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Critical Elements of A Novel Conceptual Satellite Internet Acquisition Readiness Framework for Institutions of Higher Learning in Kenya: A Systematic Review

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Abstract

Institutions of higher learning (IHLs) in Kenya face persistent digital connectivity challenges that constrain research, teaching, and administrative functions. Satellite internet technologies, particularly low Earth orbit (LEO) constellations such as Starlink, offer potential solutions; however, no comprehensive, institution level readiness assessment framework exists for this context. This study presents a PRISMA guided systematic literature review of 27 peer reviewed studies published between 2015 and 2025, synthesising critical elements required for satellite internet acquisition readiness in Kenyan IHLs. Thematic analysis identified six readiness dimensions: technical infrastructure, economic feasibility, socio cultural factors, policy and regulatory compliance, environmental considerations, and organisational capacity. These dimensions integrate constructs from the Technology Readiness Index 2.0 (TRI 2.0), the Unified Theory of Acceptance and Use of Technology (UTAUT), Technology Readiness Levels (TRL), and the Five Lenses Analytical Framework. A novel conceptual readiness model is proposed as a foundation for a Satellite Internet Acquisition Readiness Assessment Framework (SIARAF). The model requires future empirical validation through expert consensus methods and quantitative surveys in Kenyan higher education institutions.

1.0 Introduction

Access to reliable internet connectivity is widely recognised as a key enabler of socio-economic development, digital inclusion, and knowledge-based growth in the twenty first century (Chisika & Yeom, 2025). In Sub Saharan Africa, persistent disparities in terrestrial broadband infrastructure have produced a pronounced digital divide between urban centres and rural or peri urban regions. Kenya, despite recording national internet penetration of approximately 44.6% in 2023, continues to grapple with uneven distribution of connectivity, particularly in areas distant from major metropolitan corridors (Kenya National Bureau of Statistics [KNBS], 2024).

Institutions of higher learning (IHLs) located in peri urban, rural, and remote areas of Kenya are disproportionately affected by this connectivity gap. Unreliable internet access constrains research output, limits access to digital libraries and open educational resources and impedes the delivery of blended and online learning programmes (Ngaine, 2024; Singh et al., 2022). The consequences extend beyond academic performance to affect institutional competitiveness, faculty recruitment, and the capacity to attract research funding from international partners.

Recent technological advances in satellite internet, particularly the deployment of low Earth orbit (LEO) constellation systems such as SpaceX Starlink and OneWeb, have transformed the feasibility of satellite-based broadband for educational institutions. LEO systems operate at altitudes of approximately 550 km, delivering round trip latencies of 20–40 milliseconds and download speeds exceeding 100 Mbps performance parameters broadly comparable to terrestrial fibre connections (Herath, 2021). This represents a substantial improvement over traditional geostationary orbit (GEO) satellite systems, which operate at 35,786 km altitude and generate latencies of 500–600 ms that are incompatible with real time educational applications such as video conferencing and interactive simulations.

Despite the technical promise of LEO satellite internet, adoption within African higher education remains nascent. Significant barriers persist across technical, economic, regulatory, socio cultural, and organizational dimensions (Kankia et al., 2022; Micheni, 2015). Critically, no institution specific readiness assessment framework has been developed to guide IHLs in evaluating their preparedness for satellite internet acquisition. Existing readiness models including the Network Readiness Index, the ICT Development Index, and the Digital Education Readiness Framework operate at national or sector levels and do not address the specific operational, technical, and regulatory requirements of satellite internet deployment at the institutional level (Al Rikabi & Montazer, 2023; International Telecommunication Union [ITU], 2023).

This study addresses this gap through a systematic literature review (SLR) that identifies the critical elements required to develop a novel Satellite Internet Acquisition Readiness Assessment Framework (SIARAF) for Kenyan IHLs. The review is guided by three research questions: (1) What readiness dimensions are critical for satellite internet acquisition in IHLs? (2) How do existing theoretical frameworks inform these readiness dimensions? (3) What indicators can operationalise each readiness dimension for institutional self-assessment?

The remainder of this paper is structured as follows: Section 2.0 reviews existing literature on digital readiness frameworks and technology adoption in higher education. Section 3.0 describes the PRISMA guided systematic review methodology. Section 4.0 presents the thematic synthesis results and discusses each readiness dimension. Section 5.0 proposes the conceptual readiness model with operationalisation guidance. Section 6.0 concludes with implications and future research directions.

