Security Implications and Risk Mitigation Strategies in the Implementation of Artificial Intelligence for Sustainable Development

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Abstract

Artificial intelligence (AI) is poised to revolutionize multiple sectors, offering vast potential for improving sustainable development. In a bid to make sure that artificial intelligence (AI) is being used for the betterment of mankind as a whole, this article

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explores the ethical, legal, social, and governance challenges associated with AI, particularly in ensuring that its deployment serves the betterment of humanity as a whole, in overseeing its implementation. (Smith et al. 2021, Hu et al. 2021, and Gill 2022). A key aspect of this examination focuses on the role of supreme audit institutions in overseeing and regulating AI technologies to ensure they align with global goals for sustainable development. The increasing reliance on AI brings both opportunities and risks, and understanding the broader implications is critical to mitigating potential threats. One of the major concerns highlighted is the potential for AI technology to be misused in ways that could threaten global security. For instance, AI could accelerate the proliferation of weapons of mass destruction, creating new threats that are more difficult to control. Additionally, AI may enable non-state actors, such as terrorists, criminals, or rogue nations, to carry out attacks or other malicious activities more efficiently and effectively, making it harder for security services to track and prevent these actions. Beyond security threats, AI also raises concerns about its impact on societal structures, particularly with respect to social and economic inequality. (Brose 2020). The widespread adoption of AI could impair existing divides, with certain groups potentially benefiting more than others, leaving marginalized communities even further behind. While AI has the potential to drive innovation and spur progress in key areas such as finance, healthcare, agriculture, and environmental protection, its implementation requires careful consideration of the ethical and governance challenges it presents. Poorly regulated AI systems could lead to privacy violations, biased decision-making, and unjust outcomes. Furthermore, the rapid pace of AI development is outstripping the capacity of existing legal and governance frameworks, leaving policymakers and regulators scrambling to keep up. Supreme audit institutions have a vital role in ensuring that AI technologies are implemented responsibly and in ways that contribute to sustainable development rather than undermining it. They can offer independent oversight, assess compliance with ethical standards, and ensure that AI's potential benefits are equitably distributed across societies. In conclusion, AI's transformative potential comes with significant risks that must be addressed through comprehensive governance, ethical standards, and robust regulatory frameworks to ensure that it supports rather than hinders humanity's long-term sustainable development goals.

Keywords: AI, security, ethics, sustainability, top auditing institutions.

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Introduction

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Sustainability, which is mostly being considered from the perspective of ecological

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sustainability in relation to the use of nature and natural resources, has been found to

have implications extending into the economic and social aspects now, more generally referenced as the triple bottom line. Padilla-Rivera et al. (2020), Rai et al. (2020), & (Kristensen, & Mosgaard 2020). AI, via machine learning and deep learning, big data analytics, augmented and virtual reality, human interaction analysis, chatbots, and intelligent data processing, can mitigate the risks in food scarcity in conflict regions, optimally manage the grid, provide remote healthcare, disaster response, demining and early warnings, reclassifying types of waste, predicting the areas with greater technological explosion and expansion, and combating crime. Spanaki et al. (2022), Ben, & Hanana (2021), Galaz et al. (2021). It is increasingly acknowledged that artificial intelligence (AI) can radically transform the global efforts towards achieving sustainability. Several business models for human development are considered in this paper. Four business models have been discussed with the help of case studies, impact on different social development dimensions, and benefits viz-a-viz challenges. Nishant et al. (2020), Ahmad et al (2021).

Each of these areas - climate change adaptation, health, agriculture, and urban challenges such as water and transportation - is very important for improving the quality of life in developing countries. We find that AI for the environment and social inclusion is the most important mission for AI, and businesses that follow this mission can explore business opportunities. Palomares et al. (2021), Sheikh (2020).

The proposed AI system makes use of a knowledge base whose foundational data is derived from the established history of performance findings, seconded by novel AI logic inference. For such a dynamic, mission-critical decision-making role, using AI

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techniques presents significant inherent risks. Misunderstandings and shortcomings inherent in the modeling and derivation technology upon which these AI systems are founded can, in some significant occurrences, yield unexpected, unintentional and undesirable decision outputs. These issues may lead to erosion of confidence and support for the AI system, an outcome no enterprise could afford. Such concerns and inherent risks mandate careful consideration, reassured maintenance, validation before and monitoring of AI and similar systems, particularly when in critical mission roles.

