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Artificial Intelligence Inclusion and Performance of Sensor Management System in Nairobi-City Water and Sewerage Company, Kenya

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Abstract Performance has always been the most important and pressing problem for any firm worldwide. The research aimed at determining the inclusion of Artificial Intelligence such as fault detection, data mining, information inference and pattern recognition on the performance of sensor management system. The research was anchored on Technology Acceptance Model whereby descriptive and exploratory research design was adopted. The study target population was 360 and the sample size of 108 respondents were selected which represented the 30% of the target population. The researcher personally administered the questionnaire to the respondents, drop and pick method was adopted. Data were analysed by the use of descriptive, rational and inferential analysis. It can be revealed that the inclusion of artificial intelligence enables fault detection to be completed quickly, increasing user efficiency. In addition, the management system and procedures are done effectively with the inclusion of artificial intelligence. For effective data analysts to make decisions in real time, data mining is crucial. Since pattern recognition generates more value for a business, it is widely known that the sensor management system's effectiveness partially rely on data inferencing. According to the study, Nairobi City Water and Sewerage Company should regularly train their employees on the newest addition of artificial intelligence trends. To increase effectiveness, the sensor management system should be integrated. Create new competitive strategies and increase technology investments in pattern recognition.

Keywords: *artificial intelligence inclusion, performance of sensor management system, fault detection, data mining information inference, pattern recognition*

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1. Introduction

Performance is considered as source of concern to both private and public users. The performance success requires a well scheduled plan to cater for key success factors. This aids management in making wise decisions that benefited the organization [1]. Performance of sensor management system has a favorable effect on the development of both industrialized and emerging nations. The water and sewerage sector makes use of emerging technology to boost economic competitiveness [2]. The inclusion of Artificial Intelligence in the management system allows for the change from conventional to sophisticated management systems. As a component of artificial intelligence inclusions, sensor management systems are crucial to management operations [3].

Globally, increasing number of population and low supply of water has shown the sensor management system signs of poor performance. It has been determined that the sewerage system did not satisfy standards because of overflow wastes that lead to pollution [4]. Due to artificial intelligence inclusion organizations have adapted knowledge driven that provides appropriate information at convenient to support the sensor management system.

Regionally, the reports indicates that sewerage systems blockages in suburbs increase every month and with this increase in population and overflow of sewage is a potential health risk. According to studies, the collector main sewer was the component of the sewer system infrastructure that was most commonly damaged, with 4 of its components performing below specifications [4]. Rapid urbanization in developing nations generates enormous demand for essential city infrastructure [5]. Sensor management, a major factor in urban sanitation is systems. Therefore, some of the issues that affect the performance of the sensor management systems are the growth in population and the neglect of the sewer system.

In Kenya, according to the research by Kinuthia [6] revealed that Moraa et.al, (2012) underline the many initiatives aimed to reform Kenya's water and sewerage business. The initiatives include alterations to the Kenyan Water Act of 2002, which started reorganizing the water

and sewerage sector by giving everyone access to clean water and sewage services [6]. Further, it is noted that the application that is being controlled in Kenya especially Nairobi City through the Nairobi City Water and Sewerage company has improved timely and effective contact between residents and water and sewage utilities. This has strengthened communication, information storage, innovativeness efficiency, responsiveness, accountability and transparency of water and sewerage services that has led to enhanced services and performance.

Artificial intelligence inclusion is one of the essential aspects in a competitive environment for gaining an advantage. It is essential to the operation of businesses in both financial and financial elements such as the management of decisions in sensor management system [7]. With that kind of artificial intelligence inclusion and performance of sensor management system it contributes to innovative applications, change in process, links in business partners, cost reduction and relationships with clients.

Artificial intelligence inclusion in sensor management system influence performance.

1.1. Performance Sensor Management System

A study done in China, Memon contends that integrating information technology enhances organizational effectiveness [8]. To survive in this digital and dynamic world artificial intelligence is the prime source for business processes. Professionals paid much less attention to understanding how artificial intelligence affects performance, particularly sensor management systems. There are very few studies that examined the role of artificial intelligence inclusion and performance of sensor management systems which is the current research deficit.

