

Bridging the Digital Divide: How and Why the Road Development Authority should be aligned with Sri Lanka's Digital Economy Blue Print

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Abstract. This study examines the strategic alignment of Sri Lanka's Road Development Authority (RDA) with the national Digital Economy Blueprint, focusing on the institutional transformation required to modernise transport governance. This study adopts a qualitative approach, incorporating twelve in-depth stakeholder interviews alongside comparative analyses of digital governance models in Singapore, Estonia, and India. These sources provide a rich foundation for examining the RDA's institutional alignment with Sri Lanka's Digital Economy Blueprint. Thematic analysis revealed persistent barriers to digital adoption, including limited digital literacy, fragmented inter-agency coordination, and constrained financial resources. In response, this study proposes a phased implementation roadmap encompassing foundational IT infrastructure, AI-powered traffic management systems, and integrated e-governance platforms. By contextualising global best practices within Sri Lanka's regulatory and operational landscape, the paper offers a policy-relevant framework for advancing sustainable, citizen-centric mobility solutions.

Keywords: Digital Transformation, Road Development Authority (RDA), Intelligent Transport Systems (ITS), Artificial Intelligence (AI), Building Information Modeling (BIM), E-Governance, Smart Infrastructure, Transport Policy, Public Sector Innovation, Sri LankaFirst Section

1 Introduction

1.1 Background and Significance of Digital Transformation

In the 21st century, digital transformation has emerged as a critical driver of efficiency, Sri Lanka's commitment to transparency and economic growth is reflected in its Digital

Economy Blueprint [1] (see Fig. 1), which envisions the integration of digital technologies such as e-governance, artificial intelligence (AI), intelligent transport systems (ITS), and digital payment platforms to modernize public institutions and enhance governance. Infrastructure development remains pivotal to the nation’s economic trajectory, with the Road Development Authority (RDA) playing a central role in managing and expanding the country’s transport network. However, the RDA has been slow to adopt digital innovations, continuing to rely on conventional approaches to road planning, project implementation, and traffic management.

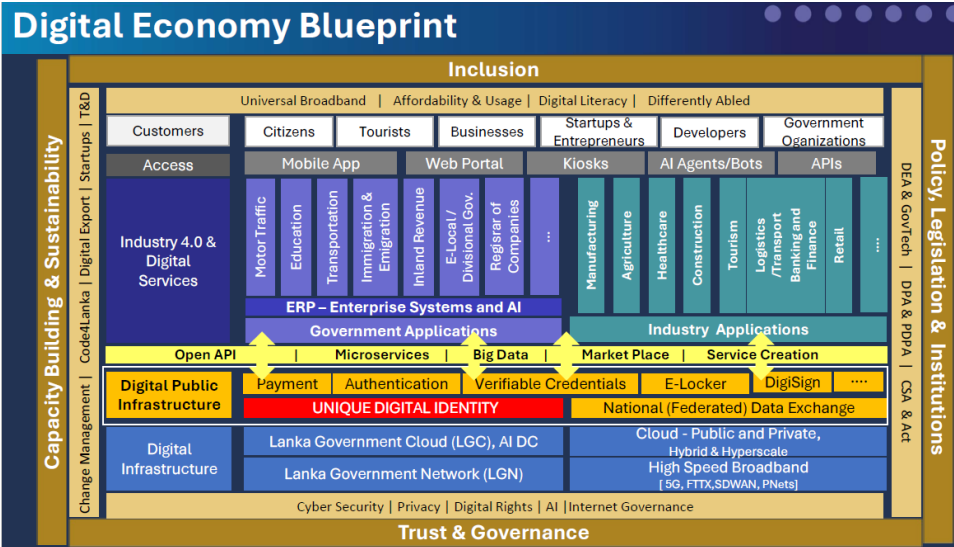


Fig. 1. Sri Lanka’s Digital Economy Blueprint (Source: Ministry of Digital Economy) [1]

This lag hinders operational efficiency and sustainability, underscoring the urgent need to align the RDA’s operations with the national digital agenda. Embracing digital transformation is not just a strategic upgrade for the RDA, but a national imperative to ensure economic resilience and global competitiveness.

