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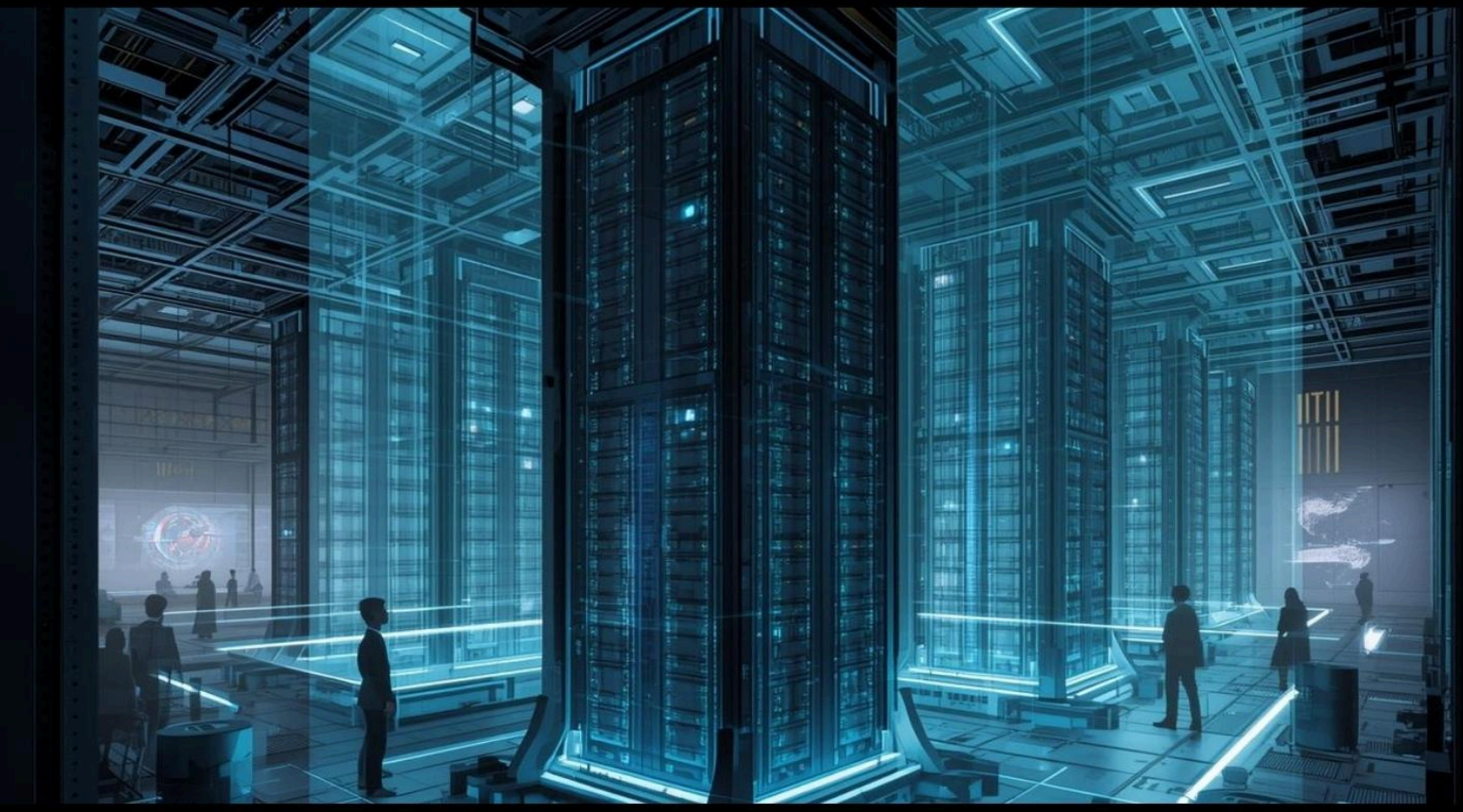

Architecting Pakistan's National AI Infrastructure for the Next Decade

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Automating the State

A Policy Blueprint for AI Driven Digital Public Infrastructure

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A Policy Blueprint of The Meridian Council's AI automation and Digitization Program.

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PREFACE

Pakistan is in a crucial phase of its governance evolution. The pressure of a fast changing global digital economy and the growing complexity of public service expectations, ongoing fiscal restraint and the compounding effects of climate change have been adding up to a case for modernising the machinery of government in NSW. Governments across the globe are calling on AI, digital identity systems, interoperable data platforms and cloud-based infrastructure to build state capacity; expand fiscal space; reduce corruption; improve service delivery; and renew trust with citizens. Despite having individual components that can serve as building blocks to a similar strategic planning for transformation, they are scattered and inefficiently utilized in Pakistan without converging into an organized programme of action. We address this gap by outlining a vision for a National AI Infrastructure (NAII) that can support public sector scale automation, transparency and institutional integration.

The concept of NAII is not just technological, it's institutional. Pakistan management will not be able to overcome the silo of information across agencies, manual systems behind building access and processes as duplicate work items could only be addressed through the support automation and scale that can bring in efficiency. What we need is a single, secure and interoperable framework that will connect national IDs, tax databases, land registries, welfare systems, procurement portals and similar administrative databases into one coherent system of governance. The ecosystem is powered and made real by AI as both the analytics engine as well as the automation layer. Predictive analytics, anomaly detection, geospatial intelligence, automated verification, and integrated digital workflows are the tools AI uses to move from reactive governance to a more predictive and evidence-based approach.

This policy brief references global case studies such as the Estonian X-Road, Rwanda's service delivery acceleration and India's Aadhaar driven digital public infrastructure and international research on responsible AI to chart a way forward that is adapted to Pakistan's institutional, social-economic and political conditions. The proposed framework is informed by these global experiences, but takes its basis in Pakistan's unique environment and assets, including NADRA's strong identity system, a fast-growing digital financial ecosystem and the budding push for public service reform. It also recognizes the importance of robust ethical frameworks, data governance regulations, cybersecurity measures and human capacity development to prevent warping AI-fueled governance to instead disenfranchise citizens rather than fulfill them.

Ultimately, this report aims to equip policymakers, development partners, civil society groups, and researchers with a clear and actionable roadmap for deploying AI as a tool of national transformation. The recommendations presented here are designed not only to enhance efficiency and reduce corruption, but also to lay the institutional foundations for long-term governance resilience, equitable service delivery, and sustainable economic growth. Pakistan's digital future will depend on its ability to integrate technology with institutional reform. The National AI

Infrastructure provides an opportunity to do exactly that by reimagining how the state functions, how citizens interact with public services, and how national development goals can be achieved in the decades ahead.

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Chapter 1. The Case for an AI-Enabled State

The Imperative for a National AI Infrastructure in Pakistan's Public Sector

The global move to artificial intelligence (AI) has revolutionized how the government functions, decides, serves the public and regulates economies. From Singapore and Estonia to the United States, China, and the United Arab Emirates, countries around the world are becoming transformed into AI-enabled governance ecologies in which data flows, algorithmic decision-making tools, predictive analytics systems, and digitized work processes reshape the architecture of power. This revolution is not just technological: it is institutional, political, economic and an integral part of national competitiveness. Pakistan, however, is at a turning point. Though India has digitized various components of identity management, taxation, land records and social protection, its national AI infrastructure is in need of a coherent system that would bind these elements into a single secure interoperable intelligence platform.

Pakistan's public sector stands in significant disarray across data, institutional mandates, digital capacities and governance structures. NADRA maintains one of the most advanced identity systems in the developing world, but its data is still walled off from tax authorities, welfare services, land registries and public procurement systems. The Federal Board of Revenue (FBR) still has a problem with tax evasion, undocumented economy and inefficient data filing despite rushing in three times to digitise the system. Land records systems –partially digitalized through Punjab's Land Record Management Information System (LRMIS) and similar efforts in the provinces– are characterized by uneven coverage, opportunities for corruption, and also lack interoperability with banking, urban planning and revenue authorities. Public procurement - which accounts for a significant portion of government spending is still subject to inefficiencies, over-charging, cartelisation and opacity. Social safety nets such as BISP and Ehsaas have moved toward data-driven targeting, but remain limited by outdated poverty monitoring systems, fraud tracking and cross-agency data sharing.

In this context, the need for a National AI Infrastructure (NAII) , a structured, interoperable, sovereign, and secure digital foundation enabling AI-driven public sector automation—is urgent and strategic. Such an infrastructure would allow Pakistan to reduce corruption, enhance state capacity, increase transparency, optimize welfare disbursement, modernize tax collection, improve land governance, streamline procurement, and strengthen national cybersecurity. Without an integrated architecture, Pakistan risks falling behind not only in governance innovation but also in global competitiveness, investor confidence, and institutional credibility.

At a global level, it is the public sector AI infrastructures that have led to transformative changes. For example, Estonia's digital government backbone "X-Road" has been a success in interlinking more than 99 percent of state services and facilitating data sharing among them without compromising on privacy (Drechsler, 2021). Singapore's "National AI Strategy" uses the technology to detect fraud, predict patient identification and improve digital identity verification which is working toward becoming one of the world's most efficient governance ecosystems (Smart Nation Singapore, 2019). China's state-centric theory of digital governance includes identity, social credit scoring, land management, taxation, and public procurement as part of a holistic digital system underwritten with AI and big data technologies (Creemers, 2018). These models are instructive—some inspiring and some cautionary—for Pakistan, which aim at building an AI driven government model based on its legal, cultural, institutional and federal convictions.

The digital governance challenges in Pakistan are not just technological, however. They arise from structural problems such as bureaucratic silos, absence of interoperability standards, and weak data governance, obsolete procurement rules, fragile cybersecurity architecture, and political hostility to administrative transparency. It is in this light that a NAI must be framed not as a technological platform but as a state building project. It has to generate common rules, common data standards and shared accountability across ministries, provinces and regulators. It needs to lay the legal framework for sharing data, protecting privacy and algorithm transparency, human oversight, auditability and national security.

Furthermore, Pakistan's economic governance cannot advance without AI enabled solutions. Tax digitization, for instance, requires machine learning models capable of detecting anomalies in tax declarations, identifying discrepancies between lifestyle and declared income, and predicting tax evasion behavior based on transactional and behavioral data patterns. FBR's current systems are insufficient for these needs. AI-enabled supply chain tracking, digital invoicing, fraud detection algorithms, and transaction analytics are essential for broadening the tax base and formalizing the economy—a priority identified repeatedly by the IMF, World Bank, and domestic policymakers (World Bank, 2020).

Similarly, land governance is in crisis. Pakistan's inability to maintain transparent, tamper-proof, digitized land records fuels corruption, litigation, inheritance disputes, land grabbing, and urban chaos. AI-driven geospatial mapping, blockchain-based land registries, automated anomaly detection, and predictive urban planning models can radically transform land administration. Land digitization is one of the most transformative yet underleveraged opportunities for Pakistan's governance reform agenda.

NADRA, Pakistan's identity backbone, holds the potential to serve as the foundational layer for public sector AI integration. But NADRA's data is currently underutilized due to legal constraints, institutional resistance, privacy concerns, and limited inter agency coordination. A

National AI Infrastructure must outline how NADRA's identity graph can be responsibly connected to taxation, welfare targeting, procurement platforms, anti-corruption tools, and cybersecurity systems, while ensuring constitutional safeguards and stringent access controls.

The modernization of the social protection is another essential aspect. It has made some progress but what is missing in Pakistan are AI driven dynamic profiles for poverty, real-time shock detection (floods, inflation, unemployment), household vulnerability prediction models, fraud detection and beneficiary risk scoring framework. AI-integrated social protection systems would help the country shift from a reactive to a proactive system of welfare governance.

Public procurement, which accounts for ~ 18–20 of Pakistan's GDP is still susceptible to inefficiency-driven inflated costs, collusion, and non-transparent bidding (OECD 2019). AI-supported procurement automation: Anomaly detection, Suppliers' risk scoring, Market benchmarking models, Automated compliance checks and Predictive cost analytics are all elements of AI infrastructure that could be leveraged to automate procurement. With so much money at stake, even relatively small efficiency improvements could add up to billions of dollars in savings.

Critical to all these reforms is data governance. There is as yet no comprehensive data protection law and overall a lack of unified metadata standards, rules for sharing of data and/or clear guidelines on the classification, retention and use of data. There must therefore be a Data Governance Act, sovereign cloud requirements, cybersecurity rules and equipment to check algorithms, but also more legal frameworks for citizens whose lives are altered by the increasing reliance on AI. Without solid data governance infrastructure, then AI risks damaging citizens, widening inequality, infringing rights and eroding trust in public institutions.

A strategic challenge for Pakistan is its limited institutional capacity to develop, test, deploy, monitor, and regulate AI systems. Many government agencies lack AI expertise, data engineering talent, cybersecurity specialists, AI auditors, and algorithmic risk analysts. A National AI Infrastructure must therefore include training academies, national AI labs, university partnerships, and public private collaboration platforms. Institutional capacity-building is not an afterthought, it is a core requirement of the reform roadmap.

Another challenge is infrastructure inequality. These high performance AI systems cannot become Pakistan's until it has invested in data centers, compute capacity, secure cloud environments and robust connectivity. A National AI Infrastructure roadmap should outline infrastructure gaps and suggest ways to financially sustain the required infrastructure be it through public investments, public-private partnerships or donor-supported digital transformation programs.

Last but not least, Pakistan's geopolitically and national security landscape necessitates that the National AI Infrastructure be designed with cybersecurity, sovereignty and strategic autonomy

baked in. Hosting data on servers abroad and outsourcing to cloud service providers, foreign AI, managing offshore storage facilities or relying upon third-party vendors might open up Pakistan to industrial espionage, blackmail and systemic risks. The architecture will therefore have to prescribe sovereign controls, secure computing, zero trust frameworks, red teaming protocols and national cyber command integration for AI governance.

The purpose of this policy brief is to sketch a comprehensive outline of how the digital transformation of the public sector in Pakistan can be carried out within the blueprint of an National Artificial Intelligence Infrastructure that brings identity systems, taxation, land governance, social protection and public procurement system under one umbrella. The document sketches a new institutional architecture and sets out the regulatory norms, risk mitigation devices, necessary investment strategy as well as architectural defining stone for changing Pakistan's governance.

Divided into several chapters, this report will:

- Analyze Pakistan's current state of digitization.
- Identify gaps in governance, data systems, and institutional capacity.
- Present global lessons and comparative frameworks.
- Propose the structural design of a National AI Infrastructure.
- Provide sector-specific AI modernization roadmaps for taxation, land records, NADRA, social protection, and procurement.
- Recommend legislative, institutional, regulatory, and cybersecurity reforms.
- Outline a phased implementation plan.
- Estimate economic, social, transparency, and efficiency gains.

