Journal of Pakistan Administration | 46(2): December (2025) | 136–157 | ISSN: 1027-1023

Transforming Public Procurement in Pakistan:

The Role of E-Procurement and Artificial Intelligence for Enhanced Efficiency and Transparency

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Suggested Citation:

Ghous, S. (2025). Transforming Public Procurement in Pakistan: The Role of E-Procurement and Artificial Intelligence for Enhanced Efficiency and Transparency. *Journal of Pakistan Administration. 46*(2). 136–157.

Received: July 15, 2025/ Accepted: October 22, 2025/ Published: December 1, 2025.

Abstract

This study investigates the transformative role of e-procurement and artificial intelligence (AI) in strengthening efficiency, transparency, and accountability within public procurement processes in Punjab, Pakistan. The primary objectives are to evaluate the performance of the e-Pakistan Acquisition and Disposal System (e-PADS), assess its conformity with international best practices, and identify opportunities for AI-enabled enhancement. A qualitative research design was employed, comprising semi-structured interviews with key stakeholders from PPRA, PITB, and LDA, supplemented by an extensive review of policy documents, government reports , and academic literature. The findings indicate that e-PADS has contributed to substantial improvements in procedural efficiency, cost reduction, and auditability; nonetheless, critical limitations persist, including partial automation, inadequate digital literacy, institutional resistance, and the absence of a regulatory framework for AI integration. Comparative analysis with leading global systems—such as KONEPS, e-GP, and AusTender—reveals notable gaps in cross-border procurement facilitation, grievance redressal mechanisms, SME inclusion, and comprehensive end-to-end digitalisation. The study concludes that AI integration holds significant potential to enhance risk management, fraud detection, supplier performance evaluation, and strategic decision-making.

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The paper offers targeted policy recommendations aimed at legal reform, institutional capacity strengthening, technological advancement, and broader stakeholder accessibility, contributing to ongoing efforts to modernise Pakistan's public procurement ecosystem.

Keywords: *E-Procurement, Artificial Intelligence (AI), Public Procurement, Transparency and Accountability, Digital Governance, e-PADS (Pakistan).*

1. Introduction

E-public procurement systems (E-PPS) are transforming procurement by enhancing transparency, efficiency, and accountability, allowing governments to optimise procurement processes and save expenses (Ahmad, 2024). E-procurement streamlines procurement processes by automating manual tasks, reducing paperwork, and enabling faster transaction processing. When integrated with AI, efficiency is further amplified through advanced data analytics, automation, and decision-support capabilities (Cui, Li, & Zhang, 2022). Transparency in e-procurement is improved through digital traceability and AI's ability to monitor and analyse procurement activities. AI enhances this by providing tools for real-time monitoring and fraud detection.

The public procurement lifecycle, from planning to contract award, has historically been cond-ucted manually, often leading to delays and inefficiencies. To address these problems, the Punjab Procurement Regulatory Authority (PPRA), in partnership with the Federal PPRA andthe Punjab Information Technology Board (PITB), has effectively executed the e-PADS across Punjab under the World Bank's PRIDE Programme (Shabbir, 2025). Primary benefits of e-PADS include but not limited to the following; reduction in processing time, cost saving, public confidence, environmental impact due to less paper consumption and increased transparency and accountability leading to legitimate audit trail (Latif, 2025).

Public procurement constitutes a substantial portion of a nation's gross domestic product (GDP), often ranging from 10% to 25%, so making even minor improvements in procurement procedures is very impactful (Ahmad, 2024). For example, the European Union (EU) has demonstrated that a 10% decrease in public procurement expenditures may eradicate budget imbalances in certain EU member states. Simultaneously, South Korea's execution of E-PP has yielded $6 billion in economic advantages, both concrete and intangible, by decreasing transaction costs and enhancing procurement efficiency (Ahmad, 2024). Pakistan spends around 20% of GDP on public procurement annually (Hussein & Najib, 2025). This paper analyses how e-procurement systems along with AI driven solutions can optimize procurement workflows, mitigate corrupt practices, enhance accountability, and cost savings.

This article analyses e-procurement systems of world leaders like South Korea,

Australia, India and Bangladesh. It delves into distinctive characteristics of each system and identifies modules which are undeveloped in the e-PADS. It also compares procurement framework of Pakistan with procurement frameworks of the World Bank, Korea, Bangladesh and offers insights into existing gaps and gives recommendations on the basis of global best practices that can be applied to enhance e-procurement framework, and thereby efficiency and transparency.

1.1. Statement of Problem

Public procurement in Pakistan has been historically characterised by corruption, lack of transparency and systemic inefficiencies, resulting in substantial financial losses and suboptimal service delivery (Azim, 2025). Conventional procurement methods are predominantly manual, and prone to discretionary practices, and procedural delays. E-procurement system called E-PADS has been implemented in a total of 6109 entities in the Punjab at the District level; however, its implementation at Tehsil level in Punjab is pending (Azim, 2025). Moreover, AI integration into E-PADS is still lacking which impacts efficiency and transparency in public procurement processes.

1.2. Key Research Questions

I. How can adoption of e-procurement system in the public sector in Punjab increase procurement efficiency and transparency?

