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Evaluating ICT Project Sustainability Using Business Intelligence and Fuzzy AHP

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Abstract. This study explores persistent sustainability challenges in ICT projects despite the widespread availability of project management tools. A mixed-method approach combining inspections, observations, and a structured questionnaire was used to evaluate the six key framework attributes drawn from existing literature. The rating response from the experienced and professional ICT projects field experts, which were based on a three-point scale, were further analyzed using Microsoft's MicroStrategy dashboard (BI). The rating outcomes predominantly revealed the outcome as follows: Value Proposition (100% - agree), Strategy (92% - agree), Governance (92% - agree), Environmental Risk Assessment (50% disagree, but 42% agree), Time Management (83% - neutral, but 17% agreed), and Resource Capacity (92% - neutral, but 8% agreed). Subsequently, Fuzzy Analytic Hierarchy Process (F-AHP) model was applied to determine the relative priority of each attribute/factor. The usage of MS MicroStrategy dashboards (BI) enabled transparent visualization of expert ratings, while F-AHP provided structured prioritization and consistency validation through Saaty's 10% rule. The integration of BI and F-AHP resulted in a study's VSGETR framework which offers a scalable, data-driven model tailored to public sector governance, bridging strategic objectives with operational execution. Findings in this study suggest that embedding this framework into project policies and evaluation checklists can significantly improve sustainability oversight and resource monitoring in ICT initiatives.

Keywords: ICT sustainability, Fuzzy AHP, BI dashboards, Public ICT, Sustainability Framework

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1. INTRODUCTION

Previous studies have identified strategic misalignment, poor planning, and technology mismatches as recurring challenges in the implementation of ICT initiatives. Despite incremental improvements noted in reports such as the 2008 and 2015 CHAOS studies, ICT initiatives, particularly in the South African public sector, continue to face significant delivery challenges. Cases like the Integrated Financial Management System and the "Who Am I?" e-Government projects [1], underscore the consequences of misaligned systems, corruption [1], and inadequate contextual adaptation, which often result in underutilized technologies and diminished public value. The disparity between system design and local needs further exacerbates inefficiencies, especially when solutions are modelled on technologically advanced environments without considering regional constraints. However, government agencies must continue to innovate, especially by involving ICT and E-Government in their public services [2].

This research introduces a business intelligence driven framework to strengthen ICT project planning and execution through integrating the business intelligence dashboard, which is based on the identified key ICT project sustainability attributes as critical success factors (CSFs), with the fuzzy analytic hierarchy process (F-AHP). The framework offers a validated and practical contribution to improving ICT management practices, particularly around ICT project management through the F-AHP inspired factors / attributes. The framework further appreciates the targeted approach of ICT sustainability, by building on conceptual models such as the design reality gap [3] and e-learning implementation frameworks [4].

To guide the framework's development and ensure its relevance, the following four core research questions were framed, in which this study is seeking to address: (1) How can gaps in ICT sustainability be identified using a BI-based approach? (2) What strategies can effectively improve ICT sustainability within organizations? (3) How can a robust framework be developed to address these challenges? (4) How can the framework's attributes be evaluated to ensure accuracy and reliability?.

The proposed BI-enabled framework offers a practical tool for enhancing long-term outcomes on ICT initiatives in the public sector. Furthermore, the framework is

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characterized by integrating ICT sustainability attributes or key success factors into a project implementation model that supports alignment [5] with local priorities and responsible usage of resource [6]. IT governance and environmental risk assessment [7] emerged as essential components in maintaining strategic alignment and operational integrity. Sustainability as a cross-sectoral imperative influences policy, behaviour, and long-term development [6]. The framework further emphasizes on a need for governance reform, fiscal discipline, and strategic planning to reduce waste and improve service delivery. Studies in [8, 3] maintain that the effective ICT initiatives must harmonize social, cultural, institutional, economic, political, and technological dimensions to ensure relevance and resilience, but also a need for integrated efforts at different points is further highlighted in [9].

2. LITERATURE REVIEW

At various times, policymakers, funding organizations, planners, program managers, taxpayers, or program clientele need to distinguish worthwhile social programs from ineffective ones or launch latest programs or revise existing ones so that the programs may achieve better outcomes [10]. To move from the failures of ICT4D 1.0, then we need to have new, broader worldviews guiding projects. Furthermore, [11] made an assertion that, new wave of "technovelty" and ICT4D 1.0 initially took an invention-down approach bringing modern technologies into development contexts much more than it took a use-up approach of understanding how existing technologies were being applied [11]. Furthermore, [2] provides that to advance environmental sustainability, organizations must establish strategic approaches that ensure operational processes and outcomes are achieved while optimizing the use of natural resources and that, various studies have stated that with this technology, government agencies can maintain environmental sustainability. Not only do many of the papers put forward quite innovative strategies to reach the goals but many also reveal where ICTs can have a negative impact on the goals or where the goals are simply internally conflicting [12]. Against this assertion, a drive to develop a framework for the sustainability of ICT project management was inspired.

2.1 Sustainability discourse

Research on opportunities and risks of ICT for sustainability transformations is conducted in many disciplines and published in various different media and journals[13].

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Institutions such as the World Bank highlight 'country ownership' as vital to project success and long-term sustainability [6], a view that informs this study's rationale. A review in [14] explored how ICT both influences and supports sustainability goals, resulting in a framework for defining sustainability indicators within project environments. E-Government development is an important factor in accelerating the country's development and having an impact on sustainable development through the economic, social, and environmental sectors [2]. Despite this progress, expert studies show sustainability remains underrepresented in mainstream project management. Drawing on Triple-P model in [14], the study emphasizes ICT's physical footprint, systemic usage, and environmental relevance, while acknowledging the difficulty of measuring its environmental impact due to complex and varied sustainability indicators. The authors [14] proposed a framework for developing sustainability indicators grounded in the Triple P concept: People, Planet, and Profit. This framework ensures that sustainability is integrated across all project phases, from proposal through to disposal [15, 14], encouraging evaluation based on social, environmental, and economic criteria, as outlined in a framework from [14]. The study in [16] links competitive advantage to corporate social responsibility, proposing that shared value creation through corporate social integration fosters self-sustaining outcomes. To support sustainability, key success factors were categorized into seven themes: social, economic, environmental, cultural, institutional, political, and technological [17].

An examination on how digitalization contributes to energy efficiency and reduces the life-cycle impacts of ICT devices and applications highlights a significant research gap around the limited exploration of digitalization's role in promoting sufficiency-oriented practices. It notes that broader questions around enabling digital sustainability transformations at macro and structural levels remain underexplored. Consequently, science policy and funding at both the European Union (EU) and national levels, as well as within the private sector and civil society, should prioritize research that integrates all three sustainability strategies: efficiency, consistency, and sufficiency, in a coherent and transformative manner [13]. Public sector organizations have a role in maintaining economic sustainability by presenting an efficient system. Based on this, economic sustainability in public organizations refers to how these organizations are able to use resources efficiently and effectively to achieve their goals optimally through public services [2].

