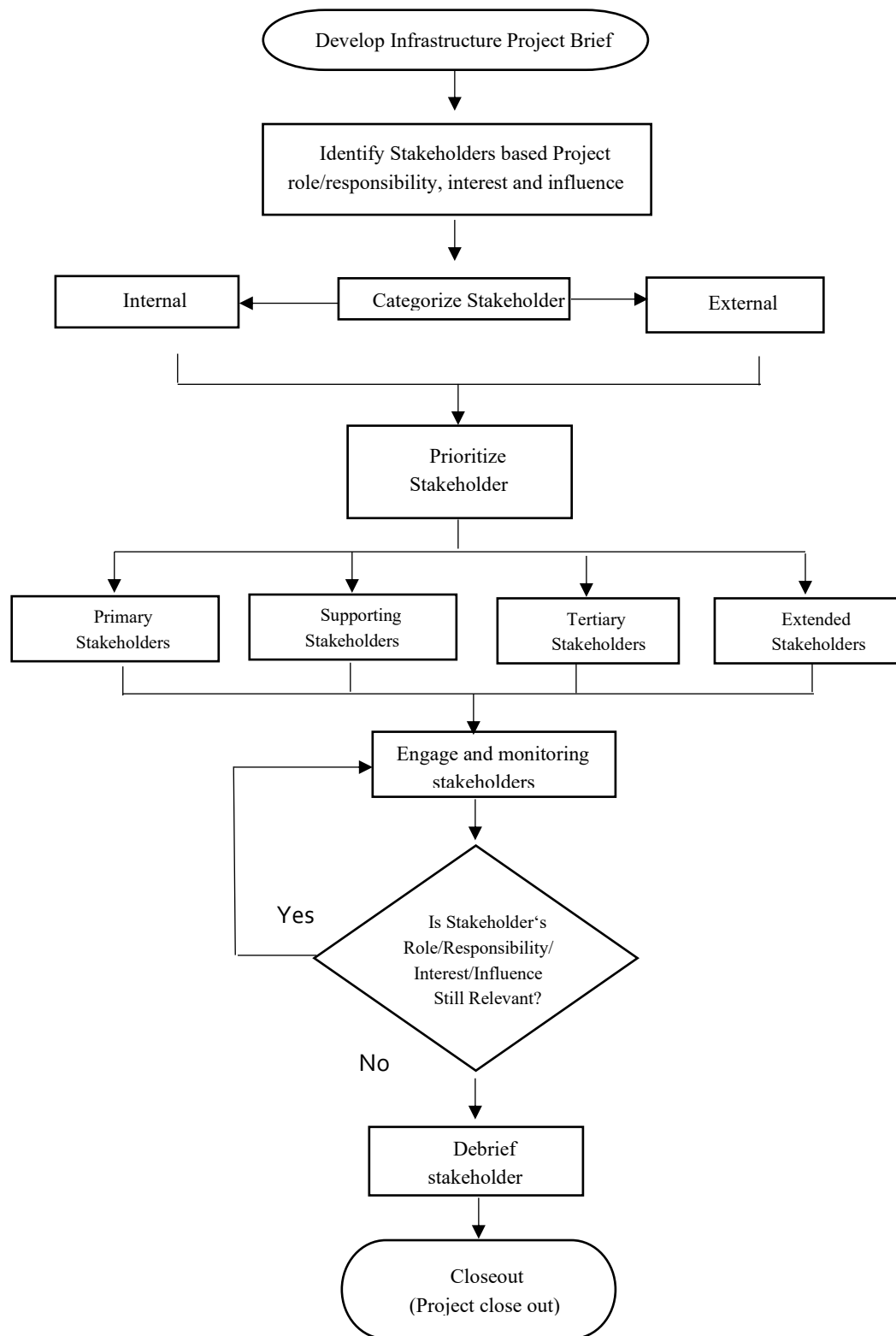


Figure 2: SIM framework. conceptualized by the Authors (2025)

The SIM framework (Figure 2) consists of six key levels of stakeholder interfacing:

- Defining the Project: Establish the project's purpose, user requirements, expected outcomes, and anticipated impacts.

