MyJICT
Malaysian Journal of Information and Communication Technology
EISSN 0127-7812

Vol. 11, Issue 1, pp. 16-30 | JUNE 2026
DOI: https://doi.org/10.53840/myjict11-1-251

TOWARDS SMART LAND GOVERNANCE: A FIT-FOR-PURPOSE ELECTRONIC LAND ADMINISTRATION FRAMEWORK FOR SUSTAINABLE DIGITAL TRANSFORMATION

[i]*Kamarul Akhtar Idris & [ii]Abdul Halim Hamzah

Faculty of Built Environment and Survey, Universiti Teknologi Malaysia (UTM), Skudai, Johor, Malaysia

*(Corresponding author) e-mail: kamarulakhtar@graduate.utm.my

Article history:
Submission date: 16 April 2026
Received in revised form: 24 May 2026
Acceptance date: 11 June 2026
Available online: 29 June 2026

Keywords:
Electronic Land Administration System (eLAS), Fit-for-Purpose Land Administration (FFPLA), Smart Land Governance, Digital Transformation, Interoperable Land Information Systems

Funding:
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Competing interest:
The author(s) have declared that no competing interests exist.

Cite as:
Idris, K. A., & Hamzah, A. H. (2026). Towards Smart Land Governance: A Fit-For-Purpose Electronic Land Administration Framework for Sustainable Digital Transformation. *Malaysian Journal of Information and Communication Technology (MyJICT), 11(1), 16-30.* https://doi.org/10.53840/myjict11-1-251

ABSTRACT

Digital transformation has become a strategic enabler of smart land governance by improving transparency, efficiency and accessibility in land administration. However, the implementation of Electronic Land Administration Systems (eLAS) remains constrained by fragmented legal frameworks, weak interoperability between cadastral and registration data, and emerging concerns over data security and institutional readiness. This paper aims to develop a Fit-for-Purpose Land Administration (FFPLA)-based conceptual framework for implementing eLAS to support sustainable digital transformation in land administration. A qualitative research design was adopted, integrating systematic literature review principles, document analysis, multiple case study analysis of Malaysia's e-Tanah implementation and semi-structured interviews with land administration experts and system practitioners. The data were analyzed using inductive thematic analysis, supported by triangulation across literature, documents and interview findings. The main findings reveal three critical implementation challenges: legal and policy fragmentation, limited system interoperability, and security and data governance risks. The study further identifies governance, data integration and FFPLA principles as essential framework components for enabling scalable, adaptive and context-sensitive eLAS implementation. The proposed framework demonstrates that smart land governance requires interaction between institutional coordination, standardized spatial–textual data integration, secure digital infrastructure and phased implementation according to local capacity. This paper contributes to information systems and land administration literature by offering a practical, transferable and sustainability-oriented framework for strengthening digital land governance.

Introduction

The global landscape of public administration has been fundamentally reshaped by digital modernization, positioning technological integration as a cornerstone for transparent, accountable and data-driven governance. Within the domain of land administration, the deployment of Electronic Land Administration Systems (eLAS) represents a pivotal structural shift aimed at optimizing land information data structures, accelerating transaction workflows and eliminating systemic bottlenecks characteristic of conventional, paper-based workflows (Enemark et al., 2014; Unger et al., 2022). Empirical literature demonstrates that computerized land frameworks strengthen tenure security, democratize data accessibility and foster open institutional governance—elements that directly underpin broader socio-economic development agendas (Williamson et al., 2010; Bennett et al., 2013).

Yet, the transition to fully digitized land ecosystems remains uneven. Globally, public sectors frequently grapple with deep-seated institutional friction, characterized by conflicting regulatory statutes, siloed administrative mandates and a pervasive technical disconnect between spatial cadastral records and textual land registries. To mitigate these rigid technical limitations, contemporary land professionals have embraced the Fit-for-Purpose Land Administration (FFPLA) methodology. This paradigm focuses on localized adaptability, scalable operational metrics and pragmatic execution rather than adhering blindly to over-engineered technical parameters (Metaferia et al., 2022; Tomic et al., 2022). FFPLA relies heavily on spatial, legal and institutional structural designs that can morph according to distinct socioeconomic realities, ensuring that legal property formalization is delivered rapidly and cost-effectively (Enemark et al., 2016; UN-GGIM, 2020).

While the literature highlights the individual successes of FFPLA initiatives, there remains a critical conceptual gap regarding unified, holistic frameworks that seamlessly bind long-term digital evolution, robust multi-agency governance protocols and socioeconomic sustainability metrics within eLAS architectures, particularly in emerging markets. Consequently, this investigation articulates a conceptual framework that operationalizes eLAS through a Fit-for-Purpose lens, directly targeting the realization of smart land governance and enduring digital evolution. To guide this inquiry, the research addresses three specific objectives:

- Identify key challenges in eLAS implementation—ranging across legal, structural and technical bounds—that restrict current eLAS operations.
- Dissecting the core structural variables essential for cross-platform data integration, secure digital infrastructure and systemic interoperability.
- Synthesizing an adaptable, context-sensitive architecture designed to aid practitioners and policy architects in achieving resilient land records management.

By unpacking these dimensions, this study bridges the existing divide between abstract digital transformation theories and pragmatic land administrative workflows, introducing a transferable, scalable operational paradigm for global contexts characterized by institutional complexity.

Literature Review

Academic literature underscores a major shift from conventional land management toward digitally integrated governance models. Modern Electronic Land Administration Systems (eLAS) leverage geospatial technologies to improve service delivery and tracking. These systems optimize administrative transparency and operational efficiency globally (Bennett et al., 2013; Williamson et al., 2010). Furthermore, contemporary paradigms like the Framework for Effective Land Administration provide flexible avenues to resolve data silo fragmentation (UN-GGIM, 2020). Applying Fit-for-Purpose Land Administration (FFPLA) methodologies also assists nations in incrementally updating legacy infrastructure according to local constraints (Enemark et al., 2014). Consequently, synthesizing these foundational viewpoints establishes the clear theoretical background necessary to analyze digital transformations in land administration.