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2.1. Governance science

Factors including ICT infrastructure, Human capital, and eServices are linked to sustainable development goals (SDGs) [15] and reflect indicators of sound *Governance,* showing notable influence on sustainability outcomes [6]. In the context of ICT sustainability, aligning strategies with business goals [18] ensuring that initiatives deliver measurable value that benefit both ICT functions and the broader organization.

2.2. Resource capacity science

The resource-based view presented in [19] provides a theoretical basis for integrating IT with other organizational capabilities to build sustainability competencies and drive competitive advantage. It introduces a framework combining HR, SCM, and IT to foster sustainability, emphasizing the Triple Bottom Line: profit, people, and planet [14, 16]. The use of this technology can support sustainability issues in various fields [2]. Building on this, our study adopts resource integration and highlights resource capacity and effectiveness as central to a resilient ICT sustainability framework. The DWESA project [17] revealed that infrastructure limitations, technology gaps, inadequate capacity building, funding shortages, political barriers, and socio-cultural complexities contribute significantly to ICT project failures. Though based in a rural context, these issues are prevalent across broader settings, including South African departments, strengthening the justification for this study's counterfactual sustainability framework. By ensuring coordinated operations and funding across all government levels, the NDP strengthens the positioning of the proposed sustainability framework within South Africa's governance landscape. Expanding on the resource-based view framework proposed in [19], this research illustrates how the synergy between Human Resources (HR), Supply Chain Management (SCM), and Information Technology (IT) fosters the development of sustainability capabilities. This underscores the importance of resource integration and strengthening capacity. Thus, the aspect of resource capacity [20] with an accentuation of time management within and across these key domains are required to ensure effective and sustainable implementation of ICT projects.

2.3. Strategy and environmental risk assessment science

The study aligned framework components with these themes, applying a strategic approach shaped by [21] and [20] to enhance ICT project resilience. Industry competitive strategy and environmental conditions were recognized in [22] as critical elements for

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effective information system planning and this therefore necessitates a need for environmental risk assessment to be key in the project management of ICT projects. Despite ongoing initiatives, [21] underscores the persistent challenge of achieving sustainability in IT solutions and as indicated by [6] overcoming sustainability barriers requires strong political and technical leadership along with sustained organizational commitment underscoring the importance of political and technical leadership. This study incorporates expert insights from ICT project managers and aligns with South Africa's 12 strategic outcomes linked to national development goals. At the core of this alignment is the National Development Plan (NDP), which acts as both a policy blueprint and an actionable framework, directing efforts to address poverty, inequality, and unemployment. Despite continuous efforts, sustainable IT projects remain challenged by inconsistent implementation [23], prompting increased emphasis on Public-Private Partnerships and stakeholder inclusion. In line with [21], which underscores stakeholder influence throughout project lifecycles, this study engaged experts and embedded a tailored partnership model to strengthen project alignment and outcomes.

2.4. Value proposition and time management science

The insights from [5] highlight the critical need for alignment between business and IT leaders around a unified value objective, be it lowering costs, enhancing process efficiency, fostering innovation, or streamlining communication. Technology as a driver of organizational change, should be embedded within the broader business strategy rather than approached in isolation. Value proposition [5, 24] and strategy [22] are key enablers in aligning IT investments with strategic business goals. Therefore, explicitly incorporating these elements into the study's framework is vital for establishing a cohesive and purpose-driven approach to ICT project implementation.

To embed the core values into ICT project management and fully realize their benefits, this study introduces a sustainability framework specifically designed for the South African ICT landscape. Anchored in six critical success factors and aligned with the ICT House of Values [18] as detailed in table 1, the framework incorporates expert insights analysed through both a business intelligence lens and a subsequent mathematical prioritization approach. Employing a structured rating scale, this section outlines results which are summarized in table 4, that aim to enhance the sustainability and effectiveness of ICT projects. In attempt to solve the sustainability problem in ICT projects, the key

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elements of sustainability which this study has considered for the development of the desired framework, were identified towards solving the ICT projects sustainability problem. Article [18] ICT house of values plays a key role in the mapping of the key elements as important attributes in the development of the intended sustainability framework in this study.

2.5. F-AHP application

Amongst other studies on the application of F-AHP method, a study was successfully conducted to select the most suitable e-learning system which are based on the 10 identified criteria from the existing knowledge. These criteria were listed using Fuzzy AHP method, where the most effective criterion was found to be interaction, as it was characterized by ease of use, relevant content and reliability [25].

Table 1. Outlines the mapping of ICT house of values with project attribute elements [18]

#	Key project attribute elements	Economie of scale	Reductionof costs	Reductionof duplicates	Interoperability	Digital inclusion(incl. BEE/EE)	Increaseproductivity	Citizenconvenience	Security	GovernmentArchitecture
C1	Project Case Governance management	X	X	X	X	X	X	X	X	X
C2	Project Case Environmental Risk Assessment	X	X	X	X	X	X	X	X	X
C3	Project Case Strategy	X	X	X	X	X	X	X	X	X
C4	Project Case value proposition	X	X	X	X		X	X		X
C5	Project Case Resource Capacity	X	X	X	X		X			X
C6	Time management Project Case	X	X	X			X			X

3. METHODS

The study employs a mixed-methods approach, incorporating both quantitative and qualitative techniques. Quantitative instruments included ICT project inspections, structured observations, and standardized questionnaires. For the qualitative dimension, semi-structured interviews were conducted with ICT professionals and industry operators to enrich contextual understanding.

3.1. Target Population And Sampling

The study targeted experts actively involved in the design, approval, and oversight of ICT projects within South Africa's public sector. A purposeful sampling strategy was employed to ensure access to individuals with ICT project management expertise. Respondents included seasoned professionals from all three spheres of government which includes national, provincial, and local governments in South Africa. The samples of participants included, but was not limited to, Chief Information Officers (CIOs), ICT Project Managers, Heads of IT / IT Managers, Executive Managers overseeing ICT Infrastructure, Applications, and Enterprise Architecture. Sample size was determined based on the accessibility and response rates of this targeted expert group, in which case 07 field experts participated in this study.