- Identifying Stakeholders: Recognize stakeholders based on their roles, responsibilities, interests, and influence.
- Assessing Stakeholder Salience: Evaluate stakeholders' prominence and their likelihood to impact or contribute to the project.
- Classifying Stakeholders: Group stakeholders according to their priority and importance.
- Engaging Stakeholders: Actively involve stakeholders in the project process.
- Debriefing Stakeholders: Provide feedback and communicate outcomes to stakeholders.

Additionally, Figure 2 illustrates the requirements engineering process. Although stakeholder requirements are initially collected, systematic requirements engineering only begins after stakeholders have been classified. This classification enables the structured collection and management of requirements. Figure 2 emphasizes the early project phase, where identifying both confirmed and uncertain (potential) stakeholders is critical. However, the SIM framework has limitations: it does not account for changes in the stakeholder network over time. Since stakeholder dynamics can evolve, ongoing analysis throughout all project phases is necessary. Moreover, the framework overlooks stakeholders' attitudes (e.g., supporters versus opponents). Regardless of their stance, all stakeholder requirements should be considered. Typically, project management views proponents as having higher salience and greater potential impact or contribution than opponents.

Pilot testing and validation of the SIM framework

To validate the SIM framework (Figure 2), two ongoing infrastructure projects at the Federal University of Technology Owerri (FUTO) were selected as case studies, and their respective Project Managers were interviewed. The summary of findings of the interviews is as follows:

Case 1 Project: School Information and Communication Technology (SICT) Building

The project manager identified 11 stakeholder groups with the following roles:

- Customer: Local physical planning unit responsible for overseeing the project's progress and success; defines project purpose and constraints.
- End Users: Teaching staff, non-teaching staff, and students.
- Main Contractor: Leads construction activities.
- Sub-contractors: Handle smaller tasks outsourced by the main contractor.
- Side-contractors: Contracted directly by the customer for specialized, complex tasks such as ventilation, air conditioning, automation, electricity, and plumbing.
- Main Designer (Architect): Oversees overall design and integrates contributions from other designers.

- Other Designers: Responsible for specific technical subsystems like ventilation, structural elements, electrical systems, and automation.
- Public Authorities: Local and public officials who supervise construction and enforce regulations (e.g., planning, fire, and health authorities).
- Material Suppliers: Provide materials and equipment such as concrete, windows, furnishings, and research instruments.
- Local Residents and Neighbours: May raise requests or requirements related to the project.
- FUTO Council and Management: Final decision-makers who approve the project and funding.

According to the project manager interviewed, while this is a traditional project, the SICT building requires specialized expertise due to its focus on digital learning environments and research facilities. Not all end-user requirements can be fulfilled, making their representation in the core project team essential. The manager emphasized the importance of their involvement and contribution to the project's success and value creation.

Case 2 Project: Perimeter Fencing of FUTO Teaching Hospital Site, Avu

According to the Project Manager, this project aims to prevent land encroachment on the Teaching Hospital site. Most stakeholders and end-users support the project's purpose. The Imo State Government also backs the initiative, recognizing the hospital's role in enhancing healthcare in the state. The project manager identified 12 stakeholder groups:

- Customer: Council and Management are responsible for final project decisions.
- End Users: Teaching and non-teaching staff, students, and future patients.
- Main Contractor: Executes the design implementation.
- Sub-contractors: Work under the main contractor, handling specific, independent tasks.
- Property Management: Manages property operations, information flow, stakeholder coordination, and topical preparations.
- Main Designer (Architect): Oversees overall design and consolidates inputs from other designers.
- Other Designers: Handle smaller, specialized design components.
- Public Authorities: Local and public officials supervising the project and imposing necessary constraints.
- Material Suppliers: Provide construction materials.
- Local Residents and Neighbours: May submit requests or requirements related to the project.
- Construction Consultant: Engaged to provide expertise that the customer may lack.
- Project Sponsor: Typically has no direct requirements or personal interest in the project.

Assessment of impacts SIM framework

Table 3 summarizes the result of analysis of the likely impact of SIM framework adoption and implementation by Nigerian universities on key performance indices of infrastructure projects as assessed by 150 infrastructure project professionals and practitioners drawn across ten (10) Nigerian federal universities, TETFund, the Accountant General's Office, Office of the Auditor General of the Federation in Abuja.