This first chapter has introduced the rationale for a National AI Infrastructure and framed the governance, institutional, economic, and technological context necessary for deep structural reform. The next chapters will detail the strategic components of the architecture and sectoral roadmaps.

Chapter 2. Pakistan's Digital Governance Baseline

Global Models of AI-Driven Public Sector Automation: Lessons for Pakistan's National AI Infrastructure

The building of a National AI Infrastructure (NAII) for Pakistan cannot be an isolated effort. In various countries, governments have trialed and in numerous cases rolled out AI-enabled public sector systems that merge national identity frameworks with tax databases, land registries, social welfare and procurement workflows into coherent digital architectures. These are global models that Pakistan should learn from in making its public institutions modern, prevent corruption, end inefficiency and raise state capacity. The specific hopes and fears from Estonia, Singapore, India, the UAE (United Arab Emirates), China, UK (United Kingdom) and Rwanda are debated in this chapter. By learning from these models, Pakistan may learn how to design its own AI for governance ecosystem, which risks to avoid, what investments are needed and what kind of institutions can best facilitate automation at scale.

2.1 Estonia: The World's Most Digitally Integrated State

Estonia is considered by many to be the Country of the digital nations. Its 20-year-old "X-Road" system underpins blind data interoperability at a national level. X-Road provides secure, standardised and encrypted data exchange between more than 900 organisations and 3000 services; citizens may nowadays use almost all of them online (Drechsler, 2021). Estonia's model power is not digitization alone but the fact that it is also automated, interoperable across agencies and the data consistency.

For Pakistan, what Estonia shows is that the need of secure data-exchange layer in National AI Infrastructure. Without an inter-operable backbone, Pakistan's institutions like NADRA, FBR, land authorities, welfare agencies and provincial governments procurement regulators cannot share data to facilitate AI solutions that need integrated datasets. Data ownership, transparency and auditability are also trussed up in Estonia. Citizens can track their own access and see who accessed them for what purpose, which serves to build trust with digital governance systems that Pakistan sorely needs as NADRA, taxation, and surveillance become politically sensitive.

2.2 Singapore: AI for High-Trust, High-Efficiency Governance

Singapore's digitalisation model is based on robust institutional capability, structured public administration and citizen-centric service design. The country's AI-based program is linked to transportation, healthcare, urban planning and public administration connecting everything from its national digital identity system to centralized data governance architecture(Smart Nation Singapore, 2019). AI algorithms are being used by Singapore to look for fraud in procurement, to automate customs scanning, and to optimize the delivery of social services or regulate financial transactions.

The Singapore model is especially relevant for Pakistan because it shows how AI can be used to enhance efficiency and bolster the legitimacy of the state. There is also Singapore's GovTech agency, which serves as a central tech arm for all sorts of ministries. Pakistan lacks an equivalent institution. Instead, numerous ministries and provincial bodies pursue their own digital reforms with little coordination or shared standards. In order for the National AI Infrastructure to become feasible in the context of Pakistan, what would be needed is an institution along the lines of GovTech that was centralised, professionalised and insulated from political disruptions.

2.3 India: Aadhaar, GSTN, and Digital Public Infrastructure

Three pillars underlie India's digital transformation: the Aadhaar for identity, the Goods and Services Tax Network (GSTN), and the Unified Payments Interface (UPI). These components constitute, together, what India refers to as Digital Public Infrastructure" (DPI) (Mehta & Roy, 2023). Aadhaar gives 1.2 billion residents biometric digital identity. GSTN consolidates tax returns across different states in India's federal structure, which allows AI-enabled compliance analytics, e-invoice reconciliation, anomaly discovery and fraud detection. Meanwhile, UPI is a game changer in payments, which has led to the creation of a standardised and unified network for digital payments.

India's experience holds crucial lessons for Pakistan. First, a digitized national identity system could be the building block of AI enabled governance if implemented ethically and integrated effectively. NADRA is capable enough to serve the purpose ofAadhaar- like one window where an individual can be verified, only political fragmentation has never allowed them to come together at a common stage. Second, GSTN shows tax modernization needs centralized data architecture and machine learning algorithms to enforce compliance. In Pakistan, the FBR is lagging far behind; utilizing AI based verification, behavioral analytics, and anomaly detection techniques could help broaden Pakistan's tax collection dramatically.

India also shows the risks. Aadhaar has been criticised over issues of privacy, potential misuse and exclusion errors. Pakistan should resist the temptation to make India's mistakes, and must incorporate privacy safeguards, audit controls as well as meaningful human oversight into its NAII. A private digital infrastructure for AI involves a tradeoff between state capability and constitutional principles.

2.4 China: State-Led AI Governance and Integrated Data Systems

China offers a radically different but strategically important model for Pakistan. China's approach integrates AI into taxation, policing, land management, social credit scoring, and welfare distribution through centralized data systems and state-led AI innovation. China's "Golden Tax Project" uses machine learning to detect tax fraud, verify invoices, and automatically identify risky entities (Creemers, 2018). Its land administration systems utilize satellite imagery and AI based monitoring to detect illegal construction, land misuse, and zoning violations.

While Pakistan cannot replicate China's governance model due to political, constitutional, and civil liberties considerations, it can draw lessons from China's focus on interoperable data, state capacity, and national tech sovereignty. China's experience also highlights the importance of national cloud infrastructure and secure data localization policies—areas where Pakistan remains underdeveloped.

2.5 United Arab Emirates: Institutional Leadership and Tech Sovereignty

One of the only countries that has a dedicated Minister of Artificial Intelligence is the UAE. Its AI approach combines objectives of economic diversification, national security, and digital service delivery reform. Innovations include AI-led applications, citizen services, land management, taxation, fraud detection and judicial analytics across the UAE. Its "Smart Dubai" program is a leading example of government and data integration to drive predictive analytics and automation at scale across public entities (UAE Prime Minister's Office, 2019).

For Pakistan, the UAE approach can point to the advantages of firm institutional leadership, centralized coordination and sustained investment in digital infrastructure. As Pakistan plans its own sovereign digital infrastructure, it can seek guidance from the UAE's state-owned cloud framework and data localization regulations. Crucially, the political commitment is the foundation of success in UAE digitization which Pakistan needs to build if it wants substantive change.

2.6 Rwanda: AI for Service Delivery in a Low-Income Context

Rwanda's Success in Digital Governance shows that resource constraints are not an obstacle to AI-enabled transformation. Rwanda, being a low income country has managed to digitize land records, harmonize tax systems and develop national ID linked service delivery platforms. Agricultural planning, health monitoring and social protection targeting all rely on machine learning models (Ndung'u & Signé, 2020).

Rwanda's experience is inspiring for Pakistan because it demonstrates that:

- political will can overcome capacity limitations;
- a centralized digital governance authority accelerates reform;
- phased implementation is possible even with limited financial resources;
- responsible AI adoption requires legal safeguards and community consultation.

Pakistan shares Rwanda's challenges around corruption, manual land disputes, narrow tax bases, and administrative fragmentation. Adopting Rwanda's incremental, high-impact approach could enable Pakistan to progress without requiring massive upfront investment.

2.7 United Kingdom: AI for Public Accountability and Ethical Governance

The UK has also championed a risk-based approach to AI governance based on transparency, accountability and protection of human rights as well as strong regulatory capability. Its AI Assurance Roadmap proposes processes for algorithmic audits, model documentation and ethical accountability, as well as public communication (CDEI, 2021).

Pakistan can benefit from the UK's emphasis on safeguards. As AI adoption expands across Pakistan's public sector—especially in sensitive domains like NADRA, policing, welfare, and taxation—ensuring algorithmic fairness and transparency is essential to prevent discrimination, wrongful ineligibility, or political misuse. The UK model reinforces how a balanced regulatory framework can build citizen trust in digital transformation.

2.8 Cross-Cutting Lessons for Pakistan

A synthesis of these global examples yields several key lessons for Pakistan:

1. Interoperability is the foundation of AI-driven governance.

Countries that successfully deployed AI in public institutions first established data-sharing protocols, standard APIs, national cloud systems, and digital identity platforms. Pakistan's NAII must therefore begin by integrating NADRA, FBR, land records, social protection databases, and procurement systems.

2. Institutional leadership drives success.

Estonia has X-Road governance authorities; Singapore has GovTech; UAE has a Minister of AI. Pakistan needs a central AI authority with legal power, technical capacity, and national oversight.

3. Sovereign digital infrastructure is essential.

Cloud sovereignty, national data centers, and secure computing are foundational to prevent foreign access, espionage, and dependency.

4. AI must be grounded in legal and ethical frameworks.

Countries with successful AI adoption paired technological progress with updated laws, privacy protections, auditability, and clear definitions of high-risk AI systems.

5. Public trust matters.

Transparent data usage, citizen recourse rights, algorithmic audit systems, and community consultation enhance legitimacy.

6. Gradual and targeted implementation is practical.

Pakistan should prioritize high-impact sectors first: taxation, land governance, identity systems, welfare targeting, and procurement.

7. Capacity-building is indispensable.

Every global model emphasizes training civil servants, developers, auditors, and policymakers.

2.9 Implications for Pakistan's National AI Infrastructure Design

Drawing from global precedents, Pakistan's NAII should:

- adopt Estonia-style data interoperability;
- integrate Singapore-style institutional coherence;
- incorporate India-style digital infrastructure strategies;
- ensure UAE-style political prioritization;
- avoid China-style overreach by embedding rights protections;
- implement UK-style risk auditing and transparency;
- follow Rwanda's phased, resource-efficient implementation model.

By adapting these global lessons to Pakistan's federal structure, political landscape, legal framework, and technological constraints, a National AI Infrastructure can be designed that advances automation without compromising democratic values, privacy, or national security.

Chapter 3. Global Lessons on AI and State Capacity

Pakistan's Current Public Sector Digital Landscape: Gaps, Constraints, and Opportunities for AI Integration

To understand how prepared Pakistan is for a National AI Infrastructure (NAII), we need to make an honest appraisal of the state of digital transformation in the public sector. Substantial progress have been made by Pakistan particularly in identity management (NADRA), social protection digitalization (Ehsaas/BISP) and partial land record reforms, but the pace of digital change across most of government remains piecemeal, disjointed, and institutionally hobbled. This chapter assesses the current digital capabilities, structural roadblocks and window of opportunity in five major areas: taxation, land records, NADRA's identity systems, social protection including safety nets and political patronage as well as public procurement. These constitute the basic structure of state capacity, and when married effectively, they serve as a springboard for a country's AI-enabled governance ecosystem.

Pakistan's digitization of the public sector is shaped by a range of cross cutting factors: political fragmentation, poor inter-agency coordination, lack of adequate legislative frameworks for data protection and AI governance, antiquated IT infrastructure, low local technical capacity and bureaucratic resistance to transparency-enhancing tools. All these elements form bottlenecks which need to be covered to realize an effective, secure and interoperable national AI infrastructure in Pakistan. Still, it is not all dark on this map. Pakistan also has assets that many other developing countries don't, including NADRA's robust digital identity architecture, a rapidly growing digital payments landscape and a population that is becoming more digitally savvy. These resources, if applied with insight, can become springboards of further AI-enabled transformation.

3.1 The Current State of Tax Digitization: FBR's Fragmented Systems

Pakistan's Federal Board of Revenue (FBR) has struggled for decades to expand the tax base, reduce leakages, and enforce compliance. Despite multiple reform attempts including IRIS, automated return systems, and withholding tax mechanisms, FBR's digital infrastructure remains fragmented and limited in analytical capability. The majority of taxpayers still file manually or through outdated interfaces, while compliance checks rely heavily on human interpretation and rarely incorporate predictive analytics or behavioral risk profiling.

A huge obstacle is the lack of interconnected datasets. For instance, FBR cannot readily access NADRA's demographic and biometric data, State Bank of Pakistan (SBP) transaction histories, real estate transactions-inflows, utility usage-patterns or travel movements. The datasets are each siloed and have limited overlap, so it's very difficult to develop accurate taxpayer risk scoring models with AI. Moreover, no requirement for retailers, wholesalers or manufacturers to utilise digital invoicing also creates huge sales tax leakage. Internationally, AI models have revolutionised tax enforcement by scanning spending patterns, lifestyle markers, digital disbursements, invoices and data from a country's supply chain; this is something that Pakistan is yet to walk down the path of(World Bank 2021).

Corruption within tax administration remains a central barrier. Without digital traceability and AI-enabled anomaly detection, frontline tax officers have wide discretionary power, resulting in inconsistent enforcement, rent-seeking, and selective scrutiny. An effective NAII must therefore embed AI into FBR's core functions: detection of suspicious patterns, cross-matching of lifestyle data with declared income, invoice verification, audit selection, and compliance risk prediction. Digitization must also target procedural workflows, replacing manual decision points with automated, rule-based processes.

3.2 Land Records: Fragmentation, Corruption, and Data Integrity Challenges

Land administration is one of the most problematic areas in Pakistani bureaucracy. Though some provinces, especially Punjab and Khyber Pakhtunkhwa have digitized segments of land records through the Land Record Management Information System (LRMIS), as yet, the reforms are far from uniform and complete. Digital records and manual ledgers are kept side by side, making room for manipulation and conflicts. Mutating (changing ownership) of land is a manual, police-maharaj type system in many areas.

The most prominent gap is the absence of geospatial integration. Even though satellite-based maps, AI algorithms for land use monitoring, and blockchain developed registries have been the modern trends all over the world in terms of how a piece of land or its usage is digitally recorded for administrative purposes; Pakistan on the other hand is still stuck with paper maps along with centuries old patwari knowledge and drawn boundaries by "Zare-Zameen" which are highly subject to manipulation (SDPI, 2020). AI enabled land monitoring systems would also be able to spot unauthorised occupation, trespassing, unauthorised construction and fake mutations using automated anomaly detection and image processing analysis.

A National AI Infrastructure would enable nationwide standardization of land data, linking registries with banks, courts, municipalities, tax authorities, housing regulators, and provincial revenue departments. Such integration would drastically reduce corruption, litigation delays, inheritance disputes, and fraudulent transfers. The Central Land Digitalization Authority

proposed later in this brief would serve as a backbone for implementing AI enhanced verification, valuation, and predictive analytics for urban planning.