1.2 The Need for RDA’s Alignment with Digitization

As the digital economy advances, transport infrastructure emerges as a critical enabler of transformation, with global leaders like Singapore and Estonia demonstrating how AI-

driven traffic analytics, smart tolling, and cloud-based asset management significantly enhance mobility, service delivery, and revenue efficiency. In contrast, Sri Lanka's Road Development Authority (RDA) faces significant barriers to digital integration, including outdated legacy systems, limited technological investment, low digital literacy among staff, and regulatory challenges impeding interoperability across transport agencies [2]. Overcoming these constraints through strategic, policy-driven digital adoption will enable the RDA to improve planning accuracy, alleviate congestion, enhance public accountability, and expand service accessibility. Moreover, embracing technologies such as Building Information Modeling (BIM), Geographic Information Systems (GIS), and AI-based traffic monitoring will empower the RDA to align with global sustainability goals by reducing emissions, optimizing urban planning, and transitioning to a smarter, more adaptive infrastructure governance model.

1.3 Key Challenges Limiting RDA's Digital Adoption

Despite the clear advantages of digital governance, the Road Development Authority (RDA) faces systemic challenges in its transition, with financial constraints being a primary obstacle, as budget priorities remain focused on traditional infrastructure projects rather than intelligent transport solutions [2]. Although international agencies like KOICA and the World Bank have funded select digital pilot initiatives, sustainable progress requires dedicated, long-term financing frameworks. Institutional resistance further hampers transformation, with entrenched bureaucratic processes and a workforce largely trained in civil engineering rather than IT governance showing reluctance toward adopting AI-driven traffic systems and digital procurement tools. Moreover, low digital literacy among staff inhibits broad implementation. Interoperability issues between government entities also present a significant barrier, limiting data sharing and collaborative planning [3]. The absence of a national Building Information Modeling (BIM) policy exacerbates this fragmentation, preventing the establishment of standardized frameworks necessary for cohesive digital infrastructure management. Without structural regulatory reform and institutional capacity building, the RDA's digital modernization risks remaining piecemeal and ineffective.

1.4 Opportunities for Digital Transformation in RDA

Despite challenges, the RDA has strong opportunities to digitally transform its operations. AI-driven traffic management and smart transport systems, such as automated tolling and real-time analytics, can ease congestion and improve revenue collection. Integrating platforms like GovPay can streamline tolls, permits, and procurement, enhancing transparency

and efficiency. Public-Private Partnerships and international collaboration can bring advanced technologies, cybersecurity, and expertise, as seen in countries like Singapore. Additionally, data analytics and machine learning enable predictive traffic planning and dynamic signal control, aligning RDA's efforts with global standards for sustainable, efficient urban mobility.

1.5 Research Objectives and Scope

This paper examines:

1. Why the RDA must align itself with Sri Lanka's Digital Economy Blueprint.
2. How digital adoption can transform the RDA's efficiency, transparency, and service delivery.
3. Challenges limiting the RDA's digital expansion.
4. Opportunities for integrating AI-driven analytics, ITS, and e-governance platforms into road governance frameworks.
5. Strategic roadmap for policy-driven digital adoption at RDA.

Through a detailed literature review, comparative case studies, and qualitative research methodology, this study provides actionable insights into bridging the digital divide in Sri Lanka's transport sector.

2 Literature Review

This section synthesizes global and local scholarship on digital transformation in public sector governance, with a focus on transport infrastructure, intelligent systems, and institutional modernization—highlighting both theoretical foundations and applied innovations relevant to Sri Lanka's evolving digital landscape.

2.1 Theoretical Foundations of Digital Transformation in Public Sector Governance

Digital transformation, rooted in e-governance and smart infrastructure planning, plays a vital role in modernizing public services, reducing inefficiencies, and enhancing transparency [4]. Technologies like cloud computing, AI, and big data have improved decision-making and streamlined workflows in governance [5]. Globally, digitalization has boosted accountability and resource optimization, enabling evidence-based policies and reducing waste [6]. Tools such as digital payments, workflow automation, and AI monitoring have reshaped infrastructure management, especially in transport. Sri Lanka's Digital Economy

Blueprint offers a timely opportunity for institutions like the RDA to embrace digital integration and modernize governance.