Modern Land Administration System

Modern Land Administration Systems (LAS) function as core institutional pillars designed to orchestrate four fundamental property management components: legal tenure verification, fiscal land valuation, spatial land-use planning and infrastructural land development. These integrated networks align legal mandates, spatial parameters and bureaucratic procedures to ensure the balanced stewardship of national real estate assets. Over recent decades, the global trajectory of LAS has shifted definitively from analog, siloed registries to consolidated digital environments that radically improve data transparency, lower transaction costs and enhance user access. When optimized, a mature LAS serves as an economic catalyst, securing marginalized property rights, stabilizing financial real estate markets and driving environmental sustainability by generating dependable geographic baselines (Enemark, 2009). Furthermore, integrating advanced Geographic Information Systems (GIS) and country Spatial Data Infrastructures (SDI) equips modern regimes with real-time analytics to formulate evidence-based environmental and urban policies (Williamson et al., 2010). The global land administration paradigm maps an unbroken flow where Land Information Infrastructures support the four core land functions (Tenure, Value, Use, Development), feeding directly into efficient real estate markets and effective spatial planning to ultimately achieve sustainable economic, social, and environmental goals as Figure 1 below (Williamson et al., 2010; Enemark, 2009).

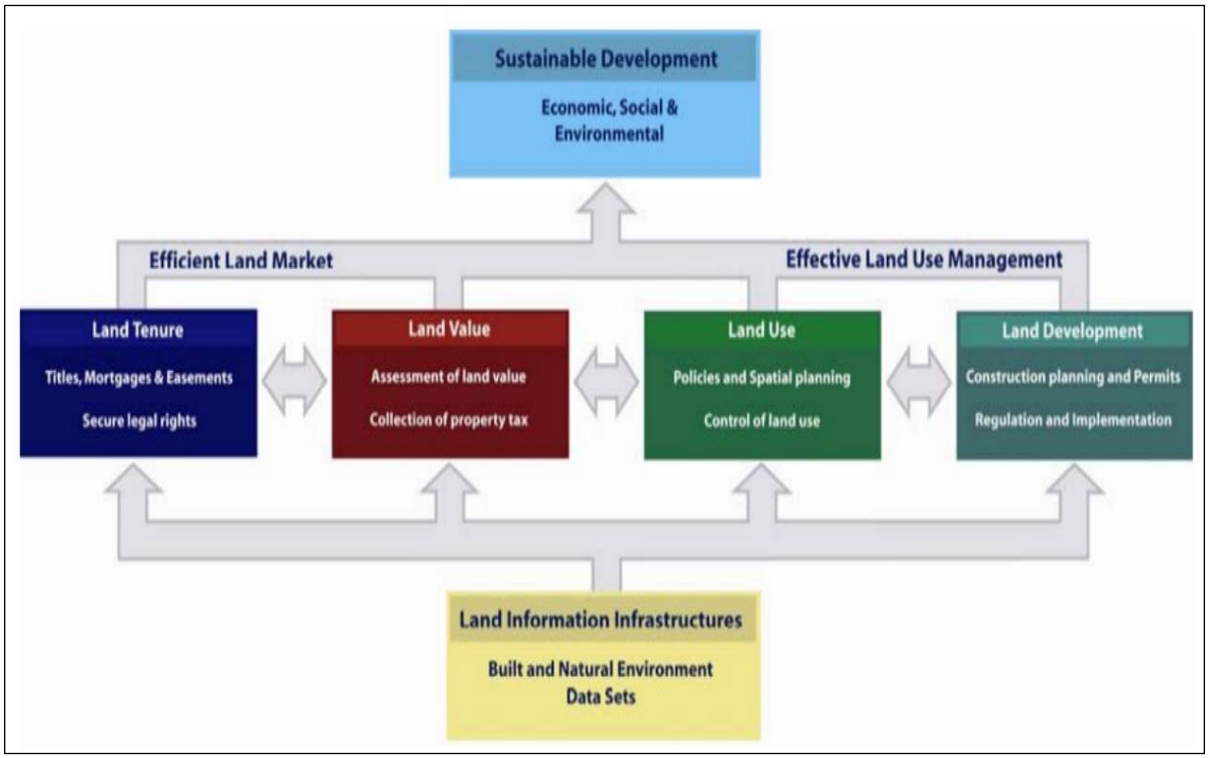

Figure 1: Global Perspective of Modern Land Administration System Model (Enemark, 2009)

Simultaneously, state-of-the-art LAS paradigms stress the importance of institutional alignment and seamless interoperability, acknowledging that land administration spans numerous institutional ecosystems—including fiscal authorities, judicial bodies, urban planners and cadastral survey teams. The academic push toward "spatially enabled government" highlights the urgency of embedding spatial coordinates across all public sector workflows to generate holistic civic services and administrative precision (Rajabifard et al., 2012). Despite this theoretical alignment, implementing such architectures remains problematic in developing countries, where fragmented governance divisions, legacy technology stacks and incompatible administrative workflows frequently disrupt inter-agency collaboration (Bennett et al., 2013).

Electronic Land Administration System

The emergence of Electronic Land Administration Systems (eLAS) represents the direct socio-technical evolution of traditional, paper-locked land records management into the digital age. By leveraging robust information and communication technology (ICT) platforms, eLAS automates core workflows associated with deed/title registration, spatial boundaries, and civil information dissemination. This shift yields substantial operational dividends, drastically shortening application processing timelines, mitigating human errors and empowering citizens through remote digital transactions (Dawidowicz & Źróbek, 2017). Beyond raw operational speed, transitioning to an eLAS structure serves as a powerful deterrent against public sector malfeasance; digital repositories instill accountability through transparent, unalterable digital ledger tracks and systematic audits of real estate shifts (World Bank, 2017).

Nevertheless, executing a durable eLAS remains fraught with multi-dimensional hurdles. Persistent challenges include an absence of standardized spatial-textual data models, a lack of system synchronization between cadastral agencies and land registries and also heightened exposure to sophisticated cyber risks (Tomic et al., 2022; Kalantari et al., 2015). Furthermore, academic consensus indicates that technology alone cannot guarantee system viability; long-term efficacy is heavily contingent upon concurrent legal modernizations, institutional capacity building and proactive stakeholder buy-in, highlighting the critical need for comprehensive, localized implementation blueprints.

e-Tanah Implementation

In Peninsular Malaysia, the *e-Tanah* framework serves as the definitive national milestone for land governance digitization, engineered to unify disjointed municipal workflows into a coordinated, electronic transactional portal. The system synthesizes diverse land functions—spanning legal registration, quit rent revenue tracking and application processing—into a single technological architecture. Empirical assessments confirm that *e-Tanah* has vastly elevated operational speeds, minimized procedural timelines and democratized document access for both corporate entities and private citizens (Halid & Nawawi, 2023; Ganason, 2022). Through centralized database hubs and digital workflow controls, it has successfully transitioned land offices from reactive paper filing to data-driven operational environments.

