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Leveraging Artificial Intelligence (AI) for the Maintenance of Science Laboratory Equipment

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Abstract
The dire need for proper maintenance of Science Laboratory Equipment (SLE) to attain efficiency, optimal results and durability cannot be overemphasized. To that end, this study proposes the leveraging of AI for optimization and efficiency in the maintenance of SLE. The study relied on both primary and secondary data. The primary data were sourced from twenty Science Laboratory (SL) professionals, while the secondary data were sourced from repositories, databases and websites on the internet. The mixed method alongside the plausible descriptive and statistical tools was employed. The analysis shows that the maintenance of SLE can be optimized and made efficient by leveraging AI for such purposes. Regrettably, public sector organizations are yet to significantly integrate AI into the maintenance of SLE. The study concludes that AI has the capacity to optimize and enhance efficient maintenance of SLE. It calls on stakeholders in the field of SL to make concerted efforts to significantly integrate AI into the maintenance of SLE. The government should help provide AI technologies for the concerned public sector organizations and sponsor the training of person for technical-know-how in using and sustaining these cutting-edge technologies in SL.

Keywords: Science Laboratory Equipment, AI, Automation, Maintenance, Optimization, Efficiency.

Introduction
Tests, experiments and analyses of samples and gathered data are done in laboratories using different equipment. Thus, maintaining science laboratory equipment (SLE) is imperative. The maintenance of SLE is not without challenges. This study argues that the challenges of maintaining SLE can be addressed significantly with the leveraging of AI in contemporary times. The importance of maintaining SLE cannot be overemphasized. In the same vein, the capacity of AI to ensure optimization and efficiency in the maintenance of SLE cannot be underestimated. While there are many studies on the place of AI in various spheres (Akinola, 2024; Akinola et al., 2024; Kodete et al., 2024; Nwadinobi et al., 2024; Nwosu et al., 2024; Obiuto et al., 2024; Okusi, 2024a&b; Oyeyemi et al., 2024; Pasupuleti et al., 2024; Thuraka et al., 2024; Juhrich, 2023; Ivanova et al., 2023; Regona et al., 2023; Kochovski & Stankovski, 2021; Yigitcanlar et al., 2020). The studies stress and show how AI optimizes and enhances efficiency in various spheres. Yet, insignificant volume of scholarly

studies exists on AI in the maintenance of SLE and its role in optimization and efficiency in the maintenance.

There currently exists a vast gap in research on the leveraging of AI for SLE maintenance and the role it is capable of playing in that regard to ensure optimization and efficiency. Thus, this study is not only an eye-opener but also a clarion call to researchers, scholars and professionals in SL and AI disciplines to take up the thankless task of bridging this current laid-bare research gap. To improve SLE maintenance and digitalize it significantly, this study proposes significant integration of AI into the maintenance of SLE in order to attain deserving optimization and efficiency and appreciable extent of integration of AI into the maintenance of SLE, particularly in public sector organizations.

Statement of Problem

First, the continuous over reliance on conventional means of maintaining SLE is the motivation of this study. That is, the study is worried by the inefficiency of the conventional means of maintaining SLE and thereby proposes the deployment of the cutting-edge technologies, particularly AI technologies, for the optimization of the maintenance of SLE. Also, the study is informed by the present vast gap in literature on AI in the maintenance of SLE. Next, given that AI is affirmed in the literature to be problem-solving and innovative in various regards, there is the dire need for optimizing the maintenance of SLE by deploying it accordingly in order to attain efficiency.

Since extant studies neither advocate nor prioritize the optimization of the maintenance of SLE for efficiency using AI, the present study is novel. It bridges that research gap and rouses scholastic attention to this seemingly neglected area that is very critical to scientific research, laboratory experiments and so on. The theme of this study is currently under-researched. Thus, the novelty of the study rests on its engagement with the theme. It offers interesting insights into the prospects of AI in the maintenance of SLE for the attainment of efficiency and optimized operations and results.