II. What are the key challenges in the integration of AI into e-procurement system (E-PADS) in Punjab?

III. How can AI-integration with E-PADS increase efficiency and transparency in the procurement process?

1.3. Significance and Scope of the Study

Public procurement typically accounts for 10% to 25% of a country's gross domestic product (GDP). Consequently, even marginal enhancements in procurement processes can generate substantial fiscal and administrative benefits (Ahmad, 2024). Evidence from the European Union (EU) illustrates that a 10% reduction in public procurement expenditure has the potential to eliminate budgetary imbalances in several member states. Pakistan allocates nearly 20% of its annual GDP to public procurement activities, underscoring the critical importance of optimizing procurement practices within the national context (Hussein & Najib, 2025). This research article analyses the implementation of E-PADS in Punjab and its impact on improving efficiency and transparency in public procurement processes. This study seeks to identify gaps in procurement policy by comparing procurement framework of Punjab ith the policy frameworks of the World Bank, Korea, and Bangladesh.

2. Research Methodology

The methodological approach employed in this research is qualitative. Data were collected using both primary and secondary sources. Primary data for this study were collected using semi-structured interviews with the participants. Secondary sources of data such as document analysis, reports of the World Bank, news articles, academic articles, policy documents, government notifications and official briefings and presentations were analysed.

Semi-structured interviews with the help of an interview guide to address specific issues were conducted. In this study, the unit of analysis is E-PADS. Therefore, individuals involved in the development of e-PADS as well as its users were selected for interviews. A sample of eight (5) individuals was selected for interviews from PPRA, PITB, LDA based on purposive sampling method. Purposive sampling method was used because it enables to choose specific people who can provide important information that could not be obtained from other sampling designs (Maxwell, 1997). The procedure of selecting information-rich cases is called intensity sampling that is a type of purposive sampling (Gray, 2014).

Table 1

Sampling Technique

Category	Description
Sampling Technique	Purposive sampling. Intensity sampling was used as a subtype of purposive sampling. The selection criterion emphasized information-rich participants.
Population	Punjab Information Technology Board (PITB), Punjab Procurement Regulatory Authority (PPRA), Lahore Development Authority (LDA)
Sample Size	Five participants
Participants	(i) Director General, PITB (ii) Project Manager, E-PADS (iii) Managing Director, PPRA (iv) Lead Trainer, PPRA (v) Engineer, LDA
Tool of Data Collection	Semi-structured interviews

3. Literature Review

The literature review deliberates over key concepts of E-procurement & AI; and examines the role of e-procurement and AI into e-procurement systems for

enhancing efficiency and transparency. Each component supports the research questions that seek to investigate as to how adoption of e-procurement can increase procurement efficiency and transparency; and the challenges involved in the integration of AI into e-PADS in Pakistan.

"E-procurement refers to the use of technology to execute procurement operations, including sourcing, bidding, contracting, and payment, using online platforms. E-procurement offers several advantages, including enhanced transparency, increased efficiency, and less corruption within the procurement process" (Kumar, Khan, & Aziz, 2023). While the Public Procurement Regulatory Authority (PPRA) introduced E-Procurement technology, its adoption remained slow (Kumar, Khan, & Aziz, 2023).

E-procurement streamlines procurement processes by automating manual tasks, reducing paperwork, and enabling faster transaction processing. When integrated with AI, efficiency is further amplified through advanced data analytics, automation, and decision-support capabilities. By automating routine tasks such as document processing, data entry, and supplier data analysis, AI, assists procurement professionals to focus on strategic activities (Cui, Li, & Zhang, 2022). For instance, AI tools can analyze large datasets to identify optimal suppliers or predict market trends, improving the preparation phase of procurement by providing insights into supply market dynamics (Wolfgang & Fabian, 2022). In the execution phase, AI-driven contractual tools ensure compliance with best practices and legislation, reducing errors and processing time (Andersson, Katrina, & Rosenqvist, 2025). Additionally, AI enhances forecasting capabilities through machine learning, optimizing procurement planning and reducing delays. E-procurement platforms facilitate real-time bidding and supplier interactions, while AI can simulate negotiation scenarios to achieve better outcomes, shortening procurement cycles. These combined capabilities lead to faster, more cost-effective processes, with the document noting time-saving benefits as a key advantage in public procurement (Andersson, Katrina, & Rosenqvist, 2025).

Transparency in e-procurement is improved through digital traceability and AI's ability to monitor and analyse procurement activities. E-procurement platforms create a centralized, auditable record of all transactions, ensuring that processes are documented and accessible for review, which aligns with public procurement's need for accountability (Sanchez-Graells, 2024). AI enhances this by providing tools for real-time monitoring and fraud detection. For example, AI can analyse supplier data to detect fraudulent or criminal behaviour, such as non-compliance with environmental or social sustainability standards, thereby ensuring fair supplier selection (Andersson, Arbin, & Rosenqvist, 2025). In the contract management phase, AI enables continuous monitoring of supplier performance, ensuring adherence to contractual obligations and reducing corruption risks (Iryna, Elina, Aki, Heikkilä, & Anni-Kaisa, 2022). AI's ability to track sustainability and compliance contributes to public value by fostering trust

among stakeholders, including citizens and suppliers (Andersson, Katrina, & Rosenqvist, 2025). Furthermore, AI-driven analytics can generate transparent reports on procurement outcomes, making it easier to demonstrate fairness and compliance with legal frameworks, which is critical in public procurement due to stringent regulatory requirements (Sanchez-Graells, 2024). By combining e-procurement's digital infrastructure with AI's analytical power, agencies can maintain high levels of transparency, ensuring that processes are open, equitable, and accountable.