Table 3: Correlation Coefficients of SIM framework impact on key project indices

Indicators	Openness	Conflict reduction	Uncertainty	Cost effectiveness	Time effectiveness	Honesty & Accountability	Quality & Reliability	Inclusivity	Buy in/ decision support
Coefficient	0.191	0.172	0.135	0.112	0.106	0.093	0.078	0.053	0.035
Sig	0.041	0.038	0.022	0.039	0.014	0.025	0.036	0.048	0.031

Source: Author's Computation from field data (2025)

Table 3 reveals that all nine identified measures of the infrastructure project stakeholders' interface management system showed significant positive correlations with the deployment of the SIM framework at a 5% significance level. Specifically, improvements were noted in the projects' communication system regarding openness (19.1%), honesty (9.3%), inclusivity (5.3%), and buy-in/decision support (3.5%). Additionally, the SIM framework contributed to reducing project conflicts (17.2%), uncertainties (13.5%), cost overruns (11.2%), time overruns (10.6%), and quality compromises (7.8%).

The adaptability of the SIM framework implemented in two case study projects showed slight variations, which were both expected and desirable as projects are always unique as supported by extant literature such as: Hawrysz and Maj (2017), Ogunsanya and Govender (2020), and Pirozzi (2020). Stakeholders were classified logically based on their roles and responsibilities. The SIM framework proved applicable across different project types. In both cases, Project Team Members (PTMs) emerged as the most salient and essential stakeholders, with a high likelihood of contributing significantly to project success. The customer, end-user, and main designer consistently needed representation in the core stakeholder group, a finding aligned with previous research such as: Mwanzia (2014), Macías (2017), and Loftus (2021).

The role of the main contractor varied depending on the project delivery method. For example, the fencing project used a design-build approach, where the main contractor had a larger influence on project outcomes compared to the design-bid-build method used in the other project. Consequently, the main contractor's classification differed between the two cases. Key supporting participants (KSPs), such as sub-designers and subcontractors, were stakeholders with personal interest in the project who could contribute despite lacking decision-making power. This finding is consistent with those of: Khan, et al. (2019) and

Pirozzi (2020). Public authorities were categorized as tertiary stakeholders: they held power through laws and regulations but lacked personal interest if compliance was maintained. Extended stakeholders, including subcontractors, material suppliers, and residents, played minor roles but required communication and information exchange to ensure their satisfaction, as emphasized by project managers.

The study confirmed that stakeholder identification and classification are always project-specific. Previous research has shown that neglecting systematic stakeholder management can lead to major project issues. Therefore, using frameworks like SIM to systematically identify and manage stakeholders can help avoid many problems. The main implication is that stakeholders must be systematically identified and classified for each project, with management strategies tailored to their salience and context. This finding aligns with those of Bryce (2017) and Shokri, et al. (2012). The SIM framework offers potential value by minimizing conflicts inherent in stakeholder management and ensuring an effective requirements engineering (RE) process. Project managers interviewed supported the SIM framework and systematic stakeholder management, provided the process is logical, concise, and user-friendly.

The SIM Framework's Applications by Project Managers in Practice

Project managers applying the SIM framework in university infrastructure projects in Nigeria, should follow these six steps:

- Identifying and analyzing stakeholders: Systematically identifying all relevant stakeholders (e.g., university officials, contractors, funders) and analyzing their interests, influence, needs, and motivations to prioritize engagement efforts effectively (Hawrysz & Maj, 2017).
- Mapping and documenting interfaces: Identifying interface points where stakeholders interact -such as design approvals, procurement, construction phases - and document responsibilities, deliverables, and communication channels for each interface.
- Developing an Agile engagement plan: Based on stakeholder analysis, create a flexible plan that enables iterative communication, collaboration, and decision-making, incorporating rapid feedback cycles to address emerging issues promptly.
- Establishing governance and roles: Defining clear roles for interface leadership and stakeholder participation, ensuring accountability for information sharing, conflict resolution, and timely delivery of interface-related outputs (Eskafi, Hashemi, et al; 2019).
- Implementing continuous monitoring: Regularly tracking stakeholder interactions, resolving conflicts proactively, and adjusting engagement strategies dynamically based on ongoing feedback and project developments (Kozma, et al; 2021).
- Reviewing and adapting the framework: Using lessons learned throughout the project life cycle to refine interface management processes, ensuring enhanced alignment and responsiveness to stakeholder needs.

Applying the SIM framework successful for infrastructure project management in Nigerian universities will not be without challenges. Likely challenges and resistance in practical application will include:

Stakeholder fragmentation and conflicting interests: Diverse priorities among university departments, contractors, and authorities could result in misalignment or resistance to collaboration.