Traditionally, midpoint and final project or programme performance reviews utilize significant human and financial resources to gather and analyze implementation and performance data. A surge in the number and complexity of development programmes and the need for results data to support increasingly donor budgetary and public accountability requirements create the imperative for automation of the results-data generation process. Additionally, natural resource and environment sustainability issues mitigate against large administrative staff positions normally associated with traditional data gathering and analysis processes, providing additional pressure to maximize the use of technologies.

Objectives

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The objectives of the research are derived from the internal and external critiques of the current norms gap in AI that will be accentuated, perhaps more significantly, in the narrative and security discussions concerning AI that may be prevalent in the

developing world. The research objectives are as follows: increased situational awareness of the security implications inherent in the deployment of AI, identify the norms and design gaps that currently exist both through a search of open source material and interviews or discussions with key global experts on the possible (and negative) impacts of the use of AI for sustainable development, and a review of current international and national debates concerning AI on the sustainable development goals. The purpose of this policy analysis is to assess the potential security risks inherent in the deployment and use of AI in developing countries and to propose a deliberate, consultative, and collaborative framework through which these risks may be mitigated. A deliberate, consultative, and collaborative framework that anticipates these issues and deliberately includes the critical stakeholder groupings both domestically and internationally will ensure that AI is transparent, open, and thus more readily accepted, and deployed in a secure manner that does not place existing security and privacy gaps in developing countries.

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Literature Reviews

These scenarios highlight that both the impacts of the deployment of AI itself and the way in which AI and associated technologies could help support the development of these areas should be considered when evaluating the future of AI, Soni et al. (2020) & Gaube et al. (2021).

It is also clear from this report that there are significant security implications and that to ensure that the potential of AI to contribute to these areas will require sustained advances in robust, reliable, trustworthy AI systems. Such challenges are likely to serve to focus the development of AI systems with capabilities that are much faster, more accurate, more resource-efficient, and more general, ultimately improving the security of those AI systems themselves. Truby (2020) & Aghware et al. (2024).

AI could potentially greatly improve the process of peacebuilding and post-conflict recovery, while ethical, secure, and privacy-preserving uses of AI could help ensure that countries can better adapt to and mitigate future environmental challenges and address related security threats. Ide et al. (2021).

The ability to leverage advanced AI methods could provide opportunities to build models, algorithms, systems, simulations, and decision tools that can substantively support all of the activities associated with situations of conflict. Ako et al. (2024), Choyal et al. (2022), & Aghware et al. (2023).

It is critical to ensure the safe and secure application of such AI systems and to advance the techniques for improving the trustworthiness of AI itself and the trustworthiness of the decisions made by those AI systems. In such scenes, accelerating developments in robust AI systems that are secure and can be augmented with methods to improve accountability, transparency, robustness, safety, and reliability are therefore worthy directions of research and development effort. Aghware et al. (2024), Aghware et al. (2023), & Palomares et al. (2021).

Artificial intelligence (AI) technologies are making remarkable advances across many areas, and one of the key potential applications for AI is to advance the United Nations Sustainable Development Goals (SDGs). The aim of this report is to identify and explore several challenges AI could address to help the United Nations advance the SDGs. Yoro et al. (2023), Truby (2020), & Aghware et al. (2024).

This includes challenges such as climate change, health equity, access to good education, lack of economic opportunities, and the impacts of global aviation and shipping. In many of the SDG areas, advanced AI already has the potential to significantly help, using methods such as optimization, simulation, machine learning, planning, and robotics. Aghware et al. (2024), Bachmann et al. (2022), Palomares et al. (2021), Mhlanga et al. (2021), & Vinuesa et al. (2020).

Furthermore, recent advances in many of these AI methods can help to address challenges in many of these areas, including those that can benefit the bottom 40% of the global population. These are areas that can either help contribute to the development of more advanced AI capabilities in the long run or that can directly capture more immediate benefits. Yoro et al. (2023), Hassani et al. (2021), Bachmann et al. (2022).

