Literature Review

KM Lekgetho

Literature Review – Advanced Technologies and the Right to Development

Submitted as partial requirement for the degree of BCIS (Honours)

Department of Computer Science and Informatics

Faculty of Natural and Agricultural Sciences

University of the Free State

Kananelo Lekgetho

Abstract

This thematic literature review explores the intersection between advanced technologies—specifically Artificial Intelligence (AI), the Internet of Things (IoT), and Big Data—and the human right to development, with a focused lens on food security and healthcare. Drawing on the framework established by the 1986 UN Declaration on the Right to Development and its related Sustainable Development Goals (SDGs), the study assesses how these technologies can either advance or hinder equitable development. Through analysis of key literature, the review demonstrates that IoT and AI have significantly contributed to improved agricultural productivity and healthcare delivery by enabling precision farming and clinical decision support systems, respectively. However, disparities in access, digital infrastructure, and financial resources pose major barriers to the universal realization of these benefits. Additionally, issues such as data privacy, e-waste, and technological overdependence present ethical and environmental challenges. The review concludes that while technological innovation holds great promise for enhancing human well-being and fulfilling development rights, intentional and inclusive policies are required to bridge the digital divide and ensure that such progress is equitably distributed across all regions and populations.

Keywords: Advanced Technologies**,** Artificial Intelligence (AI), Internet of Things (IoT), Big Data Right to Development, Food Security**,** Healthcare Innovation, Digital Divide, Sustainable Development Goals (SDGs), Precision Agriculture, Clinical Decision Support Systems (CDSS)**,** Data Privacy and Security

Introduction

Advanced technologies is a broad field that refers new or future specialised tools, techniques, devices and materials that are expected to revolutionise the social and commercial environments (Izsak, Perez, Kroll, & Wydra, 2020). Internet of Things (IoT) is a subfield concerned with internet-connected devices that have machine-to-machine communication capabilities. Artificial Intelligence (AI) and Big Data are closely related subfields, as AI broadly refers to algorithms that are designed to analyse large data sets based on rules set during development. Big Data refers to those large sets of data being collected and that continue to grow exponentially. The development of these innovations intersects with human rights in a way that if they are properly employed, they could improve human well-being across all socioeconomic groups (Willie, 2024). This literature review aims to explore the impact of these technologies on human rights, with focus on the right to development and its cascading effects on food security and healthcare.

The United Nations adopted a resolution in 1986 titled, “Declaration on the Right to Development”. The first article of the declaration advocates for all people to enjoy the right to develop socially, economically and culturally without discrimination or prejudice (United Nations, 1986). The seventeen Sustainable Development Goals (SDGs) were, in a way, introduced to realise this right. The third SDG called “Good health and well-being” endorses healthy living for people of all ages and consequently fulfils the essence of the human right to health (United Nations). The second SDG, titled “Zero hunger”, seeks to eliminate hunger, advance food security and foster sustainable agriculture. This goal directly reflects the aspirations of the UN to realising that right to food is achieved.

Advanced Technologies and the Right to Development

Human development cannot be fulfilled if the right to food and health is not fully attained by everyone. Therefore, it is essential that these two rights be considered in parallel to each other when evaluating the right to development. Duan et al. (2019) noted that there is a disparity between organisations in terms of the adoption of advanced technologies like AI. This is a concern because if access to tools is gatekept by organisations with large financial resources, it would result in a digital divide that would put marginalised groups at a disadvantage when it comes to participation in AI-driven economic activities. To address this, the authors propose that the impact of AI systems should be empirically measured to assess long-term impact on social transformation. This would be necessary if evidence-based metrics are to be used for specific initiatives that work towards reducing this digital gap to benefit all groups equally.

As with other advanced technologies, IoT is at the forefront of human development. According to Nizetic et al. (2020), the number of IoT devices is expected to rise to over 125 x10^9 over the next 10 years. This is a testament that IoT devices are becoming an integral part of our daily lives. Furthermore, efficient deployment of IoT devices require that there be adequate internet coverage and speed so that real-time efficient communication is achieved in various sectors. However, as it is noted by Nizetic et al. (2020), there is a considerable gap between other parts of the world where internet access is higher than average while there are other nations with less internet connectivity. Figure 1 shows the expected increase in

	2017	2022	
	(Mbps)	*(Mbps)*	*Rise*
Global	**24.4**	**54.2**	2.2↑
Asia Pacific	26.7	63.3	2.4↑
Latin America	9	16.8	1.9↑
North America	37.1	83.8	2.3↑
Western Europe	25	49.5	2.0↑
Central and Eastern Europe	19.5	32.8	1.7↑

Figure 1: Expected increase in Wi-fi speeds for the years 2017 to 2022 (Nizetic et al.,2020)

global Wi-fi speeds for the period dating 2017 to 2022. This shows a consistent trend in the inequality in access to technology.

