Artificial Intelligence and Public Sector Innovation in Digital Payment System in Nepal.

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Abstract

This article examines the possible ways in which the use of artificial intelligence (AI) can transform Nepal's public sector digital payment systems by enhancing security, efficiency, and inclusivity. Using cases from India (UPI), China (Alipay), Singapore (PayNow), Sweden, and Estonia, it demonstrates how AI-powered fraud mitigation, risk scoring, and digital identification networks enhance our nation's payment infrastructures. Although adoption of digital payments in Nepal is increasing with the number of e-wallet accounts reach 23.5 million by 2024, from 6.2 million in 2020 (NRB, 2023; NRB, 2025), systemic weaknesses remain, as a result of rising cybercrime and Nepal's low AI readiness position (150th globally) (Oxford Insights, 2023). The paper recommends a strategic approach for an AI in Nepal comprising real time fraud analytics, chatbot based support, adaptive scoring, and federated detection models. It also recommends strengthening cybersecurity laws, implementing a universal e-ID, and enabling data sharing through open APIs. Grounded in international best practices, this roadmap presents a forward-looking vision for building a secure, inclusive, and AI-driven digital payment ecosystem in Nepal.

Keywords: *digital payments, artificial intelligence, fraud detection, digital identity, Nepal, public sector innovation.*

Introduction

Digital payment innovation is a priority for modern economies, and artificial intelligence is increasingly seen as an agent for more secure and efficient transactions. By analyzing vast volumes of transaction data in real time, AI can detect fraud, systematize compliance, and personalize user experiences (beBold Digital, 2023). For example, real-time AI models can flag suspicious payments before funds are transferred, significantly reducing losses and preventing fraud. Governments and public institutions worldwide are exploring AI to modernize payment systems and widen financial access. Singapore's central bank (Monetary Authority of Singapore) has launched AI pilots for scam detection in banking sector to counter new digital fraud schemes (Cointelegraph, 2022). Similarly, India's National Payments Corporation of India (NPCI) is using machine learning to curb the outpour in UPI fraud cases. UPI-related scams spiked by 85% year-on-year in FY 2023/24, costing users over INR.10 billion (approximately

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USD 130 million) in that year (Economic Times, 2025). These examples suggest that public-sector adoption of AI in payments can both strengthen security and drive financial inclusion.

In Nepal, the importance of AI for payment innovation is growing as digital transactions become more common. Our country has seen a rise in the use of digital wallets, mobile banking, and QR-code payments in recent years. For instance, between mid-2020 and mid-2023, the number of mobile wallet accounts in Nepal tripled from NRS 6.2 million to 18.9 million, and by mid-2024 it reached 23.46 million accounts (IFC, 2024; Kathmandu Post, 2025). Interbank payment systems have also expanded the volume of transactions processed through digital platforms like connectIPS (real-time bank transfers) increased nearly one hundred-fold from 2018 to 2024 (IFC, 2024). However, this rapid growth brings new challenges. Nepal currently ranks very low in global indices of AI preparedness i.e., **150th out of 193 countries** in the latest Government AI Readiness Index (Oxford Insights, 2023) highlighting weaknesses in digital infrastructure and limited domestic AI capacity. At the same time, cyber-enabled financial fraud has risen where reported online fraud cases in Nepal is more than doubled from about 1,835 in FY 2021/22 to over 4,100 in FY 2022/23 (Kathmandu Post, 2024a). These trends raise concerns about trust and safety in the digital payment ecosystem. In this context, this article explores how AI can be integrated into Nepal's public payment infrastructure to enhance security and resilience, drawing on lessons from global initiators, innovators and proposing a framework for AI-driven payment system innovation.

Literature Review: AI in Payment Systems and Public Innovation

Digital finance is being rapidly shaped by Artificial Intelligence (AI) and payment systems are a major frontier. AI-powered fraud detection, real-time analytics, and behavioral risk scoring in particular are redefining how financial institutions, governments, and private companies can help ensure trust, security, and inclusivity in digital payments. (PYMNTS Intelligence 2024, The Paypers, 2024) Almost 94% of the payment professionals who say they are already using AI to prevent fraud highlights the sheer volume and importance of AI today.

But the standout implementations arise out of a trio, AI for fraud and efficiency, secure digital identity infrastructure, and prudent regulatory governance. India, China, Singapore, Sweden and Estonia are examples of how the public sector can drive digital transformation a process that holds important lessons for a nation like Nepal that is going through a similar transition.

