Adoption of Artificial Intelligence Technologies in Enhancing Dubai Electricity and Water Authority (DEWA) Operational Performance

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ABSTRACT

Objective: This study investigates the impact of Artificial Intelligence (AI) integration on the operational efficiency of the Dubai Electricity and Water Authority (DEWA), focusing on five specific AI technologies: AI Procurement in a Box Toolkit, GT Intelligent Controller, One Way Data System, Robotic Process Automation (RPA), and the Spot Robot.

Research Method: A quantitative research design was employed, using a structured questionnaire survey distributed to 253 DEWA employees who have experience using AI technologies. The data were analyzed through multiple linear regression to assess the statistical significance of each AI tool's effect on organizational performance.

Findings: The analysis led to the development of a conceptual framework demonstrating that four out of the five AI technologies examined had statistically significant effects on DEWA's operational performance. Among these, the GT Intelligent Controller emerged as the most influential predictor, followed by the AI Procurement in a Box Toolkit and Robotic Process Automation (RPA). In contrast, the One Way Data System exhibited a significant but negative relationship with performance, suggesting challenges related to system integration or compatibility. The Spot Robot did not show a statistically significant impact, indicating that its effectiveness may be limited at present or still in an early phase of implementation.

Originality: This study provides empirical evidence on the differential impact of individual AI technologies in a major utility organization. It contributes to the literature by offering a focused, tool-specific analysis of AI adoption and delivers practical insights for strategic, data-driven implementation of AI in the utilities sector.

Keywords: AI Technologies, DEWA, Operational Performance

1. INTRODUCTION

The accelerating integration of Artificial Intelligence (AI) across global industries is profoundly reshaping operational models, particularly within the utilities sector, where real-time responsiveness, efficiency, and sustainability are increasingly paramount. The Dubai Electricity and Water Authority (DEWA) serves as a leading example of how AI-driven transformation can enhance utility operations across multiple dimensions (Al Marri & Khan, 2023). By embedding AI technologies into its core infrastructure, DEWA has successfully transitioned from conventional utility management practices to a smart, data-centric framework that emphasizes predictive maintenance, operational optimization, and customer-oriented service delivery.

A basis of DEWA's transformation is its strategic implementation of AI-powered smart grids. These systems enable continuous, real-time monitoring and intelligent control of electricity and water distribution networks. By analyzing data from a vast array of sensors, these technologies can quickly detect anomalies and inefficiencies, thereby allowing maintenance teams to act proactively. This approach reduces both system downtime and maintenance costs, while also extending the operational lifespan of critical infrastructure components (Ahmed & Hussain, 2023). In parallel, the integration of AI in customer service operations through virtual assistants, intelligent

chatbots, and automated communication platforms has significantly enhanced user engagement, leading to faster issue resolution and improved customer satisfaction.

DEWA's investment in machine learning algorithms, advanced data analytics platforms, and robotic process automation has further strengthened its ability to forecast utility demand, optimize the allocation of resources, and improve grid reliability (Rashid & Salim, 2024). These advancements signify a shift toward data-informed decision-making. Rather than relying exclusively on historical data or manual oversight, DEWA now leverages AI to interpret real-time operational data, identify trends, and guide strategic interventions with a high degree of accuracy and efficiency.

The application of AI also plays a critical role in advancing DEWA's environmental sustainability goals. Through the use of predictive analytics and automated monitoring systems, the organization can identify inefficiencies early and take corrective action to minimize resource waste and reduce emissions. This approach aligns DEWA's operational objectives with broader national sustainability agendas and international climate commitments, highlighting the dual benefit of AI in improving both performance and environmental responsibility (Al-Farsi & Al-Maktoum, 2023).

Furthermore, AI has enabled DEWA to adopt a comprehensive and integrated resource management model. By anticipating fluctuations in demand and identifying potential system faults in advance, DEWA can strategically allocate its workforce and material resources, thereby improving operational continuity and reducing unnecessary expenditure. As urban populations grow and resource consumption intensifies, such capabilities are becoming increasingly critical to ensure consistent and reliable service delivery. These efforts also support long-term infrastructure resilience and operational scalability (Ibrahim & Noor, 2023).