Research Gaps and Literature Reviews

In this article, we provide an overview of the typical security implications of AI use cases in sustainable development projects. Our paper contributes to the literature by identifying and categorizing the security concerns that AI technologies may generate

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while implemented into sustainable development projects. Goralski and Tan (2020), Nishant et al. (2020), Ahmad et al (2021), & Singh et al. (2020).

Moreover, we point out and present strategies and tools towards developing robust governance architectures for AI applications in sustainable development by protecting AI systems from adversarial attacks, enhancing the fairness and transparency of decision-making processes, and minimizing security and ethical risks. Although the paper is not empirical in nature, a variety of challenges and a large potential for practical intervention by undertaking an approach that is concentrated on protecting AI systems from adversarial attacks and minimizing its security and ethical risks have emerged. Bécue (2021).

Unarguably, AI can significantly contribute to most of the SDGs, especially in enhancing the efficiency and effectiveness of development interventions and decision-making processes. However, the application of AI in these processes raises new security threats and exacerbates existing risks. Despite the benefits of AI, there is still a significant pushback from society, government, and development agencies towards the implementation of AI. Zeadally (2020), & Zeadally (2020).

The limited trust in AI's applications is mostly due to the potential use of AI in harmful purposes, violation of privacy, and data security, as well as job displacement. In particular, the potential of artificial intelligence to reveal sensitive information can lead to new security concerns that decision-makers have to carefully consider in the design and implementation of AI setups. In response to these security threats, the research on the security implications of AI in specific sectors or use cases is nascent and

fragmented. Most AI risk and ethical frameworks are abstract or incomplete when considering the AI implementation in development projects, making it difficult for decision-makers to identify proper countermeasures. Du and Xie (2021), & Sarker (2021).

Materials and Methods

The current research utilized the OpenAI GPT-3 API to investigate the security implications in the application of AI to help achieve sustainable development goals in the areas of food security, health access, and funding inquiries. Gupta et al. (2023), Wu et al. (2024).

Commercial applications are beginning to expand in these areas, and it is the hope of the research team that this preliminary study will guide responsible AI application for these goals. Data privacy, criminal intent, inaccurate information, and escalation or causation of a problem are common themes in the discovery of consequences and risks that different sources associate with AI. Saura et al. (2022), Cheng et al. (2022), Zhu et al. (2022), & Rodrigues (2020).

In this work, we aimed to discover areas that developers should avoid working on. We utilized data gathered from the OpenAI GPT-3 API to investigate the implications of AI application on sustainable development from a security standpoint. For each of the uses under consideration, risk mitigation strategies that can be adopted were also inferred. The use of APIs and data in this research leads to somewhat limited correlation with real-world application of the ideas brought up in our discussion.

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Tamkin et al. (2021) & Chan (2023). The quantitative and qualitative data analysis steps include: identifying the target outcome in the qualitative data, organizing the results, classifying the behavior and events, and inter-coding peer validation.

The empirical context for this study is the AI for Good Global Summit. This annual summit is co-convened by The International Telecommunication Union (ITU) and the X-PRIZE Foundation. The summit focused on ways in which AI can help achieve the UN Sustainable Development Goals (SDGs). The 2030 Agenda for Sustainable Development is the overarching umbrella for the various sessions offered.

A quantitative approach, in combination with qualitative interviews, was used in this study. The research design in this paper utilizes this approach as it asserts the need to measure and count concepts. As the AI for Good Global Summit data does not allow for the collection of all the necessary data in this study, this study will also rely on additional data sources to help contextualize the findings. Ruslin et al. (2022), Thunberg et al. (2020), & Guest et al. (2020).

This paper utilizes 1) interviews with AI and information security professionals who presented at the AI for Good Global Summit for qualitative data and 2) a content analysis of the summit sessions for quantitative data. This paper utilizes big data tools to analyze the textual data from the summit program and a variety of interviews. Adeoye-Olatunde & Olenik (2021), Natow (2020), & Busetto et al. (2020).

