Artificial Intelligence in Sustainable Development

***Jayant Pal**
****Prof. Y.P. Raiwani**
*****Brijesh Rajbhar**

Abstract

Business, corporate practices, and government policy are fast evolving due to artificial intelligence (AI). Machines and robots with deep learning skills have disrupted and enabled businesses, governments, and society. They also affect global sustainability trends. The AI revolution might lead to a utopian society where humans and robots coexist peacefully or a dismal one with war, poverty, and misery. More immediately, will AI accelerate UN Sustainable Development Goals (SDGs) development or lead to increased economic instability, environmental collapse, and social upheaval? What are the consequences for corporate leadership and future business leader education? The effects of AI in three case studies are examined in this essay. It has some early implications for management education and corporate leadership under fast technical and societal change. This research examines how AI affects sustainable development, with an emphasis on the SDGs, from corporate strategy and public policy perspectives. Global sustainability management learning and leadership development lessons are also drawn.

Keywords—*Artificial Intelligence, Education System, sustainable development goals, Academic life, global sustainability,*

INTRODUCTION

AI, formerly the realm of science fiction authors and filmmakers, is now a part of our high-tech cultures. AI has various meanings that have changed throughout time. Most definitions of AI say it solves complex cognitive problems related to human intelligence, helps as many people as possible through smartphones or healthcare, or recognizes problems and creates solutions for technology, people, and society. However, AI has always sought to construct robots that think like humans (Marr, 2018).

AI is becoming common in business and industry. It might change how we find, learn, live, communicate, and work. National AI offers great potential for the economy and society (..., 2016). In the Age of Sustainable Development (Sachs, 2015), where the 17 Sustainable Development Goals (SDGs) set the global development agenda, AI is quickly expanding economic, corporate, and government policies. Machines and robots using deep learning are overcoming cognitive challenges linked with human intellect.

Humankind's intellect evolved from natural to artificial in 200,000 years, and it took 10 years to

migrate from the 'earth' to the 'cloud' (Garimella & Fingar, 2018, p. 7). AI development has taught humans about human nature, intelligence structure, and learning and expertise. The concept of 10,000 hours of deliberate, structured practice is crucial for achieving expert status, as discovered by Swedish psychologist Anders Ericsson and popularized by Canadian journalist Malcolm Gladwell (Garimella & Fingar, 2018). AI is quickly replacing humans in knowledge with enhanced predictive capacity, efficiency, and outcomes. Homo sapiens will be supplanted gradually as we grow increasingly immersed in information systems and robots become important to our life (Harari, 2017).

Some towns and nations will benefit intellectually and financially from AI progress, while others will fall behind. AI is expanding faster than legal and regulatory structures and methods to manage it (Munoz & Naqvi, 2018). Most framework and mechanism developers consider short-term academic research and political cycles, often as short as 20 years (Harari, 2017). Technological advancements in computer vision, robotics, and speech recognition raise concerns among scientists, businesspeople, government officials, and policymakers about AI replacing humans, automating warfare, and surpassing human intelligence (Markoff, 2014). Stephen Hawking, physicist and cosmologist, argues that humans' sluggish biological processes cannot compete with intelligent robots, who may quickly replace them (Goralski & Górniak-Kocikowska, 2017, 2018; Goralski & O'Connor, 2018; Penn, 2017).

The research project titled "A Study of One Hundred Years of Artificial Intelligence" was funded by Dr. Eric Horwitz, who served as the President of the Association for the Advancement of Artificial Intelligence from 2007 to 2009. Dr. Horwitz, a Technical Fellow and Director of Microsoft Research Labs, collaborated on this project with his spouse, Mary Markoff (2014). The concept of nurturing is often seen as a fundamental aspect of human development. This study on artificial intelligence (AI), conducted by renowned institutions such as Stanford, Harvard, Carnegie Mellon, and the University of British Columbia, among others, aims to evaluate the legitimacy of apprehensions and worries about AI and its potential risks to human beings (Markoff, 2014, para 4-5). Horwitz has a firm conviction that, despite the cautionary advice given forward by esteemed thinkers and influential thought leaders, super-intelligent machines will not possess the capability to transcend human control and skill. According to Markoff (2014), he contends that these technologies will yield both advantageous and detrimental consequences for society. According to Lohr (2018), the introduction of artificial intelligence (AI) in developed nations has the potential to result in job displacement. However, in less affluent nations, AI might provide a novel avenue for breaking free from the cycle of poverty. According to Munoz and Naqvi (2018), the advancement of artificial intelligence (AI) is characterized by its swift pace, discerning nature, and uncontrolled emergence, rendering it unfeasible to evade its perilous expansion (p. 1). The academic community plays a crucial role in the education and preparation of aspiring business executives and politicians on a global scale. It is important to educate youngsters about the merits and drawbacks of artificial intelligence (AI) to foster comprehension of the present and forthcoming landscape.