However, the localized rollout of *e-Tanah* highlights distinct institutional vulnerabilities. Because land administration is constitutionally tethered to state jurisdictions in Malaysia, wide variations in state-level legal interpretations and regional administrative practices have hindered uniform national execution. Technical bottlenecks also persist, particularly when attempting to synchronize alphanumeric ownership text files with spatial cadastral graphics (Ishak et al., 2023; Heriz & Boubakeur, 2022). These friction points, paired with ongoing data vulnerability concerns and varying degrees of staff tech-literacy, present significant roadblocks. These national dynamics underscore the urgent necessity for a more adaptive, structurally integrated conceptual model that can accommodate administrative diversities while advancing smart land governance goals. The operational architecture of e-Tanah links public portal entry points (such as e-Carian and e-Bayar) through core administrative modules (Registration, Consent, Strata) and centralized land data banks, simultaneously interfacing with external state networks like eKADASTER and MyGDI as Figure 2 below.

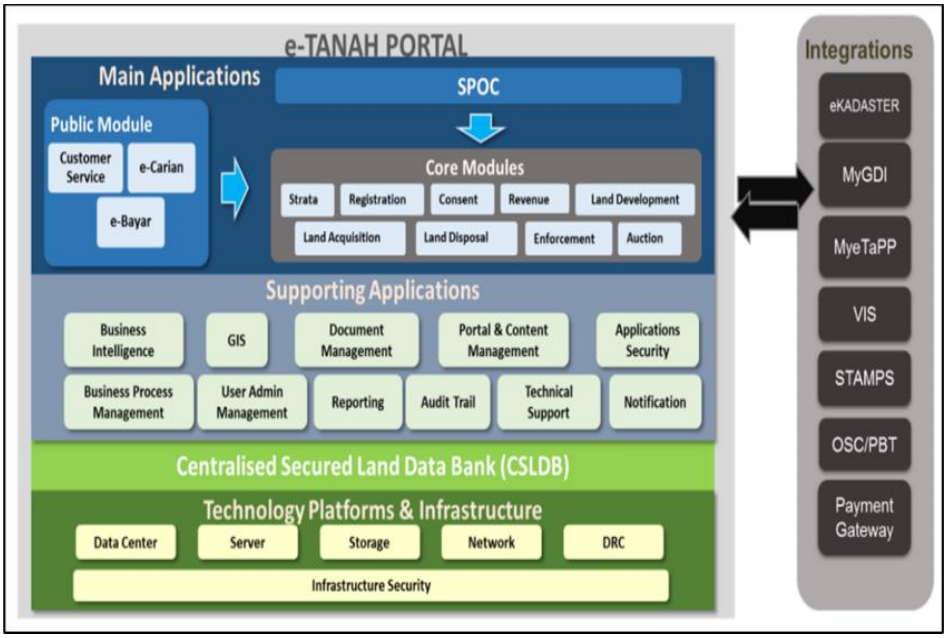

Figure 2: e-Tanah System Design.

Land Administration System Framework for Sustainable Development

To guide nations toward sustainable development, global bodies have formulated overarching benchmarks that align land administration with economic, social and environmental equity. The United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) designed the Framework for Effective Land Administration (FELA) to outline nine essential pathways—including strong governance, clear legal policies, secure data architectures and cross-sector alignment—to realize resilient land systems. FELA serves as a conceptual bridge, ensuring that national land administration directly contributes to the realization of global macro-development priorities, such as the UN Sustainable Development Goals (SDGs), while promoting transparent, evidence-based land tracking (UN-GGIM, 2020). Refer to Figure 3 below, FELA structures effective land development across nine integrated pathways: balancing policy governance, financial sustainability, data integrity, technological innovation, open standards, multi-sector partnerships, institutional capacity, and public awareness.

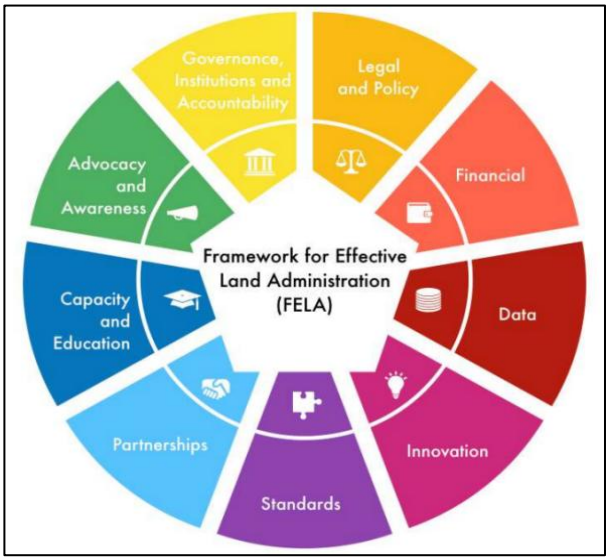

Figure 3: FELA elements (Unger et al., 2022)

Concurrently, the Fit-for-Purpose Land Administration (FFPLA) methodology has emerged as a disruptive, highly practical counterweight to traditional, rigid surveying paradigms. Rather than demanding near-perfect geometric accuracy from the outset, FFPLA prioritizes immediate functional utility, affordability and complete social inclusion. The approach rests upon a trio of flexible structural pillars: spatial frameworks that leverage scalable imagery; legal frameworks that accommodate a continuum of diverse tenure rights; and institutional frameworks built for accessible, transparent governance (Enemark et al., 2014; Enemark et al., 2016). This foundational design enables emerging economies to rapidly establish an operational baseline system, which can then be incrementally refined and updated as state funding and technical capabilities mature.

Figure 4 below explain, the FFPLA methodology operates through a continuous, reinforcing loop where flexible spatial data capture interacts with a dynamic legal framework (supporting a continuum of land rights) and an inclusive institutional framework to ensure a sustainable, cost-effective IT continuum of services.