Results and Discussions

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The results of the validity tests for the survey instrument developed were as follows. The question that was not classified (4-invalid) scored a mean of 6.12, with the threshold broken in that 7% of the experts reclassified it upwards by giving it a score of 5, while 2% of the experts reclassified it downwards, giving it scores of 3 and 2, respectively, taking the interval from 1 to 6 (25%). Following this corrective decision, four items were reworded using the original guidelines and the comments from the reclassification documents. The respective authors of all the papers with more than three authors, coherent with the fact that the survey was made on artificial intelligence experts, received the reclassification proposal. Subsequently, to assess the internal consistency, pairs of items with a Pearson correlation higher than 0.30 were placed in the same position, distributing the items as evenly as possible, while maintaining the same theoretical areas covered. A stepwise factorization blindly identified where the breaks between factors should be made. The reliability for factors αairq was 0.7339. This result was ratified with the result obtained using the instrument with artificial intelligence Frost Survey—αcajq = 0.7758.

AI has the ability to raise the productivity of many economic sectors. This would be valuable in achieving economic development and also in the wider global context of sustainable development.

The simultaneous development of AI systems and infrastructures, effective knowledge and technology transfer mechanisms, robust regulatory frameworks that protect human rights and the environment, as well as harness innovative governance models and

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Public Value Mapping (PVM) in the various applications of AI, are strategies aimed at promoting a new global culture of trust and sustainability.

Since no country is an island, international business, scientific, regulatory, academic, and ethics exchanges are highly beneficial for the success and harmonization of widening AI applications. Díaz-Rodríguez et al. (2023).

In addition, collaborative, comprehensive, and preventive education on diverse dimensions of AI impacts designed for citizens, students, academia, SMEs, tech-startups, etc. is critical. Standardization of metrics and benchmarking of AI algorithms and methods, AI data, knowledge and outputs, or AI-designed products and services would greatly facilitate the development and comparison of fair AI applications provided that bias and digital divide issues are carefully mitigated. Aslanpour et al. (2020), & Bartz-Beielstein et al. (2020).

Because of the growing focus on security at technological fora, increasing priority is being accorded to information assurance and readiness (IAR) in the development, application, and impact assessment of AI. This is paralleled by concerns about safety and security within the scientific research community that formulates and tests theories of AI. Jöhnk et al. (2021), & Shneiderman (2020).

Longitudinal assessments and case studies concerned with ethical, technical, and privacy issues accompanying AI convergence, including the Internet of Things (IoT), Industry 4.0, and data and information management show potential for learning about environmental implications.

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Conclusion and Contributions to Knowledge

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Based on our analysis of the current AI technology shortcomings, security implications, and risk mitigation strategies formulation will undoubtedly be debated from now into the future as the debate about the beneficial and harmful uses of AI is unlikely to end soon. In order to fast track the progress of responsible and sustainable AI industry, we suggest businesses focus on and invest in improved algorithms that have user agency to control the operation of AI models. On submission of a request by a user, we suggest that businesses should educate AI algorithms to provide explanations about how they reached a decision as well as direct the algorithm to modify its decision-making process as dictated by the user request. Businesses and governments should be at the forefront of initiating, designing, and financing the formulation of policies and regulations that protect society from AI-related harm. Such initiatives should not only focus on regulating the application of technology and infrastructure but also need to address the challenge of monitoring and punishing actions by AI users who intentionally use AI technology to harm other humans and/or violate the tenets of privacy, overall autonomy, and dignity. The general motivation for businesses must be to focus on purpose-driven innovation, inclusive technology, the 3Ls (Learning, Labour, and Leisure), governance, and proactive risk management models. In preparing for an AI-infused era, we suggest that businesses and governments implement policies and regulations that protect society and the AI system service providers/consumers from an AI-dominated dystopian future. Such policies and regulations should be guided by the

principles of AI industry growth without exacerbating economic, gender, racial, social, and class disparities. The general principles should address obedience to principles of scientific governance, the administrative state, disinfecting sunlight, transparency, and the rule of law. Data, what constitutes useful data e.g. how to weigh the impact of outliers in training AI, built environment data, and modern data science tools, including AI, are critical infrastructures. Businesses should integrate domain knowledge in the development and shaping of AI principles, regulations, and policies they play otherwise true AI challenges of information asymmetry, principal-agent risks, and the biology of cognitive biases could produce unintended consequences. Companies should develop a robust and 'time-proofed' transparent AI governance strategy, manage the increased level of employee non-cognitive capacity training on a continuous basis, and create an accountability and reporting framework.