The emergence of AI in the Age of Sustainable Development

According to Sachs (2015), a renowned health policy and management professor at Columbia

University, there is a hypothesis suggesting that the global community is embarking on a new epoch referred to as the Age of Sustainable Development. This era necessitates international cooperation and collective efforts to tackle persistent challenges such as extreme poverty, social exclusion, economic inequality, inadequate governance, and environmental deterioration. Sachs had a significant role as a United Nations adviser on the Sustainable Development Goals (SDGs) and Millennium Development Goals (MDGs). Additionally, he now serves as the director of the United Nations Sustainable Development Solutions Network (UNSDSN). During the 2002 UN World Summit on Sustainable Development (WSSD) in Johannesburg, the individual put up a conceptual framework aimed at examining sustainable development. This framework has four fundamental pillars, namely economic development, social development, environmental protection, and good governance. Each of the four components mentioned above is an autonomous and interdependent foundation, all of which are crucial for the achievement of sustainable development on a global scale (World Summit on Sustainable Development [WSSD], 2002, p. Sachs, through the United Nations Sustainable Development Solutions Network (UNSDSN), delineated challenges within the realm of sustainable development, put forward potential remedies and furnished extensive datasets about global phenomena associated with sustainability. Nevertheless, the impact of artificial intelligence on the progress of the Sustainable Development Goals (SDGs) is a relatively new and active area of research that requires more investigation to fully comprehend its implications. A considerable body of academic literature has been dedicated to examining the progression of artificial intelligence, tracing its development from its early stages to its contemporary state. As researchers from several disciplines integrate artificial intelligence (AI) into theoretical frameworks, cognitive processes, and applied problem-solving, scholarly publications in industry trade magazines and academic journals have made significant contributions to the existing corpus of research. Throughout its development, the field of artificial intelligence (AI) has seen a notable surge in investment, subsequently followed by a decrease, another rise, and yet another decline, exhibiting a rather constant trend (Munoz & Naqvi, 2018).

The historical trajectory of artificial intelligence (AI) has been characterized by a series of notable achievements and setbacks. According to Sainato (2015), individuals such as Elon Musk, Stephen Hawking, and Bill Gates caution that the expanded utilization of artificial intelligence (AI) would amplify worldwide economic disparity and introduce a critical predicament for the existence of mankind. This phenomenon potentially foreshadows the emergence of a forthcoming extended period, lasting around 40 to 60 years, referred to as the Kondratiev surge. This surge is indicative of a fresh cycle characterized by continuous industrial innovation and economic expansion. The economic cycles known as the Kondratieff waves were called by Joseph Schumpeter in recognition of Nikolai Kondratiev's contributions (Barnett, 2002). Undoubtedly, artificial intelligence (AI) has the potential to serve as a formidable catalyst for generating substantial economic progress, which is seen as one of the fundamental pillars of sustainable development (Sachs, 2015). Currently, there exist two distinct classifications of artificial intelligence: narrow artificial intelligence (NAI) and artificial general intelligence (AGI). The concept of Narrow Artificial Intelligence (NAI), which incorporates the whole of current AI systems, is often seen as a less advanced kind of artificial intelligence. At now, the

concept of Artificial General Intelligence (AGI) remains confined to theoretical discourse. However, its practicality is steadily growing in tandem with the proliferation of its many applications. One category within the field of artificial general intelligence (AGI) is referred to as human-level machine intelligence (HLMI). HLMI is conceptualized as possessing the ability to do intellectual activities with the same degree of effectiveness as an extraordinarily gifted person (Artificial Intelligence, 2018).

There exists a segment of individuals who harbor apprehension towards this particular manifestation of artificial intelligence (AI) due to its potential to not only expunge job opportunities in the immediate future but also supplant humans as the prevailing species on Earth in the far future. The development of Artificial General Intelligence (AGI) is progressing towards actualization, facilitated by the increasing presence and acceptance of bio-humanoid roboticists. Notably, pioneers in this area, like David Hanson, Ben Goertzel, and others, have made significant contributions via the creation of realistic robots (Goralski & Górniak-Kocikowska, 2017; Goralski & O'Connor, 2018). The objective of these innovative innovators is to develop a comprehensive database, known as OpenCog, which aims to consolidate the collective knowledge of bio humanoid robots. This database would provide an instantaneous distribution of information to all bio-humanoid robots. According to Goralski and O'Connor (2018), The accumulation and equitable dissemination of AI knowledge would be ensured. Although the potential impact of AGI on job displacement is expected to be significant, mostly driven by enhanced production and distribution efficiency, it is important to acknowledge that NAI, or Narrow Artificial Intelligence, is already creating substantial employment displacement and disruptions within existing professions. According to an article titled "Artificial Intelligence," an illustrative case is shown whereby Goldman Sachs, a financial institution, had a significant reduction in the number of human traders employed. The article reports that in the year 2000, Goldman Sachs had a workforce of 600 traders. However, as a result of advancements in narrow artificial intelligence, the corporation was able to diminish this number to just two human traders by the year 2017 (2018, para. 11).