3.2. Data Collection and Instrumentation

Primary data were collected through questionnaires distributed electronically with links sent to selected experts via email. Consent of the experts used in the study were obtained through a consent form which they signed to participant in the study allowing them to leave the study at will and that the study is voluntary. Permission to use experts from selected organization were also obtained from the various organization through their internal approval protocols. No sensitive organizational information were collected. Data obtained were anonymized and securely stored to ensure confidentiality, integrity and in line with protection of personal information act (POPIA) and ethical clearance was obtained from the North-West University, Faculty of Natural and Agricultural Sciences Ethics Committee (FNASREC) with certificate number NWU-01 289-23-A9 for this study. The questionnaire was structured around six key sustainability factors, each mapped to the nine ICT values defined by the DPSA House of Values [18]. A 1–3 rating scale was used, as outlined in table 3. Following the approach in [26], a pairwise comparison technique was used to evaluate responses, allowing not only for expert input but also for the computation of fuzzy values to support priority setting. This methodological choice was particularly suited to complex decision-making involving multiple interrelated factors. A minimum of six experts, each with extensive experience in ICT project management, contributed to the study. Their assessments helped determine the relative importance of criteria and attributes, with aggregated scores representing the perceived weight of each element's contribution to sustainable ICT project practices.

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3.3. Data Sources and Analysis

The study utilized both primary and secondary data sources. Primary data originated from expert responses and field level insights, while secondary sources included a diverse range of published materials such as annual and audit reports, policy documents, frameworks, scholarly articles, and books. The integration of both qualitative and quantitative methods ensured a robust analytical framework. Analysis was conducted using tools such as Microsoft Power BI and MS-Excel.

3.4. Data Analysis Approach

The BI dashboard played a pivotal role in enhancing both decision-making and validation within the proposed ICT sustainability framework. By integrating structured and unstructured data sources, the dashboard enabled real-time visualization of expert ratings across key sustainability indicators, such as governance, strategic direction, environmental risk assessment, and resource capacity. This visual representation facilitated clearer interpretation of complex data, allowing stakeholders to identify priority areas and performance gaps efficiently. In the validation phase, the dashboard supported the application of statistical importance coefficients and weight assignments to each indicator, ensuring that the prioritization process was both transparent and data-driven. The use of push-based insights and automated alerts further ensured that decision-makers across organizational roles could incorporate findings into their workflows, promoting consistency and accountability in ICT project planning.

The data analysis is aimed to develop descriptive, ordinal, and ratio scales to examine empirical relationships, uncover meaningful insights, and inform conclusions. These findings were used to guide decision-making processes and support the formulation of solutions to the identified challenges in ICT project sustainability. Application of AHP and Fuzzy AHP in prioritizing framework components was employed to determine the relative weights of the proposed factors within the sustainability framework, ensuring a justified and systematic allocation of reputational significance to each factor, while assessing their internal consistency. The method also reinforces fairness in the evaluation process by providing a transparent and replicable mechanism for assigning levels of importance. As substantiated by prior research [27], AHP is a rigorously developed and widely adopted technique for quantifying decision criteria weights. It is valued for its precision and methodological clarity, offering a robust foundation for informed decision-making. In this

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study, the numerical outcomes of the quantitative data analysis served as the basis for a pairwise comparative evaluation, aiding in the prioritization of critical attributes, consistent with the procedure outlined in [27]. The six steps in the application of F-AHP is shown in Figure 1.

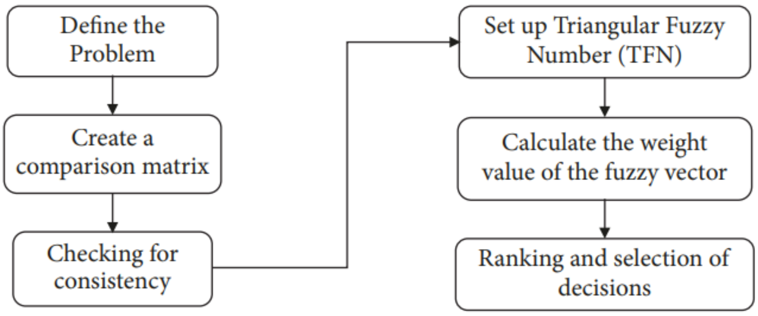

Figure 1. Six steps of F-AHP phase process [27,26]

The Fuzzy Analytic Hierarchy Process (F-AHP) enhances the classical AHP by integrating fuzzy set theory to better handle uncertainty and imprecision in decision-making. The following steps outline the F-AHP process, particularly using Chang's extent analysis method [28], which is widely adopted in sustainability and ICT project evaluations. This structured approach allows decision-makers to incorporate expert judgment while managing ambiguity, making F-AHP particularly effective for complex, multi-criteria problems like ICT project sustainability.

a) Hierarchy Construction: A decision hierarchy was developed, placing the overall goal at the top, followed by criteria and alternatives [26, 28].
b) Fuzzy Pairwise Comparisons: Expert judgments were translated into triangular fuzzy numbers (TFNs) to capture uncertainty and imprecision [26, 28].
c) Fuzzy Comparison Matrix: A matrix was constructed using TFNs, and aggregated where multiple expert inputs were available [26, 28].
d) Synthetic Extent Calculation: Fuzzy synthetic extent values were computed for each criterion using fuzzy arithmetic operations [26, 28].
e) Degree of Possibility: The degree to which one criterion is more significant than another was determined through fuzzy comparison [26, 28].
f) Weight Derivation: A normalized weight vector was calculated to rank the sustainability attributes [26, 28].
g) Consistency Validation: The consistency of expert judgments was assessed using Saaty's 10% rule, ensuring reliability of the prioritization [26, 28].

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While the traditional Analytic Hierarchy Process (AHP) method in [27] remains a well-regarded tool in multi-criteria decision-making, this study adopts the Fuzzy Analytic Hierarchy Process (F-AHP) [26] for its enhanced capability in future. The fuzzy approach accounts for the uncertainty and imprecision inherent in expert judgment, thereby offering a more flexible and robust prioritization mechanism. However, in this research, only the first three procedural steps of the F-AHP model [26] were applied, which were sufficient to evaluate the consistencies of the experts' ratings in this study.

In [29], both the Analytic Hierarchy Process (AHP) and the Fuzzy Analytic Hierarchy Process (F-AHP) were applied to rank criteria and alternatives in selecting a major within the Department of Information Systems at UIN Suska Riau. AHP was used to evaluate the criteria, while F-AHP handled the ranking of alternatives. The results showed that both sets of evaluations yielded consistency ratio (CR) values below 0.1, indicating strong internal consistency. These findings support the applicability of AHP and F-AHP in similar decision-making contexts, demonstrating their reliability and effectiveness for structured prioritization [29]. Therefore, from this analogy, one draws comfort to the fact that both options yielded the same expected result, in terms of the favorable outcome of the consistence ratio, which is smaller than 0.1 and is found satisfying the objective of this study.