3.3 NADRA: Pakistan's Greatest Digital Asset, Underutilized

NADRA (National Database and Registration Authority) is widely acknowledged as one of the most advanced identity governance systems in the developing world. It maintains biometric and demographic records for more than 90% of the population, supports secure identity verification for financial institutions, facilitates refugee registration, and underpins voting rolls and border control systems (NADRA, 2022). Its facial recognition and biometric capabilities, data architecture, and secure encryption protocols position NADRA as a robust foundation for Pakistan's NAII.

However, for all its technical capability NADRA's incorporation within broader governance systems is lacking. NADRA's efforts to adequately share data with FBR, BISP, provincial governments, police, planning authorities and procurement regulators have been stymied by legal, political and bureaucratic hurdles. These silos are major obstacles to realising the potential of AI-driven public sector automation.") For instance, the demographic data that NADRA has would enable enormous enhancements in tax compliance by identifying unregistered firms, validating income declarations and cross-referencing household consumption patterns – it's just that FBR doesn't have direct, formal access. Likewise, property records might be connected to NADRA profiles to curb bogus sales. Social safety nets can use NADRA verification and household diagrams to identify duplicate beneficiaries or misplaced households.

There are also a number of privacy concerns that need to be taken into account. NADRA has drawn criticism over data hacking and unauthorized access. Any NAII must have robust privacy-by-design specifications, access controls, encryption requirements and algorithmic audit functionality to ensure that the data held by NADRA (and requested under this program) is used responsibly and ethically.

3.4 Social Protection Systems: Progress and Limitations

Pakistan's flagship social protection programs BISP and the Ehsaas Program have made significant advances in developing digital registries, targeted cash transfers, and data-driven needs assessments. The National Socioeconomic Registry (NSER) is a valuable dataset, capturing household demographics, poverty indicators, and vulnerability profiles (ADB, 2021). However, the system is still largely static; updates occur infrequently, leading to misalignment between eligibility and evolving economic conditions.

AI-enabled dynamic poverty assessment could transform social protection. Machine learning models can predict economic shocks, identify households at risk of falling into poverty, detect fraudulent beneficiaries, and personalize welfare interventions. Countries like Brazil (Bolsa

Família) and Kenya (Hunger Safety Net Programme) have demonstrated the value of predictive analytics in social protection. Pakistan's current systems, however, lack the computational infrastructure, data integration, and institutional frameworks for deploying such models at scale.

Inter-agency coordination is also weak. BISP does not have structured integration with utility companies, land registries, FBR, or NADRA, which limits fraud detection and program accuracy. A National AI Infrastructure could create integrated welfare eligibility engines, automated payment verification, and AI-based risk scoring systems—allowing Pakistan to develop a more agile, shock-responsive welfare state.

3.5 Public Procurement: One of Pakistan's Largest Governance Risks

Public procurement accounts for nearly 18–20% of Pakistan's GDP, yet remains one of the most corruption-prone domains (OECD, 2019). Manual tender processes, lack of transparency, insufficient competition, and weak audit mechanisms allow collusion, price inflation, false invoicing, and non-performance to persist. Although the Pakistan Procurement Regulatory Authority (PPRA) maintains digital bidding portals, the underlying verification processes are not automated.

AI-driven procurement platforms can analyze supplier histories, detect fraudulent bidding patterns, identify cartel behavior, benchmark prices against global datasets, and score suppliers based on risk indicators. Such systems are deployed in countries like South Korea, Chile, and the UAE. Pakistan's NAII can integrate procurement with tax, land, and identity systems—making it more difficult for ghost firms, colluding cartels, or politically connected suppliers to operate without traceability.

However, implementing AI in procurement requires standardized digital records, secure vendor databases, contract lifecycle management systems, and strong audit institutions. Pakistan currently lacks these foundational components, although they can be built in phases through the NAII roadmap.

3.6 Cross-Cutting Challenges in Pakistan's Digital Governance

The following structural limitations impede Pakistan's ability to deploy AI-enabled automation:

1. Lack of Interoperability Across Government Systems

NADRA, FBR, land registries, social protection databases, and procurement systems operate independently. Without shared data standards or national APIs, AI deployment is practically impossible.

2. Inadequate Legal Frameworks for Data Governance and AI

Pakistan lacks comprehensive data protection legislation, AI regulatory structures, cybersecurity mandates, and algorithmic accountability mechanisms.

3. Shortage of Skilled Human Resources

Few government agencies possess sufficient AI specialists, data engineers, cybersecurity experts, or digital policy planners.

4. Weak Institutional Coordination Across Provinces

Pakistan's federal structure complicates data standardization, digital infrastructure investment, and regulatory harmonization.

5. Outdated IT Infrastructure

Many public institutions rely on decades-old servers, paper-based workflows, and manual verification systems.

6. Corruption Resistance

Digitization threatens vested interests within bureaucracy and politics; institutional resistance can sabotage reforms.

7. Cybersecurity Vulnerabilities

Government systems suffer frequent cyberattacks and data breaches, making AI deployment risky without robust cyber infrastructure.

3.7 Opportunities: Pakistan's Strategic Advantages

Despite these systemic challenges, Pakistan has several unique strengths:

1. NADRA as a Unified Identity Backbone

Pakistan's biometric database is a rare asset in the developing world—capable of supporting unified AI governance if integrated securely.

2. A Young, Digitally Adaptive Population

Over 60% of Pakistanis are under the age of 30, with rising digital literacy and mobile penetration.

3. Rapid Expansion of Digital Payments

The Raast instant payment system provides an opportunity to integrate financial data into AI-driven governance models.

4. International Donor Interest in Digital Governance

Entities such as the World Bank, ADB, DFID, and UNDP continue to invest in public sector digitization resources that Pakistan can align with NAII goals.

5. Potential for Leapfrogging

Pakistan does not need to replicate the legacy systems of developed countries; it can leapfrog directly to AI-based governance models.

Chapter 4:Designing a National AI Infrastructure (NAII) for Pakistan: Principles, Architecture, and Institutional Foundations

Developing a National AI Infrastructure (NAII) for Pakistan requires a clear conceptual foundation rooted in governance principles, institutional design, technical architecture, interoperability standards, national security considerations, and ethical safeguards. The NAII must serve not merely as a digital platform, but as a **state-wide governance ecosystem** that defines how data is collected, secured, shared, analyzed, and used to inform automated public sector processes. It must create coherence across federal and provincial institutions, embed AI into core governance workflows, ensure data sovereignty, and maintain public trust through transparency and accountability mechanisms. This chapter lays out the foundational design elements of NAII, providing a blueprint that integrates identity systems, taxation, land records, welfare databases, and procurement platforms into a unified AI-driven governance framework.

4.1 Foundational Principles of Pakistan's National AI Infrastructure

Every national AI architecture in the world is built upon a set of guiding principles that determine how technology aligns with public values, institutional responsibilities, and strategic objectives. For Pakistan, the following six foundational principles must shape the NAII:

1. Interoperability as the Core Governance Principle

Interoperability enables data exchange across institutions through standardized formats, secure APIs, and uniform metadata rules. Pakistan's institutional silos—between NADRA, FBR, provincial land departments, PPRA, BISP, SBP, and various ministries—make AI implementation nearly impossible without shared digital infrastructure. A unified NAII must mandate interoperability protocols across the entire government spectrum.

2. Privacy-by-Design and Security-by-Design

Citizens must trust that their data is secure, properly used, and protected against misuse. NAII must embed encryption, access controls, differential privacy mechanisms, and audit trails at every layer. Given the sensitivity of NADRA's biometric database, land ownership records, tax declarations, and welfare profiles, privacy-by-design is essential to prevent political misuse, discrimination, or surveillance overreach (CDEI, 2021).

3. Human Oversight and Accountability

AI must not replace human judgment in sensitive domains such as welfare eligibility denial, land claims adjudication, tax penalties, or procurement blacklisting. Human-in-the-loop mechanisms ensure that automated decisions remain explainable, contestable, and accountable.

4. Data Sovereignty and National Security

NAII must ensure that all critical government data—including identity, land registries, tax records, payments, and welfare databases—are stored on sovereign cloud infrastructure physically located in Pakistan and protected under national laws. No foreign entity should have access to operational systems or raw datasets without strict legal agreements.

5. Modular, Scalable, and Federated Architecture

Pakistan's federal structure requires an AI infrastructure that accommodates provincial autonomy while ensuring national-level standards. NAII must be modular, allowing provinces to build on shared frameworks without losing institutional independence.

6. Fairness, Equity, and Inclusion

AI systems must be designed to prevent discriminatory outcomes against marginalized groups, women, ethnic minorities, rural households, or undocumented communities. Transparent documentation, algorithmic audits, and bias detection are essential.

4.2 Structural Components of Pakistan's National AI Infrastructure

A robust NAII consists of five core layers: **data governance, digital identity, interoperability, computer infrastructure, and AI service layers**. These layers interact to create a seamless environment in which AI can enhance public sector efficiency.

Layer 1: National Data Governance Framework

Data governance serves as the foundation of NAII. Pakistan currently lacks standardized rules governing data classification, retention, access control, data sharing, cross-agency exchange, and AI usage. A comprehensive Data Governance Act must include:

- **Data classification standards** (public, confidential, restricted, secret).
- **Metadata standards** for formatting, versioning, logging, and labeling data.
- **National data-sharing protocols** enabling secure exchange across institutions.
- **Consent models** defining when citizens' data may be used.
- **Algorithmic audit requirements** for high-risk AI systems.
- **Data retention and deletion policies** ensure compliance with constitutional rights.

The law should establish a **National Data Protection Authority** tasked with oversight, compliance enforcement, redress mechanisms, and transparency guarantees.

Layer 2: Digital Identity Backbone

NADRA will serve as the central digital identity layer for NAII. To function as an AI-enabling identity backbone, NADRA must support:

- **Verified digital identities** linked to every citizen and resident.
- **API-based identity verification** for FBR, land authorities, welfare programs, and procurement systems.
- **Household graphs** representing family structures, economic relationships, and vulnerability patterns.
- **Federated identity credentials** enabling secure authentication across government portals.
- **Fraud detection mechanisms** using biometrics, face recognition, and behavioral verification.

Integration with tax and land records via NADRA identity keys is transformative: it enables automatic detection of unregistered businesses, verification of property holders, and prevention of fake welfare claims.

Layer 3: Interoperability and Secure Data Exchange Layer (SDL)

This is the heart of the NAII's architecture—equivalent to Estonia's X-Road. The Secure Data Exchange Layer (SDL) enables:

- **Encrypted communication** between government databases.
- **Standard API protocols** for seamless integration.
- **Real-time updates** across systems when records are changed.
- **Access control logs** recording every data request.

- **Digital signatures & audit trails** ensuring integrity.

Every participating institution—FBR, NADRA, land authorities, PPRA, banks, SBP, BISP—would join a federated network through standardized API endpoints.

Layer 4: Compute & Cloud Infrastructure

To support machine learning workloads, Pakistan needs reliable high-performance computing (HPC) infrastructure. NAII must therefore establish:

- **Sovereign government cloud** for hosting sensitive data.
- **Edge computing systems** for provinces and districts.
- **GPU clusters** for AI model training and inference.
- **Data lakes** storing structured and unstructured datasets for analytics.

Investment in national data centers is essential to reduce dependence on foreign cloud providers.

Layer 5: AI Service Layer

The AI Service Layer offers standardized AI tools to government agencies, such as:

- **Fraud detection engines**
- **Predictive analytics modules**
- **Risk scoring systems**
- **Anomaly detection models**
- **Geospatial analysis tools**
- **Natural language processing engines**
- **Digital assistants for citizen services**

These shared services reduce cost and eliminate duplication of AI development across institutions.

4.3 Institutional Governance Structure for NAII

The architecture cannot succeed without a strong governance model that assigns roles, responsibilities, and oversight across government bodies. Pakistan's NAII requires a **three tier governance structure**:

Tier 1: National AI Governance Council (NAGC)

The NAGC, chaired by the Prime Minister or President, should include:

- Ministry of IT and Telecom
- NADRA
- FBR
- Ministry of Finance
- PPRA
- Provincial governments
- State Bank of Pakistan
- Competition Commission
- Ministry of Planning
- Intelligence agencies

The NAGC would define strategic priorities, approve standards, review implementation progress, adjudicate disputes, and coordinate federal–provincial alignment.

Tier 2: National AI Infrastructure Authority (NAIA)

The NAIA should function as the operational arm of the NAII. Its responsibilities include:

- Building and maintaining NAII infrastructure.
- Developing national API standards.
- Designing shared AI tools.
- Managing national data lakes.
- Conducting red-teaming exercises.
- Ensuring compliance with data governance laws.
- Training public officials in AI usage.

NAIA should be a highly technical institution, modeled after Singapore's GovTech or India's NIC.

Tier 3: Sectoral AI Units in Each Department

Each participating institution—FBR, NADRA, land departments, PPRA, BISP—would create internal AI Units that:

- Integrate institutional processes with NAII tools.
- Lead sector-specific automation.
- Monitor AI performance, errors, and biases.
- Liaise with NAIA.

4.4 Ethical, Legal, and Regulatory Foundations

Pakistan's NAII requires a strong legal-regulatory framework that governs:

1. AI Risk Classification

Borrowing from the EU model, systems used in taxation, welfare eligibility, public procurement, and land governance must be classified as **high risk**.

2. Algorithmic Transparency and Documentation

Every AI model must have:

- system documentation
- data lineage logs
- bias detection reports
- modification records
- audit trails

3. Human Intervention Rights

Citizens must have the right to demand human review of automated decisions that affect welfare, property rights, or taxation.

4. Accountability and Redress Mechanisms

If AI systems cause harm or wrongful denial of services, the affected party must have clear legal recourse.

4.5 Cybersecurity and National Security Integration

A National AI Infrastructure increases the attack surface for cyber threats. Therefore, the NAII must be integrated with a national cybersecurity framework, including:

- **Zero-trust security architecture**
- **Encryption at rest and in transit**
- **Mandatory vulnerability testing**
- **Continuous monitoring with AI-driven threat detection**
- **Red-teaming and penetration testing**
- **Disaster recovery systems**

Cybersecurity must be a core pillar of NAII, not an afterthought.