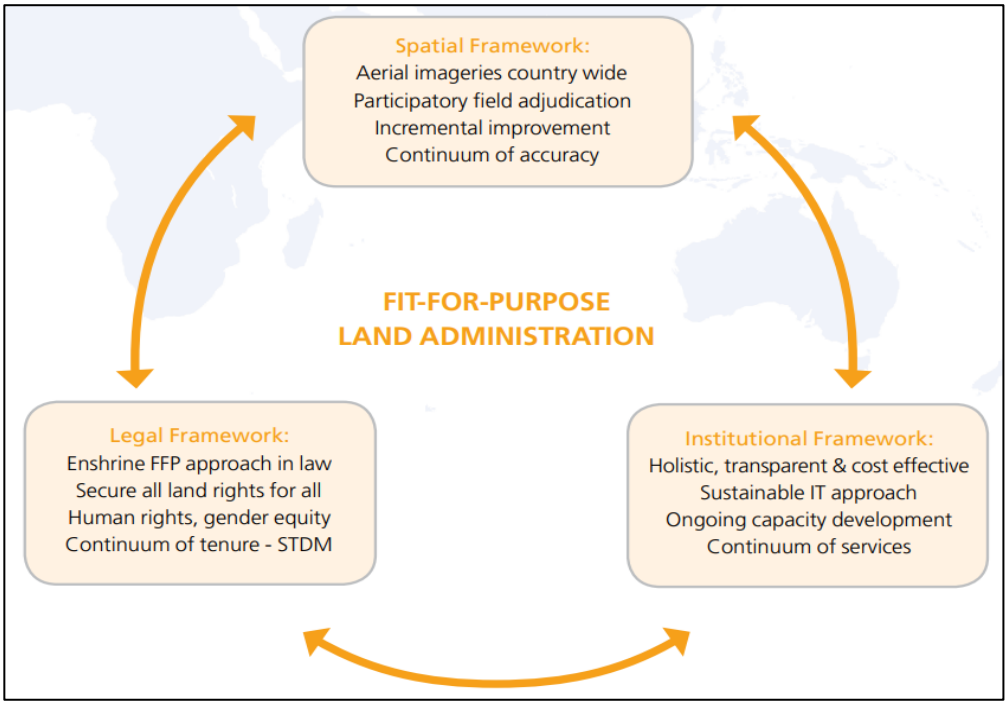

Figure 4: FFPLA Conceptual Framework (Enemark, et al., 2016).

Case studies indicate that applying FFPLA principles drastically lowers entry barriers for marginalized and rural communities, securing tenure rights rapidly without exhausting national budgets. By utilizing appropriate modern tools—such as community-led mobile mapping and high-resolution satellite imagery—countries can formalize undocumented land tracts efficiently. Merging these pragmatic FFPLA principles into automated eLAS models offers a compelling path forward for developing nations, providing a balanced trajectory that addresses structural governance realities while accelerating digital transformation (Metaferia et al., 2022). The integration of FFPLA principles into digital land systems further strengthens their ability to respond to dynamic socio-economic and governance challenges, making it a suitable approach for eLAS implementation.

Methodology

To examine the structural complexities of digital land administration, this study deploys an exploratory qualitative research architecture aimed at maximizing analytical transparency. The structural design combines a systematic review of academic literature using structured protocols with an empirical case study strategy to effectively balance conceptual theories against real-world operational insights (Moher et al., 2009; Yin, 2018). By gathering data across multiple streams—including policy papers, administrative records, and semi-structured practitioner interviews—this framework facilitates a comprehensive investigation into institutional and technical governance barriers (Creswell & Creswell,

2018; Patton, 2014). Ultimately, this multi-tiered investigative strategy establishes a rigorous platform for inductive theory-building to address local system constraints.

Research Design

To construct an adaptable and resilient conceptual blueprint for Electronic Land Administration Systems (eLAS), this inquiry deploys a qualitative, exploratory research methodology. This overarching strategic design is specifically chosen to facilitate an unrestricted, multi-dimensional exploration of the intricate institutional, regulatory and technical dynamics that govern digitized real estate tracking frameworks. Rather than applying static quantitative constraints, an exploratory approach allows for the discovery of hidden structural nuances and operational realities within public sector ecosystems (Yin, 2018). As Figure 5 below, the conceptual inquiry initiates within the Theoretical Zone by aligning primary goals with literature domains, transfers to the Methodological Workspace to execute Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) protocols and gather empirical case study data and culminates in the Output Domain through Inductive Matrix Mapping (Moher et al., 2009).

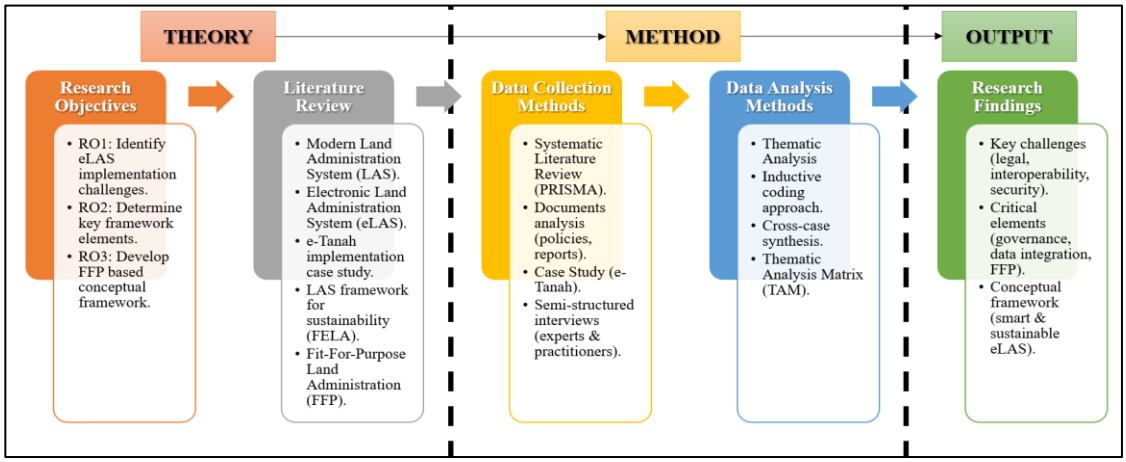

Figure 5: Research Design

To achieve analytical depth and strict academic transparency, this study relies on inductive theory-building processes. The workflow blends systematic secondary literature synthesis with deep qualitative field evidence. By matching established international literature against raw field dynamics, the research constructs a contextually grounded, transferable model that bridges abstract digital governance theories and everyday field operations

Data Collection Method, Literature Selection and Interview Sampling

The empirical baseline of this research rests on data triangulation across three distinct axes: a systematic literature search, a targeted review of state regulatory and administrative publications, and purposive semi-structured interviews with domain professionals. To minimize bias and ensure a highly systematic selection process for secondary sources, the literature review phase was structured according to the PRISMA framework (Moher et al., 2009; Page et al., 2021). Academic databases and state digital data stores were queried using target keywords such as "Electronic Land Administration System (eLAS)", "Fit-for-Purpose Land Administration (FFPLA)", "smart land governance", and "e-Tanah". Items were selected based on pre-defined inclusion metrics, prioritizing peer-reviewed articles, foundational technical white papers and formal policy assessments published in English or Malay that focused directly on digital real estate transformation or public administration dynamics.