2.0 Literature Review

2.1 Satellite Internet Technologies in Education

Satellite internet has long been recognised as a potential solution to connectivity challenges in remote and underserved regions. Early GEO satellite systems, such as those operated by Intelsat and SES, provided broadband access but were characterised by high latency, limited bandwidth, and prohibitive costs that restricted adoption in resource constrained educational settings (Herath, 2021). The emergence of LEO constellations has fundamentally altered this landscape. Starlink, operated by SpaceX, had deployed over 5,000 satellites by 2024, offering service in more than 70 countries, including Kenya (Al Awadhi et al., 2022). OneWeb and Amazon Project Kuiper represent additional LEO providers anticipated to expand competitive supply and reduce service costs.

Research on satellite internet adoption in education remains limited. Herath (2021) examined Starlink's potential to address the digital divide in Global South educational institutions, identifying technical feasibility, regulatory barriers, and cost as primary determinants of adoption. Al Awadhi et al. (2022) adapted the Technology Acceptance Model (TAM) to examine user acceptance of satellite broadband services in the UAE, finding that perceived usefulness and perceived ease of use were significant predictors of adoption intention. Neither study addressed institutional level readiness assessment in African higher education contexts.

2.2 Digital Readiness Frameworks in Higher Education

Multiple frameworks have been developed to assess digital and technology readiness in educational contexts. The School Community Remote Education Readiness Assessment Framework (SCRE RAF), developed in Chile, evaluates institutional readiness across eight dimensions: ICT skills, instructional design, infrastructure, connectivity, teaching processes, innovation policies, administration and resources, and learner services (Issa & Jaaron, 2017). While comprehensive, SCRE RAF does not address satellite specific technical or regulatory requirements.

Micheni (2015) applied the Technology Organization Environment (TOE) framework to cloud computing adoption in Kenyan IHLs, identifying organisational readiness and external regulatory environment as critical factors. Kankia et al. (2022) developed a Comprehensive Technology Readiness Adoption Model for cloud technology in Nigerian higher education, integrating TOE with Technology Readiness Index constructs. Ireri and Omwenga (2016) developed a mobile learning readiness analyser specifically for Kenyan universities, validating readiness indicators across infrastructure, devices, skills, and policy dimensions.

Ate et al. (2021) assessed e-learning readiness across universities in developing countries, identifying infrastructure deficits, limited technical skills, and inadequate institutional policies as primary obstacles. Djeri and Simmons (2020) examined e learning readiness in Togolese higher education institutions, applying a modified networked world readiness model that emphasized physical infrastructure, integrated ICT capabilities, universal access commitment, and security and policy dimensions. These studies collectively demonstrate that readiness in developing countries, higher education is multidimensional and context dependent.

Al Rikabi and Montazer (2023) conducted a comprehensive review of e learning readiness concepts, assessment models, and affecting factors, identifying over 40 readiness dimensions across the literature. Their analysis revealed that infrastructure, human capacity, organisational support, and policy environment are the most consistently identified readiness factors across contexts. Mabhele and Van Belle (2019) proposed a conceptual model for institutional adoption of learning technologies that emphasised the role of organisational culture and leadership commitment.

2.3 Theoretical Frameworks for Technology Adoption

Four theoretical frameworks inform this study's analytical approach. The Technology Readiness Index 2.0 (TRI 2.0), developed by Parasuraman and Colby (2015), conceptualises technology readiness as a psychological state comprising four dimensions: optimism, innovativeness, discomfort, and insecurity. TRI 2.0 provides constructs for assessing the attitudinal and dispositional readiness of institutional stakeholders toward satellite internet adoption.

The Unified Theory of Acceptance and Use of Technology (UTAUT), proposed by Venkatesh et al. (2003) and subsequently extended as UTAUT2, identifies performance expectancy, effort expectancy, social influence, and facilitating conditions as primary determinants of technology acceptance and use behaviour. UTAUT constructs are particularly relevant for assessing the human and organisational dimensions of satellite internet readiness, including user acceptance and institutional support structures (Taherdoost et al., 2024).