4.6 Phased Implementation Strategy

A successful NAII rollout requires a structured, phased approach:

Phase 1: Infrastructure & Standards

- Build sovereign cloud
- Establish API and data standards
- Create NAIA

Phase 2: Sector Integration

- Connect NADRA
- FBR modernization
- Land registry integration
- Welfare system automation

Phase 3: AI Deployment

- Predictive analytics
- Fraud detection
- Risk scoring
- Automated verification tools

Phase 4: Optimization & Expansion

- National predictive governance systems
- Real-time dashboards
- AI-enabled citizen services
- Advanced analytics ecosystems

Chapter 5: AI Enabled Taxation Reform: Building an Intelligent, Transparent, and Integrated Revenue System for Pakistan

A modern taxation system is the backbone of any functioning state. Without efficient revenue mobilization, governments cannot finance public services, invest in development, or maintain economic stability. Pakistan's chronically low tax-to-GDP ratio—hovering around 10%—is among the lowest in the world for a country of its size. This structural weakness constrains fiscal capacity, increases dependence on external borrowing, and limits the government's ability to respond to economic shocks. AI-enabled automation has the potential to radically transform Pakistan's taxation architecture by enhancing compliance, reducing corruption, improving accuracy, and integrating disparate datasets into a unified revenue intelligence system. This chapter presents a comprehensive roadmap for embedding AI within Pakistan's Federal Board of Revenue (FBR) and provincial revenue authorities, aligned with the National AI Infrastructure (NAII).

5.1 The Case for AI-Driven Tax Reform in Pakistan

Pakistan's taxation challenges are both deep and multi-faceted: rampant evasion, lax enforcement, lack of integration on databases, the dominance of informal economy, manual validation checks and institutional distrust among others. Previous efforts to overhaul the system increasing withholding taxes, digitizing returns and altering tax slabs have produced mixed outcomes. The AI model we propose requires a real change of paradigm; this is, the automation of relevance in AI-driven Tax Auditing systems, helping the State to understand taxpayer behavior, detect anomalies, predict risks and validate data using cross-matching.

AI can drastically increase the efficiency of tax authorities through:

- **Predictive models** that identify high-risk taxpayers before audits.
- **Machine learning algorithms** that detect patterns of underreporting.
- **Automated cross-referencing** of lifestyle indicators (travel, utilities, vehicle ownership) with declared income.
- **Reconciliation engines** linking invoices, bank transactions, and supply chain flows.
- **Natural language processing (NLP)** tools for processing unstructured financial documents.
- **Anomaly detection systems** to flag suspicious refund claims or exaggerated expense declarations.

Countries like Brazil, South Korea and India have found significant improvement in tax reforms implementation, reduction in fraud and enhanced transaction screening capability with use of AI (OECD, 2021). Pakistan has a great deal to gain from such reforms.

5.2 Current Weaknesses in Pakistan's Tax Data Infrastructure

AI can only function effectively when supported by coherent datasets. Pakistan faces several structural challenges:

1. Fragmented and Non-Interoperable Databases

FBR's datasets are not connected to:

- NADRA's demographic and household data
- Provincial land registries
- Utility companies
- Vehicle registration databases (Excise & Taxation Departments)
- Banking transaction logs
- Travel and immigration history (FIA)
- Corporate registries (SECP)

This fragmentation makes it nearly impossible for FBR to run integrated AI models.

2. Limited Adoption of Electronic Invoicing (E-Invoicing)

A digital invoice trail is essential for VAT/sales tax compliance. Pakistan's retail and wholesale sectors rely heavily on manual receipts and cash transactions. Without standardized e-invoicing, AI cannot track supply chain leakage or detect fake invoices.

3. Insufficient Data Quality and Completeness

Many taxpayer records lack:

- Updated contact details
- Correct CNIC linkage
- Verified business activity codes
- Structured financial declarations

Unclean or incomplete data reduces machine learning model accuracy.

4. Weak Audit and Verification Systems

Audit selection is highly discretionary and susceptible to corruption. AI-based automated audit selection is essential to reduce human bias.

5. Lack of Skilled Personnel

FBR has very few trained data scientists, AI engineers, or analysts who are able to handle large datasets, build risk models, or interpret outputs.

These structural barriers must be addressed through NAII integration.

5.3 AI Use Cases for Transforming Pakistan's Tax System

AI enables an entire ecosystem of tax modernization interventions.

5.3.1 Taxpayer Risk Scoring and Behavioral Analytics

AI models can generate **risk scores** for each taxpayer based on:

- Income-expenditure mismatch
- Frequent discrepancies in returns
- Unusual refund claims
- Supply chain anomalies
- Cash-heavy business patterns
- Irregular banking activity
- Lifestyle indicators inconsistent with declared income
- Geographic clustering of suspicious profiles

This system, used in countries like the UK and Denmark, allows tax authorities to prioritize high-risk cases (HMRC, 2020).

5.3.2 Automated Cross-Matching with NADRA, Land Records, and Utilities

Once NAII integrates NADRA with tax systems, AI can automatically verify:

- Whether asset ownership aligns with reported income.
- Whether household consumption (electricity, gas, telecom usage) matches declared financial capacity.
- Whether landholdings correspond to agricultural tax declarations.

AI-enabled cross-matching reduces deliberate underreporting.

5.3.3 E-Invoicing and AI-Driven Sales Tax Verification

Countries that introduced AI-based e-invoicing on real-time basis (Brazil, South Korea and Turkey) saw a significant improvement in VAT compliance(World Bank, 2020).

Pakistan can implement:

- QR-coded invoices
- Real-time invoice uploading to FBR
- AI models comparing input/output tax claims
- Automated identification of “missing trader” fraud
- Supply chain gap detection

Machine learning automates the detection of "fake invoice factories"—a common issue in Pakistan.

5.3.4 Detection of Benami (Undisclosed) Assets through Machine Learning

Pakistan’s benami assets, properties, bank accounts, business interests held under proxy names represent billions in lost revenue. AI can identify patterns consistent with benami ownership:

- Sudden asset transfers among related individuals
- Properties owned by individuals with negligible declared income
- Social network mapping showing proxy relationships
- Suspicious inheritance patterns
- Financial behavior inconsistent with official profiles

NADRA and land registries are essential for this analysis.

5.3.5 AI for Customs, Import/Export Monitoring, and Trade Mispricing

Customs fraud—undervaluation, over-invoicing, misclassification—results in massive revenue losses. AI can:

- Compare declared values with global price indexes

- Detect unusual price fluctuations
- Track importer/exporter risk profiles
- Identify suspicious shipping routes
- Predict misclassification patterns

This enhances Pakistan's ability to counter money laundering and trade-based fraud.

5.3.6 NLP for Tax Document Automation

Taxpayer submissions contracts, receipts, balance sheets, audit reports contain unstructured data. NLP tools can:

- Extract relevant fields automatically
- Verify compliance
- Flag irregularities
- Identify missing documentation

This eliminates manual labor and reduces human error.

5.4 Institutional Restructuring for AI-Based Tax Reform

FBR must undergo structural reforms to adopt AI effectively:

5.4.1 Creating the "FBR Digital Intelligence Directorate (FDID)"

This new division should include:

- Data scientists
- Cybersecurity experts
- Machine learning engineers
- Tax analysts
- Forensic accountants

FDID would serve as the operational AI arm, similar to South Korea's National Tax Service analytics unit.

5.4.2 Internal Data Integration with NAII

FBR must gain automatic, audited access to:

- NADRA
- SECP corporate data

- Provincial land registries
- Banks (under strict legal safeguards)
- Telecom usage indicators
- Utility consumption databases
- Travel and immigration logs

These integrations are essential for AI models to function.

5.4.3 Reducing Human Discretion in Audits

Automatic audit selection models should replace discretionary decisions.

Human officers would still verify outputs—but the trigger mechanism must be depersonalized to reduce corruption pressure points.

5.4.4 Legal Reforms to Support AI-Driven Taxation

Pakistan must pass legislative amendments to:

- Mandate e-invoicing across sectors.
- Require digital payments above certain thresholds.
- Protect taxpayer data from misuse.
- Define AI-based decision rights and appeal mechanisms.
- Regulate cross-agency data sharing protocols.

Without legal modernization, AI tools cannot be deployed responsibly.

5.5 Expected Economic Impact of AI-Enabled Tax Reform

International experience shows that AI-based taxation reform increases revenue significantly. The OECD (2021) reports:

- Brazil increased VAT compliance by 41% after e-invoicing.
- South Korea reduced tax evasion by 30% using AI anomaly detection.
- India added millions of new taxpayers after integrating Aadhaar and GST data.

For Pakistan, conservative estimates suggest:

- PKR 1.5–2 trillion additional annual tax revenue within 5 years.
- Major reductions in tax evasion, underreporting, and fraud.
- Significant increases in the documentation of the informal economy.
- Reduction in audit corruption and rent-seeking behavior.
- Improved investor confidence through predictable enforcement.

These fiscal gains can support development spending and reduce reliance on IMF programs.

5.6 Risks and Mitigation Measures

AI-enabled tax reform carries risks:

1. False Positives in Risk Scoring

Models may incorrectly flag individuals or small businesses.

Mitigation: Mandatory human review and appeals process.

2. Privacy Concerns

Cross-matching data from multiple agencies may alarm citizens.

Mitigation: Clear legal frameworks, audit trails, strict access controls.

3. Algorithmic Bias

Income proxies may disadvantage certain groups.

Mitigation: Bias testing, model explainability requirements.

4. Cybersecurity Risks

Tax data is highly sensitive.

Mitigation: Zero-trust architecture, encryption, penetration testing.

5. Resistance from Tax Officials

AI reduces discretionary power.

Mitigation: Training, incentives, role redefinition.

5.7 Conclusion

AI enabled Tax reform is at the center of wider governance transformation in Pakistan. Public sector automation and the development of the nation will not be possible without increased fiscal space. The NAII is the technological platform that will link FBR with NADRA, land systems and procurement and welfare programme databases. The subsequent chapters examine comparably AI-influenced innovations in land governance, identity systems, procurement and social protection.

Chapter 6. Modernizing Land Governance: AI-Enabled Land Governance Reform: Creating a Transparent, Tamper-Proof, and Predictive Land Administration System for Pakistan

Land Governance is perhaps one of the most politically sensitive, economically crucial and corruption infested governance sectors in Pakistan. The land disputes account for almost 60–70% of the civil litigation in Pakistani courts, urban encroachments continue to mark an alarmingly upward trend, provincial revenue authorities are facing recording inaccuracies as never before, and fraudulent land transfers still take place due to manual procedures and lack of verification mechanisms (SDPI, 2020). The land governance legacy of these practices from pre and post-independence era has not only led to economic inefficiency, weaker property rights, discouraged foreign investment, distorted urban growth but also massive corruption in patwari / revenue network. Artificial Intelligence (AI) which is embedded from the National AI Infrastructure (NAII), presents Pakistan a once in lifetime opportunity to revolutionize land governance by bringing precision, transparency, automation and predictive potentiality into land records / transactions & planning portals.

AI supported land reform is not only a technological upgrade, but a structural governance intervention that changes the power balance and scale of discretionary human interventions away from intermediaries, advances city development planning, safeguards citizens' property rights, and eliminates extensive manipulation. This chapter details how NAII can integrate AI into land administration systems, defines sectoral gaps, suggests the establishment of an integrated digital land infrastructure as well as measurable governance, economic and social outcomes.

6.1 Structural Problems in Pakistan's Land Administration

Pakistan's land governance challenges are systemic rather than isolated. Several long-standing issues prevent the creation of an efficient land system:

6.1.1 Fragmentation Across Provinces and Agencies

The department of revenue, land records and urban development authority is under the control of each individual province. Land data is not spatially interoperable between regions, or with federal systems. Banks, courts, municipalities, utility companies and planning agencies each separately utilize unlinked land-related data.

This fragmentation is stopping AI being implemented as there's no single source of data that is consistent and reliable.

6.1.2 Manual Records and Vulnerability to Tampering

Despite partial digitization in Punjab and KP, thousands of villages still rely on:

- handwritten revenue ledgers,
- manually drawn land maps (khasra, girdawari),
- patwari-controlled land mutation workflows, and
- informal or undocumented land transfers.

Manual systems enable:

- falsification of records,
- overwriting of entries,
- bribery-based "adjustments,"
- duplications, and
- destruction of evidence.

A digital-first AI-enabled architecture eliminates these vulnerabilities.

6.1.3 Lack of Geospatial Integration

Modern land administration relies on satellite imagery, GIS systems, and aerial mapping. Pakistan's land systems rarely use:

- geospatial boundary verification,
- AI-based encroachment detection,
- automatic zoning violation alerts,
- predictive urban expansion models, or
- illegal construction monitoring.

This technological gap enables land mafias, encroachers, and corrupt networks to exploit public and private land.

6.1.4 Disputes and Litigation Over Unclear Ownership

Millions of properties in Pakistan lack:

- clear digitized ownership records,
- accurate boundaries,
- updated inheritance transfers, or
- verified ownership chains.

Unclear titles undermine the real estate market, discourage investment, delay infrastructure projects, and overload courts.

6.1.5 Absence of NADRA Integration for Owner Verification

Land authorities rarely verify the identity of buyers or sellers through NADRA in real time. This gap allows:

- benami (proxy) properties,
- land transfers involving fake identity documents,
- transfers on behalf of deceased individuals, and
- manipulation of family inheritance patterns.

AI integrated with NADRA can prevent these abuses.

6.1.6 Limited Digital Capacity in Revenue Departments

Most patwaris and revenue officers lack training in digital systems, geospatial analysis, or AI-based decision-support tools. Institutional resistance and patronage networks further hinder reform.

6.2 The Case for AI-Enabled Land Governance

AI is particularly transformative in land governance because the sector relies heavily on:

- geospatial data,
- multi-agency verification,
- pattern recognition,
- anomaly detection, and
- predictive analytics.

AI can automate workflows that currently take months or years, eliminate discretionary power, and enable forensic-level accuracy in record management. Pakistan can implement a unified, AI-enabled land administration system built on five pillars.

6.3 Unified Digital Land Registry (UDLR): The Core AI-Ready Infrastructure

The first major institutional reform is the establishment of a **Unified Digital Land Registry (UDLR)** - a national, interoperable database of all land parcels in Pakistan.

UDLR Features:

1. Single Source of Truth (SSOT)

All ownership records, maps, mutations, valuations, and transaction histories must exist in one immutable database.

2. NADRA Authentication for All Transactions

Every land transfer, mutation, mortgage request, or lease agreement must be verified through:

- biometric authentication
- CNIC-linked digital signatures
- household ownership graph verification

This integration eliminates benami transfers and identity fraud.

3. Blockchain-Based Audit Layer

Blockchain provides a tamper-proof record of transactions, ensuring that:

- no land entry can be deleted or overwritten,
- all changes are logged, time-stamped, and signed, and
- corruption networks cannot manipulate ownership chains.