Aim and Objectives

The aim of this study is to demonstrate that AI can optimize the maintenance of SLE, leading to efficiency. Its specific objectives are to:

i. Propose the leveraging of AI for the optimization and efficiency of the maintenance of SLE.
ii. Determine the extent to which AI can optimize and enhance efficient maintenance of SLE.
iii. Examine the extent to which public sector organizations using SLE have integrated AI into the maintenance of the equipment.
iv. Contribute to finding solutions to the challenges of maintaining SLE.

Research Questions

The study is guided by the following research questions, derived from the objectives:

i. Why proposing the leveraging of AI for the optimization and efficiency of the maintenance of SLE?
ii. To what extent can AI optimize and enhance efficient maintenance of SLE?
iii. What is the extent to which public sector organizations using SLE have currently integrated AI into the maintenance of the equipment?
iv. In what way can this study contribute to finding solutions to the challenges of maintaining SLE?

Science Laboratory Equipment

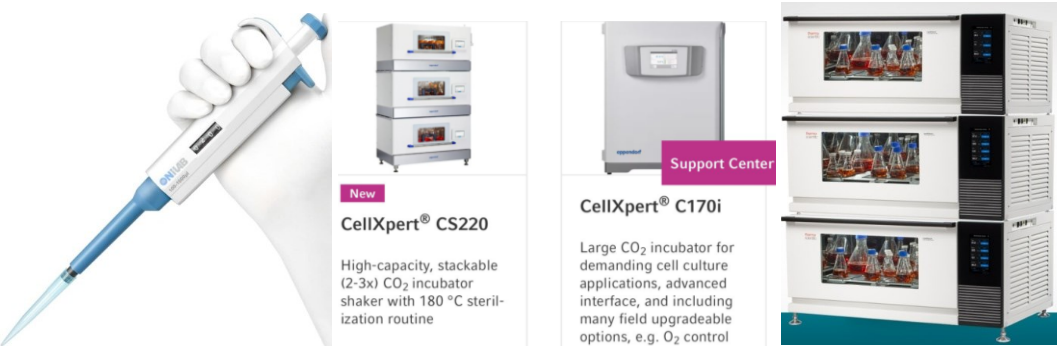
Here, a brief on the concepts of science laboratory equipment (SLE) and artificial intelligence (AI) would be made. Although the concept of SLE is not used technically herein, the essence of this section is to describe what and what make up SLE. In the same vein, AI would be described to aid a better understanding of why it is proposed for optimal maintenance of SLE.

SLE ranges from simple pipettes to complex spectrometers. There are many laboratory apparatuses regarded collectively as science laboratory equipment. These include gloves, lab coats, fume hoods, safety goggles, microscopes, spatulas, pestle, mortar, incubators, autoclaves, clam stands, funnels, pH meters, thermometers, ovens, hot plates, water baths, cylinders, Petri dishes, burettes, flasks, test tubes, and beakers. The examples of automated SLE include the following:

- Automated pipetting (e.g. liquid handler consumables, liquid handler, liquid handler accessories, epMotion products of different categories including epMotion Waste Disposal accessories);
- Biological safety cabinets and clean benches;
- Centrifuges, cold storage, colorimetry, turbidity & UV-Vis spectrophotometry;
- Hotplates, stirrers & drybaths;
- CO_2 incubators, incubators & environmental chambers;
- Lab ovens & furnaces;
- pH & electrochemistry;
- Lab shakers, vacuum concentrators, water baths, circulators & chillers;
- Water purification systems;
- Remote monitoring systems.