A large body of literature on AI technology and public procurement provide several potentials, alongside problems including ethical, legal, and safety issues (Sanchez-Graells, 2024). The use of advanced technologies, such as artificial intelligence, entails the processing of vast quantities of data, raising concerns over their security in connection to data protection rights. (Nowicki, 2020) emphasises the significance of adequate quantity and quality of data as a prerequisite for achieving optimal outcomes in the use of machine learning and AI in public procurement which might be tough. Nowicki (2020) posits that achieving exponential development in the domain of AI is a formidable challenge, alongside the creation of legal regulations that are sufficiently adaptable to prevent obsolescence, while also guaranteeing enough security and legal clarity.

4. Situational Analysis

E-PADS has been implemented across Pakistan as per the direction of the Prime Minister of Pakistan. However, Punjab took the lead where system is implemented across province since July 2024. The system has exhibited significant improvements in terms of transparency, efficiency, accountability and value for money, contributing to broader economic growth (Shabbir, 2025).

4.1. Status of e-Procurement in Pakistan as of 30th April 2025

Table 2

Key Figures for e-PADS as of 30th April 2025

PPRA	Petty Purchase		Request for Quotation (RFQ)		Open Competitive Bidding (OCB)		Registered Suppliers
	Completed	**In-Progress**	**Completed**	**In-Progress**	**Completed**	**In-Progress**	
Federal	22,177	3,467	12,724	3,960	1,943	7,587	20,369
Punjab	262,891	10,669	49,563	4,014	7,052	11,815	18,484
Sindh	06	48	09	74	408	1028	6,657
KPK	0	0	0	1	0	149	1989

PPRA	Petty Purchase		Request for Quotation (RFQ)		Open Competitive Bidding (OCB)		Registered Suppliers
Total	285,074	14,184	62,296	8,049	9,403	20,579	47,489

E-procurement systems have seen substantial evolution during the last thirty years. The oldest documented system, Canada's MERX, was initiated in 1991 and is regarded as one of the seminal efforts in electronic public procurement (Ahmad, 2024). Subsequent to its success, other governments across various continents began the implementation of their own e-procurement systems. The Republic of Korea implemented its respective system, KONEPS in the late 1990s. Australia also had rapid progress in the late 1990s, as many states adopted e-procurement programs such as EC4P and Aus-Tender. By the early 2000s, the worldwide usage of e-procurement had proliferated.

4.2. Legal, Policy and Institutional Framework

4.2.1. Federal E-Pakistan Acquisition and Disposal System (e-PADS)

At the Federal level, the Programme was initially piloted on March 1, 2023, and focused only on the health and education sectors; however, it has now been adopted by all procuring agencies. The legal framework for federal public procurement in Pakistan is anchored in the PPRA Ordinance 2002 and the Public Procurement Rules 2002, which were amended in 2020 to provide statutory support for e-procurement. Subsequent reforms, including the rollout of E-PADS in 2023, enhanced transparency and efficiency. The procurement law has undergone twenty-two revisions, introducing standard bidding documents, ADR mechanisms, and safeguards against monopolistic practices, alongside requirements for beneficial ownership disclosure.

The institutional framework is led by the Public Procurement Regulatory Authority, established in 2004 to ensure transparency, accountability, and quality in procurement. PPRA formulates regulations, monitors compliance, develops standard bidding documents, and supports capacity-building across federal agencies.

4.2.2. Punjab E-Pakistan Acquisition and Disposal System (e-PADS)

Each province in Pakistan has developed its own procurement regulatory framework modelled on the federal PPRA but tailored to provincial needs. As this article focuses on Punjab, therefore, relevant legal and institutional structures are outlined in this section. Punjab's regulatory framework is grounded in the Punjab Procurement Regulatory Authority Act, 2009, and the Punjab Procurement Rules, 2014, amended in 2024. These rules parallel federal provisions while introducing additional requirements for performance indicators, capacity building, and standard bidding documents. The 2024

amendment—issued through Notification No. SO(I&C-1) 5-4/2024—formally incorporated e-procurement via Rule 3A, mandates the use of the Punjab Online Procurement System (POPS) and standardised procedures for tendering and bidder eligibility (Ahmad, 2024).