4. Geospatial Synchronization

Each land parcel must be linked with:

- satellite imagery
- drone mapping
- cadastral GIS coordinates

This allows AI to detect unauthorized changes.

6.4 AI Use Cases in Land Governance

AI provides powerful applications at every stage of land administration.

6.4.1 AI for Ownership Verification and Fraud Detection

AI can automatically flag suspicious land transfers based on:

- sudden wealth spikes relative to declared income,
- frequent inter-family land swapping,
- individuals with extensive properties but low tax filings,
- proxy relationships revealed through NADRA-linked household graphs,
- irregular inheritance claims, and
- properties registered to deceased individuals.

Machine learning models also detect *patterns* of fraudulent behavior across districts, identifying patwaris with statistically abnormal transfer rates.

6.4.2 AI for Encroachment and Illegal Construction Detection

Using satellite imagery and geospatial analytics, AI can:

- detect illegal boundary expansions,
- identify informal settlements growing on state land,
- flag unauthorized commercial structures in residential zones,
- predict future encroachment hotspots, and
- measure urban sprawl in real time.

Countries like India and Indonesia have adopted AI-based encroachment detection to manage urbanization (World Bank, 2022).

Pakistan can deploy similar tools at national scale.

6.4.3 AI for Automated Mutation Processing

Land mutations currently take weeks or months, enabling bribery and delays. AI automates:

- verification of inheritance chains
- identity authentication
- valuation checks
- documentation completeness
- risk scoring of transactions
- cross-matching land use patterns

Instant mutation processing reduces patwari discretion.

6.4.4 AI-Driven Market Valuation Models

Real estate valuation is opaque in Pakistan. AI can analyze:

- transaction histories,
- location features,
- urban growth trends,
- building attributes,
- infrastructure access,
- nearby commercial activity, and
- previous price behavior.

Automated valuation models (AVMs) are common in the US, Australia, and the EU. Pakistan can implement AVMs to prevent fraud, increase transparency, and support taxation.

6.4.5 Predictive Urban Planning and Land Use Modelling

AI can forecast:

- future commercial district expansion,
- housing shortages,
- population density patterns,
- transport needs,
- environmental risks (such as flood zones),
- slum expansion projections.

These predictive models help governments plan roads, utilities, zoning, housing policy, and climate resilience strategies.

6.4.6 AI for Land Dispute Resolution and Court Analytics

AI-powered legal analytics tools can:

- categorize land disputes,
- extract key facts from documents,
- predict case outcomes,
- recommend settlement pathways,
- cluster similar cases for batch resolution,
- identify systemic patterns of fraud or exploitation.

India and Brazil have piloted court analytics to reduce backlog. Pakistan's judiciary can greatly benefit from these tools.

6.5 Establishing the National Land Data Exchange Layer (N-LDEX)

To integrate land authorities with NAII, a **National Land Data Exchange Layer (N-LDEX)** must be created. N-LDEX connects:

- UDLR
- NADRA
- FBR
- Banks
- Courts
- Municipal corporations
- Utility companies
- Survey of Pakistan (SoP)
- Provincial planning departments

Through secure APIs and standardized data formats, N-LDEX becomes the geospatial intelligence hub of Pakistan.

6.6 Institutional Reforms for AI-Powered Land Governance

AI cannot function in a broken institutional environment. Structural reforms are essential:

6.6.1 Establish the "Pakistan Land and Geospatial Authority" (PLGA)

A federal authority similar to Survey of India or Singapore's SLA should oversee:

- national land digitization standards,
- cadastral mapping,
- geospatial AI models,
- data exchange across provinces,
- capacity-building, and
- coordination with NAIA.

PLGA becomes the technical guardian of land governance modernization.

6.6.2 Abolish Patwari Discretion Through Process Re Engineering

AI-enabled workflows eliminate the need for:

- manual boundary descriptions,
- handwritten girdawaris,
- discretionary mutation approvals,
- informal valuations, and
- undocumented land dealings.

Patwaris shift to roles in verification, monitoring, and digital service provision.

6.6.3 Court Reforms for AI-Integrated Records

Courts often dismiss digital entries due to lack of standardized validation.

Legal reforms must grant digital land entries:

- evidentiary status,
- blockchain-backed authentication recognition,
- protection from manipulation.

6.6.4 Banks and Real Estate Markets Integration

Banks must require:

- UDLR verification for all mortgages,
- AI-driven valuation reports,
- ownership verification through NADRA.

Real estate agents must adopt standardized data formats and report transactions digitally.

6.7 Expected Impact of AI-Driven Land Reform

6.7.1 Economic Impact

AI-enabled land reforms can:

- unlock billions in dead capital,
- increase foreign investment confidence,
- reduce housing development delays,
- standardize valuation across markets,
- reduce litigation costs,
- expand property-based taxation.

6.7.2 Governance Impact

- Elimination of land mafias
- Reduction in corruption by up to 70% (SDPI, 2020 estimate)
- Increased transparency
- Efficient dispute resolution
- Improved urban planning
- Real-time policy decision-making

6.7.3 Social Impact

- Secure property rights for low-income households
- Easier inheritance transfers for women
- Protection against illegal evictions
- Reduced harassment by patwari networks
- Greater citizen trust in land administration systems

6.8 Risks and Mitigation Strategies

1. Privacy Risks

Integrating NADRA with land systems may raise concerns regarding surveillance.

Mitigation: Strong data protection laws, access logs, encryption.

2. Algorithmic Errors

Incorrect boundary detection or valuation models could harm citizens.

Mitigation: Mandatory human review for critical processes.

3. Digital Divide

Rural populations may struggle to access digital services.

Mitigation: Citizen facilitation centers and mobile land service kiosks.

4. Institutional Resistance

Patwari networks may oppose transparency.

Mitigation: Role restructuring, training, and incentives.

5. Cybersecurity Threats

Land databases can become targets for ransomware.

Mitigation: Zero-trust systems, isolated backups, AI threat detection.

6.9 Conclusion

AI-enabled land governance reform offers one of the most transformative opportunities for Pakistan's digital future. By integrating NADRA authentication, geospatial analytics, blockchain audit layers, and AI-based verifications into a unified land administration system, Pakistan can eliminate decades-old corruption structures, secure property rights, and create a predictable environment for investment and development. As part of the broader National AI Infrastructure, land reform becomes a cornerstone of state modernization, economic transparency, and social justice.

Chapter 7: AI Enabled NADRA Integration and National Identity Modernization: The Core Digital Backbone of Pakistan's Public Sector Automation.

The National Database and Registration Authority (NADRA) – Pakistan's most advanced digital institution represents the leading edge of a modern, AI-powered public sector stack that navigates frictionlessly across government machines. With a biometric database that covers over 90% of the population, NADRA has scale and precision in addition to institutional capacity found in very few developing countries (NADRA, 2022). However, NADRA is undervalued in Pakistan's governance architecture due to disintegrated inter-agency coordination, narrow legal authorization for data sharing, political qualms about surveillance and inadequate linkages with critical governance databases including taxations, land record system public procurements banking and ladies fund programme etc.

In this chapter we describe how NADRA can become a national identity spine for the National AI Infrastructure (NAII) of Pakistan to automate verification, prevent fraud, analyse population patterns, score eligibility, and build predictive models for almost all public services. It defines the current state of play of NADRA, highlights priority barriers, introduces a single digital identity integration blueprint, and demonstrates how AI-based identity systems can revolutionize government services.

7.1 The Strategic Role of Identity in AI-Driven Governance

Digital government is built upon identity. Without reliable, verifiable and inter-operable identity systems, no country can effectively deploy AI in taxation, welfare, healthcare, education, border control, land governance or financial regulation. Other countries which have managed to scale automation in the public sector, like Estonia, Singapore and India, have been able to do so because their digital identity systems are used as a single gateway or point of entry for all citizen interactions.

Pakistan's NADRA holds similar potential. Its state-of-the-art biometric identity platform including fingerprints, facial recognition, family relations and demographic profiles can ground AI enabled workflows, automate verification processes and minimize fraud across public programs. Yet, NADRA's linkage to other systems is haphazard in nature.

7.2 NADRA's Existing Capabilities: A National Asset

NADRA offers several advanced capabilities that form the building blocks of AI-driven governance:

7.2.1 Biometric Identity Verification

NADRA maintains biometric records for nearly the entire population, enabling:

- fingerprint matching,
- facial recognition,
- CNIC-linked verification,
- elimination of duplicates,
- refugee and foreign national identification,
- secure authentication for services.

This provides a robust mechanism for preventing identity theft and false beneficiary claims.

7.2.2 Family Tree and Household Graphs

NADRA maintains family linkages that allow:

- verification of inheritance claims,
- household composition analysis,
- welfare eligibility scoring,
- detection of fake guardians or dependents,
- demographic analytics.

These household graphs are essential for AI-driven social protection systems.

7.2.3 Data Encryption and Security Protocols

NADRA uses:

- PKI encryption,
- secure authentication layers,
- secure printing processes,
  forensic-level identity verification.

This security architecture can support national-scale AI deployments when combined with sovereign cloud infrastructure.

7.2.4 Integration Readiness

NADRA already provides identity verification services to:

- banks,
- telecoms,
- passport offices,
- election authorities,
- foreign governments,
- immigration systems.

This proves NADRA's ability to interface with multi-sectoral systems through secure APIs.

7.3 Constraints Preventing Full NADRA Integration

Despite its advanced capabilities, NADRA faces structural, legal, and institutional constraints:

7.3.1 Absence of Legal Mandates for Data Sharing

Pakistan lacks a national data governance law defining when and how NADRA may share identity information securely with agencies such as FBR, PPRA, provincial land authorities, police, or BISP.

7.3.2 Political Sensitivity Around Privacy and Surveillance

Citizens often express concerns that NADRA data could be misused for:

- political targeting,
- discriminatory profiling,

- unauthorized surveillance,
- selective enforcement.

AI deployment must therefore include strong privacy protections and oversight mechanisms.

7.3.3 Limited Interoperability with Provincial Systems

Punjab, Sindh, KP, and Balochistan each maintain separate:

- land registries,
- revenue systems,
- family courts,
- municipal authorities.

Without standardization, NADRA integration remains patchy.

7.3.4 Lack of AI Infrastructure within NADRA

NADRA's analytics teams are strong, but it lacks an internal AI research unit capable of:

- large-scale model training,
- anomaly detection,
- identity risk scoring,
- behavioral pattern analysis.

NADRA's integration into the NAII addresses these gaps.

7.3.5 Legacy Data Quality Issues

Some older records contain incomplete or outdated family linkages and demographic details, affecting model accuracy.

7.4 Designing NADRA's Role in the National AI Infrastructure

NADRA's integration into the NAII must be based on a four-pillar approach:

7.4.1 Pillar 1: Universal Digital Identity Integration across Public Systems

NADRA must become the central identity verification mechanism for:

- FBR (taxation),
- UDLR (land governance),

- BISP/Ehsaas (welfare),
- PPRA (procurement),
- SBP (banking oversight),
- SECP (corporate registries),
- Health and vaccination systems,
- Education records,
- Police and justice systems.

Each service provider should authenticate citizens using NADRA-linked biometrics, CNIC-based digital signatures, or AI-based identity verification.

7.4.2 Pillar 2: AI-Enabled Identity Risk Scoring

NADRA, integrated with NAIA, can deploy AI to identify suspicious identity-related patterns, such as:

- duplicate individuals using multiple CNICs;
- inconsistent biometrics;
- identity anomalies in welfare claims;
- suspicious land transfers involving deceased individuals;
- repeated high-value transactions by low-income profiles;
- networks of individuals engaged in organized fraud.

Identity risk scoring models are used globally in banks, border control, and welfare administration.

Pakistan must adopt similar models with strict ethical oversight.

7.4.3 Pillar 3: Citizen Digital Wallets and AI-Verified Credentials

A unified **Digital Citizen Wallet**, linked to NADRA, can securely store:

- education certificates,
- property titles,
- tax clearance certificates,
- welfare eligibility status,
- medical records,
- procurement participation certifications.

AI can auto-verify authenticity, eliminate forged documents, and enable seamless service access.

7.4.4 Pillar 4: Federated Identity Analytics for Policy Making

AI can use anonymized NADRA datasets to generate insights for:

- population demographics,
- migration patterns,
- labor market projections,
- vulnerable household identification,
- vaccination targeting,
- disaster response planning.

These analytics strengthen governance and allow evidence-based policymaking.

7.5.1 AI-Driven Tax Reform Using NADRA Identity Data

By linking NADRA with FBR, AI can identify:

- individuals living lifestyles inconsistent with declared income,
- undeclared businesses,
- tax fraud networks,
- benami ownership structures,
- suspicious transfers.

This integration is foundational to AI-enabled taxation described in Chapter 5.

7.5.2 AI-Enabled Land Governance Using NADRA Biometrics

NADRA integration solves:

- identity fraud in land transfers,
- inheritance manipulation,
- fake mutations,
- property transactions conducted in the name of deceased persons.

AI detects unusual ownership patterns, family tree inconsistencies, and cross-province land acquisition anomalies.

7.5.3 Welfare Targeting and Dynamic Eligibility Scoring

AI can analyze NADRA-linked household graphs to determine:

- true poverty levels,
- childcare burdens,
- elderly care responsibilities,
- disability verification,

- exposure to climate shocks.

Dynamic welfare eligibility powered by AI reduces leakage and improves coverage.

7.5.4 Procurement Fraud Detection

AI can identify:

- ghost vendors registered under multiple CNICs,
- suppliers with suspicious identity clusters,
- repetitive bidding patterns among linked individuals.

Identity analytics sharply reduce corruption in procurement.

7.5.5 Health, Education, and Civil Registration Services

AI verifies:

- student enrollment authenticity,
- health service utilization patterns,
- mortality/morbidity anomalies,
- vaccination needs,
- birth/death record accuracy.

This enables predictive healthcare and evidence-based educational planning.

7.6 Institutional Reforms Required for NADRA–NAII Integration

NADRA's integration into NAII requires structural reforms:

7.6.1 Amending Data Sharing Laws

A new **National Data Governance Act** must:

- define conditions for NADRA data sharing with other agencies,
- establish access controls,
- prohibit misuse,
- require algorithmic audits,
- mandate transparency and redress mechanisms.

This legal framework is central to public trust.