These tools, which are so many, are used for various purposes. These include generating heat, mixing and storing liquids, measurement, dispensing, cutting, sterilizing, drying, weighing and controlling substances, phenomena, situations and states health, protection from harm, ventilating substances, grinding, transferring of substances, and magnifying objects, to mention but a few. Consider the following pictographic representations of both conventional and automated SLEs:

Fig. 1: Some Automated SLE



Source: https://www.thermofisher.com/ng/en/home/life-science/lab-equipment/lab-equipment-innovations.html?icid=WB38087

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Fig. 2: Simple or conventional of SLE I

Source: IndiaMART

Fig. 3: Examples of SLE II

Source: Pinterest

The conventional maintenance practices of SLE include relying on schedule services, which likely cause:

- Delays
- Inefficiency
- Poor performance
- Unexpected and unpredicted breakdown
- High costs
- Waste of resources
- Inaccuracy and unreliability of data
- Lingering addressable management challenges, and
- Hampering of the quality of research or experiment involving SLE.

Therefore, it is imperative to leverage AI for the maintenance of SLE so as to address as well as prevent the above listed challenges and attain optimization and efficiency. This study argues that by deploying AI for the maintenance of SLE, costs would be reduced; result accuracy would be guaranteed; the time spent on managing SLE would be less; maintenance practices would get optimized; outcomes of researches would be improved; and operational efficiency would be achieved more significantly. This argument, being the thesis of this study, underscores the novelty of the study and highlights the dire need for studies on AI integration into SLE maintenance.

Artificial Intelligence

According to National Strategy for Artificial Intelligence Bangladesh (2020), AI demonstrates that machines have the capacity to perform varied tasks, such as learning, reasoning or critical thinking, seeing, strategic performance, and basic leadership. It is an evolving innovation making consistent huge advances in various human endeavors and phenomena where applied. It has been impacting on various spheres of life. The National Strategy for Artificial Intelligence Bangladesh (2020) identifies six strategic pillars of AI viz:

- Research and development,
- Re/Skilling AI workforce
- Digital and data infrastructure,
- Ethics, data privacy, security and statutory regulations,
- Funding and acceleration of AI adoption, and
- Industrialization for AI technologies.

Ro (2018) describes AI as the capability of machines to intelligibly undertake decisions, thinking, learning, perceiving, and problem-solving tasks, which were exclusively undertaken erstwhile by humans. According to Ro (2018), AI is most beneficial to healthcare, education, agriculture, smart mobility and technology, and smart cities. As Ro (2018) rightly observes, for these sectors to get the best from what AI has in stock for various endeavors, the following challenges have to be addressed head-on:

- Lack of appreciable extent of expertise in AI application and research,
- The absence of enablers– data ecosystems as well as access to intelligent data,
- High costs of resources and technologies,
- Poor encouragement of and low awareness about AI adoption,
- Cyber security threats to data and privacy
- Lack of formal regulations around anonymisation of data, and
- Insufficient collaborative approach to AI adoption or application.

AI has various constituent technologies. Okusi (2024b) identifies the following AI technologies, as the most popular ones:

Table 1.1: AI Technologies to Leverage for SLE Maintenance

AI Technologies	Citations
Automated Machinery Systems	Akinola (2024)
Computer Vision	Akinola et al. (2024) Kodete et al. (2024)
Deep learning	Alsakka et al. (2023) Ivanova et al. (2023)
Digital Image Analysis	Okusi (2024a)
Faster R-CNN	Pasupuleti et al. (2024)
Machine Learning	Regona et al. (2023)
Natural Language Processing	Thapaliya and Bokani (2024)
Reinforcement Learning	Vantara (2020)
Robotic Process Automation	Wusu et al. (2022)

Source: Adapted from Okusi (2024b)

It is quite understandable from the above Table 1.1 that the leveraging of AI for optimization and efficiency in the maintenance of SLE entails deploying its aforementioned technologies, among others, in various regards to optimize and enhance the maintenance practices of organizations using SLE, particularly those of the public sector. Adelani et al. (2024), Okusi (2024b), Peramo et al. (2024) show that AI and ML can be leveraged for the protection of critical infrastructure. This study leans on that finding to argue that SLE, as scientific critical infrastructure can be protected by leveraging AI.