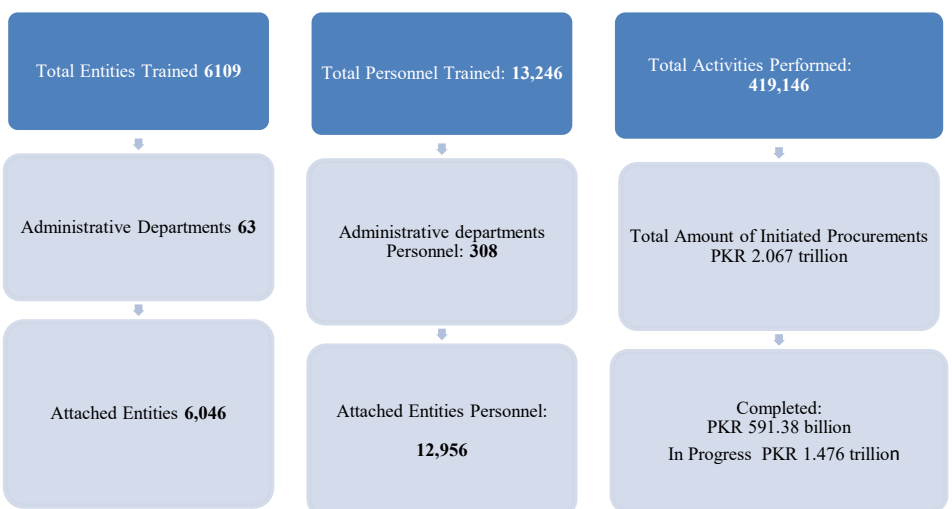
Institutionally, Punjab expanded digital procurement in 2024 through the e-Punjab Acquisition and Disposal System (e-PADS), implemented under the PPRA Act, 2009 (Ahmad, 2024). The Punjab PPRA oversees procurement regulation, monitors compliance, establishes performance indicators, supports capacity building for procuring agencies, and manages the POPS platform to ensure transparent and uniform e-procurement practices across the province.

4.3. Current Status of e-Procurement in Punjab

All administrative departments attached departments/autonomous bodies/special institutions/companies of all administrative departments of Punjab (including South Punjab) have been trained with hands-on experience and are using e-PADS. Furthermore, all divisional and district offices of Punjab have been trained with hands on experience and are using e-PADS (Azim, 2025). However, trainings of Tehsil offices (THQs, MCs, Colleges etc.) are in progress.

Figure 1

Current Status of e-Procurement in Punjab As of 2nd June 2025 (Azim, 2025)



4.4. Legal, Regulatory and Institutional Framework for AI

Presently, AI integration with e-PADS, is non-existent in both the federal and Punjab e-PADS. Furthermore, the regulatory and institutional framework for AI is also not present. Pakistan is developing an AI policy and regulations which

not been approved/passed yet (Latif, 2025). The "Digital Pakistan" vision led MoITT to publish a Draft National AI Policy in May 2023. The policy promotes a knowledge-based economy, responsible AI adoption, and digital economy growth to position Pakistan as a global AI leader. On 9th September 2024, Senator Afnan Ullah Khan presented the Regulation of Artificial Intelligence Act 2024 in Pakistan's Senate, which is pending approval. The legislation aims to provide a complete framework for controlling artificial intelligence to lower risks and promote responsible use.

5. Analysis and Findings

The Analysis and Findings section employs an integrated qualitative framework to evaluate the performance, limitations, and enhancement potential of the e-Pakistan Acquisition and Disposal System (e-PADS). Through thematic analysis of interview data, document review, and comparative benchmarking with international systems such as KONEPS, e-GP, AusTender, and GeM, the study identifies key areas of alignment and divergence in system efficiency, transparency, and digital capability. A structured gap analysis against World Bank and global best-practice standards further delineates functional and regulatory shortcomings. Additionally, a SWOT analysis provides an organisational evaluation of strengths and vulnerabilities, while a fishbone analysis identifies the root causes underpinning challenges to AI integration. Collectively, these analytical tools offer a rigorous and comprehensive assessment of e-PADS and the reforms necessary to strengthen Punjab's digital procurement ecosystem.

5.1. Comparative Analysis of Public e-Procurement Systems

This section provides a detailed comparative analysis of the e-procurement system features of South Korea (KONEP), Bangladesh (E-GP), Australia (Aus Tender) and India (Gem) with E-PADS.

Table 3

Comparative Analysis of public e-Procurement Systems

S_NO	FEATURE	KONEPS	E-GP	AUS Tender	GeM	E-PADS
1	e-Catalogue	Available	Available	Available	Available	Partially Available
2	e-APP	Available	Available	Available	Available	Available
3	e-Access	Available	Available	Available	Available	Available
4	e-Identity	Available	Available	Available	Available	Available
5	e-Attestations	Available	Available	Available	Available	Not Available
6	e-Noticing	Available	Available	Available	Available	Available
7	e-Tendering	Available	Available	Available	Available	Available
8	e-Testing & Evaluations	Available	Available	Available	Available	Available
9	e-Awarding	Available	Available	Available	Available	Available
10	e-CMS	Available	Available	Paltry	Available	Not Available
11	e-Auctions	Available	Unavailable	Unavailable	Available	Not Available
12	e-Archiving	Available	Available	Available	Available	Available
13	e-Journal	Available	Available	Paltry	Available	Not Available
14	e-Marketplace	Unavailable	Unavailable	Unavailable	Available	Not Available
15	GRM	Unavailable	Available	Unavailable	Available	Not Available
16	SRM	Unavailable	Unavailable	Unavailable	Available	Not Available

5.2. GAP Analysis: A Comparison with the World Bank, KONEPS and e-GP

This gap analysis will evaluate the regulations governing E-Pak Acquisition and Disposal System (E-PADS) against internationally recognised frameworks established by the World Bank as well as e-procurement systems implemented in Korea, and Bangladesh. The aim is to pinpoint particular deficiencies in E-PADS by assessing its legislative framework, system architecture, transparency procedures, and user accessibility in comparison to the attributes and best practices of comparable worldwide systems. This research will provide a clear evaluation of how E-PADS conforms to or diverges from worldwide e-procurement standards by concentrating on the unique characteristics of each system.