1) Step 1: Problem Definition

The core problem was defined using the DPSA ICT House of Values in figure 2 as the reference framework. These values were mapped to six attribute elements that constitute the backbone of our proposed sustainability framework. Each factor was evaluated for its relevance to the predefined criteria, with expert participants rating them against structured decision metrics. To ensure methodological soundness, the weights and consistency of the evaluations were assessed using the Consistency Ratio (CR), along with the Consistency Index (CI) and Random Index (RI). The evaluations adhered to Saaty's 10% rule of consistency, which provides a benchmark for acceptable judgment coherence [26].

2) Step 2: Create A Comparison Matrix

A comparative table was used, the values of which were extracted from the aggregated rating response of the experts.

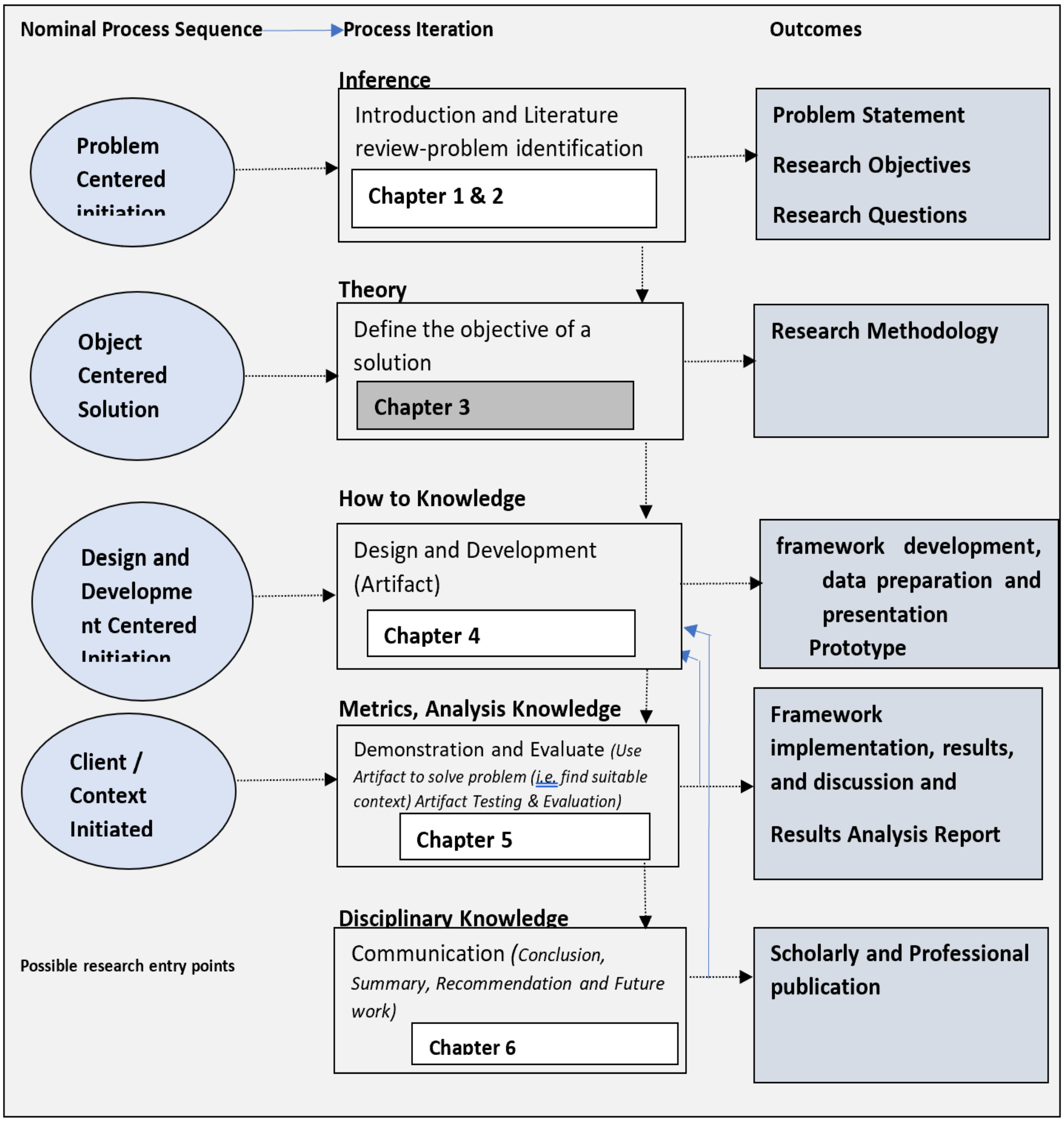

Figure 2. Design Research Process

3) Step 3: Determination of Maximum Eigenvector (λ_{max})

This is decided by adding the product of *individual eigenvector* (W_i) and *total of Criterion* (C_{t_i}). The formula uses as shown in Equation 1 to 3.

$$\text{Maximum Eigenvector } (\lambda_{max}) \quad (1)$$

$$\lambda_{max} = \sum (W_i \times C_{t_i}) \quad (2)$$

Once the Lambda maximum value (λ_{max}) was obtained, then Criteria Index (CI) was determined, to check if the matrix used is consistent.

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$$net=\sum x_i w_i+b \tag{3}$$

Criteria Index (CI)

This is determined using the formula as shown in Equation 4.

$$CI = \frac{\lambda_{max} - n}{n-1} \tag{5}$$

At this point Saaty's 10% inconsistency/consistency rule was taken into perspective as CI value greater than zero (CI > 0), therefore the limit of inconsistence applied by Saaty was tested, through the usage of Consistence Ratio (CR) guided by Table 2 for Ration Index (RI), also for calculating as shown in Equation 5.

Table 2. Ratio Index (RI) [26]

n	1	2	3	4	5	6	7	8	9	10
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

$$CR = \frac{CI}{RI} \tag{5}$$

4) Step 4: Checking for Consistencies

In this study, expert responses obtained through structured questionnaires were analysed to evaluate the relative importance of key factors contributing to the sustainability of ICT projects. This assessment was conducted through pairwise comparisons and attribute prioritization, supported by the application of the Analytic Hierarchy Process (AHP) and its fuzzy extension (F-AHP) as systematic decision-making methodologies [27, 26]. The criteria used for evaluation were derived from the ICT House of Values [18], as defined in the governance framework set up by DPSA to guide effective ICT oversight in government departments. Six critical attributes, informed by this framework, were assessed using decision metrics designed to align with the study objective of developing a framework for sustainable ICT projects. Quantitative data collected through the survey were analysed to compute the relative weights of the identified factors. This included computing the Consistency Index (CI), the Random Index (RI), and the Consistency Ratio (CR) based on Saaty's method [26]. Calculations utilized the maximum eigenvalue (λmax), the eigenvalue count (n), and adhered to the accepted 10% consistency threshold, ensuring the reliability and internal validity of expert evaluations. The integration of AHP/F-AHP provided a structured basis for translating expert

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judgment into actionable priority rankings for sustainability factors in ICT project management using the following formulars as shown in Equation 6 to 8.