For the empirical inquiry, this study anchors its analysis on Malaysia's national *e-Tanah* system, utilizing a multiple-case study design to investigate the operational layers of this digital infrastructure (Yin, 2018). Field perspectives were gathered via semi-structured qualitative interviews, using purposive sampling to recruit a specialized panel of nine domain experts and key administrative players (Patton, 2015). Semi-structured interviews were chosen because they provide a balanced approach, offering a standard topical path while leaving room to explore unique institutional insights as they arise (Kallio et al., 2016).

A total of nine interview participants were selected using purposive sampling based on their direct involvement and practical experience in eLAS implementation, particularly within the Malaysian e-Tanah environment. The respondents consisted of individuals directly engaged in land administration processes, including system users, practitioners and officers with relevant professional expertise and operational responsibilities work at various department such as Department of the Director General of Federal Lands and Mines (JKPTG), Office of the Director of Lands and Mines of the Federal Territory (PTGWP), Office of the State Director of Lands and Mines (PTG) and District and Land Office (PDT). Purposive sampling is considered appropriate in qualitative studies because it enables the selection of information-rich participants who possess substantial knowledge and experience relevant to the research objectives (Patton, 2015). The adequacy of the sample size was determined based on the principle of data saturation, whereby additional interviews no longer generated substantially new themes or insights (Guest et al., 2006). The list of respondents as in Table 1 below.

Table 1: Interview Respondents List

	Department	Name/ Position	Working Experience
1.	JKPTG	• Mr. Muhammad Rosli bin Muhammad Ja'afar • Deputy Director General of Management Development and Legal Sector (SKPP)	30 years
2.	JKPTG	• Mr. Jaiya bin Abu • Director of Land Management & Legal Division (BPPT) • Subject Matter Experts (SME) Land Management & Administration	20 years
3.	JKPTG	• Mr. Anesh a/l Ganason • Principal Assistant Director (KPP) Policy & Consultation Division (BD&K) • Subject Matter Experts (SME) Land Management & Administration	19 years
4.	PTGWP	• Mr. Ahmad Fuad bin Mustaffa • Deputy Director (Management) PTGWP (Kuala Lumpur)	20 years
5.	PTGWP	• Mr. Rozaini bin Rosley • Principal Assistant Director (Registration) PTGWP (Kuala Lumpur)	15 years
6.	PTG Selangor	• Mr. Khairi bin Zaman Huri • Senior Assistant Director (Registration)	17 years
7.	PDT Klang	• Mr. Mohd Shahrizal bin Mohd Salleh • Deputy Land Administrator	20 years
8.	PDT Kuala Selangor	• Mr. Mohd Tirmidzy bin Che Mat • Deputy Land Administrator	20 years
9.	PTG Perak	• YBhg. Dato' Mohamad Fariz bin Mohamad Hanip • Perak State Director of Land and Mines (PTG)	30 years

Sampling was extended until thematic saturation was achieved, a point where additional conversations merely reinforced established patterns without yielding new structural insights (Guest et al., 2006). This cross-examination of literature, regulatory text, and field interviews significantly enhances the analytical reliability and accuracy of the final framework (Creswell & Creswell, 2018).

Data Analysis Method

The thematic processing of the interview text and document records followed the structured six-step thematic analysis framework defined by Braun and Clarke (2006). This process includes data immersion, open code generation, preliminary theme mapping, theme refinement, definition grouping, and final narrative synthesis. An inductive coding approach was used, allowing operational codes, conceptual categories, and overarching themes to emerge directly from the raw data rather than fitting them into pre-

existing academic categories. This approach was paired with cross-case comparative synthesis techniques to identify shared challenges, technical requirements and strategic interventions across different administrative states.

Data Validation and Verification

To ensure qualitative validity and academic reliability, this investigation incorporates data triangulation, peer debriefing and formal expert validation panels (Creswell & Miller, 2000). The structural validity and operational logic of the preliminary conceptual framework were evaluated through a content validation process involving a panel of three senior land specialists, following instrument validation guidelines outlined by Lawshe (1975) and Grant and Davis (1997). This validation panel critically analysed the conceptual framework against four core criteria: operational coherence, conceptual clarity, relationship logic and practical feasibility in real-world scenarios. This process aims to assess four main criteria, namely relevance, clarity of concept, logical flow and practicality/utility with the following details:

(a) Coherence: Assess whether the proposed components/variables are in line with the study objectives and the context of the field.
(b) Conceptual clarity: Assess whether the terms, labels and operational definitions used are clear and not misleading.
(c) Logic of relationship: Assess the connections between components (arrows/process flows). Does it depict the correct theoretical or practical relationships?
(d) Feasibility: Assess the extent to which this framework can serve as a guide or model in real-world/industry situations.

The selection of experts was made based on the criteria proposed by Grant and Davis (1997), where the individuals selected had substantive expertise in the field of land administration and management and cadastre.

Table 2: Field Expert List

	Department	Name/ Position	Working Experience
1.	JKPTG	• Mr. Jaiya bin Abu • Director of Land Management & Legal Division (BPPT) • Subject Matter Experts (SME) Land Management & Administration	20 years
2.	JKPTG	• Mr. Anesh a/l Ganason • Principal Assistant Director (KPP) Policy & Consultation Division (BD&K) • Subject Matter Experts (SME) Land Management & Administration	19 years
3.	JUPEM	• LSr. Looi Kam Seng • Director of Survey and Mapping of Selangor State, JUPEM Selangor • Subject Matter Experts (SME) in the Field of Cadastre	27 years

The external validation panel consists of three subject matter experts drawn from the 2020 Directory of Expertise in Specific Fields of Public Service, representing specialized domains in land management, legal policy consultation and cadastre surveys, with individual professional backgrounds spanning 19 to 27 years based on. The list of selected field experts can be referred to in Table 2 above.

Results and Findings

The empirical data gathered during this study reveals a complex interplay between institutional policies and technical deployment outcomes. The primary results demonstrate that modern digital land transformations significantly reduce transaction backlogs, yet legacy organizational structures create distinct operational bottlenecks (Yin, 2018). Furthermore, themes derived from stakeholder interviews confirm that public sector adaptation relies heavily on continuous workforce retraining and technical system stability (Patton, 2014). This alignment between user experiences and administrative data outlines the systemic hurdles faced by public registries during modernization efforts (Creswell & Creswell, 2018). Collectively, these findings provide a grounded baseline to evaluate the overarching efficiency of localized administrative system models.

Key Challenges in Implementing eLAS

Legal and institutional bottlenecks heavily restrict the operational capacity of electronic land administration infrastructures. Discrepancies across regional property legislations, combined with a lack of comprehensive legal validation for paperless transactions, slow down administrative standardization and block inter-agency cooperation. These regulatory lags create operational ambiguity within electronic processes, which ultimately stalls broader system expansion. Consequently, these outcomes highlight an urgent requirement to develop flexible legal frameworks that formally accommodate digital workflows and secure smooth online transactions (Williamson et al., 2010).