Performance is characterized as the management of or a periodic assessment of the effectiveness and significance of a specific objective [8]. The present study considers artificial intelligence inclusion to assess the effectiveness of performance and the role of the Technology Acceptance Model as a mediator (TAM) but also inclusive of Adaptive Structuration Theory (AST), Technology Organization Environment Theory (TOE) and Diffusion of Innovation Theory (DIT).

According to Waldmann et al. [9] in the long term observations, such as sensor management systems, it is important to come to an agreement over the data's quality. The justification for this procedure is that the measured values are now available to the entire sensor management system, rather than simply being processed and used by an individual or end used by an individual or end user for a single mission. The user was only able to apply the models or test them for acquisition process if the user has enough confidence in the quality of the obtained data and the information from different sources is directly comparable.

Some empirical studies have measured performance by adopting information technology and innovations indicators. Performance of sensor management system could relate to either the reliability, estimation and convenience of using resources as well as the achievements of its specified objectives. Measuring performance is essential for this it allows sensor management system to analyze its strategies over time [10].

According to Iqbal et al. [11] indicators such as performance, accuracy and effectiveness were used in a quality control system to give competitive advantage. Accuracy and effectiveness are indicators being adopted by companies as the most preferred technique used to control operations, security and stability [12]. Martinez-Hernandez & Dehghani-Sanij [13] stated that a system for adaptive network-based inference is essential for improving performance of sensor management system. The approached uses probabilistic formulation. It uses knowledge gained from decision made over time and the measure of success in relation to a given norm is accuracy, reliability and effectiveness.

1.2. Artificial Intelligence Inclusion in Nairobi City Water and Sewerage Company

Dated back in to the colonial period, Kenya still uses the designed and developed sewerage services. Challenges include a lack of a legal framework, inconsistent and overlapping laws, outdated infrastructure, a lack of connectivity between networks and utilities with poor performance have been characterized by the provision of sewerage services. Sewer bursts, sewage floods and the release of semi treated or raw sewage into the environment have so recently become challenges [14]. Due to these concerns artificial intelligence inclusion has to be adopted to provide sensor management system with better ways of management.

Existing management system has not been kept up with in Nairobi City. Field observations in Nairobi City showed a variety of open and overflowing manholes, clogged sewers and ruptured sewers [14]. Because to open manholes and the occasional usage of manholes as landfills for solid waste, the environment is contaminated with raw sewage. The ecosystem and the general public's health are at risk as a result of this.

Recent technological advancements have led to industrialization of artificial intelligence , big data and cloud computing [15]. Artificial intelligence inclusion has to attract more and more attention and it made great progress and realize many achievements in Nairobi City Water and sewerage Company. However, usage of artificial intelligence inclusion allowed Nairobi City Water and Sewerage Company sensor management system the gain efficiency and productivity. The use of sensor management system was the best and that improves performance.

1.3. Statement of the Problem

Performance measurement has always been a very important for any business globally [16]. The sensor management system often experiences poor performance in terms of there is no proper fault detection, poor information inference, and poor data mining and unfavorable pattern recognition. Effective data management is required when collecting data on a wide scale. When there are no systems in place to organized process the data gathered, gathering a lot of data serves no

useful function [17]. Sensor management system is essential because it enables users in the company to take the information the system devices gather and extrapolate the insights from it.

Sensor management system collects, detects and estimates extremely delicate information. In the water and sewerage industry, the data collected by sensor management system devices include protected company information. Securing this data is common challenge for the users and sensor management system [18]. The company's performance is determined by the data accuracy, estimation and real time reporting. Massive amount of data is generated which is expected to grow produces turns storing, processing and transmitting it into significant challenges. Since sensor systems are frequently placed in remote locations with limited internet speed, transmitting data from them is challenging and frequently expensive in real time reporting of data [19].