Judgement relative weight i.e., Consistence Index (CI):

$$CI = (\lambda max - n) / (n - 1) \quad (6)$$

[ʎmax denotes maximum eigen value and n: eigen value]

Number of pairs in each group using AHP:

$$N = n (n-1) / 2 \quad (7)$$

[n denoting number of alternatives]

Consistence ratio (CR):

$$CR = CI / RI \quad (8)$$

[CI denotes consistence index; RI: random index]

3.5. Rating Scale Justification

The study in [30] highlights how consensus-building in decision-making is not only influenced by the factors in the study but also by the structure of the rating scale used in the study and the threshold for consensus. In [30], participants were presented with three (3) rating formats namely, three-point, five-point, and nine-point scales. Results favoured the three-point scale, especially in contexts requiring clear and actionable judgments, such as defining treatment goals in clinical settings. Given that this study's aim to validate the proposed framework while encouraging optimal expert engagement, the three-point scale as depicted in table 3 was adopted for its clarity and ease of use. The scale was employed to gauge expert assessments of the six identified criteria and their relevance to ICT project sustainability. By minimizing interpretive ambiguity, the scale facilitated precise responses, supporting the formulation of robust and context-sensitive conclusions. Ultimately, this approach aligns methodological rigor with practical applicability, ensuring that the resulting framework reflects both analytical robustness and expert-informed insight.

Table 3. Rating description used in the study

Rating	Description
1	Agree
2	Disagree
3	Neutral

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The aggregated rating response value per attribute element from the field experts shall stands for the relative importance (criteria) of the contribution of a factor to sustainability of ICT projects management. The 1-3 score rating, where (1) stands for Agree, (2) Disagree and (3) stands for Neutral. Whilst this study is appreciating the limitations [30] that comes with a three-point rating scales in terms of the limited reliability and validity, due to failure in capturing the nuance and intensity of people's opinions which may present a risk of skew data and reduction of the overall quality of research, nonetheless, the three-rating scale provides a quick and easy benefit for participants to complete the rating task. Furthermore, F-AHP method is used to mitigate the element of reliability and consistence that may have been imposed by the three-rating scale limitations, through integration of a consistence ratio (CR). The selection of rating scale and corresponding consensus thresholds should be based on the specific context, expected outcome and scale property aspects [30]. Therefore, the selection of this three-rating scale was motivated by the context of this study, expected outcome from the ratings and the scale property aspects.

3.6. Design Science Research

The research will adopt an iterative process, where the outputs of one iteration serve as inputs for the subsequent one.

1) Process Iteration 1- Problem centered initiation

   In the initial iteration, the problem statement, objectives, and research questions will be defined based on inferences from the introduction and literature review. These two elements form the first iteration, alongside their outcomes, which will then feed into the second iteration.

2) Process Iteration 2 – Object centered solution

   This phase focuses on formulating a theoretical solution context, presenting the research method as an outcome, while maintaining alignment with the initial research objectives, problem statement, and questions.

3) Process Iteration 3 - Design and development centered initiation

   The insights from this iteration specifically, the solution design theory and research method, will then be used to design and develop the intended solution.

4) Process Iteration 4 – Client context initiated

   This phase produces a prototype of the desired ICT sustainability framework along with relevant data preparation for this study. The subsequent iteration

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will analyze the proposed framework and relevant data to define and evaluate metrics. At this stage, input from field experts will play a critical role. Data artifacts will be leveraged to address the defined problem effectively, with the framework and artifacts tested for accuracy and consistency through a consistency ratio (CR) entry point which is based on F-AHP method. The outcomes of this iteration will include the framework implementation results, discussions, and an analysis report.

5) Process Iteration 5 – Possible research

   The final iteration focuses on communication, which involves compiling the research conclusion, recommendations, and future work into proper documentation for scholarly and professional dissemination.

4. RESULTS AND DISCUSSION

This study developed and validated a sustainability framework for ICT project management anchored on six success factors derived from the literature and confirmed through expert review (Table 4), aligned to seven sustainability pillars and the DPSA ICT House of Values [18]. Validation combined expert scoring (three-point scale), descriptive visualization using Microsoft MicroStrategy BI dashboards, and prioritization using AHP/F-AHP to determine relative attribute importance and to verify judgment consistency. The resulting framework—Value Proposition, Strategy, Governance, Environmental Risk Assessment, Time Management, and Resource Capacity—is presented as an integrated model in Figure 3, while the overall response distribution is summarized in Figure 4 and Figure 6.

Figure 3 illustrates the final framework structure and the interdependence of the six attributes across governance and sustainability requirements. The model positions value and strategic alignment as the primary drivers of sustainable ICT delivery, supported by governance controls, and operationalized through risk assessment, time discipline, and capacity readiness.

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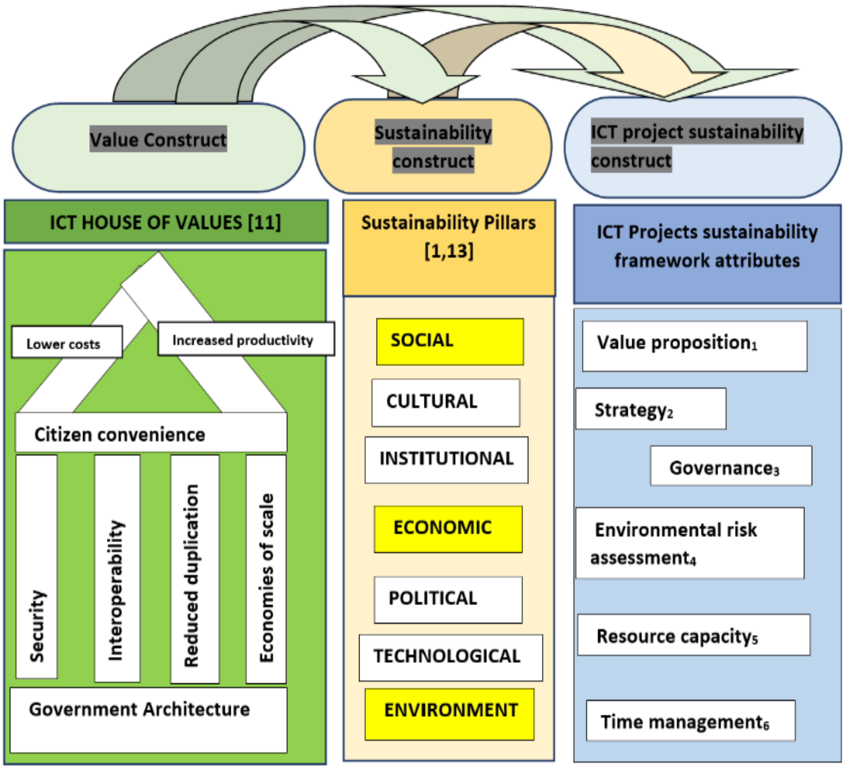