2.2 Digitalization in Public Infrastructure and Transport Management

Infrastructure modernization is central to smart city development, with technologies like BIM, ITS, and GIS enabling predictive modeling, traffic optimization, and real-time asset monitoring [7]. Countries such as Singapore and Estonia illustrate the benefits of smart mobility through AI-driven traffic systems, sensor-enabled intersections, and blockchain-based tolling [8]. In contrast, Sri Lanka still depends on manual monitoring and fragmented systems in its transport sector. To improve connectivity, traffic flow, and emergency response, the RDA must adopt data-driven governance as outlined in the Digital Economy Blueprint, promoting inter-agency collaboration and advanced mobility analytics.

2.3 The Role of Intelligent Transport Systems (ITS) in Road Infrastructure

Intelligent Transport Systems (ITS) have revolutionized urban mobility through sensor-based algorithms, adaptive signals, and real-time traffic adjustments, cutting congestion by up to 30% and improving efficiency [6], [9]. Cities like Tokyo and London use machine learning to optimize traffic light timing, reducing idling and fuel use. ITS also supports dynamic regulation based on real-time travel patterns. In Sri Lanka, ITS adoption by the RDA is still limited to pilot tolling and basic analytics. A national ITS strategy with cross-sector collaboration and policy standardization is crucial to enhance transport governance and operational efficiency.

2.4 Building Information Modeling and Digital Road Assets Management

Building Information Modeling (BIM) is revolutionizing road development by enabling detailed visualization, accurate cost estimation, and efficient resource planning [7]. It enhances construction accuracy, reduces environmental impact, and strengthens coordination across agencies [8]. Countries like Germany and Singapore have adopted national BIM policies to standardize infrastructure projects and minimize delays. In contrast, Sri Lanka's lack of a unified BIM framework leads to fragmented planning within agencies like the RDA. Implementing a standardized BIM approach would improve project execution, foster collaboration, and boost the resilience of transport infrastructure.

2.5 Digital Payments and E-Governance in Transport Institutions

Integrating digital payment solutions into transport governance enhances accountability, reduces revenue leakage, and streamlines fiscal operations [10]. Countries like Sweden and Estonia use AI and blockchain to digitize permits and approvals, improving transparency and efficiency [9]. Sri Lanka's GovPay system offers a foundation for RDA to digitize tolls, permits, and procurement, but its integration remains uneven. Strengthening interoperability with other transport systems is essential to ensure secure, accessible, and transparent digital transactions across the sector.

2.6 Public-Private Partnerships (PPPs) and International Collaborations for Digital Transport Expansion

Global benchmarks show that Public-Private Partnerships (PPPs) play a crucial role in driving innovation and scaling digital transport infrastructure [11]. Singapore partners with tech firms to develop ITS solutions like sensor-based analytics and real-time monitoring, while countries like India and Germany use private funding to support national digitization efforts [9]. Sri Lanka's RDA has engaged in some partnerships, such as the KOICA-funded traffic database project, but needs to establish broader collaboration models to ensure sustainable digital innovation in transport governance.

2.7 The Need for Policy Standardization in Digital Road Governance

Sri Lanka's road management sector faces limited multi-agency integration due to a lack of aligned digital policies, restricting the scalability of digital initiatives. Research shows that standardized e-governance frameworks enhance sustainability and ensure consistent service delivery across transport bodies [5]. For example, Singapore's Land Transport Authority enforces ITS adoption via national legislation, while Estonia uses blockchain for streamlined permit processing [6]. To modernize effectively, Sri Lanka must develop comprehensive transport digitalization policies, including national BIM mandates, ITS standards, and GovPay compliance, to drive uniform adoption across the RDA and related agencies.