Technical fragmentation across primary data repositories remains a systemic challenge for digital land platform execution. Siloed computer networks, mismatched data structures, and poor coordination between cadastral maps and registration logs frequently disrupt cross-platform data flows. This technical gap causes operational delays, data redundancy, and diminished registry reliability. Empirical evidence proves that lacking a unified data ecosystem and shared communication protocols stops an electronic system from acting as a centralized governance tool, which severely weakens public service delivery and administrative planning (UN-GGIM, 2020).

Table 3: Thematic Analysis Matrix (TAM) for RO1 – Key Challenges in Implementing eLAS

Theme (RO1)	Inductive Codes (Grouped)	Analytical Synthesis
Legal Challenges	Fragmented laws; lack of digital legal recognition; slow policy adaptation	Legal fragmentation limits digital system standardization
Interoperability Challenges	Siloed databases; inconsistent data standards; legacy systems	Fragmented systems hinder seamless data integration
Security Challenges	Weak cybersecurity; poor access control; data manipulation risks	Weak security undermines trust and system reliability

Cybersecurity vulnerabilities and data protection risks represent severe obstacles during institutional modernization. Transitioning from legacy paper records to centralized digital networks frequently exposes platforms to unauthorized system intrusions, malicious information tampering, and evolving cyber threats. These operational hazards are further intensified by weak data oversight policies and loose administrative governance models. Empirical insights highlight that deploying rigid security protocols—such as end-to-end data encryption, strict user authentication, and unalterable electronic audit logs—is absolutely essential to maintain institutional trust, system dependability, and long-term platform viability (Yin, 2018). Table 3 above summarizes the findings of 3 themes from the inductive coding approach in simple Thematic Analysis Matrix (TAM) for RO1.

Critical Elements for Conceptual Framework Implementation of eLAS

Organizational oversight serves as the core pillar for successfully executing digital land administration networks. Empirical data highlights that robust cross-agency alignment, definitive policy mandates and active stakeholder participation are crucial to ensure platform viability. Strong governance models successfully bridge the gap between legal requirements, institutional workflows and technological setups,

resulting in a unified land management ecosystem. Furthermore, this structured coordination increases public sector accountability and drives cohesive, multi-agency administrative planning (Williamson et al., 2010).

Systemic data consolidation represents the primary technical catalyst within the operational framework. The analysis proves that merging spatial maps and non-spatial registry datasets via unified structures and open communication networks vastly increases data precision, public availability and operational utility. Establishing a single, shared digital environment drives instant information sharing and strengthens fact-based public planning. Ultimately, this technical integration is vital to transform disconnected legacy systems into an interconnected, reliable national land information network (UN-GGIM, 2020).

Table 4: Thematic Analysis Matrix for RO2 Critical Elements for Conceptual Framework Implementation of eLAS

Theme (RO2)	Inductive Codes (Grouped)	Analytical Synthesis
Governance	Inter-agency coordination; policy alignment; stakeholder engagement; institutional accountability	Strong governance enables coordinated and accountable system implementation
Data Integration	Standardized data models; spatial–textual integration; interoperable architecture; unified databases	Integrated data enhances interoperability and decision-making efficiency
Fit-for-Purpose Land Administration (FFPLA)	Flexible system design; incremental implementation; context adaptability; inclusive participation	Flexible approach supports scalability and context-sensitive implementation

Flexible developmental strategies act as key operational drivers that boost both adaptability and scalability during digital network rollout. The field data shows that adopting a FFPLA framework enables public agencies to build administrative systems in gradual stages, directly aligning updates with local technical skills and institutional resources. Because this practical strategy focuses heavily on real-world utility and broad stakeholder inclusion, it lowers entry barriers and encourages wide user adoption. Ultimately, utilizing this adaptable methodology ensures that modern networks remain highly responsive to varying regional environments while securing lasting operational viability (Enemark et al., 2014). Table 4 above summarizes the findings of 3 themes from the inductive coding approach in simple Thematic Analysis Matrix (TAM) for RO2.

Developed Conceptual Framework Design (Smart & Sustainable eLAS)

The proposed Smart and Sustainable eLAS framework was formulated by synthesizing the empirical findings obtained from literature analysis, case study evaluation and expert interviews. Rather than treating governance, information management and FFPLA principles as separate domains, the framework combines these dimensions into an integrated implementation architecture for digital land administration. The model responds to the challenges identified in this study by establishing linkages between regulatory requirements, institutional arrangements and technological capabilities. Within this architecture, governance mechanisms provide policy direction and inter-agency coordination, while interoperable land information infrastructures facilitate seamless exchange of spatial and textual datasets. The incorporation of FFPLA principles further enables adaptive and incremental implementation according to local institutional capacity and operational needs. Through the interaction of these components, the framework supports improved service delivery, strengthens transparency and accountability, and promotes broader stakeholder participation in achieving sustainable land governance outcomes (Enemark et al., 2016; UN-GGIM, 2020; Unger et al., 2022).

Table 5: Summary of Key Findings and Framework Alignment

Challenges	Critical Elements	Framework Components
Legal fragmentation	Governance	Adaptive legal & institutional framework
System interoperability	Data Integration	Interoperable data architecture
Security & data integrity	FFPLA Approach + Governance	Secure, scalable, flexible system design

The proposed conceptual framework is structured through three interrelated domains, namely governance, land information management and digital service applications. These domains operate collectively to

establish an integrated environment for eLAS implementation. The governance domain provides strategic oversight through institutional collaboration, policy harmonization and regulatory coordination. The land information management domain facilitates the standardization, integration and exchange of spatial and textual land data across multiple agencies, thereby improving information consistency and interoperability. Meanwhile, the application domain delivers user-oriented digital functions that support land transactions, administrative processes and evidence-based decision-making. The interaction among these domains enables a flexible and scalable implementation mechanism capable of accommodating varying organizational capacities and operational requirements. As presented in Table 5, the framework demonstrates a direct relationship between the challenges identified, the critical implementation elements and the corresponding framework components, illustrating how each component contributes to addressing specific implementation issues (UN-GGIM, 2020; Unger et al., 2022).