Technology Readiness Levels (TRL), originally developed by NASA and subsequently adopted by the European Commission and national science agencies, provide a scale from TRL 1 (basic principles observed) to TRL 9 (actual system proven in operational environment) for assessing technology maturity. In the context of satellite internet adoption, TRL constructs inform assessment of the technical maturity and deployment readiness of satellite systems being considered by IHLs (Ireri & Omwenga, 2016).

The Five Lenses Analytical Framework, applied in African digital transformation research, examines technology adoption through technical, economic, social, cultural, and political lenses. This framework is particularly suited to satellite internet adoption in Kenya, where adoption decisions are shaped by complex interactions between technical feasibility, economic constraints, socio cultural attitudes, and national regulatory policy (Micheni, 2015; Ngaine, 2024).

The integration of these four frameworks provides complementary explanatory coverage of satellite internet readiness. TRI 2.0 addresses attitudinal and psychological readiness at the individual and institutional level. UTAUT addresses behavioural intention and use determinants. TRL addresses technical maturity assessment. The Five Lenses Framework addresses contextual and environmental factors. Table 1 presents the construct level mapping of these frameworks to the six readiness dimensions identified in this review.

Table 1: Theoretical Framework Construct Mapping to Readiness Dimensions

Readiness Dimension	TRI 2.0 Constructs	UTAUT Constructs	TRL / Five Lenses
Technical Infrastructure	Innovativeness, Optimism	Facilitating Conditions	TRL 6–9; Technical Lens
Economic Feasibility	Discomfort (cost anxiety)	Performance Expectancy	Economic Lens
Socio Cultural Factors	Optimism, Discomfort	Social Influence, Effort Expectancy	Social & Cultural Lenses
Policy & Regulatory	Insecurity (regulatory risk)	Facilitating Conditions	Political Lens
Environmental	Insecurity (weather risk)	Facilitating Conditions	Technical & Environmental Lens
Organisational Capacity	Innovativeness, Optimism	Social Influence, Facilitating Conditions	TRL Institutional; All Lenses

Source: Researcher synthesis (2026)

2.4 Gap in Existing Literature

Despite the breadth of readiness frameworks in the literature, a critical gap exists: no comprehensive, institution specific readiness framework addresses satellite internet acquisition in African IHLs. Existing frameworks either operate at national level (Network Readiness Index, ICT Development Index), focus on generic broadband or e-learning readiness without satellite specific technical and regulatory considerations, or are developed for non-African contexts with limited transferability to Kenya's regulatory environment and resource constraints (Chisika & Yeom, 2025; Kankia et al., 2022). This study addresses this gap by synthesising the critical elements of a satellite specific institutional readiness model for Kenyan IHLs.

3.0 Materials and Methods

3.1 Research Design

A systematic literature review (SLR) was conducted following the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) 2020 guidelines (Page et al., 2021). The SLR methodology was selected because it provides a transparent, replicable, and rigorous approach to synthesising existing evidence on a defined research question, minimising selection bias through pre specified inclusion and exclusion criteria (Moher et al., 2009). This study presents a conceptual framework synthesised from the literature; no primary empirical data were collected, and no statistical validation was conducted. Future empirical validation of the proposed framework is identified as a priority research direction in Section 6.0.

3.2 Search Strategy

A systematic search was conducted across five databases: Google Scholar, Scopus, Web of Science, IEEE Xplore, and PubMed. Grey literature, including policy reports from the International Telecommunication Union (ITU), Communications Authority of Kenya, and World Meteorological Organisation (WMO), was included to capture regulatory and technical guidance relevant to satellite internet deployment. The search was conducted between January and March 2026, covering publications from January 2015 to December 2025.

The primary search string applied across all databases was: ("satellite internet" OR "satellite broadband" OR "satellite connectivity" OR "LEO satellite" OR "Starlink") AND ("higher education" OR "university" OR "institution of higher learning") AND ("readiness" OR "adoption" OR "implementation" OR "framework"). Secondary search strings targeted theoretical frameworks: ("technology readiness" OR "UTAUT" OR "TRI" OR "TOE framework") AND ("higher education" OR "developing countries" OR "Africa" OR "Kenya"). Boolean operators, truncation, and database specific syntax variations were applied consistently.