DEWA's experience demonstrates the transformative power of Artificial Intelligence in modern utility management. The organization's strategic deployment of AI technologies has significantly enhanced operational efficiency, improved customer engagement, and contributed to environmental sustainability. By evolving its infrastructure into a smart, interconnected, and responsive system, DEWA offers a practical model for utility providers seeking to modernize their operations. The lessons from DEWA's AI journey present a valuable framework for others in the sector who aim to harness technological innovation for performance enhancement and sustainable growth (Al Zeyoudi & Rashed, 2024).

2. AI TECHNOLOGIES IN OPERATIONAL PERFORMANCE

The integration of Artificial Intelligence (AI) into the utilities sector has evolved from a novel innovation into a strategic imperative, driven by the need to enhance operational efficiency, optimize resource use, and meet growing sustainability targets. AI's role in this transformation is particularly evident in advanced utility providers such as the Dubai Electricity and Water Authority (DEWA), which has adopted a comprehensive suite of AI technologies to modernize its infrastructure and service delivery. Early academic discourse in this domain focused primarily on smart grids and predictive maintenance systems, emphasizing AI's potential to shift utility operations from reactive to proactive paradigms (Al Marri & Khan, 2023; Ahmed & Hussain, 2023). However, recent technological advances have led to broader applications, including real-time decision support, automated workflows, intelligent procurement, and customer experience optimization (Rahman et al., 2024; Zhao & Lin, 2023).

Among the key AI technologies transforming DEWA's operations are the GT Intelligent Controller, AI Procurement in a Box Toolkit, Robotic Process Automation (RPA), One-Way Data System, and the Spot Robot. Each plays a unique role in enhancing specific facets of organizational performance. The GT Intelligent Controller, for example, serves as a central hub for data-driven control of electricity flow and

system balancing. Through advanced machine learning algorithms and real-time sensor data analysis, it enables precise load forecasting and predictive fault detection, significantly reducing unplanned outages and improving system reliability (Rashid & Salim, 2024; Wang et al., 2023). It also supports distributed energy resource management, making it crucial in integrating renewable energy sources into existing infrastructure.

Complementing this, the AI Procurement in a Box Toolkit represents an innovative application of AI in strategic sourcing and supply chain management. By automating procurement workflows and applying predictive analytics to supplier performance and market conditions, this tool helps DEWA reduce lead times, improve cost efficiency, and mitigate procurement risks (Al-Farsi & Al-Maktoum, 2023; Singh & Kumar, 2023). Its implementation also contributes to improved transparency and compliance, which are critical in public sector utilities.

The use of Robotic Process Automation (RPA) further amplifies DEWA's operational capabilities by automating routine administrative tasks such as billing, meter reading reconciliation, and data entry. RPA not only accelerates these processes but also reduces human error and frees up personnel to focus on higher-value tasks such as strategic planning and technical maintenance (Chen et al., 2024; Oliveira & Rodrigues, 2022). It also enhances customer service by supporting backend operations that enable seamless front-end user interactions.

While the One-Way Data System was developed to facilitate centralized data aggregation and reporting, studies have identified limitations associated with its unidirectional communication architecture. Specifically, the inability to provide real-time feedback or adaptive responses can hinder its integration with dynamic AI applications, suggesting the need for future iterations to incorporate bidirectional data flow and interoperability with Internet of Things (IoT) networks (Zhang et al., 2024; Li & Qureshi, 2023). Nonetheless, it continues to play a supportive role in data collection and archival processes.

The Spot Robot, a mobile robotic platform equipped with sensors and AI navigation systems, has been piloted in field inspections, particularly in hard-to-reach or hazardous areas such as substations and underground water facilities. While its current impact remains limited due to scalability challenges and relatively high deployment costs, its potential to improve workplace safety and perform autonomous inspections in critical infrastructure environments is promising (Ibrahim & Noor, 2023; Gao & Patel, 2024). Future enhancements in robotic autonomy and AI-guided diagnostics could significantly broaden its utility.