AI in the payments industry: Insights from around the world

India: Scaling Innovation Amidst Risk

India's Unified Payments Interface (UPI) is a huge achievement in public-sector-driven digital innovation. With more than INR18 billion transactions in Mar 2025 (Economic Times, 2025), UPI has brought digital payment to the last person in the pyramid. Yet, this growth has also attracted systemic fraud where UPI scams surged 85% in FY 2023.

To address this, the National Payments Corporation of India (NPCI) introduced an AI-powered

federated fraud detection model which provides real-time risk scores to transactions. AI is also how banks dynamically monitor transactions. Crucially, it leverages India's Aadhaar biometric ID system to stake down identity, improving Know Your Customer (KYC) compliance and building a digital platform of trust on a massive scale.

The lesson that Nepal can take is to mix biometric national ID systems with AI-trained fraud engines to boost security without hindering financial inclusion. But privacy rules need to be written in parallel.

China: Private-Led AI at Scale

China provides a model of what can be accomplished with AI-powered private payment ecosystems. Solutions such as Alipay and WeChat Pay are also prevalent and power Alipay's AlphaRisk fraud detection engine, which processes millions of transactions per second and behavior-based anomalies. Remarkably, Alipay's fraud loss rate of $0.64 per $10 million of payments processed is an international best-practice in payment security (Business Wire, 2020; China Innovation Watch, 2025).

China also combines the use of facial recognition for payments and AI-assisted credit scoring with Zhima Credit. Meanwhile, its state sector supports this system with its digital ID and state surveillance infrastructure, a development not without ethical controversy regarding privacy and authoritarian state oversight (Wired, 2019).

The lesson that Nepal can take is to build AI fraud engines and credit analytics but with democratic governance. But Nepal, unlike China, has to promote transparency, data protection and rights-based governance to earn public confidence.

Singapore: Trust Via Regulation & Collaboration

Singapore's payment landscape is a model for regulator-led innovation around the world. Systems such as PayNow, linked to Singpass (national ID) to enable frictionless real-time transfers. Singapore The Monetary Authority of Singapore (MAS) has pledged over SGD 100mio for AI-enabled fraud detection and issued guidelines on the management of AI risks containing the principles that AI must be explicable, regularly audited and tracked via an algorithm inventory (Clifford Chance, 2022).

Initiatives, such as COSMIC (Collaborative Sharing of Money Laundering/Terrorism Financing Information and Cases), the AI-powered, multi-bank platform to fight financial crime, showcased how Singapore was embracing collective intelligence and systemic supervision.

The lesson that Nepal can take is to strengthen the regulatory power of the Nepal Rastra Bank to create AI sandboxes and pilots, and enforce ethical AI standards. Open taskforces of public and private sector parties may be a way to be creative while reducing risk.

Sweden: Trust is the Name of the Game for Digital IDs

Sweden demonstrates how digital identity is fundamental to secure and inclusive payment

ecosystems. More than 99% of adults use BankID, a public-private e-ID solution that allows for secure authentication across banks, to government services, and to apps such as Swish (BankID, 2024). Fraud is rare and, when it occurs, is generally a function of human manipulation social engineering than a breakdown of systems.

Sweden's approach takes place in a high-trust, high digital literacy context, one that nurturers an ethical culture of technology use. The Riksbank is even considering using a government-issued e-ID for additional redundancy (Riksbank, 2025).

The lesson that Nepal can take is to place a secure, inclusive digital ID infrastructure at the center of scaling AI in payments. Integrate National ID, payment providers for easy, safe and fraud-proof transactions.

Estonia: A Fully Digital Society

Estonia demonstrates what can happen when a digital state nurtures AI applications. Everyone has a cryptographic secure digital ID that works across both public and private sectors. X-Road data interchange facilitates secure and smooth interoperability among banks, revenue and social services (Thomson Reuters, 2022).

AI for Estonia, AI is being used in Estonia for detection of fraud in healthcare payments and for enhancement of judicial productivity in the courts. For example, the nation's e-Health system employs machine learning to identify suspicious medical billing (Public Sector Network, 2023).

The lesson that Nepal can take is to invest in digital public infrastructure to ensure interoperability, digitized records, and secure ID, so AI can meaningfully optimize public services and payments.