3.3 Inclusion and Exclusion Criteria

Studies were included if they: (1) were published in peer reviewed journals or credible policy repositories between 2015 and 2025; (2) were written in English; (3) addressed technology adoption readiness, digital readiness, or internet connectivity in educational or organisational contexts; (4) provided empirical evidence, conceptual frameworks, or policy guidance relevant to satellite internet or broadband adoption. Studies were excluded if they: (1) focused solely on technical satellite engineering specifications without organisational or institutional dimensions; (2) addressed primary or secondary education without transferable insights to higher education; (3) were published before 2015, given the rapid evolution of LEO satellite technology; or (4) were duplicate publications or conference abstracts without full text availability.

3.4 Study Selection and PRISMA Flow

The initial database search identified 235 records. Following deduplication, 198 unique records were screened at the title and abstract stage. Two independent reviewers (YCM and JWK) conducted screening, with disagreements resolved through discussion with the third author (JWG). Following title/abstract screening, 54 full text articles were assessed for eligibility. A total of 27 studies met all inclusion criteria and were included in the final synthesis. The PRISMA flow diagram (Figure 1) documents the selection process with counts at each stage.

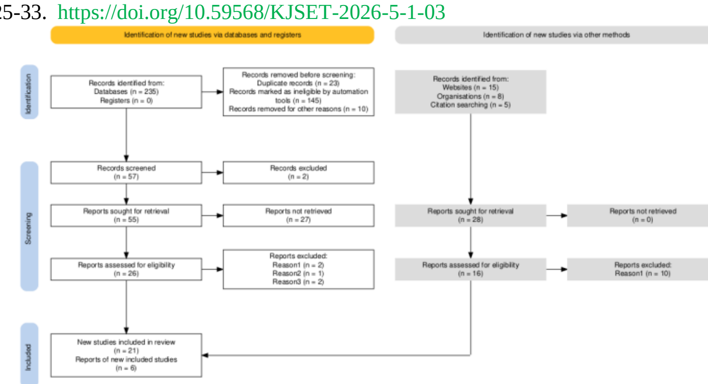

Figure 1: Search Process by PRISMA

3.5 Quality Assessment

Each included study was assessed for methodological quality using an adapted Critical Appraisal Skills Programme (CASP) checklist tailored for mixed methods and review studies (CASP, 2022). The quality assessment instrument comprised eight criteria: (1) clarity of research aims and questions; (2) appropriateness of research design; (3) rigour of data collection or search strategy; (4) transparency of analysis procedures; (5) credibility and trustworthiness of findings; (6) relevance to satellite internet or broadband readiness; (7) applicability to developing country or higher education contexts; and (8) overall contribution to the review questions. Each criterion was scored on a three-point scale (0 = not met, 1 = partially met, 2 = fully met), yielding a maximum quality score of 16 points.

Studies scoring 12–16 were classified as high quality, 8–11 as moderate quality, and below 8 as low quality. Studies scoring below 6 were excluded from synthesis. Two reviewers independently assessed all 27 included studies; inter rater reliability was calculated using Cohen's kappa (κ = 0.82), indicating strong agreement (Landis & Koch, 1977). Of the 27 included studies, 15 were rated high quality, 10 moderate quality, and 2 low quality. The two low quality studies were retained as they provided unique contextual data on Kenyan IHLs unavailable in higher quality sources, and their limitations were explicitly noted in the synthesis.

3.6 Thematic Synthesis

Thematic synthesis followed the three-stage procedure described by Thomas and Harden (2008). In Stage 1 (open coding), two researchers (YCM and JWK) independently read each included study and assigned provisional codes to text segments describing readiness factors, barriers, enablers, and indicators. A total of 184 provisional codes were generated across the 27 studies. In Stage 2 (axial coding), provisional codes were clustered into descriptive themes representing conceptually related readiness factors. Seventeen descriptive themes were identified through iterative discussions between the research team. In Stage 3 (selective coding), descriptive themes were abstracted into six higher order analytical categories representing the core readiness dimensions of the proposed framework.

ATLAS.ti version 9 qualitative analysis software was used to manage codes and link extracts to source documents. Inter coder agreement was assessed at each coding stage; Cohen's kappa ranged from κ = 0.79 (open coding) to κ = 0.85 (selective coding), indicating consistent and reliable coding throughout the synthesis process. Discrepancies were resolved through discussion, and a shared codebook was developed and applied uniformly across all included studies.