The aforementioned influential factors would exert a significant influence on Sustainable Development Goal 9 (Industry, Innovation, and Infrastructure), Sustainable Development Goal 8 (Decent Work and Economic Growth), and to a lesser extent, Sustainable Development Goal 10 (Reduced Inequalities) and Sustainable Development Goal 1 (No Poverty), particularly in developing nations with limited social safeguards against unemployment and inadequate labor rights. On the contrary, there exists a school of thought positing that the heightened utilization of artificial intelligence (AI) may serve as a potential solution to the issue of income disparity, a matter intricately linked to the pursuit of Sustainable Development Goal 10, namely the goal of reducing inequalities. Nevertheless, considering the historical disparity in the equitable distribution of advantages stemming from enhanced production and efficiency, it is impractical to presume that the individuals responsible for the advancement and ownership of forthcoming AI technology will opt for a widespread allocation of benefits, as opposed to a limited distribution that primarily serves to augment their wealth. This phenomenon has the potential to result in the accumulation of wealth in a few hands, thereby exacerbating the socioeconomic disparity between affluent individuals and those who are economically disadvantaged. The presence of disparities in the distribution of income,

expertise, and power is not limited to individual circumstances but is also seen at a concentrated level within certain nations and cities. This further exacerbates global inequalities, impeding progress towards the attainment of Sustainable Development Goal #10, which aims to reduce such disparities. The emergence of artificial intelligence (AI) has enabled the more efficient and effective execution of tasks that were previously limited to human capabilities. This development has resulted in significant challenges in the work landscape and has also introduced psychological strain on individuals (Goralski & GórniakKocikowska, 2017; 2018). If Artificial General Intelligence (AGI) exceeds the cognitive capacities of the average human across several economic domains, a significant portion of the workforce may face displacement. In January 2015, a collective of prominent figures including Stephen Hawking, Elon Musk, and several specialists in the field of artificial intelligence (AI) issued an open letter, urging for more investigation into the social ramifications and inadvertent outcomes of AI. The correspondence recognized the potential advantages of artificial intelligence, while also expressing concerns about the possibility of automated weaponry and unmanageable robots exacerbating military conflicts, hence posing a threat to human survival (Sainato, 2015). According to Marconi (2019), Stanford University has recently established an institution known as the Human-Centered Artificial Intelligence (HAI) Institute. This establishment aims to facilitate the collaboration of professionals from many fields such as economics, philosophy, ethics, and psychology.

Artificial intelligence and the SDGs:

Different types of artificial intelligence have been integrated into the Sustainable Development Goals (SDGs), first via experimental approaches and subsequently through initiatives aimed at promoting sustainable management and leadership. This study aims to analyze three of these initiatives: The use of artificial intelligence (AI) in addressing the water crisis involves the implementation of intelligent water management systems. These systems are designed to mimic the learning capabilities of people in dynamic environments. By doing so, they enhance the efficiency of decision-making processes and investments in water management infrastructure (Hill, 2018). The use of artificial intelligence (AI) in the agricultural sector has been explored by Plant Village, an effort focused on research and development, with its main base of operations located at Penn State University. This project aims to harness the capabilities of AI to benefit small-scale producers, namely those that cultivate land areas of 2 hectares or less. It is worth noting that these small-scale producers play a significant role in the production of food within developing nations (Lohr, 2018). The utilization of artificial intelligence (AI) by Peter Ma in assessing the integrity of water systems holds significant potential for municipalities and individuals alike. This innovative approach allows for the identification of water sources contaminated with waterborne diseases, as well as the mapping of bacteria and potentially viruses present in these waters. Moreover, this AI-driven testing method offers a cost-effective solution to address these concerns (AI-Driven Test..., 2018; Lant, 2018).

AI and the Water Crisis-the case of smart water management:

Water is an essential component for the sustenance of life. For millennia, the establishment and development of human communities have relied heavily on a consistent and uncontaminated source of water. Individuals experienced various outcomes, such as thriving, migrating, or perishing, as a

result of an unreliable distribution system (Hill, 2018, para. 1). Water and sanitation serve as the foundational components of the SDG resource trinity. The aforementioned factors have significant implications for women's empowerment and gender equality, food and agriculture, energy and climate, as well as infrastructure and technology. Water is widely used in agricultural, industrial, and residential contexts. Every day, urban areas and societies around the globe use millions of metric tonnes of raw water, treated water, and wastewater to fulfill the needs of the human population. To satisfy the needs of end users, it is essential to adhere to hygiene and health regulations while treating and transporting water, therefore ensuring its quality and qualities are suitable. In recent times, there has been a growing emphasis on the utilization of new technology to provide sustainable solutions for the treatment, transportation, recycling, and reuse of water resources. According to Cosgrove and Loucks (2015), the present global water supply is deemed enough to fulfill existing needs and expectations. However, it is important to note that the infrastructure and networks responsible for the treatment and distribution of water are insufficient.