The study looked at why so little work has been done to ascertain and explain how the performance of the sensor management system used by Nairobi City Water and sewerage Company is impacted by artificial intelligence. For the past few years, Nairobi City Water and Sewerage Company has invested on artificial intelligences such as sensor system application to automate sensor management system in the company, fault detection to carry through the monitoring of system with objective of identifying faults, data mining to predict future trends that helps in decision making, information inference to generate conclusions from evidence detected by sensor system and pattern recognition for finding the patterns and similarities to help solve a complex problem through observations derived from the data.

1.4. Research Objective

The general objective of this study is to investigate the effect of artificial intelligence inclusion and performance of sensor management system in Nairobi City Water and Sewerage Company.

2. Literature Review

Presented in this part are the theoretical, empirical, and conceptual frameworks.

2.1. Theoretical Review

2.1.1. The Technology Acceptance Model (TAM).

This is the theory that anchors my research as compared to others. This model was first presented in 1986 and is still the most commonly used theoretical model in the field of Artificial Intelligence. The Theory of Reasoned Action was the basis for the technology acceptance model that Davis first developed in 1986. It makes the assumption that a person's acceptance of Artificial Intelligence is influenced by perceived usefulness and perceived ease of usage variables [20].

Technology Acceptance Model, the model's objective is to give a justification for the elements that affect computer acceptance, including both economical and theoretically justifiable and that can explain behaviour spanning a wide range of end-user computer technologies and end user demographics [21]**.** A theoretical framework for investigating the critical elements influencing computing acceptance in an organization is the Technology Acceptance Model.

The theory's main objective is to investigate the elements that facilitate the uptake of computing technology by various end users and organizations. According to Davis (1989) [22] the model consists of perceived utility and perceived ease of use are two separate variables that affect the decision to employ new information technology systems [22]. According to Davis, perceived ease of use refers to how easy and straightforward a person perceives using a particular technology to be. How much a person believes using a particular method would boost their capacity to do their task is known as perceived usefulness [21].

This model is applied to sensor management system to explore end user acceptance for the inclusion of sensor management system if the Artificial Intelligence Inclusion is easy to use then they had positive attitude towards it, if not easy to use, then interface is complicated, therefore no one has positive attitude towards it.

2.2. Empirical Literature Review

Scholarly research, publications, and articles on previous studies on the impact of artificial intelligence on performance were examined.

2.2.1. Artificial Intelligence Inclusion

Many have hailed artificial intelligence as the upcoming source of economic value. However, there haven't been many empirical studies that have looked at how organized artificial intelligence has affected key performance measures. A lot of conversation is also being heard about how AI might foster creativity in businesses [23]. AI has been presented to improve a variety of key performance indicators at a company in addition to enhancing creativity [24].

In their recent article, Ronanki and Davenport [25] suggested that Artificial Intelligence inclusion is increasing the range of information that top management and other important decision makers have access to is thought to enable better decision making. This makes it feasible to gain understanding that would otherwise be impossible to discover [25]. With such data, a business significantly influenced performance outcomes and extend its offerings of goods and services while cutting costs and improving productivity.

In this system, the AI applications enabled better detection of anomalies, highly efficient data analysis, organizing data, facilitate decision-making, real-time communication and efficiency, are suggested to improve performance of sensor management system.

2.3. Conceptual Framework

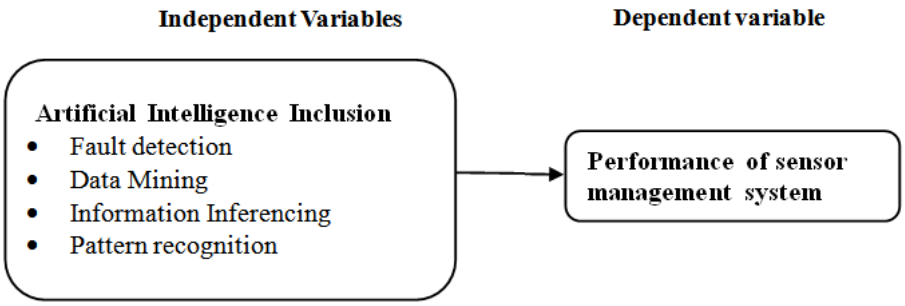

Figure 1. Conceptual Framework

3. Research Methodology

To accomplish its goals, the study used descriptive research approaches. A descriptive study design is employed to do in-depth research about a person, organization or phenomena [26]. Research design is defined as detailed analysis and arrangement that seek to guarantee the evidence gathered during the study process clearly and sufficiently addresses the research difficulties to meet the goal [27]. The who, what, where, when and how of the current study are all answered by descriptive research.