7.6.2 Establishing NADRA–NAIA Integration Unit

A joint "Identity Integration Unit" between NADRA and NAIA will:

- standardize identity API protocols,
- develop identity-related AI models,
- oversee cybersecurity architecture,
- coordinate with provincial governments.

7.6.3 Creating Provincial Identity Integration Desks

Provincial authorities must adopt:

- standardized identity verification systems,
- interoperable databases,
- NADRA-linked service delivery portals.

This ensures federal–provincial harmony.

7.6.4 Citizen Consent and Transparency Mechanisms

NADRA must publish:

- annual transparency reports,
- usage logs,
- access histories for citizen records,
- AI model explainability summaries (for high-risk applications).

This builds legitimacy in identity-linked AI systems.

7.7 Risks and Safeguards in AI-Driven Identity Integration

1. Privacy Intrusions

AI models using identity data may be viewed as surveillance.

Safeguard: Encrypted storage, independent audits, judicial warrants for sensitive access.

2. Algorithmic Bias

Incorrect identity-based patterns could marginalize certain groups.

Safeguard: Testing datasets, fairness analysis, stakeholder consultation.

3. Data Breaches

Identity data is highly sensitive.

Safeguard: Zero-trust architecture, sovereign cloud, multi-factor encryption.

4. Misuse by Political Actors

Identity analytics could be weaponized.

Safeguard: Legal penalties, monitoring logs, strict governance rules.

5. Digital Exclusion

Rural or poor populations may face access barriers.

Safeguard: Mobile registration units, offline verification options.

7.8 Impacts of AI-Enabled Identity Integration

Economic Impact

- Increased tax collection
- Reduction in fraud and identity theft
- Strengthened investment climate
- Efficient welfare targeting

Governance Impact

- Transparent identity verification
- Reduced corruption
- Improved inter-agency coordination
- Faster service delivery

Social Impact

- Protection of citizen rights
- Greater trust in institutions
- Reduced manipulation of inheritance and land records
- Expanded access to public services

7.9 Conclusion

NADRA's integration into the National AI Infrastructure is the keystone of Pakistan's digital transformation. By enabling secure identity verification, preventing fraud, supporting AI-driven analytics, and powering automated workflows across taxation, land governance, welfare systems, procurement, and urban planning, NADRA becomes the central nervous system of Pakistan's AI-enabled governance architecture. This integration, supported by strong legal frameworks and ethical safeguards, will ensure that Pakistan's public sector modernization is secure, equitable, transparent, and citizen-centered.

Chapter 8: AI-Enabled Social Protection Reform: Building a Dynamic, Integrated, and Predictive Welfare System for Pakistan.

Social welfare is a core function of the contemporary state. A robust welfare system is crucial to preventing poverty traps and ensuring upward mobility, particularly in countries like Pakistan, with millions of people exposed to economic vulnerability from natural disasters, disability, unemployment and climate-induced disruptions. Pakistan has achieved considerable success in the past decade, particularly with BISP and Ehsaas introducing digital cash transfers, biometric verification and a single household registry (NSER). But these systems are fragmented, slow to update, prone to fraud and somewhat reactive instead of predictive. With AI embedded in the NAII, Pakistan has an opportunity to create a way-forwards-versus that is dynamic, shock-responsive, data-rich, analytically modern welfare ecosystem.

This chapter maps out how AI could transform Pakistan's social protection landscape by allowing it to become more targeted, fraud resistant, predictive in identifying households-at-risk, capable of providing better delivery systems, as wellbeing integrated with national identity (NADRA), taxation (FBR), land records, banking networks and disaster response platforms. The chapter also suggests institutional changes, mechanisms of governance and long term policies for the creation of a just, equitable and efficient welfare state.

8.1 The Current Landscape of Pakistan's Social Protection System

Pakistan's social protection ecosystem consists of multiple overlapping programs, including:

- **BISP**: unconditional cash transfers to low-income women.
- **Ehsaas Program**: an umbrella initiative with scholarships, health coverage, interest-free loans, and cash support.
- **Zakat and Ushr system**: religious welfare contributions.

- **Provincial initiatives**: such as Punjab's education stipends, Sindh's poverty support, and KP's social assistance programs.
- **Utility subsidies**, food support, and climate relief initiatives.

The National Socioeconomic Registry (NSER) is the central database, containing household-level information used to determine eligibility scores. While NSER represents significant progress, several limitations restrict its effectiveness:

8.1.1 Static and Infrequently Updated Data

Household surveys are updated only every few years, making the system unable to account for:

- sudden income shocks,
- climate disasters,
- inflation-driven household vulnerability,
- migration,
- job loss,
- illness or disability.

AI requires more dynamic and regularly updated data streams.

8.1.2 Limited Integration with Other Datasets

NSER does not automatically pull information from:

- NADRA family trees,
- land ownership records,
- utility usage patterns,
- telecom data,
- banking activity,
- tax filings.

This isolation prevents precise targeting.

8.1.3 Fraud and Duplication Risks

Common issues include:

- forged eligibility documents,
- duplicate beneficiaries,
- beneficiaries no longer eligible due to income changes,
- "household splitting" to receive multiple benefits,

- transfers to deceased individuals due to outdated records.

AI can detect such anomalies rapidly.

8.1.4 Lack of Predictive Vulnerability Tools

Pakistan's welfare programs are mostly reactive. There are limited tools to forecast:

- which households are about to fall below the poverty line,
- which communities are at highest risk from climate events,
- which individuals will require health or disability support,
- likely school dropout patterns among children,
- seasonal migration pressures.

Predictive AI models are essential for designing preventive social protection strategies.

8.2 Why AI is Transformative for Social Protection

AI strengthens welfare systems in five key domains:

8.2.1 Better Targeting Through Machine Learning Models

Traditional eligibility scoring relies on fixed indicators and linear scoring. AI models can handle:

- nonlinear relationships,
- large numbers of variables,
- unstructured data,
- geospatial information,
- household dynamics,
- behavioral signals.

Countries like Brazil and Kenya have integrated machine learning into poverty targeting with success (World Bank, 2022).

8.2.2 Fraud Reduction Through Pattern Recognition

AI systems detect:

- duplicate identities,
- households with unusually high consumption but low declared income,
- suspicious transfers within family networks,
- ghost beneficiaries,
- forged documents,

- cross-district inconsistencies.

Identity integration with NADRA and transaction-level audit trails drastically reduce leakages.

8.2.3 Predictive Analytics for Anticipatory Governance

AI can forecast:

- households likely to become poor within 6–12 months,
- school-age children at risk of dropout,
- vulnerable groups before climate disasters,
- households at risk of medical impoverishment,
- food insecurity in specific districts.

This enables proactive rather than reactive welfare.

8.2.4 Personalized Welfare Pathways

AI can recommend custom interventions based on:

- household composition,
- disability status,
- education levels,
- land ownership,
- income streams,
- geographic climate risks.

This mirrors innovations in Singapore's and Brazil's personalized social protection systems.

8.2.5 Transparent and Efficient Service Delivery

AI-powered chatbots and virtual agents can help citizens:

- check eligibility,
- apply for benefits,
- file complaints,
- track payments,
- update information.

Automated service delivery reduces transaction costs and bureaucratic barriers.

8.3 AI Use Cases for Transforming Pakistan's Social Protection System

8.3.1 AI-Driven Dynamic Eligibility Scoring

Current eligibility systems rely on rigid formulas. AI models can integrate:

- NADRA household graphs,
- land records,
- utility consumption patterns,
- school attendance data,
- mobile money transactions,
- income proxies from FBR,
- climate exposure indicators.

Eligibility becomes dynamic, updating monthly or quarterly.

8.3.2 Real-Time Fraud Detection Using Anomaly Detection Models

AI can flag cases such as:

- multiple CNICs linked to the same household pattern,
- sudden drops in reported income inconsistent with spending,
- beneficiaries traveling internationally,
- landowners receiving poverty benefits,
- duplicate payments across agencies.

Anomaly detection models reduce leakage by 25–40% in pilot projects worldwide (OECD, 2021).

8.3.3 Targeting Climate-Vulnerable Households Using Geospatial AI

Pakistan is highly exposed to floods, droughts, and heatwaves. AI can analyze:

- satellite imagery,
- rainfall data,
- soil moisture,
- river swell patterns,
- historic flood zones.

This identifies households at risk **before** disasters strike, enabling anticipatory cash transfers.

8.3.4 School Dropout Prediction Models

AI can predict which children are likely to drop out by analyzing:

- attendance records,
- disability statuses,
- household income volatility,
- parental education,
- distance to school,
- gender-specific barriers.

This helps the government intervene early.

8.3.5 Automated Verification for Disability and Health Support

Computer vision tools can support medical boards by:

- analyzing diagnostic reports,
- confirming disability documentation,
- standardizing eligibility verification,
- eliminating fraudulent claims.

8.3.6 Personalized Social Support Recommendations

Based on household profiles, AI can recommend:

- cash transfers,
- nutrition programs,
- skills training,
- relocation support (for climate),
- microloans,
- school stipends,
- disability aids.

This shifts Pakistan from a one size fits all system to a tailored, citizen centric model.

8.4 Institutional Integration Required for AI-Enabled Social Protection

AI-enabled welfare requires deep inter-agency integration:

8.4.1 Full NADRA Integration with NSER

NADRA must:

- verify all identities receiving welfare,
- provide household structures,
- remove duplicate or deceased individuals,
- validate family linkages for inheritance-based vulnerability.

8.4.2 Integration with FBR and Land Records

This allows AI to assess:

- true income capacity,
- land ownership patterns,
- agricultural assets,
- urban property holdings.

Households with significant assets can be automatically excluded or re-evaluated.

8.4.3 Banking and Mobile Wallet Integration

AI can analyze:

- transaction patterns,
- financial behavior,
- spending instability,
- cash flow irregularities.

This helps identify vulnerable households more accurately.

8.4.4 Health, Education, and Utility Data Integration

AI benefits from:

- school attendance patterns,
- electricity usage trends,
- hospital visits,

- family health burdens.

Welfare becomes contextually aware.

8.4.5 Climate and Disaster Data Integration

Linking welfare with:

- NDMA datasets,
- SUPARCO satellite imagery,
- meteorological data,
- flood risk predictions.

This enables anticipatory social protection.

8.5 Building an AI-Enabled Social Protection Infrastructure

Pakistan needs the following building blocks:

8.5.1 Social Protection Data Lake (SPDL)

A unified data lake hosting:

- NSER enriched datasets
- NADRA-verified household graphs
- FBR income indicators
- geospatial climate data
- education and health records
- welfare payment histories

This becomes the training ground for machine learning models.

8.5.2 Social Protection AI Engine (SP-AI)

A central analytics platform that provides:

- eligibility prediction models,
- fraud detection tools,
- vulnerability scoring,
- disaster exposure mapping,
- early warning dashboards.

8.5.3 Automated Case Management Systems

Cases are automatically:

- created,
- assessed,
- prioritized,
- escalated,
- Resolved.

Human officials intervene only when anomalies are detected.

8.5.4 Citizen Digital Welfare Portal

Citizens can:

- check eligibility,
- appeal decisions,
- update family information,
- access entitlements.

AI chatbots offer 24/7 assistance.

8.5.5 Mobile Welfare Units

For rural areas, offline-enabled mobile kiosks can collect data and update records using AI-based document scanning and biometric verification.

8.6 Expected Impact of AI-Enabled Social Protection

8.6.1 Economic Impact

AI can:

- reduce leakage by 25–35%,
- improve targeting accuracy by 20–30%,
- stabilize consumption during shocks,
- reduce poverty persistence,
- bring long-term savings of billions of PKR annually.

8.6.2 Governance Impact

- Increased transparency
- Standardized decision-making
- Reduced political influence
- Improved grievance redress systems
- Faster eligibility determination

8.6.3 Social Impact

- More equitable access to assistance
- Faster help during crises
- Tailored interventions for women and vulnerable groups
- Reduced bureaucratic hurdles

AI creates a welfare system that is responsive, fair, and human-centered.

8.7 Risks and Mitigation Strategies

1. Exclusion Errors

AI may misclassify vulnerable households.

Mitigation: Human appeals panels, field verification, hybrid scoring.

2. Privacy Concerns

Integrating welfare with NADRA, tax, and land records creates surveillance fears.

Mitigation: Legal limits, consent models, transparent governance frameworks.

3. Algorithmic Bias

AI may misinterpret gender or rural factors.

Mitigation: Bias audits, representative data sampling.

4. Cybersecurity Risks

Welfare databases are sensitive.

Mitigation: Encryption, zero-trust systems, penetration testing.

5. Digital Illiteracy

Some households cannot access digital portals.

Mitigation: physical centers, mobile units, assisted service delivery.

8.8 Conclusion

AI-based social protection reform can transform Pakistan's welfare ecosystem into a dynamic, predictive, transparent, and integrated entity that is equipped to anticipate vulnerabilities before they become severe; it will also help in minimizing fraud and enhancing social equity. Plugged into NADRA, FBR, land systems and climate intelligence platforms, social protection network is one of the most formidable components of the National AI Infrastructure. With adequate legal protections, ethical monitoring and robust institutional governance, Pakistan can create a modern, inclusive and sustainable welfare state.

Chapter 9: AI Enabled Public Procurement Reform: Creating a Transparent, Competitive, and Fraud Resistant Procurement System for Pakistan

Public procurement goods, service and infrastructure purchases - is one of the biggest governance spheres in Pakistan, constituting almost 18-20% GDP (OECD, 2019). As the decisions that are made regarding procurement directly impact on the nation's public funds, service delivery and infrastructure, citizen confidence is also highly susceptible in this sector to bribery, collusive practice, favouritism, overinflation of cost and political manipulation. Poor trails, lots of discretion, lack of transparency and siloed digital systems create an environment ripe for rent-seekers. AI, on the back of NAII to be integrated, presents an opportunity for Pakistan to re-design its procurement ecosystem into a transparent, rule-based, data-driven and fraud-resistant system.

This chapter discusses how AI can make procurement processes robust, but prioritize supplier selection also.It explains to the reader how procurement process workflow can be improved with AI including better vendor rating; detecting collusion and pricing anomaly in tenders/call for bids were discussed as well. Also, it may be noted on the work integrating data from-all Indian taxes departments (like centralized excise), database of land records, NADRA database, SECP information of default companies and Integration of various financial systems by using RPA in data extraction reported in this review. It identifies weaknesses of existing procurement systems, suggests an integrated AI-based procurement ecosystem, and discusses the governance, economic and integrity dividends of an upgraded procurement system.