Adelani et al. (2024) are of the view that since AI and machine learning (ML) play identification and prediction functions, they can help detect and prevent harmful occurrences that would have taken place if they were applied. It follows that AI technologies can help identify and predict the basics that have to be put in order beforehand in the maintenance of SLE, without which equipment breakdown can occur. It is logical to argue that human functions, as in the maintenance of SLE, can be optimized, strengthened and made efficient by AI technologies. This argument is given credence by Binhammad et al. (2024), who emphasize the supportive role AI plays in human undertaken activities, where AI technologies are applied.

Govea's et al. (2024) study shows that AI technologies can solve problems through detection of threats that prompt proactive decisions, actions, and measures. For the present study, AI can help detect faults and lapses in the maintenance of SLE, which humans would likely be unable to detect. Upon detection, decisive actions and measures are followed up, for which efficiency in the maintenance practices obtains. Also, the study by Ojo and Aghaunor (2024) reveals that AI technologies can prevent cyber attacks on critical infrastructure. By implication, AI technologies can also be leveraged for the prevention of cyber threats to SLE, such as computers and other internet-based equipment, which vulnerable to cyber threats.

Theoretical Framework

Theory concerns human and computer kinds of intelligence in the field of AI (Wang, 2012). Intelligence is said to be of three sets: human intelligence, computer intelligence, and general intelligence (Jarrahi et al., 2023; Wang, 2012). Computer intelligence is artificial, unlike human intelligence that is natural. The general intelligence comprises human and computer intelligence, animal intelligence, collective intelligence, and alien intelligence, among other categories (Jarrahi et al., 2023; Wang, 2010). Basically, "projects in mainstream AI are guided by practical problem-solving demands, knowledge about human intelligence, or/and available normative models" (Wang, 2012, p. 3). The theory adopted for this study has practical problem-solving potentials, elements and ideals.

Theories of psychology or neuroscience are often adopted for projects concerning AI, because the human mind is the best-known form of intelligence (Newell, 1990; Rumelhart & McClelland, 1986). On the basis of practical problem-solving demands, the theory of computation is usually considered to suffice for any other or a new theory of AI and its integration into any project or endeavor (Hayes & Ford, 1995; Marr, 1982). The third consideration is that of available normative models, in which projects are designed, analyzed and associated with revised mathematical theories (McCarthy, 1988; Pearl, 1988). Classical Logic and Probability Theory are some of such prominent mathematical theories.

There are different theories of technology alongside their integration, including AI. These are the Diffusions of Innovations Theory (DOI), Technology Acceptance Model (TAM), Theory of Reasoned Action (TRA), the Model of PC Utilization (MPCU), Theory of Planned Behavior (TPB), Motivational Model (MM), the combined TAM and TPB (C-TAM-TPB), the Social Cognitive Theory (SCT), and the Unified Theory of Acceptance and Use of Technology (UTAUT). Among the aforementioned theories, the UTAUT is adopted for this study. The UTAUT unifies the other 8 previous theories or models. It is considered the most encompassing and integrative theory of the 9 popular theories of AI and technology adoption (Moheb, 2021; Tamilmani et al., 2021). Being that it encompasses and integrates other theories, this study adopts for its theoretical backing.

The proponents of UTAUT, Venkatesh et al. (2003), explain how to understand the acceptance process of an innovation like AI and other technologies. The conceptual elements of UTAUT, which constitute its five key dimensions, are:

i. Behavioral intention and use,

ii. Expectancy effort,
iii. Social influence,
iv. Facilitating conditions, and
v. Behavioral intention.