Lack of stakeholder awareness or buy-in: Some stakeholders may resist structured engagement due to unfamiliarity with agile practices or perceived added workload.

Communication barriers: Inadequate communication infrastructure, cultural differences, or hierarchical organizational structures can hinder transparent information flow.

Resistance to change and uncertain roles: Stakeholders may be reluctant to adopt new governance protocols or unclear about their interface responsibilities.

Resource constraints and delays: Limited funding, bureaucratic delays, and evolving project scope amplify interface complexities.

Addressing these challenges requires proactive leadership, transparent communication, early stakeholder involvement, and iterative adjustments that are core principles embedded in the agile SIM framework's design for dynamic, context-specific stakeholder interface management in Nigerian university infrastructure projects.

Summary of Main Lessons Learned

The following are the lessons learned for improving infrastructure project delivery in Nigerian universities through the application of an agile stakeholder interface management framework as advocated by this paper:

- Early stakeholder identification is crucial: Comprehensive and timely identification of all relevant stakeholders reduces conflicts and enhances collaboration.
- Agility enhances responsiveness: Iterative communication and feedback loops allow prompt resolution of interface issues amid changing project conditions.
- Clear role definition prevents overlaps: Explicitly assigned responsibilities at interface points minimize confusion and delays.
- Contextual adaptation is needed: Rigid, one-size-fits-all approaches fail in diverse Nigerian university environments; agile flexibility is key.
- Continuous monitoring improves outcomes: Regular stakeholder engagement and progress review maintain alignment and manage expectations effectively.
- Effective communication mitigates resistance: Transparent and culturally sensitive communication fosters trust and reduces stakeholder pushback.
- Resource constraints impact implementation: Limited funds and bureaucratic hurdles often challenge seamless stakeholder interface management.
- Capacity building boosts adoption: Training stakeholders in agile principles increases framework acceptance and practical usability.

Impact Variation by University/Project Context

The following variations in the application of the SIM framework are likely to occur across universities given differences in universities and project context:

- Size and complexity of the university project: Larger universities or projects with multiple campuses may face more complex stakeholder networks requiring more rigorous interface management compared to smaller projects.
- Institutional culture: Universities with more hierarchical or bureaucratic cultures may exhibit higher resistance to agile, requiring tailored change management strategies.
- Funding sources and constraints: Projects funded by governmental bodies versus international donors may differ in regulatory requirements and stakeholder expectations, affecting framework application.
- Technical capacity: Institutions with limited technical expertise or project management maturity may need additional support to fully leverage the agile framework.
- Geographical location: Universities in remote or less-developed regions may face infrastructure and communication challenges affecting stakeholder engagement dynamics.
- Project scope and objectives: The SIM framework's impact will vary depending on specific project goals (e.g., new construction versus renovation), affecting stakeholder involvement intensity and interface complexity.

Overall, the SIM framework's agility enables customization to multiple contexts, but understanding and proactively managing these contextual factors is essential for maximizing its effectiveness across varied Nigerian university infrastructure projects.

Sustainability and Future Monitoring

To ensure sustainability and future monitoring of the application of the SIM framework for infrastructure project management in the Nigerian university system, the following actions are to be taken:

- Sustainability through continuous engagement: The SIM framework ensures sustainability by embedding ongoing stakeholder engagement processes that adapt dynamically to evolving project needs and contextual changes, fostering long-term collaboration and ownership among university infrastructure stakeholders (Ebiringa & Lasis, 2014)
- Adaptive monitoring mechanisms: Future monitoring leverages agile principles by implementing iterative feedback loops and real-time communication channels that track stakeholder concerns, interface effectiveness, and project progress, enabling timely adjustments to the framework and project execution.
- Inclusive and context-sensitive surveillance: Monitoring activities should emphasize inclusiveness, particularly of vulnerable groups (e.g., disabled persons,

community members), to ensure social sustainability dimensions are addressed and that stakeholder voices continually shape project outcomes.