The target population involves the whole individuals of interest in research and in this research the target population was a total of three hundred and sixty (360) respondents. The complete target population was studied using a sample size of one hundred and eight (108) respondents. A random selection approach was used to pick respondents who the researcher believes helped the research progress. A semi- structured questionnaire was used to obtain primary data which had both open ended and closed questions that was filled by the respondents in Nairobi City Water and Sewerage Company.

3.1. Data Analysis and Presentation

The information gathered by the questionnaire was coded, corrected and entered into SPSS that assisted in the data analysis. In order to provide a summary of the sample through the demographic information of the participating respondents, descriptive statistics analysis was carried out. Both quantitative and qualitative data was produced through the study. Questions that are both closed-ended and open-ended and open-ended produced qualitative data, which was analyzed and presented alongside quantitative data. Quantitative information was examined using inferential and descriptive statistics. Because it is possible to display the individual scores in the population for a certain variable, descriptive statistics are chosen.

The link between the independent variables (fault detection, data mining, information inferencing and pattern recognition) and the dependent variable (performance) was evaluated using multiple regression by using inferential statistics by establishing a link between the dependent and independent variables.

3.2. Response Rate and Descriptive Statistics

The study was intended for 108 respondents in total. However, only 90 respondents filled out and returned their questionnaires, which resulted in an 83.33% response rate but 10 questionnaires were not return and 8 of the questionnaires were disregarded because they lacked both consistency and completeness, making them unsuitable for analysis. A response rate of 50% is sufficient for analysis and reporting, a rate of 60% is good, and a rate of 70% or above is exceptional, according to Mugenda & Mugenda (1999); hence, this response rate is sufficient for analysis and reporting.

A crosstabulation of the effectiveness of Artificial Intelligence Inclusion and the extent of influence of Artificial Intelligence Inclusion was conducted. It was discovered that 67.7% of respondents concurred that the performance of Nairobi City Water and Sewerage Company is significantly influenced by Artificial Intelligence Inclusion. In a similar vein, 20.1% reported only a little bit. However, 12.2% said it had no effect on their performance.

Table 1 Extent of influence of Artificial Intelligence Inclusion on Performance of Sensor management system of Nairobi City Water and Sewerage Company

Extent of Influence of Artificial Intelligence on performance of Nairobi City Water and Sewerage Company						
			No Extent	**Small Extent**	**Large Extent**	**Total**
Influence of Artificial Intelligence Inclusion	Yes	Count	0	18	61	79
		% Of the Total	0.0%	20.1%	67.7%	87.8%
	No	Count	0	11	0	11
		% Of the Total	0%	12.2%	0.0%	12.2%
Total		**Count**	**0**	**29**	**61**	**90**
		% Of the Total	**0%**	**32.3%**	**67.7%**	**100.0%**

As a result, the use of artificial intelligence had a significant positive impact on the Nairobi City Water and Sewerage Company's sensor management system's performance.

3.3. Regression Analysis

The extent of the independent factors' influence on the dependent variable was ascertained using a multiple regression model. Model summary tables, ANOVA and coefficients tables present the findings.

Table 2. Model Summary

Model Summary[b]				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.976[a]	.953	.951	1.79523

a. Predictors: (Constant), pattern_recognition, fault_detection, data_mining, data_inferencing
b. Dependent Variable: performance sensor management system

According to the model description in Table 3, the sensor management system's fault detection, data mining, information inference, and pattern recognition, with a standard error of 1.79523, can account for 95.3% of the variation in performance. This demonstrates that 4.7% of the variation was unexplained and may be accounted for by variables not included in the model's parameters. That is, explanatory factors such fault detection, data mining, information inferencing, and pattern recognition had been used to explain variances in sensor management system performance.