According to Venkatesh et al. (2003), job performance is driven by behavioral intention and use; the extent to which the system can be used easily is the concern of expectancy effort. The consideration of the new system or innovation by the individual on the basis of importance is what is referred to as the social influence dimension of the UTAUT (Venkatesh et al., 2003). The enablers or support systems that make the adoption of an innovation to be possible and easy are the "facilitating conditions" (Venkatesh et al., 2003, p. 453). The last but not the least dimension, being behavioral intention, concerns the intention of the individual user of the particular innovation, AI for example (Venkatesh et al., 2003). The five dimensions are influenced and moderated by experience, usage voluntariness, age, and gender (Venkatesh et al., 2003). The proponents of UTAUT later added habit, hedonic motivation, and price value (Moheb, 2021; Tamilmani et al., 2021). It is in view of the foregoing that the UTAUT is adopted to be the theoretical framework of this study.

Methodology

The study adopted mixed method, which is both descriptive or qualitative and statistical or quantitative. This method combines the two approaches to ensure and demonstrate quantitative and qualitative exploration of the engaged thematic concerns and the reliability of the associated plausible tools employed. These include interpretive, descriptive and statistical tools. The primary data were sourced from twenty (20) Science Laboratory (SL) professionals. The secondary data were sourced from repositories, databases and websites on the internet. These include Google Scholar, ResearchGate, Academia.edu, Semantic Scholar, CORE, and Microsoft Academic.

The gathered secondary data were scrutinized, synthesized and subjected to a thematic systematic review. Exclusion and inclusion criteria of the systematic review were employed to exclude the secondary data found unrelated to the present study. Deploying the inclusion criteria, those used were screened and found worthwhile. For qualitative and quantitative results, the mixed method was employed alongside the plausible descriptive and statistical tools was employed. The tools include tables, figures, percentage, scale coding, and interpretive devices.

Data Presentation and Analysis

Here, the thrust of the study is engaged with and demonstrated. The thrust is leveraging AI for optimization and efficiency. The answers to the research questions are presented and analyzed concisely hereafter. The answer options are Strongly Agreed (SA), Agreed (A), Neutral (N), Strongly Disagreed (SD), and Disagreed (D). Only their abbreviations are used in the tables.

Table 1: Answers to Research Question 1

SN	Variables	SA	A	N	SD	D
Why proposing the leveraging of AI for the optimization and efficiency of the maintenance of SLE?						
	To digitalize the maintenance of SLE and exploit the huge benefits of integrating AI into maintenance practices	9	11	-	-	-

Source: Author, 2024

The reason given for why AI is proposed to attain optimization and efficiency of the maintenance of SLE is sustained by 9 interviewees, who strongly agreed, and 11 agreed but not strongly. The main reason for proposing optimization and efficiency of the maintenance of SLE is "to digitalize the maintenance of SLE and exploit the huge benefits of integrating AI into maintenance practices." Clearly, all the 20 interviewees confirmed the reason for proposing optimization and efficiency of the maintenance of SLE.

Table 2: Answers to Research Question 2

SN	Variables	SA	A	N	SD	D
To what extent can AI optimize and enhance efficient maintenance of SLE?						
	High	10	4	-	-	-
	Low	-	5	-	-	-
	Intermittent	1	-	-	-	-

Source: Author, 2024

On the extent to which AI can optimize and enhance efficient maintenance of SLE, 10 of the participants strongly agreed that the extent is high. That is, AI can optimize and enhance efficient maintenance of SLE at a high extent. Additionally, 4 supported the 10 by agreeing with the 'Agreed' option. Although their option is not 'Strongly Agreed', their option is for acceptance just like those of the participants for 'Strongly Agreed'.

On the contrary, 5 of the interviewees indicated 'Agreed' for the 'Low' extent option. And, 1 of them opted for 'Strongly Agreed' to indicate that the extent to which AI can optimize and enhance efficient maintenance of SLE is intermittent– neither high nor low. Nevertheless, from the responses, it is quite clear that 14 of the 20 participants proved that AI can optimize and enhance efficient maintenance of SLE at a high extent. The other responses are statistically insignificant and thereby not sustained.