The authors do acknowledge however, that this integration has benefits to the people, like improving the quality of living. Conversely, they also note that this increase has had growing negative effects. Specifically, the increasing electronic waste (e-waste) caused by the increasing number of devices and the demand of these devices which has led to an increased usage of limited raw materials. Challenges persist when it comes to recycling e-waste globally, Nizetic et al. (2020) points out that the yearly production of e-waste is above 44x10^9 metric tonnes and that few states have policies in place to curb this increase. This is highlighted by the fact that only 50% of the global population is not covered by adequate legislation in terms of e-waste and that the annual recycling rate is very low, standing at around 5% (Nizetic, Solic, Gonzalez-de-Artaza, & Patrono, 2020).

Despite the concerns about its usage, there has been a growing necessity for smart technology worldwide. This has also led to the application of IoT into many domains and industries, including health and agriculture. Studies show that IoT reduces resource utilisation in the agricultural sector (Nizetic, Solic, Gonzalez-de-Artaza, & Patrono, 2020), and therefore increases crop production and quality, consequently ensuring food security. As sustainability is the key theme of the UN SDGs, IoT has the potential to play an important role in realising the goal of sustainable living by all nations.

Cascading Effects on Healthcare

The use of computerised decision support technology in the health sector has been around since the 1970s (Sutton, et al., 2020). This technology was developed to improve the decision-making of health specialists with targeted medical knowledge and patient profile. With the right decision-support system, health practitioners can deliver high quality services to their patients, which directly affects the society's quality of life. Some of the benefits of clinical decision support systems (CDSS) include, reducing the likelihood of prescribing wrong medication, providing diagnostic support based on the patient's data and direct patient decision assistance is provided via personal health records (PHR) and other platforms. Sutton et al. (2020) further notes that adoption rate is higher in western countries like the USA, Canada, England, Denmark, Estonia and Australia among others, highlighting the need for equitable access.

The continued advancement of technology in the healthcare sector has come with some risks that are too significant to ignore. Among others, Sutton et al. (2020) note, as health practitioners must be alerted every time a significant event occurs, this will lead to a phenomenon known as alert fatigue. Additionally, the use of CDSS will have a negative impact on the skills of user, this is when the user develops an over-reliance on the system. To mitigate this risk, the authors note that systems should be developed in a way that does not make them too prescriptive or in a way that jeopardises the autonomy of health

practitioners and that their impact should be monitored and evaluated continuously over time. This oversight will ensure that technologies developed to benefit the health of the people are reliable and do not obstruct access to high quality healthcare.

IoT together with AI have the potential to directly benefit people to an individual scale. This can be seen when an individual or a patient is using wearable IoT sensor devices that are embedded with AI to monitor some factors relating to the individual like their blood pressure, weight, and stress or glucose levels (Muthu, et al., 2020). This application means that these advanced technologies can be used to predict and analyse symptoms of diseases and that the individual will be informed about their health status in real-time. The implication is that the individual will be aware of his/her health and will hopefully play a role in maintaining it. As noted earlier that technology comes with risks, the dangers involved in such health systems has to do with data security and privacy. Often, patients do not trust other people enough to let them hold or know about their health conditions (Sutton, et al., 2020).

Cascading Effects on Food Security

Agriculture has evolved from traditional methods of farming to usage of advanced technologies to a grow, manage and sustain farms. This current practice is known as Precision Agriculture (PA) and is becoming more relevant today as result of severe weather patterns, Zamora et al. (2019). It involves using sophisticated machinery and computer systems to enable sustainable farming with the goal of reducing costs and effort to produce. IoT has been at the forefront of this space as noted by Zamora et al. (2019). The observed benefits of using IoT in agriculture include, using sensor devices to manage irrigation, automate data capturing and improved quality of agricultural produce. These benefits directly tie technological advancements with food security, illustrating that improved agricultural processes result in food that can be obtained by everyone.

The use of AI and Big Data in agriculture would include the analysis of large data sets that are being continuously collected by IoT devices deployed in that space, such data would be used for analysis or machine learning to train AI systems to make predictions or elicit insights from the large pool of data to assist users with decision making. Decision support systems have also been developed and implemented in the agricultural sector, and like the health sector, IoT can be used to detect crop diseases and manage its growth (Zhai, Martínez, Beltran, & Martínez, 2020). The aim of introducing decision support systems in agriculture is to enhance productivity, to adjust to climate and to evade food waste. The challenges faced with the adoption of these technologies is capital, only a few organisations or individuals have enough financial resources to invest in these technologies.

How Advanced Technologies Advance or Hinder Rights

From the studies that have been evaluated, It has been noted that the impact of technological advancements on the human right to development has been significantly difficult to quantify. This is understandable considering that most of the times when such

advancements take place, they would most likely be developed for institutional use by large organisations who are mostly aiming to make profits from those advances. However, there are some specific indicators that we can use to evaluate the extent to which these technologies have impacted the right to development and particularly its effects on right to food and right to health.