5.2.1. The World Bank

5.2.1.1. Cross-border procurement

The World Bank facilitate cross-border procurement, enabling bidders from many nations to participate in tenders seamlessly, supported by established norms for international procurement, including currency conversion and language translation resources.
Pakistan: E-PADS, while accessible to foreign bidders, still lacks comprehensive assistance for cross-border bidding, especially regarding the management of different currencies, tax legislation, and adherence to international regulatory standards.

Gap: The WB systems prioritise universal participation via integrated tools for

managing cross-border transactions, a feature that is now undeveloped in E-PADS.

5.2.1.2. Grievance Redressal Procedures and Evaluations

- World Bank: The procurement standards of the WB mandate the incorporation of comprehensive complaint-handling systems into the e-procurement system, as well as automatic auditing functionalities that identify irregularities for evaluation by independent panels.
- Pakistan: E-PADS has fundamental complaint reporting functionalities; nevertheless, comprehensive audit monitoring and automatic anomaly identification remain under development.
  Gap: MDB systems emphasise formal complaint channels and automated audit trails that are more advanced than those now offered in e-PADS.

5.2.1.3. KONEPS

i. End-to-End Automation:

- KONEPS handles the entire procurement process from bidding to payment electronically, reducing paper documentation through data sharing with other public agencies (e.g., business registration and tax certificates). It is completely paperless and uses blockchain for security and transaction integrity.
- Pakistan: e-PADS provides electronic submission and assessment tools; nevertheless, it still incorporates manual procedures at certain stages, particularly in contract management and bid review.
- Gap: KONEPS is fully automated, including payment stages and contract award, whereas, e-PADS is partially automated.

ii. Vendor Registration and Prequalification:

- KONEPS in Korea facilitates ongoing vendor registration and automated pre-qualification, with real-time updates.
- Pakistan: E-PADS mandates that suppliers register manually, and the pre-qualification procedure is distinct and not entirely integrated into the system. Korea's real-time vendor pre-qualification is far more efficient than Pakistan's mostly manual procedure.
- Gap: Pakistan’s partially manual system makes it less efficient as compared to KONEPS.

iii. Transparency

- All procurement information is publicly accessible online, reducing opportunities for corruption by eliminating unnecessary supplier visits to public offices.

- Gap: Procurement information is not publicly accessible online.

iv. Security

- KONEPS employs advanced security measures, including PKI and redundant systems to ensure uninterrupted service.
- Gap: There is no AI integration in e-PADS, therefore, PKI feature is not available.

v. International Recognition

KONEPS is recognized by the UN and OECD for its high standards, processing nearly two-thirds of South Korea's public procurement market

5.2.1.4. Bangladesh's E-GP:

i. Focus on SME Inclusion:

- Bangladesh: e-GP has specific features designed to promote (SME) participation in public procurement. It provides a streamlined bidding process for SMEs, including reduced bid security requirements and simplified documentation.
- Pakistan: E-PADS does not yet have special provisions or separate modules tailored for SME participation in procurement.
- Gap: Bangladesh has dedicated modules to encourage SME participation, while Pakistan's system treats all bidders uniformly, with no simplified processes for smaller companies.

ii. Localized Language Interface:

- Bangladesh: The e-GP system supports multiple language options, including Bangla, allowing local contractors and smaller businesses with limited English proficiency to participate more easily.
- Pakistan: E-PADS operates predominantly in English, which can limit participation from local, non-English speaking contractors.
- Gap: Bangladesh's multilingual interface is more inclusive for local users, while Pakistan's system could be more accessible with language options.

This research highlights many critical areas where E-PADS has deficiencies in compared to worldwide best practices. Significant shortcomings include the lack of comprehensive end-to-end automation in procurement procedures, which constrains E-PADS from delivering smooth, paperless operations akin to systems such as Korea's KONEPS. E-PADS also lacks robust cross-border procurement capabilities, which are crucial for enticing foreign bidders and promoting global involvement, a domain in which (MDBs) have established significant benchmarks. Moreover, the system's inability to match comparable bids and

notify the relevant suppliers limits its capacity to enhance procurement results. Moreover, a notable disparity exists regarding accessibility for (SMEs), as Bangladesh's e-GP system exemplifies by providing streamlined procedures designed for smaller bids, hence promoting inclusion

5.3. SWOT Analysis of E-PADS system (Punjab)

5.3.1. Strengths

The E-PADS system in Punjab demonstrates several notable strengths that collectively enhance the efficiency and integrity of public procurement. Its digital architecture significantly improves transparency and accountability by limiting human intervention, minimising corruption risks, and creating a comprehensive audit trail of all procurement activities. Automation accelerates tendering and bidding processes, reduces paperwork, and mitigates manual errors, thereby improving administrative efficiency. The system further promotes standardisation by ensuring uniform procurement procedures, templates, and compliance with Punjab Procurement Regulatory Authority (PPRA) rules across departments. Centralised data facilitates real-time monitoring, analytical reporting, and informed decision-making, contributing to improved vendor assessment and performance evaluation. Additionally, remote accessibility enables wider supplier participation, while digital transparency and competitive bidding contribute to substantial operational and logistical cost savings.