Table 3: Answers to Research Question 3

SN	Variables	SA	A	N	SD	D
What is the extent to which public sector organizations using SLE have currently integrated AI into the maintenance of their equipment?						
	High	-	3	-	-	-
	Low	9	6			
	Intermittent	2				

Source: Author, 2024

As evident in the Table 3 above, the integration of AI into the maintenance of SLE in public sector organizations is currently low. This is proven by 15 of the 20 interviewees, who strongly agreed and agreed to the 'low' extent variable. Only 3 claimed that the extent is high, while 2 indicated that the extent to which public sector organizations have integrated AI into the maintenance of their SLE is intermittent. Based on the statistical prominence of the responses of the 15 interviewees, the upheld finding is that the extent to which public sector organizations using SLE have currently integrated AI into the maintenance of their equipment is low.

This finding draws attention to the backdrop, charging stakeholders in the concerned public sector organizations to increase the adoption of AI. Doing so includes creating awareness, carrying out training, professional and interdisciplinary collaboration, support, mitigating the challenges of adoption, ethical considerations, AI regulations, and what have you.

Table 4: Answers to Research Question 4

SN	Variables	SA	A	N	SD	D
In what ways can this study contribute to finding solutions to the challenges of maintaining SLE?						
	Proposing the integration of AI into the maintenance of SLE	4	3	-	-	-
	Through its findings and recommendations	-	5	-	-	-
	Affecting change and influencing policies on the subject matter	6	2	-	-	-

Source: Author, 2024

The novelty of this study is proven by the research participants, as they affirmed the ways through which the study contributes to finding solutions to the challenges of maintaining SLE. Accordingly, 4 of them strongly agreed that by proposing the integration of AI into the maintenance of SLE, the study contributes to finding solutions to the challenges of maintaining SLE. Three (3) other participants supported the 4. The 3, unlike the 4, agreed but not strongly.

Another option for the contribution of the current study is "through its findings and recommendations". This option is upheld by 5 of the 20 interviewees, who agreed to the option. Finally, 8 of the 20 respondents agreed that the study contributes to finding lasting solutions to the maintenance of SLE in that it aims towards "affecting change and influencing policies on the subject matter". Out of the 8, 6 strongly agreed, while 2 agreed but not strongly.

Table 5: Benefits of leveraging AI for the maintenance of SLE

Variables	SA	A	N	SD	D
Optimization and efficiency	11	9	-	-	-
Computerized diagnostics	17	3	-	-	-
Prediction and detection of faults, lapses and future breakdowns	19	1	-	-	-
Optimized support & improved training	20	-	-	-	-
Record management	9	7	-	4	-
Data-driven decision-making	5	15			
Resource management, thereby saving and preventing wastage	18	2	-	-	-

Source: Author, 2024

Out of the 20 (100%) interviewees, 11 of 55% strongly agreed (SA) that the integration of AI into the maintenance of SLE would lead to optimization and efficiency. The remaining 9 (45%) supported the 11 with the Agreed (A) option. None of them 'strongly disagreed' (SD), 'disagreed' (D) or opted for 'Neutral' (N). While 17 (85%) interviewees indicated SA, the 3 (15%) others indicated A. This means that they all agreed that leveraging AI for the maintenance of SLE would lead to computerized diagnostics in SL practices. AI can detect and predict faults, lapses and future breakdowns, which humans cannot predict and detect inaccurately.