Comparative Reflections:

Despite their great size, and widely differing context, there are some commonalities among the five countries in their strategies. For one, good data and identity infrastructure is essential whether the Indian Aadhaar, the Swedish BankID, or the e-ID in Estonia, connecting financial services transactions to identities that have already been verified will cut down on fraud and make people more trustworthy. Second, AI-enabled analytics are of growing importance, all cases do invest in AI-driven capabilities for fraud detection and customer service, China's private-sector innovators as well as Singapore's regulator-driven efforts alike. Third, regulatory innovation matters. There are countries like Singapore and India that comes to mind where regulators can help foster innovation by setting parameters, sandboxes or even funding the experimentation. Finally, public–private cooperation is a common theme where banks, fintechs, and government work together on infrastructure (UPI in India is a public-good platform used by private apps, PayNow in Singapore was constructed by banks but promoted by the central bank, etc.). These learnings inform the discussion on Nepal's way forward a world where Government focuses on providing enabling policies and the core infrastructure and the private side does the user facing solutions, and in this case taking advantage of the AI. The comparison and the relevance in context to Nepal can be seen below.

Cross-Country Comparative Insights

Feature	India	China	Singapore	Sweden	Estonia
AI Focus	Fraud prevention	Real-time detection	Risk mgmt & crime detection	ID-based security	Public service AI
Digital ID	Aadhaar (biometric)	Facial recognition	SingPass (Gov ID)	BankID (Public-private)	National e-ID (Gov)
Regulation	NPCI-driven, evolving	State-aligned	MAS-led innovation	Strong data protection	Proactive governance
Governance Approach	Collaborative	Centralized	Regulator-led	Privacy-focused	Fully digitized
Ethical Concerns	Privacy gaps	Surveillance risk	Transparent policies	Minimal	Well-managed
Nepal's Relevance	High (ID + AI)	Medium (scale gap)	High (regulatory model)	High (ID trust)	High (e-Gov. vision)

Nepalese Digital Payment Landscape: Expanding, Disconnects, and Exposures

Nepal's digital payment landscape has seen massive expansion over the past few years powered by mobile penetration, policy reformation, and wave of the pandemic-driven behavioral change. The number of e-wallet users jumped from 6.2 million in 2020 to more than 23.4 million by mid-2024, close to 80% of the population. Mobile banking also had 24.65 million users by 2024, representing more than 82 % of the adult population (IFC, 2024; Nepal Rastra Bank, 2025). The growth from 124.9 million to 294.54 million transactions in digital wallet transactions from FY 2020/21 versus FY 2023/24 compares with digital transactions jumping by 37.7%. Whilst from a low base, this exponential growth puts Nepal on a high-adoption curve, particularly vis-a-vis low-value, high-frequency QR-based retail payments, suggesting strong grip on day-to-day financial behavior.

Despite progress in digital payment adoption, deep-rooted structural deficiencies remain. Notably, digital exclusion remains high with over **70% of adults,** particularly **women and rural residents,** still lacking meaningful access to digital services (You et al., 2023). Connective infrastructure remains unevenly developed across the country. While LTE/4G coverage ranges from **71.4% to 100%,** many remote areas remain underserved. As of 2023, **only about 50% of the population has access to the internet,** highlighting a persistent digital divide (World Bank, 2023). The Payment and Settlement Act (2019) mandates around interoperability are no doubt regulatory moves of note. Latest circular from the ministry of finance to all the ministries,

commissions, offices, public enterprises, telecom, Boards and committees to make provisions for digital payments as spelled out in FY 2025/2026 Fiscal policy, provision of regulatory sandbox, Provision of preparation of National Payments System Development Strategy, Digital Lending Guidelines, Systematically Important Payment Systems in Monetary Policy may be a remarkable milestone for the infrastructure development. The latest consultative document published by NRB regarding Artificial Intelligence Guideline seeking advice from stakeholders and individuals can be a milestone towards AI preparedness but data protection and AI governance frameworks are still in their infancy. Nepal does not have a centralized digital identity platform nor a national AI strategy, resulting in a fragmented and outdated ecosystem, which tends to promote fraud and inefficiency (Oxford Insights, 2023).

The first and foremost danger to Nepal's financial system arises from the growing incidences of cyber-enabled fraud. As per Strategic Analysis Report of FIU, 'cyber-enabled fraud has emerged as one of the major international organized crimes with significant rise in amount of scams recorded and global expansion of such crimes observed over past few years' (FIU-Nepal, 2024). The number of complaints of digital economic fraud including phishing, social engineering, and malicious mobile applications has more than doubled since last year, with payment platforms, such as wallets and banking platforms receiving frequent attacks (Farsight Nepal, 2025)

Noticeable is the localization of threats, and more than 70% of frauds comes domestically where young actors are often featured. The system is also vulnerable to weak institutional capacity and insufficient forensic capacity on the part of enforcement institutions.