4.0 Results and Discussion

4.1 Overview of Included Studies

The 27 included studies comprised 19 peer reviewed journal articles, 5 conference papers, and 3 policy reports. Studies were drawn from Kenya (n = 6), other Sub-Saharan African countries (n = 7), other developing countries (n = 9), and developed countries with transferable insights (n = 5). Publication years ranged from 2015 to 2025, with 74% published between 2019 and 2025, reflecting the recency of LEO satellite technology research. Table 2 summarises the distribution of included studies by readiness dimension addressed.

Table 2: Distribution of Included Studies by Readiness Dimension

Readiness Dimension	No. of Studies	% of Studies
Technical Infrastructure	22	81.5%
Economic Feasibility	18	66.7%
Socio Cultural Factors	20	74.1%
Policy & Regulatory	15	55.6%
Environmental	12	44.4%
Organisational Capacity	21	77.8%

Note: Studies may address multiple dimensions. Source: Researcher synthesis (2026).

4.2 Technical Infrastructure Readiness

Technical infrastructure readiness was the most frequently addressed dimension, appearing in 22 of 27 included studies. The synthesis identified five sub factors: (a) availability and compatibility of ground station equipment; (b) existing network infrastructure for integration; (c) technical capacity and skills of IT staff; (d) power supply reliability and backup systems; and (e) physical site suitability for satellite dish installation.

Satellite specific technical requirements distinguish this dimension from generic ICT readiness assessments. LEO satellite systems require unobstructed lines of sight to the sky, with Starlink terminals requiring a clear view within approximately 100 degrees of the sky (Herath, 2021). Ground station equipment includes a satellite dish (approximately 0.5 m diameter for LEO systems), a router, and power supply, with installation requiring trained technicians. GEO systems require larger dishes (0.75–1.8 m) and precise azimuth and elevation alignment to a fixed orbital position, increasing installation complexity and cost (Al Awadhi et al., 2022).

Network integration capacity is critical for distributing satellite connectivity across campus infrastructure. Institutions must assess existing local area network (LAN) and wireless infrastructure to determine whether satellite internet can be effectively distributed to classrooms, laboratories, libraries, and administrative offices (Kankia et al., 2022). Technical staff capacity for installation, configuration, and maintenance of satellite equipment was identified as a significant readiness gap in Kenyan IHLs, consistent with broader findings on technical human resource deficits in Sub Saharan African higher education (Ngaine, 2024; Ate et al., 2021).

Power supply reliability emerged as a satellite specific concern not typically prominent in terrestrial broadband readiness frameworks. Satellite internet equipment requires continuous power supply; power outages common in many Kenyan institutions disrupt service and may damage equipment without adequate surge protection and uninterruptible power supply (UPS) systems (Chisika & Yeom, 2025). Institutions in areas with unreliable grid power must evaluate alternative energy sources, including solar photovoltaic systems, as components of technical readiness (Ireri & Omwenga, 2016).

4.3 Economic Feasibility Readiness

Economic feasibility was addressed in 18 of 27 included studies and represents one of the most significant barriers to satellite internet adoption in Kenyan IHLs. The synthesis identified five economic sub factors: (a) capital expenditure (CAPEX) for equipment procurement and installation; (b) operational expenditure (OPEX) for monthly service subscriptions; (c) institutional budget availability and procurement processes; (d) cost sharing and partnership financing models; and (e) affordability perception and cost benefit assessment.

Cost ranges for satellite internet deployment vary significantly by institution size and technology choice. For LEO systems such as Starlink, terminal hardware costs approximately USD 300–600 per dish, with monthly service subscriptions of USD 120–500 depending on the service tier (Herath, 2021). For institutional deployments requiring multiple access points and high-capacity service tiers, total annual costs may range from USD 5,000–50,000 depending on campus size and bandwidth requirements. GEO satellite systems typically involve higher CAPEX for larger dish infrastructure (USD 2,000–15,000 per terminal) but may offer lower per Mbps costs at scale (Al Awadhi et al., 2022).