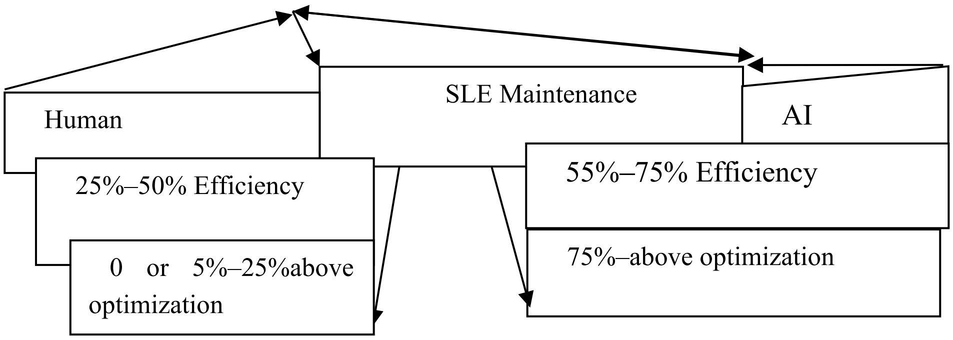
The respondents showed that AI can predict and detect faults, lapses and future breakdowns in the maintenance of SLE. This finding is realized from 19 responses for SA and 1 for A. All the respondents, 20 of 100%, strongly agreed that leveraging AI for the maintenance of SLE leads to optimized support and improved training. With these, manpower personnel acquire or increase their technical-know-how. The variable "record management" had 9 responses for SA, 7 for A, and 4 for D. That is, 4 of the interviewees disagreed to the variable, while 16 agreed to it– that leveraging AI for the maintenance of SLE brings to place optimization and efficiency in record management.

Discussion and Impact

Obviously, deploying AI for the maintenance of SLE implies going beyond the conventional maintenance practices of using and relying on analogous means of maintaining SLE. Maintaining SLE means ensuring safety, efficiency, and optimal and maximal performance, productivity, services and results. ACT (2020) observes that AI can transform various aspects of work, which include the work of maintaining SLE advocated by the present study. Jarrahi et al. (2023) argues that the combination of human intelligence with machine intelligence would yield better results, wherever that is done. The present study avers that it is important to integrate AI into the maintenance of SLE, because it would optimize and make the whole process efficient.

Data-drive decision-making is another benefit of leveraging AI for the maintenance of SLE. This benefit is upheld by 5 responses for A and 15 responses for SA. The research participants, 18 strongly agreed and 2 agreed that by leveraging AI for the maintenance of SLE, resource management gets optimized and efficient, saving resources and preventing wastage. Of course, the benefits of optimized and efficient resource management cannot be quantified. These include effective time and cost management, time, costs and resources are saved, and workloads are reduced. The foregoing is represented graphically in Figure 3 below, showing the difference between the maintenance of SLE by humans and AI:

Fig. 3: Human vs. AI SLE Maintenance



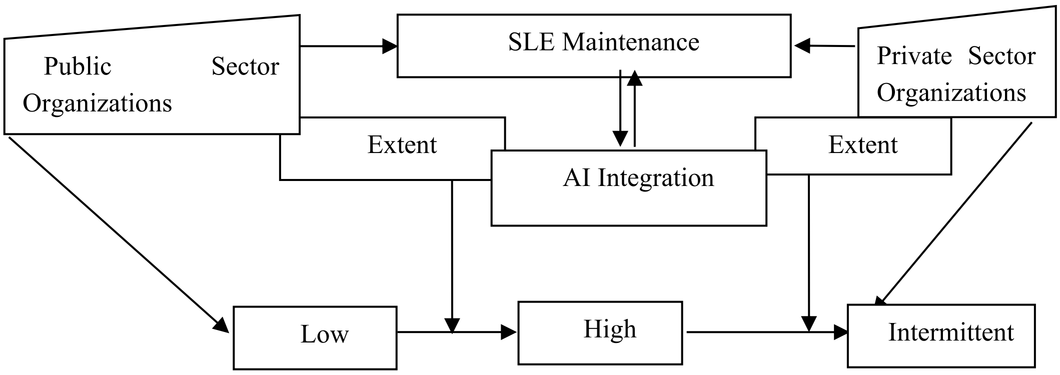
Source: Author, 2024

The above Fig. 3 shows the flow of maintenance optimization and efficiency by humans and AI. Humans are involved in both technological and non-technological maintenance measures, while AI maintenance of SLE is solely technological. The human maintenance flows both rightwards and leftwards, while that of AI is only leftwards, from its base to the maintenance engine house of maintenance – the 'SLE Maintenance'. Although efficiency obtains in both human and AI maintenances, the extent varies between the two sets of maintenance.