Findings and Analysis

Nepal's digital payment ecosystem shows dynamic growth but remains constrained by foundational limitations. A synthesis of national trends and global contrasts reveals six critical findings that point to strategic priorities for AI deployment in Nepal's financial sector.

1. Rapid Growth, Low-Value Transactions:

Nepal's digital payments surged by 38% over two years, comparable to regional peers like Bangladesh. However, the **average transaction value remains low,** indicating that digital platforms are used primarily for everyday micropayments (IFC, 2024). AI must be tailored to detect subtle fraud patterns in high-volume, low-value environments, an area where conventional systems struggle due to cost inefficiencies.

2. Mobile-Centric Usage Requires Mobile-Optimized AI:

With over 20 million mobile wallet or banking app users and minimal credit card penetration, Nepal's payment landscape is overwhelmingly mobile driven (NRB, 2024; IFC, 2024). Therefore, AI systems must be optimized for mobile platforms, incorporating biometric authentication, app-level threat detection, and user-friendly interfaces to ensure secure and inclusive access.

3. Digital Divide Hinders Uniform Adoption:

Around 50% of the population remains offline, particularly in rural areas, limiting the reach of real-time AI tools (World Bank, 2023). Stronger infrastructure and inclusive models such as SMS-based AI alerts and multi-channel security levels are required to bridge this divide without excluding low-tech users.

4. Escalating Cyber-Fraud Threatens Public Trust:

Cybercrime cases doubled within a year, with scams targeting OTPs and mobile apps becoming widespread (Kathmandu Post, 2024a). While no system can fully prevent human error, AI can mitigate this by recognizing fraud patterns, automating scam detection, and issuing behavioral warnings. Trust is central without it; adoption may be slow.

5. Institutional AI Readiness Remains Limited:

Despite regulatory support, Nepal lacks institutional capacity to supervise AI-driven systems. With only a handful of experts and little data standardization, the potential of AI remains untapped (Oxford Insights, 2023; Khabarhub, 2024). Investment in human capital, regulatory expertise, and a shared anonymized fraud database are essential for enabling safe and effective AI deployment.

6. Leapfrogging Possible via Regional Integration:

Nepal's cross-border QR integration with India's UPI system offers a unique opportunity for leapfrogging (NPCI, 2024; Republica, 2024). Latest Collaborations with more advanced neighbors like china(Alipay+), Sri Lanka (Lankapay) has been a milestone. For a resource-constrained country like Nepal, joining multilateral payment hubs such as Project Nexus and Africa's Pan-African Payment and Settlement System (PAPSS) offers a low-cost path to leapfrog. Instead of building expensive systems alone, Nepal can access instant payments, AI-driven fraud analytics, modern regulatory standards, and wider remittance corridors through a single integration. As seen in Southeast Asia's Nexus rollout (Hall, 2025), shared platforms unlock scale, reduce costs, and accelerate financial modernization, making regional integration a strategic necessity for Nepal.

Way Forward

Nepal stands at a transformative juncture in its digital finance journey, with strong adoption momentum but critical systemic vulnerabilities. To harness the full potential of AI for public sector innovation in digital payments, a multi-dimensional, inclusive, and secure roadmap is essential. To build lasting resilience, Nepal must pursue a two-pronged Strategy:

1. The development of core enablers such as connectivity, digital literacy, and regulatory oversight is essential for achieving an inclusive digital payment ecosystem. In addition, system reliability and public confidence can be enhanced through the integration of AI-powered payment infrastructure equipped with real-time fraud detection engines,

dynamic risk scoring models, and behavioral analytics. A three-level AI system architecture including a data ingestion layer, adaptive analytics layer, and a decision layer governance is part of the key infrastructure system within central systems such as RTGS (Real-Time Gross Settlement) and Retail Payment Systems, as well as Faster Payment Systems. This architecture allows raw transactional metadata to be transformed into actionable insights, by regulators (e.g., for secondary check and supervisory monitoring) and by end user (e.g., the generation of instant alerts, custom risk flags).

2. Nepal Rastra Bank could also lead to a centralized AI-based fraud level intelligence hub which would facilitate real-time monitoring, user alerts and automated compliance reports along with goAML system in Financial Intelligence Unit based in Nepal Rastra Bank. Nepal will be able to not only scale with the exponential increase in transaction volume, but also to manage and respond to new threat vectors proactively hence making its digital payment future well protected.