Funding models identified in the literature include: government subsidy programmes for educational connectivity (Kenya's Universal Service Fund has supported rural connectivity initiatives); public private partnerships with satellite operators offering educational pricing tiers; consortium models enabling cost sharing among multiple institutions; and international development funding from organisations such as the World Bank's Digital Development Partnership and the African Development Bank's Digital Transformation Strategy (Chisika & Yeom, 2025; Kankia et al., 2022). Institutions must assess their eligibility for these funding mechanisms as part of economic readiness evaluation.

4.4 Socio Cultural Readiness

Socio cultural readiness was addressed in 20 of 27 studies and encompasses the human and attitudinal dimensions of satellite internet adoption. The synthesis identified four sub factors: (a) digital literacy levels of academic staff, administrative staff, and students; (b) awareness of satellite internet capabilities and limitations; (c) cultural attitudes toward technology adoption and change; and (d) stakeholder acceptance and willingness to adopt.

Digital literacy deficits were consistently identified as a barrier to technology adoption in Kenyan and Sub Saharan African higher education (Ngaine, 2024; Singh et al., 2022). Satellite internet adoption requires not only basic ICT skills but also specific knowledge of satellite system characteristics including latency implications for different applications, weather related service disruptions, and data usage management that are not typically addressed in standard digital literacy curricula (Herath, 2021).

TRI 2.0 constructs of optimism and innovativeness are relevant to socio cultural readiness, as positive attitudes toward technology and openness to innovation facilitate adoption (Parasuraman & Colby, 2015). Conversely, discomfort and insecurity reflecting concerns about technology complexity and reliability may inhibit adoption, particularly among older faculty members and administrative staff with limited prior exposure to satellite technology (Taherdoost et al., 2024). UTAUT's social influence construct highlights the role of institutional leadership, peer networks, and professional communities in shaping adoption attitudes (Venkatesh et al., 2003).

4.5 Policy and Regulatory Readiness

Policy and regulatory readiness was addressed in 15 of 27 studies. Satellite internet deployment in Kenya is subject to a complex regulatory environment governed by the Communications Authority of Kenya (CA Kenya), the Kenya Information and Communications Act, and international obligations under the International Telecommunication Union (ITU) Radio Regulations. Institutions must navigate spectrum licensing requirements, terminal equipment type approval, and landing rights for international satellite operators (ITU, 2023).

The synthesis identified five policy and regulatory sub factors: (a) compliance with national telecommunications regulations and licensing requirements; (b) internal institutional IT policies supporting satellite service acquisition; (c) procurement policies and procedures for satellite service contracts; (d) data sovereignty and cybersecurity policy compliance; and (e) capacity for ongoing regulatory risk management and compliance monitoring.

Kenya's Digital Economy Blueprint 2019 and the National Broadband Strategy 2018–2023 provide policy frameworks supportive of satellite internet as a complementary connectivity solution for underserved areas. However, institutional procurement processes in Kenyan public universities are often governed by the Public Procurement and Asset Disposal Act, which imposes competitive tendering requirements that may slow satellite service acquisition (Micheni, 2015). Private universities have greater procurement flexibility but may face challenges in accessing government subsidy programmes restricted to public institutions.

4.6 Environmental Readiness

Environmental readiness was addressed in 12 of 27 studies and represents a particularly salient dimension for satellite internet that is often absent from terrestrial broadband readiness frameworks. The synthesis identified five sub factors: (a) regional weather patterns and their impact on satellite signal quality; (b) physical site characteristics and line of sight availability; (c) availability of alternative energy sources for power resilience; (d) environmental sustainability of satellite infrastructure; and (e) climate change implications for long term service reliability.

Rain fade signal attenuation caused by precipitation is a significant technical challenge for satellite internet in equatorial regions such as Kenya, where heavy rainfall is common during the long rains (March–May) and short rains (October–December) seasons. Ka band satellite systems, including Starlink, are more susceptible to rain fade than Ku band systems due to their higher operating frequency (Herath, 2021). Institutions in high rainfall regions must assess weather related service disruption risk and develop contingency plans, including backup connectivity options, as part of environmental readiness evaluation.

Physical site assessment for satellite dish installation must account for obstructions including buildings, trees, and topographical features that may block line of sight to LEO or GEO satellites. The WMO's Guidelines on Best Practices for Achieving User Readiness for New Satellite Systems (WMO, 2020) provide technical guidance on site suitability assessment applicable to educational institutions. Environmental sustainability considerations include the energy consumption of satellite equipment and the lifecycle environmental impact of ground station hardware.