9.1 Current Challenges in Pakistan's Public Procurement System

Despite the existence of the Pakistan Procurement Regulatory Authority (PPRA) and provincial procurement agencies, substantial constraints limit effectiveness:

9.1.1 Paper-Based or Semi-Digital Workflows

Many procurement processes—including tender advertisements, bid evaluations, and contract monitoring—still involve:

- manual paperwork,
- physical bid submission,
- offline file evaluations,
- paper-based verification, and
- non-standardized procurement forms.

This creates opportunities for manipulation, bid tampering, and post-hoc alterations.

9.1.2 Weak Transparency and Limited Public Scrutiny

Tender outcomes, evaluation criteria, supplier profiles, and contract performance indicators are not consistently published. Citizens, media, and oversight bodies lack real-time visibility into:

- why bidders were accepted or rejected,
- how price decisions were made,
- whether timelines were met,
- whether conflicts of interest existed.

AI-enabled transparency dashboards can change this.

9.1.3 High Human Discretion and Conflict of Interest Risks

Procurement committees often have broad decision-making power with minimal oversight. Without automated decision-support systems, discretion may lead to:

- favoritism,
- cartel formation,
- inflated pricing,
- preferential awarding to politically connected firms.

AI reduces these risks by standardizing evaluations.

9.1.4 Limited Supplier Vetting Mechanisms

Procurement authorities struggle to verify supplier authenticity due to lack of integration with:

- SECP corporate records,
- FBR tax data,
- NADRA identity systems,
- banking compliance records,
- land ownership or asset declarations.

Ghost firms or shell companies can easily exploit gaps.

9.1.5 Lack of Real-Time Contract Monitoring

Post-award monitoring is weak, allowing:

- incomplete delivery,
- delayed infrastructure timelines,
- inflated invoices,
- substitution of inferior materials,
- deviations from contract terms.

AI-enabled monitoring tools can detect deviations early.

9.1.6 No Predictive or Risk-Based Procurement Oversight

Procurement oversight in Pakistan is reactive. There are no systems to:

- assess risk of corruption in real time,
- identify high-risk contracts or vendors,
- predict fraud patterns based on historical data,
- flag unusual pricing trends.

AI can provide these capabilities.

9.2 The Case for Integrating AI Into Public Procurement

AI-enabled procurement systems can:

- reduce overpricing and wastage,
- prevent fraudulent suppliers from entering bidding processes,
- detect collusion and cartel behavior,
- automatically identify suspicious bid patterns,

- benchmark prices using historical and market data,
- produce standardized evaluation scoring,
- enhance contract monitoring.

Countries like South Korea, Chile, and Brazil have used AI to reduce procurement corruption and achieve major fiscal savings (World Bank, 2021).

9.3 AI Use Cases in Public Procurement

9.3.1 Supplier Verification and Authentication

AI can cross-match supplier data with:

- **NADRA** (identity verification),
- **SECP** (company registration status),
- **FBR** (tax compliance),
- **banking systems** (financial history),
- **land records** (real asset footprint).

This eliminates ghost suppliers and ensures only legitimate, financially stable entities participate.

Machine learning algorithms can profile suppliers by analyzing:

- historical performance,
- contract completion timelines,
- litigation history,
- financial irregularities,
- ownership networks,
- conflict-of-interest patterns.

9.3.2 AI-Based Bid Evaluation

AI models can:

- standardize bid scoring criteria,
- detect unusually low or high bid prices,
- flag inconsistencies in technical proposals,
- identify "copy-paste" submissions in collusive tenders,
- reveal relationships between competing bidders,
- analyze tender document complexity.

AI reduces subjective bias and increases fairness.

9.3.3 Anomaly Detection in Pricing

AI compares submitted bids against:

- historical contract prices,
- global market trends,
- commodity price fluctuations,
- vendor-specific pricing histories.

Anomaly detection flags:

- overpricing,
- price inflation,
- collusive pricing clusters,
- sudden cost spikes unsupported by market conditions.

This strengthens financial discipline.

9.3.4 Collusion Detection and Network Analysis

AI can detect collusion networks by analyzing:

- repeated joint bidding patterns,
- alternating winning patterns among the same firms,
- shared addresses, employees, or directors,
- similar proposal language or formatting,
- synchronized bid timings,
- price clustering patterns.

Network mapping tools visualize collusive groups, enabling enforcement.

9.3.5 Predictive Corruption Risk Scoring

AI can produce risk scores for:

- procurement officers,
- vendors,

- types of contracts,
- geographic regions.

Risk scoring considers variables such as:

- repeated single-bid tenders,
- contract amendments post-award,
- high variation in supplier pricing,
- unexplained extensions,
- deviation from technical specifications.

Predictive tools allow early intervention.

9.3.6 AI for Contract Monitoring and Project Oversight

AI-enhanced tools enable:

- satellite imagery to track infrastructure progress,
- computer vision models detecting construction quality issues,
- IoT-based sensors in government projects,
- NLP-based analysis of contractor reports,
- anomaly detection in billing cycles.

This prevents manipulation and enhances accountability.

9.3.7 Procurement Chatbots and Automated Citizen Transparency

AI chatbots can assist:

- bidders with application queries,
- agencies with compliance checks,
- citizens with transparency requests,
- oversight bodies with compliance monitoring.

Public dashboards increase scrutiny and reduce corruption risks.

9.4 Designing an AI-Enabled Procurement Architecture

Pakistan needs a unified **AI-enabled National Procurement Intelligence System (NPIS)** integrated into the NAII.

9.4.1 National Supplier Registry (NSR)

A centralized registry combining:

- SECP company data,
- FBR compliance records,
- NADRA identity verification,
- banking and financial indicators,
- litigation and blacklisting histories.

AI flags suspicious supplier profiles.

9.4.2 National Procurement Data Lake (NPDL)

A central repository storing:

- tender documents,
- bid submissions,
- price histories,
- contract amendments,
- performance records,
- vendor networks.

This becomes training data for machine learning.

9.4.3 Procurement AI Engine (PAI)

A shared analytics engine performing:

- anomaly detection,
- collusion analysis,
- risk scoring,
- price benchmarking,
- supplier profiling,
- document analysis.

9.4.4 Integration with Other Systems

NPIS must connect with:

- FBR (for financial verification),
- NADRA (identity authentication),
- banks (financial credibility),
- land records (asset validation),
- SECP (legal registration standing),

- PPRA databases (compliance).

This creates an end-to-end verification chain.

9.5 Institutional Reforms Required for AI-Enabled Procurement

9.5.1 Strengthening PPRA Through Digital Transformation

PPRA must:

- establish AI procurement standards,
- mandate digital submissions,
- enforce bid transparency,
- publish evaluation results,
- standardize scoring models.

9.5.2 Mandatory E-Procurement Across All Agencies

All public procurement—including at provincial, district, and municipal levels—should shift to AI-enabled e-procurement portals.

9.5.3 Procurement Officer Training and Certification

A national certification program for AI-based procurement will:

- reduce misinterpretation,
- standardize evaluation methods
- build technical capacity.

9.5.4 Creating Independent Oversight and Audit Units

AI audit units will investigate:

- flagged collusion clusters,
- unusual contract amendments,
- red-flagged officer behavior,
- supplier manipulation patterns.

9.6 Expected Impact of AI-Enabled Procurement

9.6.1 Economic Impact

AI-based procurement can reduce procurement costs by **15–25%**, saving billions annually. This aligns Pakistan with international benchmarks where e-procurement reforms yielded massive fiscal savings (World Bank, 2021).

9.6.2 Governance Impact

AI enhances:

- transparency,
- fairness,
- auditability,
- accountability,
- public trust.

Institutions become less vulnerable to political interference.

9.6.3 Integrity and Anti-Corruption Impact

AI significantly reduces:

- bribery,
- favoritism,
- ghost suppliers,
- cartel behavior,
- invoice manipulation.

Corruption-prone officers are identified early.

9.6.4 Social Impact

Public funds are redirected from corrupt pockets to public services such as:

- schools,
- hospitals,
- roads,
- poverty relief.

Citizens benefit directly from better governance.

9.7 Risks and Safeguards

1. Overreliance on AI Scoring

Procurement may depend too heavily on AI-generated risk scores.

Mitigation: Human review and appeals mechanisms.

2. Algorithmic Bias Against Small or New Vendors

AI may favor established firms due to larger data footprints.

Mitigation: Bias testing and proportional scoring adjustments.

3. Cybersecurity Threats

Procurement systems are attractive targets for hackers.

Mitigation: Zero-trust architecture and secure cloud environments.

4. Resistance from Procurement Officers

AI reduces discretionary power.

Mitigation: training, incentives, role redesign.

9.8 Conclusion

AI-enabled procurement reform is one of Pakistan's greatest opportunities to reduce corruption, strengthen governance, and increase fiscal efficiency. By connecting procurement systems to NADRA, SECP, FBR, land registries, and banking networks and by deploying AI-driven tools for supplier profiling, anomaly detection, contract monitoring and predictive oversight, Pakistan can build a world-class procurement ecosystem. Such modernization will save billions annually, enhance public trust, and strengthen state capacity.

Chapter 10: AI Enabled Public Sector Integration: Building a Unified, Secure, and Interoperable Government Ecosystem for Pakistan

The strategic control of information across institutions drives contemporary governance. Disjointed bureaucracies, disparate databases, variegated data formats and manual verification systems, all significantly impede the ability of governments to provide efficient, transparent and citizen-centric services. In Pakistan, every single major sector of government taxation, land management, identity systems, welfare disbursement and procurement service delivery, police services and courts provision of law enforcement and judicial services, municipal governance for the most part works in silos with no or at best minimal real-time integration. This fragmentation leads to slow reform, promotes corruption, stifles evidence-based decision-making and prevents widespread uptake of artificial intelligence (AI).

The National AI Infrastructure (NAII) envisages an integrated public sector architecture where data securely roams between institutions, identities are instantaneously validated, fraud detected in real-time and AI models constantly learning from national datasets. This chapter presents how Pakistan can ensure its public sector is interconnected through a common governance back bone, the technical infrastructure and institutional softwares it requires, risks and privacy concerns, and also enjoins the potential benefits over years of having an integrated public sector automation.

10.1 The Need for Public Sector Integration in Pakistan

Pakistan's public sector faces four fundamental integration challenges:

10.1.1 Siloed Databases and Lack of Interoperability

Most government departments maintain separate digital systems with incompatible formats. For example:

- FBR tax data does not automatically sync with NADRA or land registries.
- BISP welfare data is not cross-matched with property or income databases.
- PPRA procurement systems do not automatically verify supplier authenticity using SECP, FBR, or NADRA.
- Police and judiciary databases lack consistent linkages with identity or criminal history systems.

Integration is essential for AI models to function.

10.1.2 Excessive Human Discretion and Manual Verification

Manual workflows undermine transparency and efficiency. Integration reduces discretionary decision-making by embedding digital verification steps directly into automated processes.

10.1.3 Weak Coordination Across Federal and Provincial Jurisdictions

Federal and provincial agencies often duplicate systems, adopt incompatible standards, or withhold data for institutional or political reasons.

10.1.4 Limited Visibility Into Cross-Sectoral Risks

Without integrated data, the state cannot detect:

- networks of corruption,
- fraudulent supply chains,
- tax evasion patterns,
- welfare duplication,
- land ownership manipulation,
- criminal networks leveraging identity gaps.

AI cannot detect what it cannot see.

10.2 Vision for an Integrated AI-Enabled Public Sector

An integrated public sector for Pakistan is built on four pillars:

1. A Unified Identity Backbone

Powered by **NADRA**, every citizen has a verified digital identity that links them to:

- tax records,
- land titles,
- welfare eligibility,
- procurement participation,
- education and health records,
- criminal justice information.

Identity becomes the anchor of government automation.

2. A National Interoperability Framework (NIF)

This includes:

- standardized APIs,
- metadata formats,
- encryption protocols,
- cross-agency data exchange rules,
- audit trails.

NIF allows every public agency to talk to each other securely.

3. A Shared AI Services Layer

Instead of each department building AI separately, Pakistan uses shared engines for:

- fraud detection,
- risk scoring,
- anomaly detection,
- geospatial analysis,
- document verification.

This reduces duplication and ensures standardization.

4. A Federated Governance Model

Federal and provincial authorities share:

- infrastructure,
- standards,

- oversight mechanisms,
- but retain operational autonomy.

This respects Pakistan's constitutional structure.

10.3 Core Components of the Integrated Public Sector Architecture

10.3.1 National Data Exchange Grid (NDEG)

A secure, encrypted, government-wide grid enabling:

- real-time identity verification,
- automatic data exchange,
- cross-agency event triggers,
- instant fraud alerts.

Modeled after Estonia's X-Road and India's DigiLocker ecosystem, NDEG became the digital backbone of Pakistan's governance.

10.3.2 Government Cloud Infrastructure (GovCloud PK)

A sovereign cloud that hosts:

- national data lakes,
- AI engines,
- digital identity services,
- procurement and tax analytics,
- disaster management platforms,
- e-governance services.

GovCloud ensures data sovereignty and cybersecurity.

10.3.3 National Digital Identity Layer (NDIL)

An upgraded NADRA identity protocol providing:

- biometric verification,
- CNIC-linked digital signatures,
- identity APIs for all government services,
- fraud protection,

- cross-agency household linkage analytics.

NDIL is the trust anchor for AI-enabled automation.

10.3.4 Sectoral Integration Modules

1. Taxation Integration Module

Allows FBR to automatically verify:

- land ownership,
- supplier authenticity,
- income consistency,
- property transactions,
- procurement participation.

2. Land Governance Module

Connects UDLR with:

- NADRA,
- FBR,
- banks,
- courts,
- municipal authorities.

AI detects tampering, encroachments, and valuation anomalies.

3. Social Protection Module

Integrates NSER with:

- NADRA family trees,
- land assets,
- FBR income indicators,
- climate risk maps.

Eligibility becomes dynamic and fraud-resistant.

4. Procurement Module

Connects PPRA with:

- SECP corporate registries,
- FBR compliance data,
- NADRA identity verification,
- banking records.

AI detects collusion and corruption.

5. Justice and Policing Module

Integrates:

- FIR databases,
- court case information,
- prison records,
- identity verification,
- facial recognition feeds.

AI assists predictive policing and forensic analytics under strict safeguards.

6. Health and Education Modules

Integrate:

- vaccination records,
- hospital databases,
- student enrollment systems.

AI identifies service gaps and risk groups.