There are a multitude of communities in developing regions that continue to have inadequate access to water resources, hence impeding their ability to meet essential household, economic, and environmental needs. Within these particular places, the absence of drinkable and uncontaminated water to meet the essential needs of humans for drinking and sanitation purposes persists, resulting in detrimental effects on human well-being and efficiency, as well as hindering economic progress, environmental conservation, and the preservation of natural ecosystems. As a result, several Sustainable Development Goals (SDGs) have been established to tackle the aforementioned concerns about water utilization for consumption and production, as well as the preservation of aquatic ecosystems (SDG #6 focusing on Clean Water and Sanitation, SDG #12 emphasizing Responsible Consumption and Production, and SDG #14 centering on Life under Water). The decision-making processes undertaken by communities, municipalities, and countries with regard to the management of water resources have significant consequences for our future economic well-being. Certain individuals have put their future security or sustainability at risk through the disruption and excessive utilization of freshwater resources, the excessive extraction of groundwater from aquifers, the contamination of natural water bodies such as estuaries, coasts, and oceans, and the degradation of ecosystems that provide support to the food chain (Cosgrove & Loucks, 2015, pp. 2823–2880). Humanity must harness technology and artificial intelligence (AI) progress to effectively address both immediate economic needs and the enduring ecological sustainability of natural ecosystems and bioregions. While the fundamental characteristics of water sources and supplies have remained relatively stable throughout time, the methods and tools used for their management have undergone tremendous advancements.

The use of AI-driven intelligent water management systems has been shown to provide valuable support to water utilities, as shown by the studies conducted by Hill (2018) and O'Connor (2017). According to Artificial Intelligence (2018), advancements in artificial intelligence (AI) technology have the potential to enhance the cost-effectiveness and efficiency of monitoring processes at water treatment facilities, ultimately contributing to the safeguarding of public health. In the realm of just-in-time applications, the first AI-driven software relied on expert systems or rule-based algorithms to

ascertain outputs or evaluate alternatives within a range of possibilities. Conversely, contemporary AI tools emulate the learning process used by people. During the learning phase, the incoming data is systematically associated with pre-existing outputs, allowing algorithms to acquire knowledge and improve their performance over time. During the ensuing operational phase, the software starts the process of pattern recognition when it is exposed to fresh data.

The capacity of artificial intelligence (AI) to dynamically adjust and analyze substantial quantities of data in real-time renders it a highly suitable instrument for the management of water resources in a constantly evolving context and the water industry. This capability empowers water utility managers to optimize existing revenue and efficiently strategize for the future (Hill, 2018, p. 3). By using these emerging software-as-a-service platforms, water utilities can establish and manage innovative financial operations that are characterized by adaptability and cost efficiency. Furthermore, the system incorporates cost-effective sensors and communication networks to actively monitor real-time water loss and effectively manage distribution networks. According to Hill (2018), the use of artificial intelligence (AI) has the potential to stimulate the creative thinking and problem-solving abilities of those working in the field of water management. The utilization of artificial intelligence in the water utility industry presents an intriguing prospect. By integrating development projections, future water availability, and infrastructure condition assessment, managers are empowered to optimize their decision-making and investment strategies about infrastructure. Like other forms of artificial intelligence that have limitations, the effectiveness of the system is contingent upon the quality of the data it is provided with and the level of comprehension shown by those managing the output it produces. In the context of artificial intelligence (AI), it is observed that when AI assumes the role of generating questions and supplying answers, people experience a reduction in the level of understanding they had previously acquired via independent problem solving endeavors. At now, human involvement remains indispensable for interpretation. Nevertheless, with the advancement of artificial intelligence (AI) in terms of perceptiveness and the increasing prevalence of AI-generated replies and solutions, the significance of human engagement is expected to diminish, leading to a more discernible inflection point. According to Kaufman (2018), the primary objective of artificial intelligence is not to achieve flawlessness but rather to surpass human performance. The utilization of artificial intelligence (AI) in the field of water management holds promise for enhancing productivity, enhancing water conservation efforts, and consequently making significant contributions towards the attainment of various Global Goals. These goals include SDG #3, which focuses on promoting good health and wellbeing, SDG #6, which emphasizes the importance of water and sanitation, and SDG #14, which addresses the preservation of life below water.