Beyond operational improvements, AI integration supports DEWA's broader goals of environmental sustainability and digital transformation. AI-powered analytics contribute to optimizing energy and water consumption, minimizing waste, and achieving compliance with environmental regulations. Real-time monitoring and predictive maintenance enabled by tools like the GT Intelligent Controller and RPA help prevent resource overuse, while AI procurement systems ensure that sustainability criteria are embedded into purchasing decisions (Al Zeyoudi & Rashed, 2024; Torres & Medina, 2023).

Moreover, AI technologies enhance the customer experience by enabling responsive and personalized service delivery. AI-driven chatbots, virtual agents, and sentiment analysis tools facilitate real-time engagement, while RPA ensures accurate and timely back-end processing of customer requests and feedback (Ibrahim & Noor, 2023; Fernandez & Lee, 2023). These improvements are critical in fostering customer trust and loyalty, especially as utility consumers increasingly demand digital and efficient services.

The strategic deployment of AI technologies at DEWA reflects a holistic transformation that extends across operational efficiency, cost optimization, sustainability, and customer engagement. The integration of the GT Intelligent Controller, AI Procurement in a Box Toolkit, RPA, One-Way Data System, and Spot

Robot illustrates a multifaceted approach to digital innovation in utility management. These developments not only provide a model for regional utility transformation but also contribute to the global discourse on AI's role in building smarter, more resilient infrastructure systems.

3. METHODOLOGY

This study used a quantitative research approach to examine the influence of five Artificial Intelligence technologies on the organizational performance of the Dubai Electricity and Water Authority (DEWA). These technologies include AI Procurement in a Box Toolkit, GT Intelligent Controller, One Way Data System, Robotic Process Automation, and Spot Robot. A structured questionnaire was distributed to DEWA employees who are actively involved in or familiar with the use of these AI tools. Using purposive sampling, a total of 253 valid responses were collected. The questionnaire was divided into two main sections. The first section gathered demographic details of the participants, while the second section consisted of Likert scale questions designed to assess the perceived impact of each AI technology on key performance areas such as operational efficiency, predictive maintenance, cost effectiveness, and service quality.

The collected data were analyzed using the Statistical Package for the Social Sciences software. Descriptive statistics were used to summarize the characteristics of the sample. Cronbach's alpha was applied to test the reliability and internal consistency of the measurement scales. To ensure there was no multicollinearity among the independent variables, Variance Inflation Factor values were assessed. Finally, multiple linear regression analysis was conducted to determine the extent and significance of the relationship between the AI technologies and DEWA's organizational performance. The level of significance was set at 0.05. Ethical approval for the study was obtained from the relevant department within DEWA. All participants were informed about the purpose of the research, and their consent was obtained before data collection. Confidentiality and anonymity were maintained throughout the study.

4. RESULTS AND DISCUSSIONS

To examine the influence of artificial intelligence (AI) adoption constructs on DEWA's organizational performance, a multiple linear regression analysis was conducted. The results are presented in Table 1. The model tested the predictive power of five AI-related initiatives: AI Procurement in a Box Toolkit, GT Intelligent Controller, One-Way Data System, Robotic Process Automation, and Spot Robot.

Table 1: Results of Multi Linear Regression Analysis

Coefficients*

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	0.520	0.183	–	2.850	0.004
AI Procurement in a Box Toolkit	0.313	0.110	0.300	2.850	0.004
GT Intelligent Controller	0.421	0.108	0.363	3.894	0.000
One-Way Data System	-0.040	0.010	-0.058	-4.000	0.000
Robotic Process Automation	0.287	0.088	0.254	3.271	0.001
Spot Robot	0.061	0.099	0.055	0.619	0.537

a. Dependent Variable: Organizational Performance

As presented in Table 1, four out of the five Artificial Intelligence (AI) technologies demonstrated statistically significant effects on the organizational performance of the Dubai Electricity and Water Authority (DEWA). The GT Intelligent Controller emerged as the strongest predictor of performance ($\beta = 0.363$, $p < 0.001$), followed by the AI Procurement in a Box Toolkit ($\beta = 0.300$, $p = 0.004$) and Robotic Process Automation (RPA) ($\beta = 0.254$, $p = 0.001$). These findings indicate that intelligent control systems,

data-driven procurement frameworks, and automated workflows play critical roles in improving operational effectiveness within DEWA.