10.4 AI as the Integrator: How AI Connects the Public Sector

AI acts as the interpretive layer across systems:

10.4.1 Fraud Pattern Detection Across Institutions

AI identifies cross-sectoral schemes such as:

- individuals using fake identities to receive welfare, evade taxes, and bid on procurement tenders simultaneously;

- land mafias using shell companies for real estate;
- taxpayer networks hiding assets across provinces;
- suppliers registered under multiple identities;
- criminal networks linked to banking anomalies.

These patterns cannot be detected without data integration.

10.4.2 Predictive Risk Scoring

AI can predict:

- which businesses pose high tax evasion risks,
- which welfare beneficiaries are likely ineligible,
- which land parcels are at risk of encroachment,
- which procurement officers exhibit suspicious behavior,
- which regions have high corruption clusters.

Risk scores help target enforcement efficiently.

10.4.3 Automated Decision-Support Systems

AI assists officers by:

- highlighting anomalies,
- suggesting investigations,
- verifying identity,
- recommending actions,
- analyzing case histories.

Human oversight remains essential.

10.4.4 Natural Language Processing for Government Documents

AI can:

- read thousands of tenders,
- extract key clauses,
- compare legal documents,
- detect inconsistencies,
- summarize policy files.

This increases productivity.

10.4.5 Geospatial Intelligence for Integrated Planning

AI analyzes:

- satellite imagery,
- illegal construction,
- environmental threats,
- flood risks,
- infrastructure progress.

Integrated geospatial intelligence supports planning ministries.

10.5 Institutional Changes Needed for Integrated Governance

Public sector integration requires major institutional reform:

10.5.1 Establish the National Digital Integration Authority (NDIA)

NDIA oversees:

- interoperability standards,
- identity integration,
- data sharing frameworks,
- AI ethics and compliance,
- cybersecurity.

NDIA works closely with NAIA and NADRA.

10.5.2 Federal–Provincial Data Coordination Councils

Councils coordinate:

- data formats,
- legal frameworks,
- dispute resolution,
- standardized API adoption.

Participation from all provinces is essential.

10.5.3 Mandatory Digital and AI Capacity Building

Civil servants must be trained in:

- digital literacy,
- AI-assisted workflows,
- cybersecurity,
- data protection compliance.

10.5.4 Legislative Modernization

A modern data and technology governance regime must include:

- National Data Governance Act,
- AI Use and Accountability Act,
- Public Sector Cybersecurity Law,
- Digital Court Evidence Law,
- National Interoperability Regulations.

These provide the legal backbone.

10.6 Risks, Safeguards, and Ethical Considerations

1. Privacy and Surveillance Fears

Integrated data may raise public concerns.

Safeguard: Strong encryption, disclosure logs, parliamentary oversight.

2. Algorithmic Errors Across Systems

A single misclassification can affect multiple services.

Safeguard: Human review panels, appeal mechanisms.

3. Cybersecurity Threats

Integration increases the attack surface.

Safeguard: Zero-trust architecture, continuous monitoring, sovereign cloud.

4. Political Misuse

Integrated data may be misused by powerful actors.

Safeguard: Strict laws, judicial oversight, audit trails.

5. Provincial Resistance

Provinces may resist federal integration.

Safeguard: federated architecture preserving autonomy.

10.7 Benefits of Full Public Sector Integration

10.7.1 Economic Benefits

- Reduced corruption and leakages
- Faster public service delivery
- Greater investor confidence
- Increased tax compliance
- More efficient allocation of public funds

10.7.2 Governance Benefits

- Transparency
- Predictability
- Data-driven decisions
- Reduced bureaucratic delays
- Enhanced crisis response

10.7.3 Social Benefits

- Faster access to welfare
- Clearer property rights
- Fairer taxation
- Reduced harassment
- Simplified citizen experience

10.8 Conclusion

AI-enabled public sector integration is essential for Pakistan's modernization. Only through a unified digital identity, interoperable systems, shared AI services and secure data governance, can Pakistan unlock the full benefits of automation. Integration strengthens transparency, reduces corruption, accelerates economic development, and restores citizen trust in institutions. The NAII serves as the platform that ties together all reforms in taxation, land, welfare, procurement, justice, and identity into a cohesive, future-ready governance model.

CONCLUSION

Toward a National AI Infrastructure for Public Sector Automation in Pakistan: A Strategic Roadmap for Governance Transformation

Pakistan stands at a decisive moment in its governance evolution. For decades, fragmented bureaucratic systems, manual verification procedures, limited institutional coordination, and pervasive corruption have undermined state capacity and public trust. Yet the country simultaneously possesses a set of unique assets: NADRA's world-class identity system, rapidly improving digital literacy, emerging fintech ecosystems, expanding broadband coverage, and an increasingly reform-minded policy community. This combination creates a historic opportunity: the possibility of building a **National AI Infrastructure (NAII)** that fuses identity, taxation, land records, welfare, procurement, and sectoral databases into one integrated, automated, transparent, and intelligent governance ecosystem.

The preceding chapters have demonstrated that AI is not an isolated technology upgrade; it is an **institutional reinvention** of how the Pakistani state collects information, processes decisions, allocates resources, and safeguards citizen rights. When combined with strong legal frameworks, ethical guidelines, cybersecurity protocols, and federated governance models, AI becomes a driver of national development rather than a source of risk. The NAII can transform Pakistan's governance architecture by reducing leakages, strengthening revenues, improving public service delivery, enhancing disaster response, enabling long-term planning, and restoring citizen trust.

The conclusion below synthesizes the cross-sectoral insights of earlier chapters, and articulates a strategic policy roadmap for implementing AI-enabled public sector automation at national scale.

A New Governance Paradigm for Pakistan

The modernization of Pakistan's public sector through NAII represents a decisive shift toward **evidence-based, automated, citizen-centered governance**. Centralizing identity verification, standardizing data exchange, embedding predictive analytics, and deploying autonomous verification systems across land, taxation, procurement, social protection, and justice institutions fundamentally alters the relationship between the state and society. With NAII, governance becomes:

- **Transparent**, with audit trails, digital logs, and minimal human discretion.
- **Integrated**, with real-time data exchange between federal and provincial sectors.
- **Predictive**, using machine learning to anticipate risks, fraud, and vulnerability.
- **Secure**, through sovereign cloud infrastructure and zero-trust cybersecurity.
- **Efficient**, reducing processing times, administrative burdens, and service delays.
- **Equitable**, ensuring that citizens receive rights and services without patronage networks.

In essence, NAII becomes the **backbone of a modern digital state**.

Strategic Policy Recommendations:

For Pakistan to successfully implement NAII, the government must adopt a multi-dimensional policy strategy involving legislation, institutional reform, capacity building, technology standards, and phased implementation.

1. Enact a National Data Governance & AI Security Act

Pakistan must establish a legal framework that governs:

- data protection and privacy standards,
- cross-agency data sharing protocols,
- algorithmic accountability requirements,
- documentation of AI decision-making,
- rights for citizens to contest automated decisions,
- penalties for misuse of national data,
- oversight mechanisms for high-risk AI systems.

This legislation forms the ethical and legal foundation of NAII. Without it, institutions cannot share data securely or deploy AI transparently.

2. Establish the National AI Infrastructure Authority (NAIA)

A specialized federal authority must be empowered to:

- design national APIs, metadata standards, and interoperability protocols,
- maintain sovereign cloud and national data centers,
- oversee identity integration with NADRA,
- provide shared AI engines for fraud detection, risk scoring, and analytics,
- audit departmental AI models for fairness and security,
- coordinate federal–provincial data policies.

NAIA becomes the technical guardian of the digital state.

3. Mandate Full Interoperability Across Government Systems

Every public service—taxation, land, welfare, procurement, policing—must adopt:

- standardized data formats,
- secure APIs,
- uniform metadata schemas,
- audit-logged data exchange mechanisms.

The integration of NADRA, FBR, land registries, BISP/NSER, SECP, SBP, and municipal systems must no longer be optional; it must be a national requirement for digital governance.

4. Build a Government-Wide Sovereign Cloud (GovCloud PK)

Pakistan must invest in national data centers that guarantee:

- physical data sovereignty,
- low-latency compute access,
- high-performance GPU clusters for AI,
- secure enclaves for confidential datasets,
- 24/7 cybersecurity monitoring.

GovCloud PK ensures that critical national data is not dependent on foreign companies or external jurisdictions.

5. Modernize NADRA for AI-Driven Identity Integration

NADRA's role should evolve from a standalone identity authority into the **central verification spine** of the automated state. This requires:

- expanded API services,
- updated biometric systems,
- identity risk-scoring models,
- blockchain-secured identity logs,
- AI-enabled fraud detection units,
- integration with land, taxation, welfare, and procurement systems.

NADRA must serve as the "single source of truth" for identity in public services.

6. Digitize and AI-Enable Land Governance Nationwide

A unified national land registry requires:

- geospatial mapping,
- cadastral digitization,
- AI-enabled boundary and encroachment detection,
- NADRA-based owner authentication,
- blockchain-based registry integrity,
- national-level digital mutation workflows.

This reform eliminates patwari-driven manipulation and strengthens property rights.

7. Deploy AI for Taxation and Revenue Enhancement

FBR must implement:

- real-time invoice verification,
- e-invoicing across all sectors,
- lifestyle–income mismatch detection,
- machine learning audit selection,
- AI-driven customs valuation,
- integration with NADRA, land, and banking data.

This increases national revenue by trillions over a decade and reduces human discretion. This shifts Pakistan toward anticipatory governance helping citizens before crises escalate.

8. Develop Predictive Welfare Systems Using AI

Integrating AI into social protection enables:

- dynamic eligibility updates,
- fraud detection via anomaly analysis,
- climate vulnerability prediction,
- school dropout prediction,
- personalized welfare recommendations.

9. Modernize Procurement with AI-Based Transparency Tools

Pakistan must establish:

- a national supplier registry,
- automated bid evaluation,
- AI-based collusion detection,
- anomaly detection in pricing,
- satellite-based project monitoring,
- end-to-end e-procurement.

This single reform can save billions annually and dramatically reduce corruption.

10. Build Human Capacity for AI-Enabled Governance

Civil servants require:

- AI literacy training,
- digital governance certification,
- cybersecurity awareness programs,
- specialized AI fellowships and scholarships,
- incentives for tech adoption.

Technology cannot succeed without human capability.

11. Implement a Phased Rollout Strategy

Pakistan should adopt a three-phase roadmap:

- **Phase 1:** Build foundational NAII infrastructure (APIs, cloud, NADRA integrations).
- **Phase 2:** Modernize key sectors (taxation, land, welfare, procurement).
- **Phase 3:** Scale AI-driven predictive governance across departments.

This phased approach ensures stability, continuity, and political feasibility.

Benefits of Implementing the National AI Infrastructure

The benefits of NAII extend across economic, governance, social, and institutional dimensions.

1. Economic Benefits

The NAII enhances fiscal capacity by reducing evasion, fraud, and leakage, leading to substantial increases in government revenue. Improved procurement transparency results in cost savings of 15–25%, while automated taxation and customs systems increase collection efficiency. Clarifying land titles unlocks dead capital, stimulates investment, and increases property-based taxation. Meanwhile, welfare precision reduces waste and ensures funds reach the right households, strengthening economic resilience.

2. Governance Benefits

A coherent AI-enabled approach undermines bureaucratic silos, makes public services more efficient, provides less opportunities for corruption, and promotes uniform decision making across departments. Interoperability supports data driven policy, responsive crisis management, and planning for the long term. Automated compliance logs, audit trails and transparency dashboards enhance government accountability and reduce rent seeking.

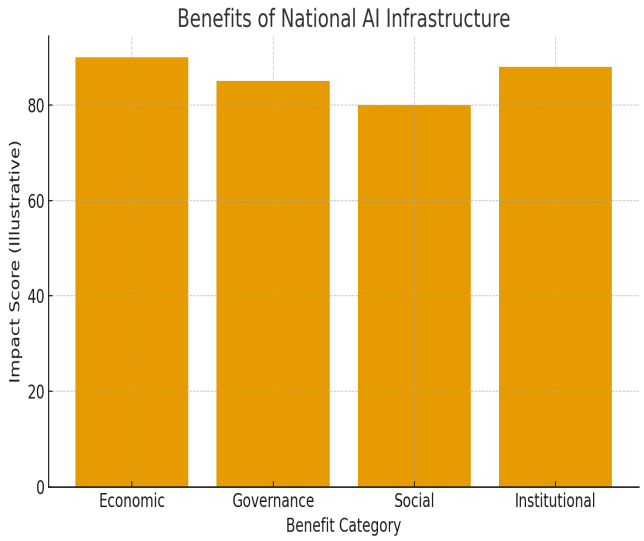
3. Social Benefits

NAII ensures that identity, welfare, and legal safeguards reach all citizens, including marginalized communities. Fairer taxation, clearer land rights, fraud free welfare access, and transparent procurement improve public trust in the state. AI enabled governance reduces harassment, bureaucratic delays, and discrimination while ensuring that assistance reaches vulnerable groups during climate emergencies, economic shocks, or health crises.

4. Institutional Benefits

AI-enabled automation bolsters the institutional capacity of Pakistan offering a level playing field, by removing discrepancies and enabling harmonious integration between federal and provincial authorities while enhancing the quality of public governance. It

will also bring Pakistan in line with global digital governance norms and enhance its competitiveness.



The comparative analysis of benefits reveals that the National AI Infrastructure (NAII) has a transformative impact across economic, governance, social, and institutional domains. The economic benefits rank the highest, driven by increased tax revenues, reduced procurement losses, and enhanced investment confidence. Governance improvements follow closely, reflecting gains in transparency, accountability, and real-time decision-making. Social benefits, particularly in welfare targeting and citizen service delivery, demonstrate significant equity and inclusion gains. Institutional benefits also rank high, highlighting improvements in inter-agency coordination, administrative efficiency, and long-term state capacity. Collectively, the benefits chart illustrates how NAII represents not just a technological upgrade, but a multi-sectoral governance reform with widespread national impact.

If implemented with care, transparency, and strong ethical safeguards, the National AI Infrastructure could become one of the most transformative public sector reforms in Pakistan's history. It can shift the state from reactive to predictive, from opaque to transparent, from discretionary to automated, and from fragmented to integrated. More importantly, it can ensure that governance serves the people, efficiently, fairly, and securely.

By embracing AI-enabled public sector automation, Pakistan positions itself among the emerging leaders of the global digital future. The vision is aspirational yet achievable: a modern, resilient, citizen-centered governance system capable of supporting national development for generations.