5.3.2. Weaknesses

Despite its advantages, the E-PADS platform faces several structural and operational limitations that hinder its full effectiveness. The system lacks end-to-end automation, particularly as contract management, bid security submission, and handling of financial instruments continue to be executed manually. Resistance to change among government officials and suppliers accustomed to traditional processes also affects system adoption. Capacity constraints, including limited digital literacy and insufficient trained personnel in various departments and lower administrative tiers, further impede optimal utilisation. Dependence on stable internet connectivity creates challenges in rural and underdeveloped regions, while technical issues such as potential system downtime, bugs, and the need for continuous IT support pose additional risks. Vendor onboarding remains limited, partly due to inadequate awareness or technological capacity among smaller suppliers. Differences between federal (FPPRA) and Punjab PPRA regulations require harmonisation, and resource constraints have delayed implementation at the tehsil level. Training the large number of personal assistants in Punjab also remains a significant logistical challenge.

5.3.3. Opportunities

The E-PADS system holds substantial potential for expansion and enhancement within Punjab's public procurement landscape. It can be scaled to integrate with

related government platforms such as E-FOAS, PRIDE, and budget management systems, thereby enabling a more cohesive digital governance ecosystem. Its adoption can be extended to local governments and autonomous bodies, contributing to broader institutional digitalisation. The system also provides a favourable environment for strengthening policy and legal frameworks, including the introduction of updated e-procurement guidelines and amendments to PPRA rules. By promoting transparency and standardisation, E-PADS has the capacity to enhance public trust and attract donor and investor confidence. Furthermore, the system can stimulate growth in Punjab's vendor ecosystem by encouraging digital adoption among suppliers and fostering a more robust e-commerce environment. Expansion of training programmes and ICT capacity-building initiatives offers an additional opportunity to strengthen institutional capabilities and promote long-term sustainability.

5.3.4. Threats

Several external threats may affect the long-term effectiveness and sustainability of the E-PADS system. Cybersecurity vulnerabilities, including risks of hacking, data breaches, and other cyber-attacks, pose significant concerns for system integrity and public trust. Political shifts, administrative changes, or policy reversals may disrupt system continuity or reduce institutional commitment to e-procurement reforms. Legal challenges from dissatisfied vendors also create potential obstacles, particularly in cases where procurement outcomes are contested. The risk of underutilisation remains high if departments revert to hybrid or manual processes, undermining the system's intended benefits. Additionally, digital disparities among suppliers may enable technologically advanced or larger vendors to dominate procurement activities, thereby reducing competition and potentially leading to market monopolisation.

5.4. Fishbone Analysis: Challenges of AI Integration into e-PADS

This section identifies several key challenges associated with integrating artificial intelligence (AI) into public procurement processes. These challenges are primarily categorized into Policy, process, organizational, technological, digital literacy and environmental challenges.

Policy: Policy framework for integration of AI into e-PADS is non-existent. The AI Bill remains unfinalized, and currently, there are no established regulations regulating the use of AI in public offices (Latif, 2025).

Organizational challenges: These include a lack of top management support, often coupled with rigid, silo-based structures and a culture resistant to digitalization, which hinders AI adoption (Enholm et al., 2021; Merhi, 2023).

Process: Process related challenges involve concerns about resistance, inertia, and unclear responsibilities due to limited AI capabilities and technical expertise within agencies. Technological: Technological challenges are significant,

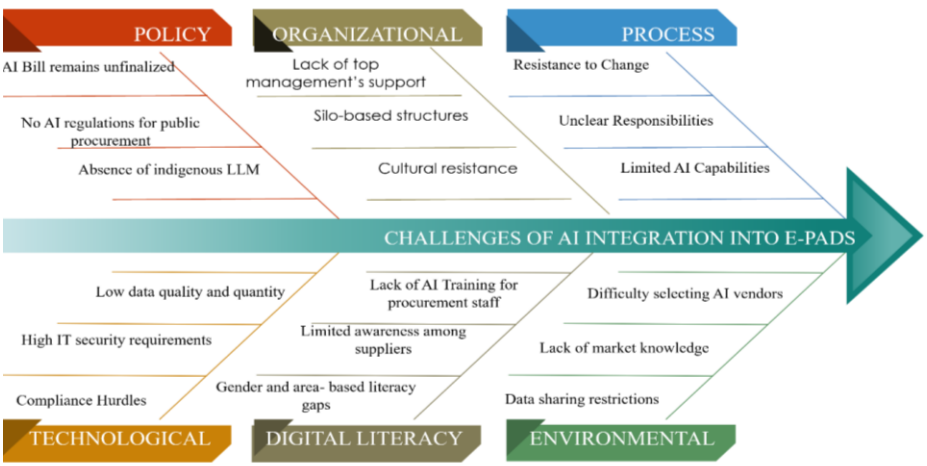
particularly around data management, with issues such as low data quality, insufficient data quantity, data security, and governance posing barriers (Merhi, 2023; Nowicki, 2020). Additionally, high IT security requirements, especially for agencies handling sensitive data, complicate the use of external AI vendors, while legal and regulatory compliance further restricts implementation (Sanchez-Graells, 2024b).