AI maintenance is shown to be more than human maintenance. Thus, since AI maintenance is more efficient, it is crucial to leverage it for efficiency in maintenance practices. See the Fig. 3 above for percentage and figure variances between the two diagramed sets of SLE maintenance. More so, in terms of optimization, the human set of SLE maintenance completely lacks optimization in some cases, and insignificant extent of optimization in other cases. The opposite obtains in the AI SLE maintenance, in which optimization obtains at a high extent. The reason for the discrepancy rests on the fact AI is technological (computer-based), while humans involved in the maintenance of SLE either combine new technologies (e.g. smart technologies, computers, applications, the internet, AI algorithms) with manpower and human intelligence, or rely entirely on human resources and intelligence alone.

Given the above Fig. 3, the extent to which AI can optimize and enhance efficient maintenance of SLE is determined to be high. In the same vein, it is realized from the Fig. 3 that AI maintenance of SLE guarantees optimization, while human maintenance either lacks optimization completely or has it in place at an insignificant level or extent. Consider the following diagram showing discrepancy in the extent of AI integration among organizations involved in using SLE:

Fig. 4: Extent of AI in SLE Maintenances among organizations



Source: Author, 2024

It is evident from the Fig. 4 above that the extent of AI integration into the maintenance practices of private sector and public sector organizations varies. Those of the public sector have low current extent of integration, unlike the private sector organizations that have neither low nor high extent of integration. Thus, they currently integrate AI into their SLE maintenance practices at an intermittent extent or level of integration. The implication of the discrepancy is that government's unwillingness to integrate AI into SLE maintenance is higher than that of the management bodies of private sector organizations.

Despite the high costs of AI technologies and application, usage and sustenance, private sector organizations are more willing to integrate AI than their counterparts in the public sector. The above illustration answers the research questions and at the same time meets the research objectives. In other words, the extent to which public sector organizations using SLE have integrated AI into the maintenance of SLE is currently low.

Conclusion

The study has concerned itself with proposing the integration of AI into the maintenance of SLE, determining the extent to which AI can foster optimization and efficiency in the maintenance, and presenting practicable scholarly solutions to the challenges of maintaining SLE. It has demonstrated that AI has the capacity to optimize and enhance efficient maintenance of SLE. The capacity is evident in its commonly attested problem-solving functions and human-like and yet computer logical and beneficial manipulations of things and tasks. The maintenance of SLE has to be digitalized significantly in order to attain efficiency, optimal performance, and accurate results, among others. One of the ways of doing so is the integration of AI into it, as proposed by this study. By so doing optimization and efficiency can be attained undoubtedly. By attaining these, scientific tests, observations, experiments and research would be improved. These would contribute significantly to quality, reliability, efficacy, performance and productivity of SLE, scientific endeavors and the larger society.

Recommendations

Since AI cannot be integrated into SLE maintenance without several challenges, the following recommendations are made:

- Stakeholders in the field of SL should make concerted efforts to significantly integrate AI into the maintenance of SLE.
- Government should help provide AI technologies for the concerned public sector organizations.
- Providing financial support for public sector organizations using SLE would help address issues of financial constraints to AI adoption into the maintenance practices of SLE.
- Organizations using SLE should make concerted efforts to set up broad data management systems so as to make it possible for AI algorithms to deliver accordingly with little or no errors.
- Personnel should be trained and armed with the technical-know-how in using and sustaining these cutting-edge technologies in SL. In the public sector, doing so requires sponsorship and support by government. Donor Non-Governmental Organizations (NGOs) and other well meaningful individuals can also help supplement government's responsibilities and gestures to that end.

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