4.7 Organisational Capacity Readiness

Organisational capacity was addressed in 21 of 27 studies and encompasses the institutional governance, management, and change management capabilities required for successful satellite internet adoption. The synthesis identified five sub factors: (a) senior management commitment and strategic alignment with institutional ICT strategy; (b) governance structures for ICT decision making and procurement; (c) change management capacity for managing the transition to satellite connectivity; (d) vendor relationship management and service level agreement (SLA) negotiation capacity; and (e) monitoring and evaluation systems for assessing service performance and value for money.

Management support is consistently identified as a critical enabler of technology adoption in higher education, consistent with UTAUT's facilitating conditions construct and the TOE framework's organisational context (Micheni, 2015; Kankia et al., 2022). Institutions with dedicated ICT steering committees, clear ICT strategic plans, and allocated ICT budgets demonstrate higher technology adoption success rates (Mabhele & Van Belle, 2019). In the Kenyan context, organisational readiness is further shaped by the distinction between public and private universities, with public institutions subject to additional governance requirements under the Universities Act 2012.

5.0 Proposed Conceptual Framework

5.1 Framework Overview

Based on the thematic synthesis of 27 included studies, this review proposes a Satellite Internet Acquisition Readiness Assessment Framework (SIARAF) for Kenyan IHLs. SIARAF conceptualises institutional readiness as a multidimensional construct comprising six interrelated dimensions: Technical Infrastructure (TR), Economic Feasibility (EcR), Socio Cultural (SCR), Policy and Regulatory (PRR), Environmental (EnR), and Organisational Capacity (OR). Each dimension comprises sub factors operationalized through measurable indicators, as detailed in Table 3.

SIARAF is explicitly proposed as a conceptual framework derived from systematic literature synthesis. It does not constitute a validated instrument and has not been subjected to empirical testing. Future research must validate the framework through expert consensus methods (such as Delphi studies), pilot testing in Kenyan IHLs, and quantitative survey research to assess construct validity, reliability, and predictive validity. The framework is offered as a structured foundation for this future validation research programme.

5.2 Overall Readiness Index

An aggregate Satellite Internet Acquisition Readiness Index (SIARI) can be computed as a weighted average of the six-dimension scores, with weights reflecting the relative importance of each dimension as suggested by the literature. Provisional weights derived from the frequency of dimension citation across included studies are TR (22%), EcR (19%), SCR (21%), PRR (16%), EnR (13%), and OR (22%). These weights are indicative and must be refined through empirical validation and expert elicitation. The SIARI formula is expressed as:

$$SIARI = (0.22 \times TR) + (0.19 \times EcR) + (0.21 \times SCR) + (0.16 \times PRR) + (0.13 \times EnR) + (0.22 \times OR)$$

where each dimension score is the meaning of its sub factor scores rated on a five-point scale (1 = Very Low Readiness, 5 = High Readiness). SIARI scores are interpreted as follows: 4.0–5.0 = High Readiness (proceed with acquisition planning); 3.0–3.9 = Moderate Readiness (targeted capacity building required); 2.0–2.9 = Low Readiness (substantial preparation required before acquisition); 1.0–1.9 = Very Low Readiness (foundational capacity building required).