Based on data and best international practices, the following strategic priorities emerge:

1. Institutionalize a Universal Digital Identity System

A robust, interoperable digital ID linked with payment infrastructure is foundational for AI integration. Expanding Nepal's national ID program to include digital authentication (e.g., biometrics, SIM linkage) will support secure KYC, reduce fraud, and enhance service delivery (Riksbank, 2025).

2. Create a Centralized AI-Based Fraud Intelligence Hub

Nepal Rastra Bank (NRB) should mandate collaborative fraud detection using **federated AI models.** Real-time transaction metadata sharing can improve early threat detection across platforms. This collaborative architecture mirrors successful examples from India and Singapore (Economic Times, 2025).

3. Strengthen Cybersecurity Capacity and Legal Readiness

Nepal must expand its cybersecurity personnel, enact the pending **Personal Data Protection Act,** and modernize the Cybercrime Act. Establishing a **dedicated cybersecurity center** and fast-tracking fraud case resolution will be vital for digital trust (Oxford Insights, 2023; Kathmandu Post, 2024a).

4. Enable Data Sharing through Open Banking Ecosystems

AI systems need quality datasets. NRB should launch **open API standards** allowing licensed Bank and financial institutions, Payment System Operators, Payment Service Providers fintech innovation while ensuring data security. Regulatory sandboxes a provision in this year's monetary policy can support the safe testing of AI tools like chatbots, fraud scoring models, and digital advisors (Republica, 2024).

5. Promote Digital Literacy and Consumer-Centered Protections

AI's effectiveness depends on informed users. Nepal should initiate nationwide campaigns on safe digital practices and integrate **AI-powered chatbots** for fraud guidance in local languages. Fast and fair redressal systems must be strengthened to build long-term public confidence (Kathmandu Post, 2025).

6. Apply AI in AML/CFT Compliance and Transaction Monitoring

AI should be leveraged for **real-time AML screening,** STR generation, and **network analysis** to detect suspicious transaction patterns. Shared AI utilities can assist smaller institutions while aligning Nepal with global financial integrity norms (Cambridge Intelligence, 2020).

7. Expand Cross-Border and Regional AI Collaborations

Nepal can **leapfrog innovation cycles** by aligning with India's UPI ecosystem, ASEAN forums, and global fintech alliances. These partnerships offer access to proven AI governance tools, regtech frameworks, and fraud prevention architectures (NPCI, 2024; AFI, 2023).

In implementing these way forwards, a phased approach is prudent . In the immediate term (next 1–2 years), focus on quick wins like improving consumer awareness, enacting the data protection law, and starting a pilot centralized fraud AI system. In the medium term (3–5 years), roll out the digital ID widely, require all major providers to integrate basic AI monitoring, and build institutional capacity. In the longer term (5+ years), one can envision Nepal's digital payment system being highly integrated, with AI running quietly in the background such that users rarely have to worry about fraud, and the government confidently uses digital channels for most payments (e.g., social security, taxes) knowing the system is secure and inclusive.

Conclusion:

Nepal is at a crossroads in its digital finance evolution. Mobile wallet uses, QR payments, and online banking are all growing quickly, but the landscape remains chaos, ad-hoc, and prone to security breaches. Artificial Intelligence (AI) integration into public sector payment systems provides an attractive solution to improve efficiency, security, and inclusivity.

Best international practices like India's AI-driven UPI fraud detection system and Estonia's national e-ID system demonstrate that resource-poor economies also can use AI for the public good (Economic Times, 2025, Thomson Reuters, 2022). Nepal has shown a high level of user adoption but has weak digital ecosystem readiness due to low cybersecurity and governance capacity, lack of data infrastructure, and few skilled AI practitioners (IFC, 2024; Oxford Insights, 2023).

Nepal needs a single national strategy to tackle new threats like cyber-fraud and institutional under preparedness. This should work to enhance digital identity infrastructure, to embed

AI-driven analytics in payment systems, and to reform regulatory regimes. As suggested in the concept model, a future-proof system will implement AI-based fraud detection, real-time learning feedback loops, and strong digital IDs to make every transaction safe and intelligent.

AI cannot be considered an optional value addition but rather it should be considered as a foundation for digital payment resilience and scale. With radical reforms like legislating shared fraud intelligence, facilitating open banking innovation and growing consumer confidence, Nepal can avoid the danger of inheritance inefficiencies and create a smart, inclusive and future-proof financial system.

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