3 Methodology

This section outlines the qualitative research design, data collection strategies, comparative case study approach, and thematic analysis framework used to investigate the RDA's digital transformation, while acknowledging contextual limitations and the need for adaptive policy insights.

3.1 Research Design and Approach

This study adopts a qualitative research design to examine the strategic alignment of Sri Lanka's Road Development Authority (RDA) with the national Digital Economy Blueprint. The approach integrates semi-structured stakeholder interviews, thematic analysis, and comparative case studies to explore institutional, policy, technological, and financial factors influencing digital transformation. The design is exploratory in nature, aiming to generate context-sensitive insights and propose a phased modernization roadmap tailored to Sri Lanka's transport governance landscape.

3.2 Data Collection Methods

Primary data were collected through twelve semi-structured interviews with key stakeholders, including senior RDA officials, transport engineers, IT personnel, and external experts affiliated with international agencies such as KOICA and the World Bank. Participants were selected based on their direct involvement in digital initiatives or strategic planning within the transport sector. Interview questions focused on institutional readiness, digital literacy, funding mechanisms, technological feasibility, and inter-agency coordination. All interviews were conducted in accordance with ethical research protocols, ensuring informed consent, voluntary participation, and confidentiality of responses. Participants were briefed on the study's objectives and their right to withdraw at any stage without consequence.

Secondary data included national policy documents, internal RDA reports, and international benchmarks from Singapore, Estonia, and India. Academic literature on digital governance, intelligent transport systems (ITS), and public sector innovation was also reviewed to ensure theoretical grounding and comparative relevance.

3.3 Comparative Case Study Methods

The study compares digital transformation models from Singapore's Land Transport Authority, Estonia's e-governance systems, and India's digital infrastructure projects. It assesses technology, funding, policies, and workforce adaptation to identify lessons applicable to RDA.

3.4 Thematic Analysis and Framework

Interview transcripts were analysed using inductive thematic coding. Key themes were identified through iterative reading and categorisation, including:

- Financial constraints and budget prioritisation
- Workforce resistance and digital literacy gaps
- Interoperability challenges across transport agencies
- Institutional inertia and regulatory fragmentation
- Opportunities for AI-driven traffic optimisation and e-governance integration

3.5 Research Limitations

Limitations include limited access to real-time data, budget restrictions on empirical analysis, institutional resistance affecting transparency, and reliance on developed-country benchmarks requiring contextual adaptation.

4 Findings and Discussion

This section presents key empirical insights from stakeholder interviews and comparative analysis, structured around five thematic areas that influence the RDA's digital transformation trajectory.

4.1 Financial Constraints in Digital Expansion

A major barrier to the Road Development Authority's (RDA) digital transformation is its limited financial capacity, as funding prioritizes traditional road maintenance and construction over IT innovation. Despite support from donors like the World Bank and KOICA, reliance on external funding hampers scalability and sustainability of projects such as EDMS and GIS integration. To advance digital capabilities like BIM, ITS, and cloud platforms, RDA needs dedicated IT budget allocations, expanded public-private partnerships, and diversified international funding. Without a clear investment strategy, Sri Lanka risks lagging in transport modernization and failing to fully realize the Digital Economy Blueprint.

4.2 Workforce Adoption and Digital Literacy Challenges

Institutional resistance within the Road Development Authority (RDA), driven by a workforce accustomed to manual processes and limited digital literacy, significantly impedes the adoption of intelligent transport solutions. Many civil engineers and administrative staff remain skeptical of AI-driven analytics, automated monitoring, and e-governance workflows due to reliance on traditional paper-based approvals and manual tracking. To overcome this, structured capacity-building programs are essential, including integrating

digital literacy into training, incentivizing IT certifications, and partnering with academic institutions like the University of Moratuwa to enhance skills in transport analytics. Without these proactive initiatives, RDA risks delaying the implementation of AI-powered traffic optimization and compromising service efficiency.