Table 3: SIARAF Operationalisation Framework

Dimension	Sub Factors	Measurement Indicators	Scoring (1–5)
Technical Infrastructure (TR)	a) Ground station equipment b) Network integration c) IT staff capacity d) Power supply e) Site suitability	Bandwidth (Mbps); IT staff certifications; UPS availability; Site survey report; LAN coverage (%)	1=No infrastructure 3=Partial readiness 5=Fully equipped
Economic Feasibility (EcR)	a) CAPEX budget b) OPEX sustainability c) Procurement process d) Funding access e) Cost benefit awareness	Allocated ICT budget (USD); Funding sources identified; Procurement timeline; Cost benefit analysis completed	1=No budget allocated 3=Partial funding secured 5=Full funding plan
Socio Cultural (SCR)	a) Digital literacy b) Stakeholder awareness c) Adoption attitude d) Change acceptance	Digital literacy assessment scores; Awareness survey results; TRI 2.0 scores; Training completion rates	1=Very low literacy 3=Moderate awareness 5=High readiness
Policy & Regulatory (PRR)	a) Regulatory compliance b) Internal IT policy c) Procurement policy d) Data sovereignty e) Risk management	CA Kenya licence status; IT policy document; Procurement procedure; Data policy; Legal review completed	1=No compliance 3=Partial compliance 5=Full compliance
Environmental (EnR)	a) Weather patterns b) Site line of sight c) Alternative energy d) Sustainability e) Climate risk	Rainfall data (mm/year); Site survey (LOS clearance); Solar/backup power; Environmental assessment	1=High risk environment 3=Moderate suitability 5=Optimal conditions
Organisational Capacity (OR)	a) Management support b) ICT governance c) Change management d) Vendor management e) M&E systems	ICT strategic plan; Steering committee; Change management plan; SLA template; KPI dashboard	1=No governance 3=Partial structures 5=Mature governance

Source: Researcher synthesis from systematic review (2026).

5.3 Framework Validation Roadmap

SIARAF requires systematic empirical validation before deployment as an operational assessment instrument. A four-phase validation roadmap is proposed: Phase 1 (Content Validity): Expert panel review using a Delphi methodology with 15–20 experts drawn from satellite technology, higher education ICT management, regulatory affairs, and development economics. Phase 2 (Face Validity): Cognitive interviews with ICT directors from 5–10 Kenyan IHLs to assess clarity, relevance, and completeness of indicators. Phase 3 (Construct Validity): Pilot survey with a sample of 30–50 Kenyan IHLs using structural equation modelling (SEM) to test construct validity, reliability (Cronbach's alpha $\geq$ 0.7), and discriminant validity. Phase 4 (Predictive Validity): Longitudinal study correlating SIARI scores with actual satellite internet adoption outcomes over a 12–24-month period.

6.0 Conclusions

This systematic literature review identified six critical readiness dimensions for satellite internet acquisition in Kenyan institutions of higher learning: technical infrastructure, economic feasibility, socio cultural factors, policy and regulatory compliance, environmental considerations, and organisational capacity. These dimensions, synthesised from 27 peer reviewed studies through a rigorous PRISMA guided and quality assessed review process, provide the empirical foundation for the proposed Satellite Internet Acquisition Readiness Assessment Framework (SIARAF).

The principal theoretical contribution of this study is the integration of TRI 2.0, UTAUT, TRL, and the Five Lenses

Analytical Framework into a unified, satellite specific institutional readiness construct. This integration addresses a documented gap in the literature: the absence of a comprehensive, institution level framework that accounts for the unique technical, regulatory, and economic characteristics of satellite internet in African higher education contexts. The proposed SIARAF extends existing readiness models by incorporating satellite specific sub factors including line of sight requirements, LEO versus GEO technology selection, spectrum licensing, rain fade risk, and LEO specific cost structures that are absent from generic ICT or e learning readiness frameworks.

For practice, SIARAF provides IHL administrators with a structured self-assessment tool for evaluating institutional readiness prior to satellite internet procurement. The operationalisation framework in Table 3 translates conceptual dimensions into measurable indicators, enabling institutions to identify specific readiness gaps and prioritise targeted capacity building interventions. For policymakers, the framework highlights the critical role of national regulatory frameworks, government subsidy programmes, and private public partnerships in enabling satellite internet adoption in resource constrained institutions.

This study has several limitations. First, the review is based on 27 studies, a relatively small corpus reflecting the novelty of LEO satellite internet in educational contexts. Second, the proposed framework is conceptual and has not been empirically validated; the SIARI weights and scoring rubrics are provisional and require expert elicitation and empirical testing. Third, the review focused primarily on Kenya, and the framework's applicability to other Sub-Saharan African contexts requires validation in those settings.

Future research should prioritise: (1) empirical validation of SIARAF through Delphi expert consensus and quantitative survey research in Kenyan IHLs; (2) comparative studies examining satellite internet readiness across multiple Sub Saharan African countries; (3) longitudinal studies tracking adoption outcomes to validate the framework's predictive validity; (4) investigation of artificial intelligence applications for optimising LEO satellite performance in educational settings; and (5) policy research evaluating the effectiveness of government subsidy and public private partnership models for educational satellite connectivity.

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