In contrast, the One-Way Data System exhibited a statistically significant but negative relationship with performance ($\beta = -0.058$, $p < 0.001$). This suggests that the system may encounter challenges in integration or functionality. The lack of bidirectional data exchange may limit real-time adaptability, hinder interoperability with other AI systems, and ultimately reduce the system's effectiveness in supporting performance goals. These findings support previous research which emphasizes the importance of integrated and dynamic data architectures in realizing the full benefits of AI (Solanki et al., 2024; Al-Farsi and Al-Maktoum, 2023).

The Spot Robot did not show a statistically significant effect on organizational performance ($\beta = 0.055$, $p = 0.537$), implying that its influence is either currently limited or still in an early phase of development. Although robotic technologies have potential for inspection, safety monitoring, and fieldwork, their practical impact in DEWA appears to be constrained by deployment scale, technical limitations, or early-stage integration. These observations align with studies that suggest robotic systems require iterative optimization, advanced analytics support, and broader integration into existing infrastructures in order to yield measurable benefits (Oliveira et al., 2014; Kalaitzi and Tsolakis, 2022).

A comparative analysis of the five AI tools reveals important insights into their relative effectiveness. The GT Intelligent Controller, AI Procurement in a Box Toolkit, and RPA appear to deliver the most substantial organizational benefits. This is consistent with the broader academic consensus that well-integrated AI technologies can enhance process efficiency, improve decision-making, and support cost-effective operations in utility environments (Ahmed and Hussain, 2023).

Conversely, the negative correlation observed for the One-Way Data System raises important concerns about the limitations of linear or siloed data infrastructures. Improving data interoperability, enhancing cross-system communication, and ensuring compatibility with other AI platforms may help reverse this negative effect. These enhancements are necessary to promote seamless integration, a factor that is increasingly recognized as vital to successful AI deployment in complex systems (Zhang et al., 2024; Solanki et al., 2024).

The findings regarding the Spot Robot also point to the need for further development in AI-enabled robotics. The lack of significant results may be attributed to a range of factors, including underutilization, limited analytical capacity, or insufficient integration with other digital systems. Research suggests that robotic systems achieve optimal outcomes when supported by adaptive learning algorithms, real-time data processing, and a clearly defined operational role within broader automation strategies (Kalaitzi and Tsolakis, 2022).

From a policy and strategic planning perspective, the results provide actionable recommendations for DEWA. Expanding the application of the GT Intelligent Controller, AI Procurement in a Box Toolkit, and RPA can yield tangible performance improvements. Simultaneously, enhancing the implementation frameworks for the One-Way Data System and Spot Robot, particularly through improvements in system compatibility, scalability, and workforce training, could enhance their future effectiveness (Khan and Al-Marri, 2023).

Thus, the study contributes valuable empirical evidence to the evolving discourse on AI's role in utility management. It reinforces the assertion that strategically deployed AI technologies can improve operational performance, resource optimization, and service quality. Nevertheless, the success of AI applications depends heavily on integration readiness, system interoperability, and alignment with organizational goals (Rashid and Salim, 2024).

Although DEWA's adoption of AI technologies has resulted in measurable performance enhancements, their effectiveness varies according to deployment strategies, integration quality, and technological maturity. Future research should

explore the long-term impacts of these technologies, examine methods for improving underperforming tools, and assess the broader scalability of AI-driven innovations across the utility sector. These insights can inform best practices and guide other organizations seeking to leverage AI for improved operational outcomes.

4.1 THE DEVELOPED CONCEPTUAL FRAMEWORK

Based on the results of the data analysis, a conceptual framework has been developed to illustrate the impact of Artificial Intelligence (AI) technologies on the operational performance of the Dubai Electricity and Water Authority (DEWA). This framework is presented in Figure 1 below.