First, we can analyse the rate of adoption and evaluation of the specific groups or areas that are quick to adopt these technologies. The rate of adoption is mostly impacted by capital cost to access these technologies, this proportionality means that the more capital you have, the greater the access you will have. The inverse is also true. This would correctly explain why there are some parts of the world that have less internet connectivity than others, and why there has been, in specific nations, individuals who have more access to advanced healthcare technologies than others. A good example would be the United States of America, where citizens have to pay for their medical treatment if they do not have insurance (Zhang, 2024).

The human right to development applies equally to everyone, so to measure and to evaluate its realisation we need to see how each person is impacted. The extent to which this right is realised by everyone differs significantly due two important factors. The first is, in which area or group does the individual belong and the second is, whether the individual has adequate capital to access these technological advancements themselves.

Even though there is a well-established literature in advanced technologies, there is not enough to link the impact which these technologies have on the human right to development. This is an opportunity in research to assess whether our technological development as a civilisation benefit everyone or whether specific groups only get to benefit. Additionally, it opens an opportunity for researchers to craft out policies and measures aimed at addressing specific concerns that have been raised concerning equitable access and ethical usage.

Conclusion

Advanced technologies such as AI, IoT and Big Data have been discussed with special focus on how they are employed in the healthcare sector to meet one of the SDGs which is “Good health and well-being” which aims to realise the right to health. Additionally, the employment of these technologies in the agricultural sector with the aim of ensuring food security and meeting one of the SDGs which is “Zero hunger” and the broader objective of realising the right to food. These two rights are inherently essential to fully realise the right to development, and without neither, it cannot be concluded that this right has been attained.

It has been demonstrated that IoT and AI are used in health to monitor health of individuals and to make them aware of their health status and may provide the individual with motivation to take care of his or her health and to provide health practitioners with decision

support systems. The challenges faced in this sector include the risk of too much dependence on such systems and ethical concerns regarding data security and privacy.

It has also been shown that in agriculture, IoT, Big Data and AI can be used to automate farming practices and to reduce the use of resources to achieve sustainable farming with advanced technologies. The main challenges faced in this sector include the large capital required to access these tools. But advances may eventually result in lower costs and thus greater access.

References

Chan, H. W., & Lo, N. P. (2025). A Study on Human Rights Impact with the Advancement of Artificial Intelligence. *Journal of Posthumanism*, 3. doi:10.63332/joph.v5i2.490

Duan, Y., Edwards, J. S., & Dwivedi, Y. K. (2019, January 28). *Artificial intelligence for decision making in the era of Big Data– evolution, challenges and research agenda.* doi:10.1016/j.ijinfomgt.2019.01.021

Muthu, B., C.B.Sivaparthipan, Manogaran, G., Sundarasekar, R., Shanthini, S. K., & Dasel, A. (2020, September 24). IOT based wearable sensor for diseases prediction and symptom analysis in healthcare sector. *Peer-to-Peer Networking Applications*. doi:10.1007/s12083-019-00823-2

Nizetic, S., Solic, P., Gonzalez-de-Artaza, D. L.-d.-I., & Patrono, L. (2020). Internet of Things (IoT): Opportunities, issues and challenges towardsa smart and sustainable future. *Elsevier*, 2. doi:10.1016/j.jclepro.2020.122877

Sutton, R. T., Pincock, D., Baumgart, D. C., Sadowski, D. C., Fedorak, R. N., & Kroeker, K. I. (2020). An overview of clinical decision support systems: benefits,risks, and strategies for success. *Digital Medicine*. doi:10.1038/s41746-020-0221-y

United Nations. (1986, December 04). *Human Rights Instruments: Declaration on the Right to Development*. Retrieved Arpil 6, 2025, from Office of the High Commissioner, Human Rights: https://www.ohchr.org/en/instrumentsmechanisms/instruments/declaration-right-development

United Nations. (n.d.). *The 17 Goals.* Retrieved April 06, 2025, from SDGs United Nations: https://sdgs.un.org/goals

Willie, A. (2024, September). *AI and Human Rights: Examining the Intersection of AI Technologies with Fundamental Rights, such as Freedom of Expression and the Right to Privacy.* Retrieved April 2024, from Research Gate:

https://www.researchgate.net/publication/387364328_AI_and_Human_Rights_Examining_the_Intersection_of_AI_Technologies_with_Fundamental_Rights_such_as_Freedom_of_Expression_and_the_Right_to_Privacy

Zamora, M., Santa, J., Martinez, J., Martinez, V., & Skarmeta, A. (2019, January 19). Smart farming IoT platform based on edge and cloud computing. *Biosystems Engineering*. doi:10.1016/j.biosystemseng.2018.10.014

Zhai, Z., Martínez, J. F., Beltran, V., & Martínez, N. L. (2020, Feb 08). Decision support systems for agriculture 4.0: Survey and challenges. *Computers and Electronics in Agriculture*. doi:10.1016/j.compag.2020.105256