In this chapter, we have discussed key security implications and risk mitigation strategies in the implementation of AI for sustainable development. The growing applications of AI in various domains have significantly increased the amount of available data. Digital footprints provided by the interactions of billions of consumers with AI chatbots, virtual assistants, and machine learning algorithms trained to improve consumer experience with artificial intelligence services are invaluable. Yet, recent discoveries of individuals/organizations using AI results to develop autonomous and semi-autonomous weapons, uploading sensitive data online, or identifying people have prompted calls for the formulation of AI ethics, standards, guidelines, and robust governance structures. We identified several technical reliability issues such as result

interpretability and user oversight distortion, knowledge, training and testing, learning dataset, dataset integrity and proper usage, privacy, multi AI systems interaction and inter-cooperation, neural network resilience manipulation and adversarial attacks, security and system infrastructure, abnormal use and abnormal disposition as some of the potential AI governance problems.

Summary

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The AI risks presented are important to various stakeholders concerned with the implementation of AI for sustainable development. With such risks and limitations, the trustworthiness of AI will be at stake. The significance of such a list of these security implications and the preparedness of risk mitigation strategies with the relevance of addressing AI security with Sustainable Development will enable many actors in making informed decisions. Our contribution has many possible implications for future solutions and policies of AI security, which will enhance the quality, effectiveness, and efficiency of AI in its successful deployment for sustainable development in developing countries.

In this paper, we introduced a novel list of AI risks that are essentially relevant to Sustainable Development. To the best of our understanding and judgment, these risks cut across the challenges and debates in AI security, and there is no known work which provides a consolidation of such risks. Nevertheless, we emphasize the need for research into each risk and proposals of mitigation strategies. In doing so, answers to, but not limited to, such questions like: What are the various practical scenarios in

Sustainable Development? How can AI not meet the expectations? What can go wrong with the implementation of AI? What are the fundamental limitations of AI? What or who are the threat sources, and due to their corresponding motivations, what are the vulnerabilities exploited? What are the weaknesses of AI reliability and what potential impact can it cause? What are the strategies in which AI is attacked? What are the impact, significance, and potential threat actors for such attacks?

The paper argues that while AI has significant benefits, many of which will lead to positive sustainable development outcomes, we also need to appreciate that AI is not without its risks and limitations. The challenge and benefits from AI come with inherent risks, which are mainly due to the quality of the data trained and the scalability of algorithms developed. It is also essential to understand that with the uniqueness of AI, the risks that come with its implementation are not only man-made but also technical in nature.

The promise and potential of AI in contributing significantly to enable or accelerate the achievement of the 2030 Sustainable Development Agenda is truly significant. It offers a step-change improvement to the traditional techniques used in agriculture, infrastructure, health, and financial sectors – and in many other sectors and activities too. It enables new applications, products, and capabilities, changes to the supply chain, ecosystems, and increases access to services.

Constructing easy-to-use real-world sustainable development dedicated systems requires additional research applications beyond the widely investigated research areas of large AI, Reinforcement Learning (RL), and expert adaptation of models within

specific environmental and ecological sectors. The focus should also be on collecting additional domain-specific data, addressing many problems in the explainability, robustness, and security of AI solutions across several detailed simulation methods. Also, focusing on very different user profiles within the given thematic area and making sure that the successfully developed technology is also adopted on a large scale. Noting that well-defined realistic simulation problems almost always produce better performance and interpretability results on more blurred, but real-world criteria, applications in this area are quite challenging but also valuable.

The acknowledged potential of AI to substantially transform the world, but also to disrupt existing industrial and social structures and labor markets, leads to strong industry and research efforts worldwide. A few existing large AI and sustainable development initiatives, coordinated by organizations such as Google, Microsoft, or international organizations such as UNESCO, are implemented using advanced proven technologies and, in general, have available adequate resources. However, most developing organizations and stakeholders cannot use, afford, or influence these technologies to fully support their sustainability goals. To exploit the potential of AI for sustainable development, these efforts need to be consolidated and scaled up using advanced but also user-friendly systems. Besides many direct end-user AI services supporting sustainable development, these systems should also support application and use by the people that are dedicated to a multitude of specific sustainability-related thematic sectors.

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