- Integration with university governance: Embedding the agile interface framework within university management structures ensures institutionalization of stakeholder engagement practices, promoting consistent oversight beyond the project lifecycle.
- Use of technology for monitoring: Digital tools and platforms should be utilized for transparent reporting and grievance redressal, simplifying ongoing stakeholder communication and enabling data-driven decision-making to enhance project sustainability.
- Capacity building for sustainability: Training project managers and stakeholders on agile principles and the SIM framework's processes will ensure maintenance of momentum, improve interface management skills, and safeguard sustained application in future infrastructure project developments (Khan & John, 2019).
- Periodic evaluation and refinement: Scheduled evaluations to assess the SIM framework's effectiveness across different project phases, incorporating lessons learned and making iterative improvements to address contextual challenges unique to Nigerian universities.

This approach aligns with agile and adaptive stakeholder management best practices, promoting resilient and sustainable SIM implementation outcomes tailored for diverse university infrastructure contexts in Nigeria.

Recommendations and Policy Implications

The following recommendations and policy implications are made for the adoption and implementation of the Agile SIM framework for university infrastructure project management in Nigeria:

Policy Recommendations

a) Institutionalizing agile principles in project governance

- Mandating iterative planning and review cycles for infrastructure projects, enabling frequent feedback and rapid adaptation to changing requirements and campus needs.
- Embedding continuous stakeholder engagement, ensuring representation of key groups (students, academics, administration, local community) in all project phases.

b) Developing structured hybrid management protocols

- Combining agile flexibility with traditional project controls, adopting hybrid methodologies tailored for educational infrastructure - balancing regulatory compliance with adaptability.

- Defining clear governance mechanisms that allow for dynamic stakeholder coordination while maintaining accountability and risk controls.
- c) Strengthen stakeholder identification and interface management
- Making stakeholder mapping and analysis a compulsory early-stage activity for all university projects, preventing marginalization, and ensuring all relevant interests are acknowledged.
 - Using interface management platforms to facilitate timely communication and collaboration among various project parties (contractors, consultants, end-users) (Aapaoja & Harri Haapasalo, 2014).
- d) Building capacity and fostering culture change
- Investing in systematic training programmes for project teams and university administrators focused on Agile tools (e.g., Scrum, Kanban) and collaborative skills.
 - Promoting a culture of transparency, flexibility, and openness to change across all levels of the institution, actively reducing resistance to new methodologies. (Pirozzi, 2020)
- e) Regulatory and policy support
- Integrating Agile requirements into higher education infrastructure policies, ensuring that funding and oversight recognize the iterative and dynamic nature of campus development projects.
 - Revising procurement and contract frameworks to facilitate modular project delivery, allowing changes in scope as needs evolve without undue penalty or bureaucratic delay.
- f) Incentivize technological integration
- Encouraging the use of digital project management platforms that support real-time stakeholder feedback, progress visualization, and resource tracking.
 - Providing policy support for pilot projects that integrate smart technologies (IoT, AI) with Agile management, documenting and sharing best practices for wider adoption.
- g) Monitor and evaluate for continuous improvement
- Establishing feedback-driven monitoring systems, using metrics such as stakeholder satisfaction, adaptability to change, project delivery time, and cost control as standard success indicators.
 - Requiring periodic policy reviews to ensure that regulatory frameworks continue to foster innovation and stakeholder value maximization.

Policy Implications

Key issues and policy implications to ensure effective stakeholder interface management practices during infrastructure projects implementation in Nigerian universities within the framework of SIM (Figure 2) are summarized in Table 4.

Table 4: Issues and policy implications

S/N	Issue	Policy Implication
1.	Rigidity in current project management	Calls for a shift toward more flexible, stakeholder-centric policies and the embedding of Agile hybrid models in national/university guidelines
2.	Stakeholder exclusion	Necessitates mandatory stakeholder interface and robust stakeholder mapping in public procurement and project cycles
3.	Training deficits	Highlights the need for continuous professional development and the mainstreaming of Agile competences
4.	Technology adoption lag	Requires new policy incentives and support for integrating digital and smart management tools into infrastructure delivery
5.	Change resistance	Underlines the necessity for cultural reforms and leadership in promoting Agile values and processes

Conclusion

Based on the results obtained, this study concludes that adopting an Agile stakeholder interface management approach such as the SIM framework (Figure 2) in infrastructure projects by Nigerian universities can lead to faster, more cost-effective, and user-centric campus developments. Policy frameworks should institutionalize these adaptive, collaborative approaches to achieve sustained improvements in infrastructure delivery and stakeholder satisfaction.

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