Figure 6 illustrates the proposed framework, which promotes the transition towards smart land governance by combining digital innovation with sustainable land administration principles. The framework serves as a practical implementation guide that can be adapted to different administrative environments while maintaining consistency with international land governance objectives. Through the integration of coordinated governance mechanisms, interoperable information infrastructures and adaptive FFPLA implementation strategies, the framework enhances organizational effectiveness, strengthens accountability and supports informed decision-making processes. Consequently, eLAS is positioned not merely as a technological platform but as a strategic governance instrument capable of advancing sustainable, transparent and citizen-centric land administration in line with global sustainable development aspirations (Enemark et al., 2016; Williamson et al., 2010; UN-GGIM, 2020).

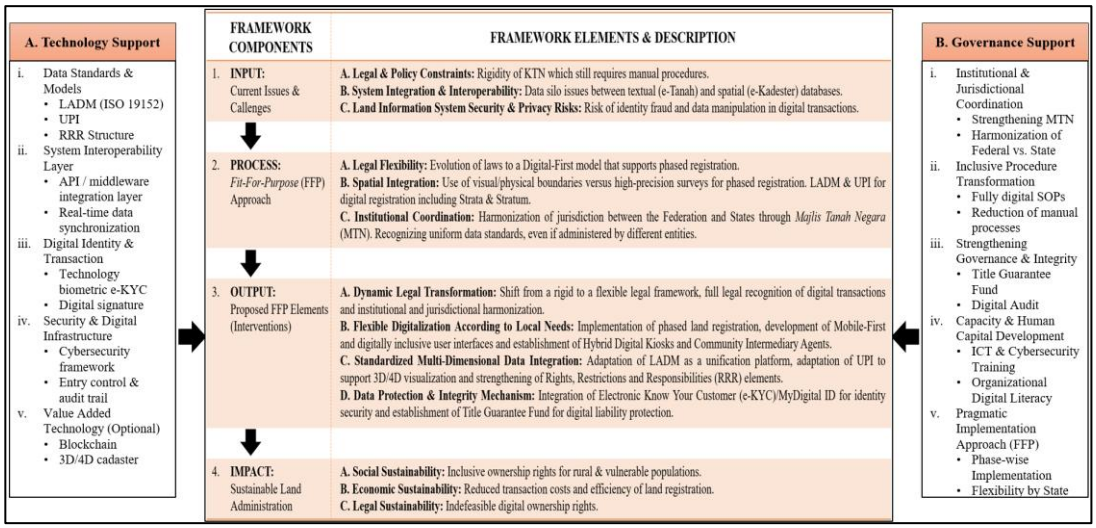

Figure 6: Proposed Conceptual Framework Implementing eLAS Toward Sustainable Land Administration.

Discussion

The empirical findings of this inquiry offer an integrated pathway for digital land administration, connecting theoretical models with field operational realities. By analysing the identified challenges and core structural components, we can understand how interactive socio-technical elements support smart land governance.

Overcoming Structural Challenges Through Policy and Technology

The operational hurdles identified in this study—namely regulatory fragmentation, technical isolation and data security risks—confirm the systemic barriers highlighted in international literature (Bennett et al., 2013; Tomic et al., 2022; World Bank, 2017). However, this research contextualizes these dynamics within a multi-tiered federal structure. In such environments, regional autonomy over land matters often clashes with national digitization goals. The findings show that technological upgrades alone cannot fix deeply entrenched administrative issues. True modern modernization requires updating the legal framework first. For example, the rigidity of current laws means digital records must be backed up by physical documentation. This doubles the administrative workload and defeats the purpose of automation.

To address these issues, the proposed conceptual framework moves away from fragmented implementations. Instead, it views governance, data integration and the FFPLA approach as an interconnected system. In practice, governance serves as the primary tool for institutional alignment. It enables policy consensus and legal adaptation across independent state and federal land entities (UN-GGIM, 2020). Once this collaborative environment is established, data integration standardizes information exchange using international specifications like the Land Administration Domain Model (LADM; ISO 19152). This resolves the long-standing divide between cadastral mapping and textual ownership registries (Kalantari et al., 2015; Rajabifard et al., 2012).

Operationalizing the FFPLA Pathway

The integration of FFPLA principles provides a flexible and scalable alternative to rigid, over-engineered technical systems (Enemark et al., 2016). Within decentralized land ecosystems like Malaysia's *e-Tanah*, a one-size-fits-all rollout often fails due to unequal funding, varying infrastructure quality and different levels of staff tech-literacy across regions. An FFPLA-driven approach helps administrators avoid these pitfalls through a phased, incremental rollout. This strategy allows less technically advanced regions to adopt baseline features first, matching their current capacity while keeping their databases compatible with the national grid (Metaferia et al., 2022).

Additionally, the framework embeds security mechanisms across all layers. By using tools like secure electronic audit trails, multi-factor biometric authentication, and digital signature registries, the system builds long-term public trust (World Bank, 2017). This multi-layered structure ensures that data accessibility does not come at the expense of system security. It protects the system against data tampering and identity fraud.

Practical and Policy Implications

For policy architects and land professionals, these findings emphasize that successful digital transformation depends on systemic alignment. Rather than simply shifting from physical paper to digital files, organizations must pursue broad regulatory and structural updates. From a practical perspective, this study shows that the proposed model can serve as a flexible guide for emerging markets. It provides a structured method to evaluate legal readiness, balance institutional capabilities, and launch scalable data systems that support sustainable economic growth and secure property rights.

Limitation and Future Research

While this study provides valuable insights into the implementation of eLAS, several methodological considerations should be acknowledged when interpreting the findings. The research adopted a qualitative design to obtain detailed perspectives on governance, interoperability and implementation practices; however, the context-specific nature of qualitative inquiry may limit the transferability of the findings to countries operating under different legislative, administrative and socio-technical environments. Furthermore, the empirical investigation cantered on Malaysia’s e-Tanah initiative, which reflects unique institutional arrangements and land governance practices that may not be fully representative of other jurisdictions. Although expert perspectives contributed substantial practical knowledge, the interpretation of findings may still be influenced by individual experiences and professional viewpoints. To strengthen the credibility of the analysis, evidence from interviews was systematically cross-validated through literature review, document examination and multiple-source triangulation procedures (Creswell & Creswell, 2018; Yin, 2018).

Building upon the outcomes of this study, subsequent investigations may focus on empirically testing the proposed framework using quantitative techniques and larger datasets across diverse national settings. Such efforts would enable a more robust assessment of the framework’s applicability under varying legal, institutional and technological conditions. Cross-country comparative analyses could further improve understanding of how contextual factors influence digital land administration initiatives and governance outcomes. In addition, emerging technological innovations, including blockchain-enabled land registries, artificial intelligence applications and advanced geospatial analytics, warrant further examination to determine their potential contribution to enhancing system interoperability, security and service delivery. Future studies may also adopt longitudinal research designs to observe implementation dynamics over

extended periods, thereby generating deeper insights into the sustainability and evolution of digital land administration reforms (Enemark et al., 2016; UN-GGIM, 2020; Williamson et al., 2010).