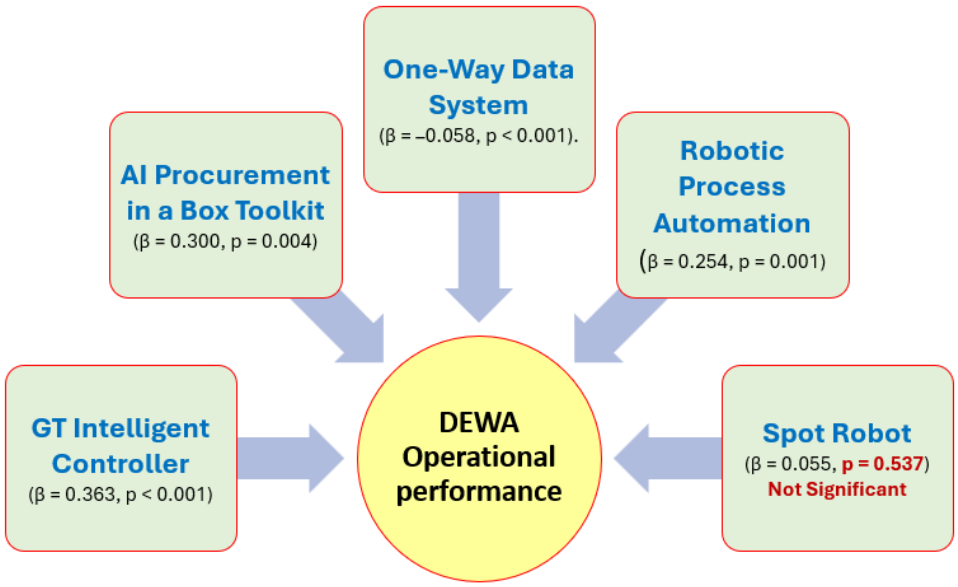

Figure 1: Framework of AI Technology Adoption on DEWA's Operational Performance

Figure 1 visually represents the relationship between the five AI technologies—AI Procurement in a Box Toolkit, GT Intelligent Controller, One Way Data System, Robotic Process Automation, and Spot Robot—and key dimensions of DEWA's operational performance. The framework highlights that AI tools such as the GT Intelligent Controller, AI Procurement Toolkit, and Robotic Process Automation have a strong positive influence on performance indicators, including efficiency, predictive maintenance, and cost optimization. In contrast, the One Way Data System is shown to have a negative association, pointing to integration or interoperability issues, while the Spot Robot has a minimal or statistically insignificant impact.

This framework provides a practical and theoretical model for understanding how targeted AI implementation can drive measurable improvements in performance within utility organizations. It also serves as a guide for future decision-making in technology investment, adoption strategies, and continuous performance evaluation.

5. CONCLUSIONS

This study investigated the impact of five Artificial Intelligence technologies which are the AI Procurement in a Box Toolkit, GT Intelligent Controller, One Way Data System, Robotic Process Automation, and Spot Robot on the organizational performance of the Dubai Electricity and Water Authority (DEWA). The findings revealed that four of the five technologies had a statistically significant influence on performance, with the GT Intelligent Controller emerging as the strongest predictor, followed by the AI Procurement in a Box Toolkit and Robotic Process Automation. In contrast, the One-Way Data System demonstrated a significant but negative

association, indicating potential integration or implementation challenges. The Spot Robot did not exhibit a statistically significant impact, suggesting that its current role within DEWA may be limited or still developing.

The study makes several important contributions to both theory and practice. Academically, it provides empirical evidence that supports the positive relationship between AI adoption and operational performance in the utilities sector, a relatively under-researched area. By evaluating specific AI technologies rather than AI as a general construct, the study offers a more granular understanding of how individual tools contribute to efficiency, cost reduction, and predictive maintenance.

From a practical perspective, the research offers valuable insights for policymakers, technology managers, and decision-makers within DEWA and similar utility organizations. It highlights the importance of prioritizing AI tools that demonstrate measurable performance improvements and underscores the need to address integration challenges associated with data systems. Furthermore, the study emphasizes the necessity of strategic planning and continued evaluation when deploying emerging technologies such as AI-driven robotics.

Overall, the findings support the growing consensus that AI technologies, when effectively implemented and aligned with organizational needs, can serve as powerful enablers of innovation, sustainability, and improved service delivery in the utilities sector. Future research should explore long-term outcomes of AI integration, assess user adoption and training factors, and investigate the scalability of successful tools across different operational contexts.

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