Digital literacy and Training: Digital literacy and training for procurement staff and suppliers remains a significant challenge.

Environmental: It includes difficulties in selecting vendors and a lack of market knowledge about AI solutions, compounded by agencies' inability to share data due to legal restrictions, which limits collaborative efforts (Nowicki, 2020).

Figure 2

Fishbone Analysis of Challenges of AI Integration in e-PADS



5.5. The Perceived Benefits of AI integration into E-PADS

E-procurement, the use of digital platforms to manage procurement processes, combined with AI, significantly enhances efficiency and transparency in public procurement. This section discusses how these technologies contribute to these outcomes, drawing on insights from the literature and unstructured interviews. Current research posits that emerging technologies, such as AI, will unequivocally enhance and optimise the public procurement system. (Nowicki, 2020) contends that machine learning and AI provide significant prospects, particularly in the planning and preparation of awarding processes for specific contracts, as well as in the management of public procurement contracts.

5.5.1. Efficiency Enhancement

AI is seen to improve operational capabilities by automating routine tasks like document processing and data analysis, leading to time and labour savings, which allows procurement professionals to focus on strategic activities (Cui, Li, & Zhang, 2022)

5.5.2. Enhancing Transparency

BDA provides real-time access to procurement data, such as bidding information, ensuring stakeholders can monitor processes transparently. By reducing human interference in bidding and procurement activities, AI minimizes biases and promotes fairness .AI supports consistent and open information sharing, making procurement processes more visible and traceable (Alnuaimi, Chatha, & Abdallah, 2024)

5.5.3. Improving Accountability

It enhances process effectiveness through better supplier selection, fraud detection, and compliance monitoring, particularly in the preparation and contract management phases, where AI can identify new suppliers and ensure adherence to sustainability standards (Iryna, Elina, Aki, Heikkilä, & Anni-Kaisa, 2022).

5.5.4. Improved Public Service Delivery

Long-term benefits include broader societal impacts, such as improved public service quality, citizen satisfaction, and market development by fostering competition and innovation among suppliers, especially small and medium-sized enterprises (Merete, Emmanouil, Mikalef, & John, 2022).

5.5.5. Sustainability

AI also supports sustainability by monitoring environmental and social compliance in supply chains, contributing to public value creation (Iryna, Elina, Aki, Heikkilä, & Anni-Kaisa, 2022).

5.5.6. Streamlining Data Processing and Decision-Making

AI-driven BDA processes vast and complex datasets in real time, enabling faster and more accurate procurement decisions. It automates data analysis to uncover patterns and anomalies, reducing manual effort and improving operational efficiency (Merete, Emmanouil, Mikalef, & John, 2022)

5.5.7. Optimizing Supplier Relationships

AI-powered e-procurement coordination (EPC) applications facilitate seamless information exchange with suppliers, improving partnerships and coordination. Real-time data sharing via AI systems enhances collaboration, reducing delays and miscommunications (Alnuaimi, Chatha, & Abdallah, 2024).

5.5.8. Enhancing Performance Outcomes

AI improves both financial performance (e.g., cost reduction, higher profit margins) and non-financial performance (e.g., service quality, supplier satisfaction) by leveraging data-driven insights (Alnuaimi, Chatha, & Abdallah, 2024).

5.5.9. Supporting Strategic Decision-Making

AI provides actionable insights from large datasets, enabling strategic procurement planning and better resource allocation. It aligns procurement strategies with organizational goals by analyzing market trends and supplier performance (Merete, Emmanouil, Mikalef, & John, 2022) .

6. Conclusion

This study set out to examine the performance of the e-Pakistan Acquisition and Disposal System (e-PADS), assess its alignment with international best practices, and explore the prospects for AI-enabled enhancement within Punjab's public procurement landscape. The findings demonstrate that while e-PADS has contributed meaningfully to improving transparency, standardisation, and procedural efficiency, its impact remains constrained by partial automation, uneven institutional capacity, and gaps in regulatory and technological readiness. Comparative analysis with global systems—including KONEPS, e-GP, AusTender, and GeM—reveals significant structural and functional disparities, particularly in end-to-end digitalisation, cross-border procurement facilitation, SME inclusion, and integrated grievance redressal. The gap analysis further underscores the system's divergence from established World Bank procurement standards, while the SWOT and fishbone analyses highlight persistent organisational inertia, fragmented governance arrangements, limited digital literacy, and the absence of an enabling AI policy framework as core impediments to reform. Collectively, the evidence suggests that e-PADS represents an important but incomplete step toward modernising public procurement in Punjab. It requires not only technological upgrades but also deeper institutional reforms grounded in policy coherence, capacity strengthening, and strategically governed AI integration. Without addressing these structural deficits, the transformative potential of digital procurement—particularly its promise of enhanced accountability, efficiency, and public value—will remain only partially realised.