Figure 3. Composition of the sustainability framework for ICT projects

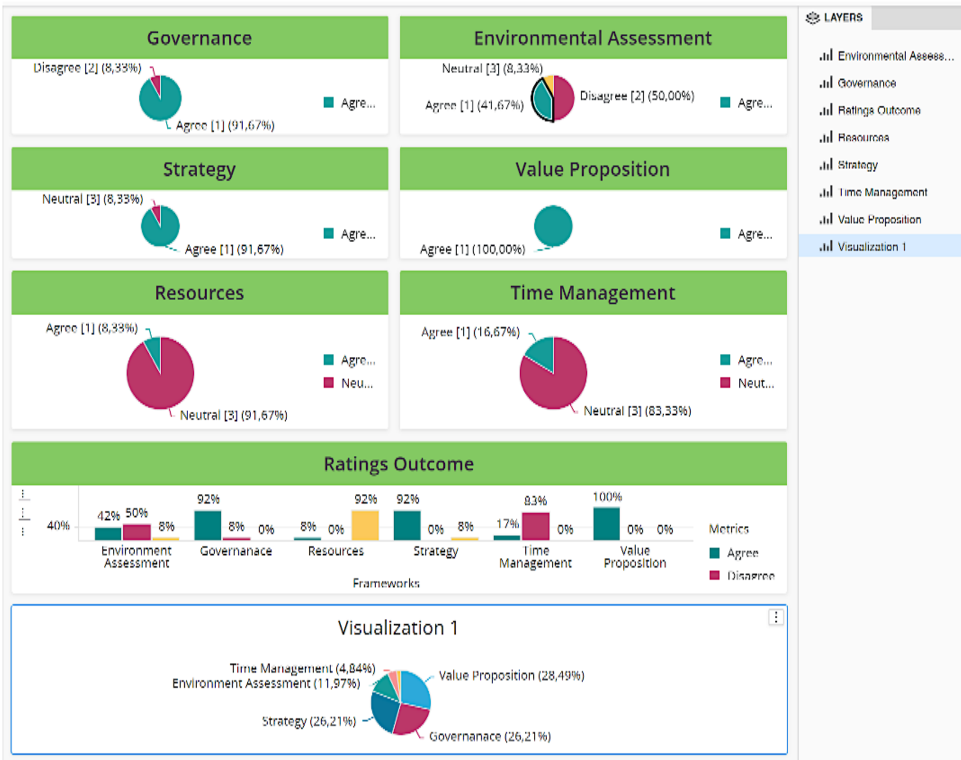

Figure 4. A dashboard synopsis of experts' responses for the sustainability framework attributes

The MicroStrategy dashboard in Figure 4 provides a consolidated view of expert ratings across the six attributes. Three attributes demonstrated strong agreement, while the remaining attributes showed neutrality or divergence, indicating areas of inconsistent practice and implementation maturity.

4.1. Attribute

1) Governance

Governance received strong endorsement, with 92% of experts agreeing that successful ICT projects are characterized by clearly defined problem statements and decision structures (Figure 4; Figure 6). This supports the role of governance as a mechanism for stakeholder alignment, accountability, and auditability. A practical weakness identified by experts is the risk of misalignment between project initiatives and institutional strategic objectives, coupled with limited stakeholder engagement. These conditions increase the likelihood of duplicated investments and fragmented planning—particularly costly within public-sector ICT portfolios.

2) Environmental Risk Assessment

Environmental risk assessment displayed notable inconsistency: 50% of experts disagreed that assessments were conducted, 42% agreed, and 8% were neutral (Figure 4; Figure 6). This variability suggests uneven integration of environmental and regulatory risk considerations into ICT project planning. In public-sector contexts, omission of such assessments can expose projects to non-compliance risks, including legal penalties, delays, or redesign requirements. The findings indicate that environmental risk assessment remains a weakly institutionalized sustainability control compared to governance and strategic alignment.

3) Strategic Direction

Strategic direction was strongly supported, with 92% of experts agreeing that ICT projects require clearly defined, business-aligned objectives (Figure 4; Figure 6). This reinforces the view that sustainability is strengthened when ICT initiatives are explicitly linked to strategic outcomes and benefits. Expert commentary also highlighted a recurrent execution risk: without sustained strategic alignment, teams may operate in silos, generating competing priorities, duplicated effort, and unclear accountability. This

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underscores the need to embed strategic alignment checks throughout the project lifecycle rather than only at initiation.

4) Value Proposition

Value proposition achieved unanimous endorsement (100% agreement) (Figure 4; Figure 6), confirming that ICT projects are expected to deliver demonstrable organizational value. This result aligns with sustainability principles emphasizing benefits realization and stakeholder value. Nevertheless, experts noted that when a project's value proposition is poorly aligned with strategic objectives or stakeholder expectations, the initiative may produce low adoption and underutilization outcomes, resulting in sunk costs and limited long-term benefit.

5) Resource Capacity

Resource capacity attracted predominantly neutral ratings: 92% neutral and 8% agreement (Figure 4; Figure 6), indicating limited confidence that adequate funding and appropriately skilled personnel are consistently assigned. This pattern suggests uncertainty and variability in capacity planning and resourcing practices. From a sustainability perspective, inadequate resourcing undermines delivery quality, increases schedule and cost risk, and weakens post-implementation support. In the public sector, chronic underfunding and insufficient project management capability can also contribute to governance and compliance risks (e.g., audit findings associated with budget overruns or weak controls).

6) Time Management

Time management also showed limited positive confirmation, with 17% agreement and 83% neutral (Figure 4; Figure 6). The dominance of neutrality suggests weak scheduling baselines, inconsistent measurement, or limited transparency in timeline performance reporting. Time management is directly linked to sustainability because schedule slippage delays benefits, increases costs, and can erode stakeholder confidence. Experts identified typical consequences of persistent delays: cost escalation, stakeholder dissatisfaction, and reputational impact, which collectively reduce the long-term viability of ICT initiatives.

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4.2. AHP/F-AHP prioritization and consistency

To strengthen reliability, the study applied AHP/F-AHP to prioritize the six attributes and to validate consistency in expert judgments. Following the AHP process and Saaty's consistency rule, a consistency ratio (CR) of 0.06 was obtained, which is within the acceptable threshold of ≤ 0.10 (10%), supporting the credibility of the prioritization [26], [27]. The matrix-based summary of the rating outcomes is illustrated in Figure 5, and the aggregated ratings distribution is shown in Figure 6.