4.3 Inter-operability Gaps and Data Fragmentation

Interoperability gaps between Sri Lanka's transport agencies significantly hinder RDA's digital alignment, as the lack of a standardized governance framework and national BIM policy prevents seamless data sharing and coordinated project execution. Unlike global leaders like Singapore's LTA, which integrates multi-agency datasets for synchronized urban planning and transport management, RDA operates without a unified digital platform, limiting real-time analytics, automated approvals, and collaboration. Addressing these gaps requires establishing a centralized transport database, mandating BIM standards within RDA's workflows, and implementing AI-driven cross-agency mobility planning to enable predictive congestion management and infrastructure optimization. Without such standardization, RDA's transition to a fully digital transport authority remains constrained.

4.4 Bureaucratic Resistance to Digital Transformation

Bureaucratic inertia within Sri Lanka's public sector, particularly at RDA, impedes the adoption of AI-driven traffic management, blockchain project tracking, and cloud-based governance due to fears of job displacement, unfamiliarity with new technologies, and concerns over disrupting established policies. Unlike Singapore, which mandated cross-sector digital governance and replaced legacy systems with AI-powered monitoring, RDA remains reliant on manual processes that limit efficiency and innovation. Overcoming this resistance requires embedding digital governance in RDA's mandates, executive training on emerging technologies, and fully transitioning to cloud-based workflows to ensure meaningful transport modernization. Without such reforms, RDA's digital transformation will remain stalled.

4.5 Opportunities for AI Driven Traffic Management

Despite existing structural challenges, AI offers transformative potential for Sri Lanka's transport governance by enabling advanced urban congestion forecasting, vehicle flow optimization, and predictive maintenance. Drawing from global examples like Singapore, London, and Tokyo, AI-driven models can facilitate adaptive traffic signal control, real-time incident monitoring, and data-driven infrastructure planning. For RDA, integrating

AI could optimize Colombo's traffic light coordination, enhance predictive road maintenance through stress analysis, and streamline digital toll collection via automated vehicle classification, ultimately boosting transport efficiency and sustainability.

5 Strategic Road Map for Digital Implementation

This section presents a phased, policy-driven roadmap to guide the RDA's digital transformation, detailing infrastructure upgrades, AI integration, funding strategies, workforce development, and inter-agency coordination aligned with Sri Lanka's Digital Economy Blueprint.

5.1 Introduction to the Implementation Road Map

For the Road Development Authority (RDA) to successfully align with Sri Lanka's Digital Economy Blueprint, it must adopt a phased digital transformation strategy that ensures structured execution, financial sustainability, workforce adaptation, and interoperability standardization. A strategic roadmap provides a clear pathway toward modernizing RDA's operations, enhancing mobility governance, and embedding AI-driven, data-centric solutions within transport infrastructure management [2].

This section outlines a step-by-step action plan encompassing policy standardization, technological integration, funding diversification, skill development, and inter-agency collaboration to ensure a seamless transition into smart infrastructure management.

5.2 Phased Implementation Framework

Phase 1: Foundational IT Infrastructure Development (Year 1-2)

The first implementation phase should focus on building RDA's digital foundation by creating a centralized transport data platform for seamless inter-agency coordination, upgrading fiber optic networks across key offices and control units, adopting cloud-based mobility analytics for real-time traffic management, and deploying robust cybersecurity measures including AI-driven threat detection. This foundational upgrade will enable RDA to move away from paper-based processes toward secure, integrated, and resilient cloud-enabled governance systems.

Phase II: AI Powered Traffic Optimization and ITS Expansion (Year 2-3)

After stabilizing the digital foundation, RDA should implement AI-driven transport analytics and Intelligent Transport Systems (ITS) by deploying adaptive traffic signal control for congestion reduction, automating toll collection with AI-based vehicle classification, utilizing predictive maintenance analytics for proactive road repairs, and launching ITS pilot projects featuring sensor-enabled intersections and machine learning mobility models. This phase will enable RDA to transition into an adaptive, real-time, AI-powered road governance system.