7. Recommendations

The following recommendations are proposed to strengthen the efficiency, transparency, and institutional robustness of the e-PADS platform in Punjab. These recommendations are grounded in the findings of the SWOT analysis and aim to address existing system gaps while capitalising on emerging opportunities within the digital procurement landscape. By integrating

technological advancements, regulatory reforms, and capacity-building initiatives, these measures seek to enhance the long-term sustainability and inclusiveness of e-procurement across the public sector.

7.1. Facilitation of Cross-Border Procurement

Incorporating a cross-border procurement module within e-PADS would enable systematic engagement with international suppliers, supported by automated compliance checks aligned with global trade regulations. The provision of multilingual documentation, integrated currency conversion tools, and periodic upgrading of standards to match international procurement norms would enhance global competitiveness and ensure seamless participation by foreign vendors.

7.2. Contract Management Module inside E-PADS

The establishment of a contract management module within e-PADS would allow full digitisation of contract formulation, implementation, and monitoring. Integrating AI-enabled performance tracking mechanisms, automated alerts for milestone achievements, contract renewals, and compliance obligations would strengthen oversight. Utilisation of secure cloud-based storage and immutable audit trails would reinforce transparency, accountability, and long-term record integrity.

7.3. JV Registration Module

Introducing a dedicated Joint Venture (JV) registration module would streamline verification processes through the use of AI-based document authentication and partner credibility assessments. Automated evaluations of financial capacity, legal standing, and historical performance records of consortium members would reduce dependence on manual scrutiny and accelerate the verification of JV eligibility.

7.4. Automated Corrigendum Notification Mechanism

The development of an automated notification mechanism would ensure that all registered bidders receive real-time alerts regarding corrigenda or addenda issued at any stage of the tender cycle. The system should automatically extend response deadlines where appropriate, thereby enhancing procedural fairness and obviating the need to reissue entire tender documents following late-stage amendments. Such real-time updates would strengthen transparency and improve bidder confidence.

7.5. Online Guarantee Verification through Bank Integration

Integrating banking APIs into e-PADS would allow real-time digital verification of bid securities and performance guarantees. Automated authentication would significantly reduce delays and vulnerabilities associated with manual verification procedures, thereby enhancing procurement security through

traceable, system-generated verification logs.

7.6. Digitise Submission of Financial Instruments

The transition from manual to digital submission of financial instruments can be facilitated through the upload of digitally validated instruments via secure banking APIs. This measure must be supported by appropriate legal provisions and reinforced with advanced encryption protocols. It would streamline administrative processes, reduce processing time, and improve the reliability of audit trails.

7.7. Addressing Wrong Uploads with Smart Checks

The implementation of AI-driven verification tools within e-PADS would help identify inconsistencies, incomplete documentation, or incorrect file submissions by bidders. Intelligent prompts and real-time validation mechanisms would reduce clerical errors, thereby decreasing procedural delays and limiting the risk of litigation arising from bid submission discrepancies.

7.8. Financial Integration with Banks

Comprehensive integration between e-PADS and major financial institutions, supported by standardised digital templates and blockchain-enabled verification registries, would optimise the authentication of financial assurances. This approach would reduce turnaround time, enhance transparency, and mitigate risks associated with fraudulent, expired, or counterfeit instruments.

7.9. Integration of Company Performance History

Developing an integrated supplier performance dashboard within e-PADS would consolidate procurement histories, compliance records, project performance indicators, and grievance data. AI-generated reputation scores would assist procurement officials in making evidence-based decisions. This increased transparency would discourage repetitive engagements with underperforming firms and reduce post-award disputes.

7.10. Enforce E-Procurement in Public Sector

Formulating policy that require all public sector organisations to adopt e-procurement through e-PADS would institutionalise digital procurement practices across Punjab. It should be reinforced by amendments to procurement regulations, accompanied by a phased compliance schedule. A strengthened regulatory framework would support data centralisation and enhance the analytical capabilities of the procurement ecosystem, with PPRA serving as the lead implementation authority.

7.11. Capacity Building

A structured and continuous programme of capacity-building initiatives is

essential to improve digital proficiency among procurement officials and suppliers. Training programmes should adopt hybrid learning formats, offer accreditation, and be flexible enough to accommodate the diverse needs of stakeholders. Extensive training is required for personal assistants (PAs) across Punjab, and all tehsil-level procurement personnel should be fully trained by June 2025 to ensure uniform system adoption and institutional resilience.

7.12. Integrate Grievance Redressal with e-PADS

Integrating a formalised grievance redressal and feedback management mechanism into e-PADS would enable stakeholders to register, track, and resolve complaints more efficiently. AI-assisted categorisation and prioritisation tools would accelerate the handling of grievances. Public-facing transparency dashboards displaying timelines and resolution statistics would reinforce accountability and enhance user trust in the digital procurement environment.

7.13. Simplify e-PADS for Broader Supplier Access

Simplifying the e-PADS interface and registration procedures would significantly improve accessibility for small and medium-sized suppliers, especially those located in rural or underserved regions. A multilingual, mobile-responsive platform with reduced procedural complexity would promote broader participation. Additional support through helpdesks and digital literacy programmes would further democratise access to public procurement opportunities.

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