Table 4. A descriptive and prioritized attribute elements for the ICT project sustainability framework

Highest descending order	Criterion
1	Value proposition
2	Strategy
3	Governance
4	Environmental risk assessment
5	Time management
6	Resources capacity

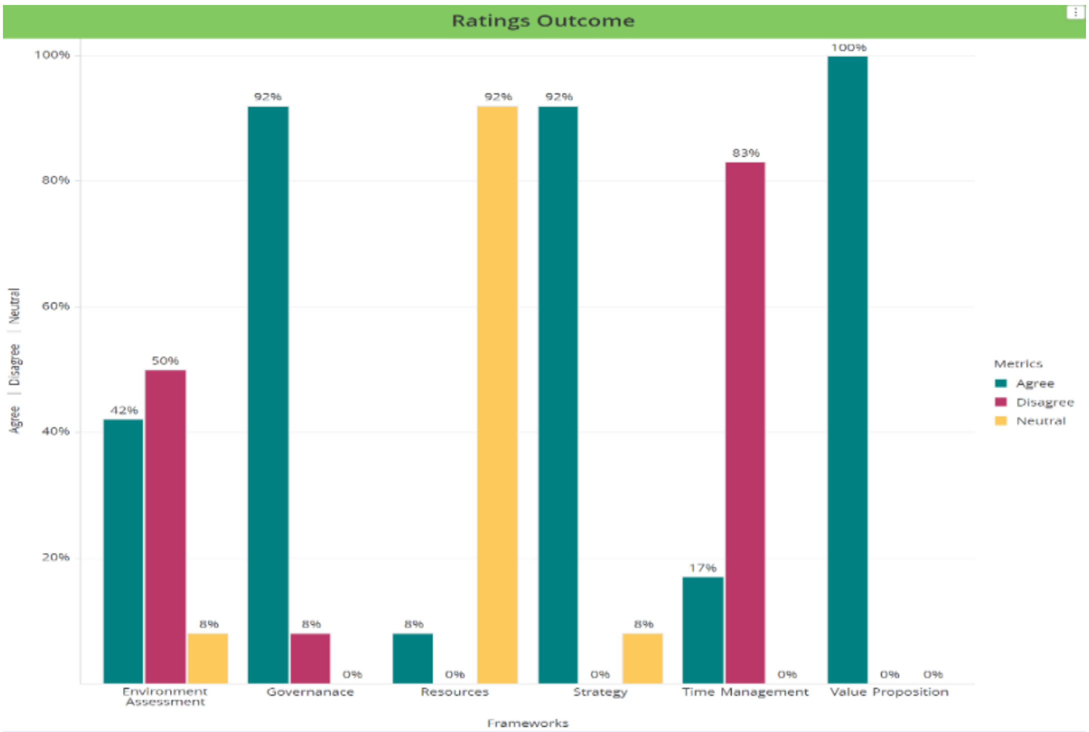

Figure 5. A single view of rating outcomes, based on matrix per attribute element

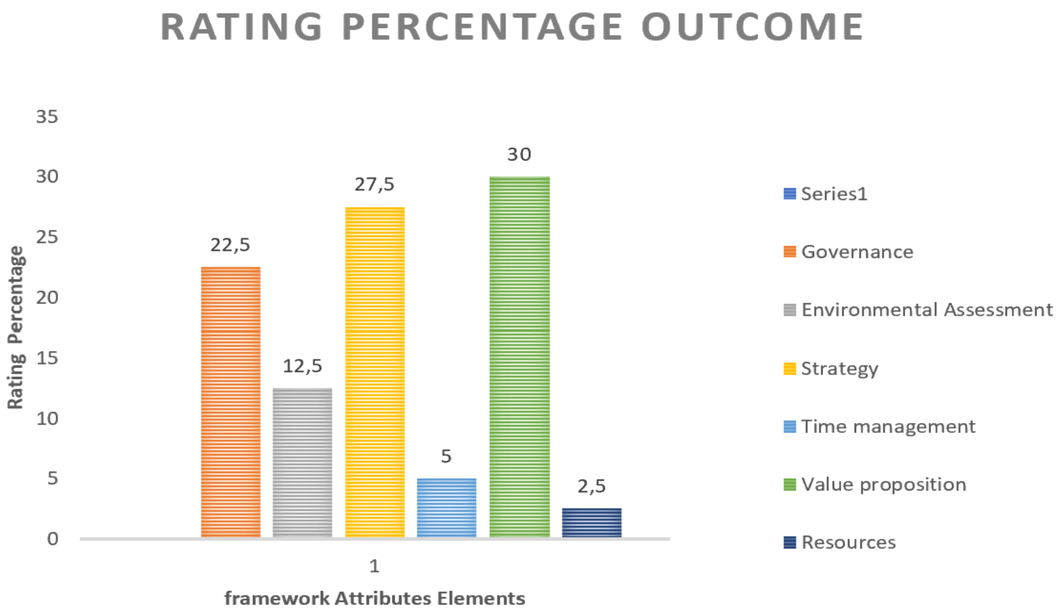

Figure 6. Aggregated attributes ratings (%) outcome

The resulting priority order derived from the AHP/F-AHP process is presented in Table 4, ranking attributes from most to least important:

a) Value proposition
b) Strategy
c) Governance
d) Environmental risk assessment
e) Time management
f) Resources capacity

This ordering indicates that experts place the greatest emphasis on the rationale and alignment of ICT investments (value and strategy), followed by governance mechanisms. Operational sustainability enablers—risk assessment, time control, and capacity readiness—were ranked lower and also demonstrated weaker consensus in the descriptive ratings, suggesting that these controls are less consistently embedded in practice.

4.3. Discussion

The results reinforce a consistent theme in the project management and ICT governance literature: sustainable ICT delivery is most strongly associated with clear value logic, strategic alignment, and effective governance controls. The strong expert agreement for Value Proposition (100%), Strategy (92%), and Governance (92%) indicates that, at least at a conceptual and policy level, institutions broadly understand what sustainable ICT projects should achieve and how they should be justified. This aligns with widely accepted governance principles that emphasize business-case discipline, alignment to institutional priorities, and structured oversight as prerequisites for ICT success. In practical terms, these findings suggest that many organizations have developed baseline maturity in the "front-end" of project sustainability—i.e., defining the problem, articulating benefits, and anchoring initiatives to strategic intent.

However, the results also reveal a critical and frequently reported gap between strategic intent and operational execution. The divergence observed in Environmental Risk Assessment (50% disagree; 42% agree; 8% neutral) points to inconsistent institutionalization of risk practices beyond conventional technical risk. Prior studies repeatedly note that ICT risk management often prioritizes schedule, scope, cybersecurity, and vendor risks, while broader environmental and regulatory risks are treated as secondary or assumed to be covered elsewhere. In public-sector ICT environments, this assumption is particularly problematic because compliance obligations are explicit and auditable. The split responses therefore suggest a fragmented risk culture: some institutions embed environmental and regulatory assessment early (e.g., procurement, infrastructure, waste, energy impacts), while others apply it selectively or not at all. This inconsistency can explain why sustainability challenges persist even where governance structures appear strong—governance without comprehensive risk discipline may remain procedural rather than preventative.