AI and agriculture: the case of Plant Village

The Plant Village project was established by David Hughes, an entomologist affiliated with Penn State University, and Marcel Salathé, a digital epidemiologist associated with the Swiss Federal Institute of Technology (EPFL) in Lausanne, Switzerland. As part of this program, a cultivator in the field will use a mobile application on an affordable and widely accessible smartphone to identify plant illnesses. Simultaneously, the team is engaged in the development of a database capable of discerning and

classifying plant illnesses via the use of mobile phone imagery. According to Brewster (2016), the application is supported by a database including 150,000 images of plants affected by diseases. The team has expressed their intention to augment this collection to include three million photos. According to Lohr (2018), artificial intelligence (AI) serves as a cost-effective tool for prediction and discovery, enabling the utilization of vast amounts of data to spot patterns and provide predictions. Plant Village was built based on this foundation. According to Agrawal, Gans, and Goldfarb (2018) as well as Plant Village (n.d.), an estimated 550 million small farms, each occupying 2 hectares or less, play a crucial role in supplying the bulk of food for developing nations. However, these farms face significant challenges due to their limited or nonexistent access to knowledge about enhancing production. Plant Village, in conjunction with international organizationsion programmes (upon which Plant Village is established), and Google engineers, is adapting artificial intelligence (AI) research to cater to Tanzanian farmers who use affordable gadgets to diagnose crop diseases. The occurrence of plant diseases and the presence of local vermin have the potential to significantly diminish a farmer's cassava yield by a minimum of 40 percent, despite the well-recognised resilience of cassava as a crop that can endure drought and thrive in dry soil conditions. According to Hughes (year), the consumption of cassava sustains a population of around 600 million humans. According to Plant Village (n.d.), the economic value of cassava in Nigeria alone amounts to $2 billion.

The database was started by including the ten most prominent ailments that impact the 30 commodities identified as the most important by the research team. According to Brewster (2016), the algorithm demonstrated a high level of accuracy, almost 99 percent, in correctly identifying both the plant and illness in high-quality photographs. However, the accuracy rate dropped significantly to approximately 32 percent when the system was applied to field images of lower quality. Presently, the picture database is freely available to individuals worldwide who express a desire to use it. According to Brewster (2016), Salathé posits that the team would be receptive to the emergence of an enhanced algorithm from an external team or organization. Currently, the aim is to distribute the information to as many persons as possible in the most efficient way. The establishment of Plant Village was undertaken by Salathé and Hughes in response to their recognition that crucial plant-related information was not effectively reaching those in need of guidance. Farmers encountering a disease outbreak in their fields sometimes face challenges in accessing photographs of sick plants from other databases, despite the presence of such images in other sources. The database established by Salathé and Hughes has an extensive compilation of plant disease photos that are publicly accessible. The inclusion of Zhiwen Liu, an electrical engineer from Penn State University, has resulted in the integration of a miniature spectrometer into the mobile devices being used in the Tanzanian field. The use of this spectrometer enables the examination of the structural characteristics of a leaf, hence facilitating the detection of illnesses at an early stage, before their visibility to the unaided human sight (Digging Deeper: Plant Village, 2018). The early detection of a virus's chemical signature allows for the timely identification of diseases, hence facilitating the global community's awareness of potential health issues before their escalation.

The aforementioned finding has the potential to enhance worldwide food security, therefore making a significant contribution towards achieving the Global Goals of eliminating persistent poverty (SDG 2)

and mitigating the proliferation of crop diseases resulting from climate change (SDG 13). Amanda Givens, a plant pathology researcher at the University of Wisconsin-Madison, who is not associated with Plant Village, raises apprehension on the potential for misdiagnoses due to the presence of comparable symptoms across various plant diseases. Such misdiagnoses might potentially lead to significant ramifications in terms of human health, economic implications, and environmental impacts. In her work, Brewster (2016) recommends the use of skilled observation and evaluation in combination with the application. According to Givens, the Plant Village application may be beneficial for those engaged in family gardening. However, for commercial farmers whose livelihood depends on the land, a more thorough approach is necessary to authenticate a disease, taking into account factors beyond just photographic signs.

According to Agrawal et al. (2018), in Tanzania, a farmer may use the AI assistant Nuru, which translates to "light" in Swahili, to get a software-based diagnostic of diseases or parasites affecting a plant leaf by just hovering a smartphone over it. Additionally, this AI assistant provides suggestions for low-tech cures. Upon successful installation of the application, farmers residing in rural villages are relieved from the need for wireless connectivity to cellular data or distant computing capabilities, bestowing upon them a substantial advantage. According to Hughes (as cited in Lohr, 2018), there exists a potential to use artificial intelligence (AI) in low-income nations with little human capital in areas such as agricultural science, intending to disrupt the cycle of poverty. The novel use of artificial intelligence (AI) in conjunction with affordable mobile phone technology tailored to local contexts holds promise for enhancing agricultural efficiency, augmenting agricultural yields, and bolstering food production. This initiative offers a type of developmental assistance aimed at reducing the disparity in digital access between affluent and impoverished nations. Additionally, it facilitates the dissemination of inventive technological advancements in the agricultural sector. This is particularly crucial given the projected food scarcity in numerous developing countries, particularly those in Sub-Saharan Africa and South Asia, due to their rapidly growing populations. As a result, it can have a positive impact on the attainment of many Sustainable Development Goals (SDGs), including SDG 2 which focuses on eradicating hunger, SDG 9 which emphasizes industry, innovation, and infrastructure, and SDG 10 which aims to reduce inequalities.