Table 3. ANOVA

ANOVA[a]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	5543.613	4	1385.903	430.024	.000[b]
	Residual	273.942	85	3.223		
	Total	5817.556	89			

a. Dependent Variable: performance of sensor management system
b. Predictors: (Constant), pattern_recognition, fault_detection, data_mining, data_inferencing.

The p value of 5% was below the significance level of 0.00%. This demonstrated that the model was statistically significant and that the data were perfect. Fault detection, data mining, information inferencing, and pattern recognition all had a significant impact on the performance of the sensor management system, as shown by the critical value of 430.024 being more than 2.40 (from the F test tables), or (430.024>2.40).

Table 4. Coefficients

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.247	.526		-.469	.640
	fault_detection	.915	.212	.452	4.320	.000
	data_mining	.558	.136	.333	4.100	.000
	pattern_recognition	.052	.058	.022	.898	.372
	data_inferencing	.425	.238	.199	1.786	.078

a. Dependent Variable: performance_sensor.

The regression coefficients demonstrate that fault detection significantly affects sensor management system performance (β_1=0.915; p0.05). Similarly, data mining significantly affects the functionality of the sensor management system (p=0.05, β_2 =0.558). Also, with β_3=-0.052 and β_4=0.425, respectively, information inference and pattern recognition have a beneficial and significant impact on the performance of the sensor management system. Their corresponding p values are lower than 0.05.

3.4. The Overall Model

Following the format below, the regression model was used to assess the degree of influence the independent variables have on the dependent variable:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$$

$$Y = -0.247 + 0.915 X_1 + 0.558 X_2 + 0.052 X_3 + 0.425 X_4 + 1.8$$

According to the regression equation above, the constant growth rate of Nairobi City Water at zero will be -0.247 when all elements (fault detection, data mining, information inference, and pattern recognition) are taken into account. A unit increase in fault detection would result in a 0.915 increase in the growth of Nairobi City Water and Sewerage Company, according to the findings given, which also indicate that, if all other independent factors were held constant. The results also indicate that Nairobi City Water and Sewerage Company's growth

would increase by 0.558 units for every unit more data mining is done.

The results also indicate that Nairobi City Water and Sewerage Company's growth will be reduced by 0.052 for every unit less data inferencing. The study also discovered that Nairobi City Water and Sewerage Company will expand by 0.425 more for every unit increase in pattern recognition. Overall, data mining had the most impact while data inferencing had the least on the expansion of Nairobi City Water and Sewerage Company.

4. Conclusion and Recommendation of the Study

Artificial intelligence's importance in a business has been acknowledged. It can be said that with the use of artificial intelligence, management systems and procedures are carried out effectively, which raises productivity and lowers total cost of ownership while also enhancing user performance for the business.

Data mining is essential for sensor management system user. It was notable that there are highly efficient data analyst to make real time decisions on the use of the sensor management system. It was evident that incorporation of artificial intelligence assisted management in making lucrative changes to production and operations

The effectiveness of the sensor management system depends heavily on data inferencing. It was established that through data inferencing The staff users have increased estimation accuracy, which enables the business to analyze and promptly predict data outcomes, enhancing user performance of the sensor management system. Last but not least, it is widely acknowledged that pattern recognition creates higher value for a business. From the findings, it can be concluded that the staff is capable of offering engaging and useful data visualizations such as dashboards, charts, reports, and other sorts of data representations that not only provide more insightful analyses than plain data but also enhance the usability and interest of the data.

The study recommends that Nairobi City Water and Sewerage Company should routinely train their staff on the latest trend of artificial intelligence inclusion. This would improve the ability to discover faults. The sensor management system should be integrated, according to the study's advice to Nairobi City Water and Sewerage Company. The incorporation of artificial intelligence improves organizational efficiency, resulting in quick data processing and decision-making in the moment. New competitive strategies that might position and set the company apart in the direction of dependability and profitability should be developed by the sensor management system. Through additional investment, pattern recognition could obtain cutting-edge technology that are appropriate for the company.

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