Phase III: E-Governance and Digital Transaction Expansion (Year 4-5)

Following ITS and AI integration, RDA should scale e-governance solutions by fully implementing GovPay for digital tolls and permit approvals, automating government contracting with AI-driven bid evaluations, digitizing urban transport governance through synchronized real-time dashboards with municipal councils, and expanding blockchain-based infrastructure tracking to secure transport records. This phase will establish comprehensive digital integration across Sri Lanka's transport governance, maximizing transparency and operational efficiency.

5.3 Funding Strategies for Digital Expansion

Sri Lanka's transport modernization requires a structured financial model leveraging diverse funding sources, including Public-Private Partnerships with AI and mobility tech firms, multi-lateral development grants from institutions like the World Bank, JICA, and KOICA, and dedicated national IT budget allocations within the annual transport expenditure. This approach will enable RDA to build a self-sustaining financial framework, ensuring continuous and scalable digital transformation.

5.4 Workforce Digital Literacy Initiatives

Successful digital transformation at RDA hinges on structured skill development programs that equip personnel to effectively manage ITS and AI-driven governance platforms. Key strategies include mandated AI certification for transport engineers, digital workflow training for administrative staff, and collaborative knowledge-sharing initiatives with the University of Moratuwa's ICT faculty. This will ensure RDA's workforce evolves into a digitally proficient team, capable of sustaining long-term infrastructure modernization objectives.

5.5 Inter-agency Collaborations and Policy Standardizations

To overcome interoperability gaps, Sri Lanka must implement standardized governance frameworks that enable seamless cross-sector integration within the transport sector. Key policies include adopting a National BIM Policy to harmonize infrastructure planning, enforcing ITS interoperability mandates across urban councils and expressway authorities, and institutionalizing AI-driven traffic governance standards under the Ministry of Transport and Highways. These measures will create a synchronized digital transport ecosystem, eliminating procedural inefficiencies and enhancing collaborative decision-making.

6 Future Directions and Policy Recommendations

The Road Development Authority (RDA) of Sri Lanka is at a critical stage in its journey toward full digital governance. While progress has been made, the integration of Artificial Intelligence (AI), Intelligent Transport Systems (ITS), Building Information Modeling (BIM), and e-governance platforms requires strategic focus to align with the nation's Digital Economy Blueprint. Sustainable digital transformation demands robust policy frameworks, financial sustainability, workforce capacity building, and technological standardization.

A key priority is establishing a National Transport Digitalization Policy to unify fragmented governance. This policy should mandate ITS adoption, AI-based congestion monitoring, BIM integration for consistent infrastructure design, and inter-agency data-sharing protocols to enhance cross-sector coordination. Institutionalizing AI in mobility governance is critical; AI-driven traffic signal optimization, predictive maintenance, and automated toll monitoring can significantly improve transport efficiency and infrastructure longevity.

To overcome inconsistent infrastructure planning, standardized BIM adoption must be enforced, defining digital modeling guidelines and asset tracking across RDA and municipal bodies. Financially, Sri Lanka needs to allocate dedicated budgets for transport digitization, expand donor-supported initiatives, and promote public-private partnerships to attract innovation investment. Collaborations with international agencies such as JICA, World Bank, and KOICA will provide vital multi-lateral funding to support scalable ITS and AI deployment.

Addressing the workforce skills gap is essential. Nationwide training programs for transport engineers and digital workflow workshops for administrative staff must be implemented, with strong partnerships between RDA and academic institutions like the University of Moratuwa. Furthermore, developing digital leadership among RDA executives will help overcome bureaucratic resistance and drive AI adoption.

Technological standardization will consolidate Sri Lanka's ITS ecosystem through a unified national traffic management framework, sensor-enabled intersections, and AI-based vehicle tracking. Expanding blockchain technology will enhance transparency and accountability by securing toll collections, digitizing procurement, and safeguarding infrastructure asset documentation.

In conclusion, the strategic roadmap outlined for RDA's digital transformation—spanning policy, funding, workforce, and technology—positions Sri Lanka's transport sector to emerge as a globally competitive smart mobility ecosystem. Successful implementation will drive economic growth, improve urban connectivity, and enhance service delivery through efficient, AI-powered governance.

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