Artificial intelligence technologies as a trend in education:

The modern educational landscape is characterized by a prominent movement towards individualization and customization of learning. The concept of individualization in the context of learning pertains to the establishment of a structured framework for interaction, whereby the distinct attributes of each participant are maximally and efficiently exploited (Osadcha et al., 2021). The term "personalization" refers to the establishment of an interactive system inside an organization, whereby students develop socially meaningful, distinct, and distinctive traits and attributes that enhance their ability to fulfill a social function (Osadcha et al., 2021). Contemporary information and communication technologies (ICT) enable the effective integration of individualization and customization within the realm of education. The use of artificial intelligence (AI) technology to address customization challenges has significant potential. Artificial intelligence

(AI) refers to a structured collection of information technologies that enable the execution of intricate tasks through the utilization of scientific research methods and information processing algorithms. These tasks involve the handling of acquired or autonomously generated information during the operational process. Additionally, AI encompasses the creation and utilization of knowledge bases, decision-making models, and algorithms for information processing and the identification of strategies to accomplish objectives AI technologies such as machine learning, deep learning, language recognition, language processing, and computer vision have been successfully used in the field of education. The use of artificial intelligence (AI) techniques and methodologies enables the development of intricate digital learning environments that strive to be highly personalized, flexible, inclusive, and captivating for students.

AI, Sanitation and Health-the case of clean water:

In the context of a worldwide population that encompasses billions of individuals, the acquisition of uncontaminated water has a paramount significance due to the widespread prevalence of waterborne illnesses. The management of this enduring issue poses challenges due to the need for financial resources and the time required to acquire proficiency in using a novel water purification technology (Lant, 2018). Peter Ma, a renowned software inventor and developer employed at Intel, actively engages in "hackathons" and has garnered a multitude of accolades in these highly competitive events. A hackathon is an organized event that often spans several days, during which a substantial number of participants get together to engage in collaborative problem-solving activities using computer programming. Ma's particular area of focus is on using technology to improve the quality of human existence.

The individual began their involvement with the Clean Water AI effort during December in the year 2017, as part of their participation in the World Virtual GovHack competition. Two problems encountered in this specific tournament were the scarcity of clean water and food. The aggregate sum of the monetary prize equated to $450,000. Ma achieved the top position and was bestowed with a monetary prize of USD 200,000 by His Highness Mansoor of Dubai at the awards event held in February 2018. According to AI-Driven (2018), in the paragraph... According to Ma (year), a key factor contributing to their success in hackathons is their emphasis on the potential of technology to enhance the quality of life for people, rather than only focusing on their technical capabilities. According to the study conducted in 2018, the eighth paragraph of the research paper titled "AI-Driven..." discusses... The Clean Water AI test system can conduct real-time analysis and detect toxins even in the absence of an internet connection. The use of a digital microscope, a cost-effective computer operating on the Ubuntu platform, and an Intel Movidius Neural Compute Stick enables the realtime implementation of machine learning and artificial intelligence (AI-Driven..., 2018). The test may be comprehensively developed for a cost of less than US$500, making it attainable for several businesses that may lack the financial means to invest in a costly conventional system. Acknowledging the ubiquity of clean water concerns, particularly inside the United States, Ma sought to use his experience in artificial intelligence.

The individual and their team expressed a desire to develop a system that utilizes artificial

intelligence to detect water pollution. When seen with a microscope, the pure water system is capable of detecting the molecular geometry. Convolutional neural networks have distinct characteristics such as form, color, density, and edge properties, which enable them to effectively recognize aquatic microorganisms. The researchers restricted their first identifying markers to Escherichia coli (E. coli) and the bacteria responsible for producing cholera (Lant, 2018). However, due to the unique structures and behaviors shown by different categories of bacteria, the process of identification may be expanded to include other bacterial taxa. In the foreseeable future, Ma and his colleagues want to discern between advantageous and detrimental microorganisms and viruses that possess dimensions ten to one hundred times smaller than bacteria (AI-Driven..., 2018; Lant, 2018). The AI-based testing system developed by Ma et al. demonstrates the capability to identify dangerous bacteria and promptly indicate contamination on a map in real time. Moreover, this system exhibits a user-friendly interface, necessitating little training for operation. The author proposes a sequential approach to the implementation of monitoring devices in water sources by municipalities. The first step involves the installation of such devices in water sources, followed by the development of specialized regional versions and their integration into water pipelines. Ultimately, the author suggests the production of a consumer version, enabling anyone worldwide to monitor the water entering their households. The idea introduced by Ma has significant significance for worldwide breakthroughs in the safety and efficacy of water and sanitation systems and practices.