Conclusion

This research contributes to the ongoing discourse on digital land administration by developing an empirically grounded conceptual framework that integrates FFPLA principles within a smart and sustainable governance perspective. The analysis reveals that the effectiveness of eLAS initiatives continues to be influenced by persistent challenges associated with regulatory inconsistency, fragmented information infrastructures and increasing concerns regarding data protection and system integrity. Drawing upon evidence from literature, case studies and expert insights, the study identifies governance capacity, interoperable data environments and FFPLA-based implementation strategies as the principal mechanisms required to facilitate successful digital transformation in land administration. The resulting framework illustrates how coordinated institutional arrangements, integrated land information management and adaptive implementation practices can collectively strengthen operational performance, improve accountability and support informed decision-making processes. Consequently, the framework offers a practical reference for policymakers and practitioners seeking to advance sustainable land governance through digitally enabled and context-responsive land administration systems (Enemark et al., 2016; UN-GGIM, 2020; Williamson et al., 2010).

Building on these findings, this study concludes that successful eLAS implementation requires the framework components to operate interactively within an integrated socio-technical environment rather than functioning independently. Governance mechanisms provide policy direction, legal legitimacy and institutional coordination; data integration enables interoperability between spatial and textual land information systems; while the Fit-for-Purpose approach supports flexible and incremental implementation according to institutional readiness and local requirements (Enemark et al., 2016; UN-GGIM, 2020). Within the Malaysian e-Tanah environment, practical implementation should prioritize adaptive legal reform, standardized cadastral–registration integration, strengthened security mechanisms and continuous organizational capacity development. The proposed framework therefore provides not only theoretical contributions but also an operational pathway capable of supporting smart, secure and sustainable land governance within diverse institutional environments.

Acknowledgement

This paper is not under any scholarship or research grant.

References

Bennett, R., Rajabifard, A., Kalantari, M., & Wallace, J. (2013). Cadastral futures: Building a new vision for the nature and role of cadastres. International Journal of Geographical Information Science, 27(4), 1–18. https://doi.org/10.1080/13658816.2012.745497.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa.

Creswell, J. W., & Miller, D. L. (2000). Determining validity in qualitative inquiry. Theory into practice,39(3), 124-130.

Creswell, J. W., & Creswell, J. D. (2018). Research design: Qualitative, quantitative, and mixed methods approaches (5th ed.). SAGE Publications.

Dawidowicz, A., & Źróbek, R. (2017). The role of land administration systems in the process of sustainable development. Land Use Policy, 68, 604–614. https://doi.org/10.1016/j.landusepol.2017.08.042.

Enemark, S. (2009). Sustainability and land governance: Three key challenges. FIG Working Week 2009 Proceedings.

Enemark, S., Bell, K. C., Lemmen, C., & McLaren, R. (2014). Fit-for-purpose land administration. International Federation of Surveyors (FIG). https://www.fig.net/resources/publications/figpub/pub60/Figpub60.pdf.

Enemark, S., McLaren, R., & Lemmen, C. (2016). Fit-for-purpose land administration: Guiding principles for country implementation. Land Use Policy, 56, 1–13. https://doi.org/10.1016/j.landusepol.2016.03.010.

Ganason, G. (2022). Digital transformation in Malaysian land administration: Evaluating the e-Tanah system. Journal of Property and Land Management, 15(2), 45–60.

Grant, J. S., & Davis, L. L. (1997). Selection and use of content experts for instrument development. *Research in nursing & health*, *20*(3), 269-274.

Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. *Field methods*, *18*(1), 59-82.

Halid, H., & Nawawi, A. (2023). Enhancing land governance through digital systems: A case study of e-Tanah implementation in Malaysia. Malaysian Journal of Information and Communication Technology, 8(1), 25–38.

Ishak, M. H., Karim, H. A., & Wahid, R. (2023). Challenges in integrating cadastral and land registration systems in Malaysia. Land Use Policy, 125, 106512. https://doi.org/10.1016/j.landusepol.2022.106512.

Kalantari, M., Rajabifard, A., Wallace, J., & Williamson, I. (2015). Spatially enabled society: A new perspective on the role of land administration. Land Use Policy, 49, 312–321. https://doi.org/10.1016/j.landusepol.2015.08.013.

Kallio, H., Pietilä, A. M., Johnson, M., & Kangasniemi, M. (2016). Systematic methodological review: developing a framework for a qualitative semi-structured interview guide. *Journal of advanced nursing*, *72*(12), 2954-2965.

Lawshe, C. H. (1975). A quantitative approach to content validity. *Personnel psychology*, *28*(4)

Metaferia, H., Bennett, R., & Alemie, B. K. (2022). Fit-for-purpose land administration: Progress and challenges. Land Use Policy, 114, 105998. https://doi.org/10.1016/j.landusepol.2021.105998.

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. PLOS Medicine, 6(7), e1000097. https://doi.org/10.1371/journal.pmed.1000097.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... & Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *bmj*, *372*.

Patton, M. Q. (2014). *Qualitative research & evaluation methods: Integrating theory and practice*. Sage publications.

Rajabifard, A., Kalantari, M., & Williamson, I. (2012). Spatially enabled society. GSDI World Conference Proceedings.

Tomic, H., Roić, M., & Mađer, M. (2022). Interoperability in land administration systems: A review of challenges and solutions. ISPRS International Journal of Geo-Information, 11(2), 123. https://doi.org/10.3390/ijgi11020123.

Unger, E. M., Bennett, R. M., Lemmen, C., & Zevenbergen, J. (2022). A framework for assessing land administration systems. Land Use Policy, 112, 105807. https://doi.org/10.1016/j.landusepol.2021.105807.

United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development. https://sdgs.un.org/2030agenda.

United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM). (2020). Framework for effective land administration (FELA). https://ggim.un.org/meetings/GGIM-committee/10th-Session/documents/E-C.20-2020-29-Add_2-Framework-for-Effective-Land-Administration.pdf.

Williamson, I., Enemark, S., Wallace, J., & Rajabifard, A. (2010). Land administration for sustainable development (p. 487). Redlands, CA, USA: ESRI Press Academic.

World Bank. (2017). Land governance assessment framework: Identifying and monitoring good practice in the land sector. World Bank Publications. https://openknowledge.worldbank.org/server/api/core/bitstreams/bba1b7f1-6520-5e92-962b-7735eec15ded/content.

Yin, R. K. (2018). Case study research and applications: Design and methods (6th ed.). SAGE Publications.