The neutrality-heavy ratings for Time Management (83% neutral) and Resource Capacity (92% neutral) further highlight operational weaknesses that the literature commonly links to ICT project underperformance. Neutrality is not simply "middle performance"; it often indicates uncertainty, lack of measurement, or uneven application across projects. In many organizations, schedule baselines are not consistently established, benefits-linked milestones are weak, and timeline deviations are normalized rather than actively controlled. Similarly, resource capacity neutrality suggests that staffing and budget adequacy may not be formally validated or transparently reported—especially when projects rely on blended sourcing (internal staff, rotating teams, consultants, or shared

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services). Prior work frequently identifies capacity and time controls as primary failure points because they determine whether strategic plans can be translated into deliverable outcomes. This study's results support that view: institutions may be effective at answering "Why are we doing this project?" but less consistent at ensuring "Can we deliver it with the time and capacity we have?"

The priority order generated through AHP/F-AHP (Table 4) offers a useful interpretation of these patterns. The high ranking of Value Proposition and Strategy suggests experts place greatest importance on ensuring projects are justified and aligned. Yet the lower ranking and weaker consensus around Time Management and Resource Capacity indicate that delivery controls are perceived as weaker levers or harder to enforce in practice—despite their known impact on performance. This is consistent with governance research arguing that public-sector ICT programs can be "policy strong but execution constrained," where approval artifacts exist (strategic plans, business cases, governance committees) but operational realities (skills scarcity, procurement lead times, competing priorities, rigid funding cycles) reduce delivery predictability. The implication is not that time and capacity are unimportant; rather, they are areas where institutions may lack the mechanisms, incentives, or capabilities to consistently implement best practice.

From a practical standpoint, the proposed framework provides a structured way to close this strategy–execution gap. Embedding the framework into project policies, approval gates, and evaluation checklists can operationalize sustainability by converting the six attributes into auditable requirements. For example, approval gates can require evidence of: (i) a measurable value proposition linked to service outcomes, (ii) explicit strategic alignment, (iii) defined governance roles and decision rights, (iv) documented environmental and regulatory risk screening, (v) schedule baselines with milestone controls, and (vi) verified resource capacity covering delivery and post-implementation support. Importantly, BI-enabled monitoring strengthens this approach by making sustainability signals visible during execution rather than after failures occur. Dashboards can track attribute compliance, highlight weak areas (e.g., missing risk registers or unstable resourcing), and support governance forums with real-time evidence. Coupled with AHP/F-AHP, institutions can also justify where to invest improvement effort—whether in strengthening environmental risk practices, enhancing time-control discipline,

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or building project management capacity—based on structured prioritization rather than intuition.

The persistent sustainability challenges in ICT projects are less about the absence of tools and more about inconsistent institutionalization of operational controls. The framework therefore contributes a governance-to-execution bridge tailored to public-sector conditions by combining transparent BI reporting with structured prioritization and consistency validation. When adopted as a standard evaluation instrument, it can improve sustainability oversight, strengthen resource monitoring, and reduce avoidable delivery risk in ICT initiatives [18].

5. CONCLUSION

This study underscores the need for strengthened governance to address persistent inefficiencies in ICT project planning, execution, and monitoring, particularly within Southern African public-sector environments. In response, the study proposes the VSGETR Framework, named from the first letters of its six validated attributes—Value Proposition, Strategy, Governance, Environmental Risk Assessment, Time Management, and Resource Capacity—and aligned to the DPSA ICT House of Values. The framework was empirically validated through expert ratings and structured multi-criteria decision analysis. Application of AHP and F-AHP produced a Consistency Ratio (CR) of 0.06, which satisfies Saaty's acceptance threshold and confirms the internal reliability of the prioritization results. Beyond methodological rigor, the framework offers a practical governance-to-execution bridge: it enables institutions to translate strategic intent into measurable oversight controls, supported by BI-driven transparency and evidence-based prioritization.

Future research should test the VSGETR Framework across diverse organizational and sectoral contexts to assess scalability, generalizability, and comparative performance. Longitudinal studies are recommended to evaluate how adoption influences sustainability outcomes over time, including compliance readiness, benefits realization, delivery predictability, and resource efficiency. Further refinement of F-AHP inputs (e.g., expanded expert panels, sensitivity analysis, and alternative fuzzy membership functions) may strengthen precision. At an implementation level, maturity assessments within South

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African government entities can identify capability gaps and guide targeted interventions. Ultimately, developing a dedicated project management application and evaluation toolkit grounded in VSGETR could support standardized adoption, improve portfolio-level sustainability governance, and foster stronger institutional alignment in ICT initiatives.

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APPENDIX

Deploying this framework into an organization, following is a summary of a proposed high-level guideline:

Phase 1: Establishing environment for PM implementation

#	Milestone	Deliverable
1	Development of ICT project management Policies and Methodologies	Approved PM policy Approved PM methodology framework
2	Officials are inducted /trained on the policy directives or requirements.	Training schedule Attendance register
3	Designated project management office (PMO) is established, with official holding the relevant project management skill or upskill designated officials with the necessary skill required in project management environment.	Established PMO office
4	Develop the necessary templates for usage in ICT project management	Project monitoring checklist (VSGETR framework aligned) Business cases (BC) Business Requirement specification (BRS)
5	Decide of the project management software / application tools that will be used to manage and monitor the projects and commission the application to the environment	Purchased PM application software Installed the software
6	Training of officials in the project management office (PMO) trained on the system.	Training schedule Attendance registers for training
7	Establishment of robust oversight governance structures for project management	Appointment letters of committee members Clear terms of reference for the PM steering committee (*Defined roles, responsibilities, and accountability structures)*
8	Appoint/ designate an enterprise architect, who will ensure issues of alignment between ICT and business processes and objectives are proactively addressed.	Appointed enterprise architect

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Phase 2: Implementation of the VSGETR framework

#	**Milestone**	**Deliverable**
1	Start with a pilot program: *(Test the framework on a small scale, in a single department or on one specific project. This "trial mode" allows you to gather data, evaluate success, and learn from mistakes before a full rollout.)* To enable data gathering, evaluate success and lessons learned, the system shall be piloted in one department and implemented on a specific project.	One piloted project
2	Develop a communication plan. *(Establish clear and consistent channels for keeping all stakeholders informed throughout the deployment. Transparency about the progress, challenges, and successes is crucial for maintaining support.)*	Approved communication plan
3	Implement a training and development plan. *(Execution is reliant on employee skills. Provide training initiatives to help employees develop the competencies needed for the new framework.)*	Approved and development Training plan