Implications for management education:

It is essential to provide comprehensive education to students, as well as prospective business executives and lawmakers, including not just the benefits and expenses associated with particular, narrow-scale implementations, but also the broader macro-level considerations that emerge within the framework of advanced artificial intelligence infrastructure. The importance of education in the domains of science, technology, engineering, and mathematics (STEM) is expected to grow significantly in various regions worldwide in the coming years. Should this trajectory persist, it is anticipated that the disparity between nations in terms of their digital technology access will widen further (Galperin, 2010; Ogunsola & Okusaga, 2006; Schwab, 2018). The article presents three case studies that illustrate the potential benefits of using AI technologies in a company or organization. The use of AI technologies in the current academic landscape is transforming the decision-making capabilities of researchers and students. This, in turn, is reshaping the approach of higher education institutions towards issue investigation, solution implementation, and subsequent evaluation of efficacy. The researchers of Plant Village developed a neural network to investigate the feasibility of using automated image recognition for diagnosing plant diseases. Their objective was to assess the potential for disseminating this diagnostic information worldwide. In essence, their objective was to ascertain the feasibility of providing widespread access to this information on a global scale. During this phase of the project, students engaged in collaborative efforts with scholars to gain practical insights into the implementation of deep learning, which is also referred to as machine learning. This provided researchers with an equivalent opportunity. The network is then trained to discern patterns in the data via the use of this deep learning methodology, whereby it is exposed to images of both diseased and healthy plants.

The network has a superior capacity for learning, storing, comparing, and generating suggestions at a much-accelerated rate compared to human individuals. Even a globally distributed team of humans collaborating would need an equivalent duration to the network to arrive at a solution. Students are presented with the choice of acquiring the skills to effectively use this knowledge for the sake of humanity and addressing the difficulties emphasized in the Sustainable Development Goals (SDGs), or attempting to impede the progress of this emerging body of knowledge. However, it is important to acknowledge the formidable difficulty of obstructing innovation. The use of this novel approach for remote data collection facilitates the diagnosis of agricultural diseases with the assistance of smartphones, therefore enabling individual farmers in remote regions of the world to obtain help that would otherwise be unavailable to them.

The execution of this investigation would be unfeasible in the absence of the technological functionalities offered by a smartphone. In both the United States and Switzerland, scholars and students engage in the implementation and examination of educational practices that combine experiential learning methods, drawing insights from feedback provided by farmers residing in sub-Saharan Africa. The educational content is then scrutinized by students and academics in both nations. The data is fed into a neural network, which afterward produces a profound learning experience for all those involved in the endeavor. This experience may also be evaluated and modified, if necessary. Plant Village operates as an open-source endeavor, allowing those outside the current community of students, researchers, and farmers to actively contribute to the maintenance and expansion of the information repository. The research process inherently presents a valuable educational experience that is consistently refined and adapted to provide enhanced teaching prospects. Professors have the obligation of instructing students on the proper techniques for inputting data into AI decision-making neural networks since the accuracy of the networks' output is contingent upon the quality of the data provided. Lastly, it is essential to provide students with education on deep learning, as it will equip them with the necessary knowledge to engage with the potential opportunities that may arise in the future. These opportunities will include the integration of profound expertise into artificial intelligence systems, which will play a crucial role in facilitating decision-making processes within various managerial contexts. The case study of Peter Ma is used as an illustrative example to emphasize the need for students to utilize the opportunities available to them to achieve success in their future endeavors.

This assertion has validity even in the context of a chance to engage in a hackathon, a collaborative form of computer programming that seeks to tackle global challenges. One potential inference that might be derived from this particular case with education is that students, like Ma, need not prioritise the monetary value associated with different competitions or opportunities. During the developmental phase of a new creative product or service, students should take into account the potential beneficiaries of their innovation. It is essential to provide students with instruction on the importance of questioning, addressing concerns, including significant global ones, and engaging in critical thinking to propose viable solutions to these challenges. The cognitive abilities and intellectual processes shown by students are characterized by a high degree of sophistication and originality, making them noteworthy within the annals of cosmic history. They embody the

succeeding cohort. As educators, our responsibility is to cultivate students' creative thinking abilities to enable them to effectively address and resolve various challenges. We are now unable to provide children with definitive solutions to effectively navigate this swiftly evolving new context. Similar to the intrepid explorers of bygone eras, our role is limited to providing guidance and orienting students towards the appropriate path, allowing them to independently uncover their trajectory. The advent of novel technologies and artificial intelligence (AI) entails inherent risks and has the potential to provide results characterized by winners and losers. For example, those who engage in non-digital activities characterized by repetition may face the potential consequences of job loss or stagnant/diminished wages.

The potential exacerbation of existing inequities among different categories of workers might be attributed to the shifting demand for different skill sets. To effectively address the adaptive problems arising from the implementation and integration of artificial intelligence (AI), it is essential for students, as well as aspiring corporate managers and executives, to possess the necessary mentality and skillset. This aspect assumes particular significance when taking into account the inherent challenges associated with risk prediction and the realization that achieving success requires a phase of trial and arduous adaptation. If properly handled, artificial intelligence (AI) has the promise of initiating a positive feedback loop characterized by heightened production, economic advancement, and the adoption of socially inclusive and environmentally responsible practices. Kaneshige and Hong (2018) argue that the implementation of artificial intelligence, despite good intentions, may yield unanticipated consequences and provoke a negative response toward the technology if not managed well. In the context of Plant Village, Smart Water Management, and Clean Water AI, the successful implementation of AI applications requires human decision-making and active involvement.

This entails making adjustments to existing protocols and adapting to novel approaches in the execution of routine tasks. Each of the applications possesses the capacity to offer a substantial alternative to the current work being undertaken, potentially leading to job displacement, a shift in skill requirements, and financial difficulties for key stakeholders who rely solely on the existing status quo for their livelihood. Plant Village and Clear Water AI may be cited as instances of interdependencies that foster dependence. However, it is important to note that both of these initiatives also provide substantial advantages for individuals worldwide. Goralski and Górniak-Kocikowska (2014) suggest that the effects of AI-induced change are not universally experienced in a same manner by all individuals.

The exclusive adoption of new applications may provide some benefits to specific firms at a smaller scale, but it may obscure the underlying systemic problem when considering the broader context of a significant and widening digital divide between technologically affluent countries and those that lag behind in terms of technology. In order for poor countries to effectively transition into the future of green technology and new energy facilitated by artificial intelligence (AI), it is imperative that they get structured assistance and sustained development aid to enhance their educational systems, business enterprises, and government. In order to effectively harness the benefits associated with the adoption of novel technologies, it is essential for corporations, governments, and other societal

sectors to engage in collaborative efforts. These techniques include an extended duration and beyond the incremental transfer of technological components from affluent countries to underdeveloped ones. The Global Goals aim to address enduring global challenges by prioritising Industry, Innovation, and Infrastructure in Sustainable Development Goal 9, Sustainable Cities and Communities in Sustainable Development Goal 11, and Partnerships for the Goals in Sustainable Development Goal 17. The conclusions that may be drawn from the three case studies pertain to the potential for development and notable improvements in efficiency that are linked to artificial intelligence (AI).

Conclusion

In the context of sustainable development, the involvement of diverse stakeholders from different countries, cultures, and sectors is crucial. Artificial intelligence (AI) offers a wide range of applications that have significant transformative potential in this endeavour. Enterprises from various regions throughout the world have been invited to engage in the execution of the Sustainable Development Goals (SDGs) under the framework of the United Nations Global Compact. The aforementioned three case studies demonstrate that artificial intelligence (AI) possesses the capacity to effectively support the worldwide endeavour to foster economic growth, while also addressing the impact of our production and consumption on our societies, governance systems, and the environment in a sustainable manner. This observation may be derived from the three aforementioned case studies. In light of the advancements made by innovators, activists, and worldwide advocates of development via the use of artificial intelligence (AI)- enabled technologies, these individuals occupy a prominent position in the ongoing efforts to foster sustainable development.

he advancements they have introduced have played a significant role in enhancing the efficiency of various industries and sectors, preserving valuable non-renewable resources, facilitating the widespread dissemination of knowledge and expertise, bridging global disparities in resources and technology, and fostering productive collaborations among governments, private sector entities, civil society organisations, and individual citizens, all of which contribute to the promotion of global sustainability. The achievement of the Global Goals and the ambitious vision for a sustainable future articulated in the Sustainable Development Goals (SDGs) encounter formidable and deeply rooted obstacles, presenting substantial difficulties in their implementation. The factors contributing to this issue encompass a range of elements, including but not limited to, the apathy, inaction, and lack of awareness among individuals, as well as the insufficient allocation of resources and absence of political determination on the part of governments. Additionally, the pursuit of immediate financial gains by corporations and the narrow focus on national interests by nation states further exacerbate the problem. Ultimately, the disregard for the global common good can be attributed to the combined influence of these aforementioned factors.

The achievement of global sustainability and the preservation of humanity's future on Earth need the dedicated involvement of diverse public and private sector institutions, national governments, and civil society. Furthermore, these entities must harness all available resources to address this pressing challenge. Moreover, it would be advantageous for individuals to use the newly available capabilities

and technology facilitated by artificial intelligence The adoption of Sustainable Development Goals (SDGs) has given rise to a nascent sector within the artificial intelligence (AI) industry, which has significant economic prospects. Artificial intelligence (AI) has the potential to facilitate more precise intervention targeting, as demonstrated by the Plant Village project. Additionally, AI can minimise waste and losses in production and consumption, as exemplified by the Smart Water Management initiative. Furthermore, AI has the capacity to generate novel applications that can revolutionise entire industries and professions. Moreover, AI can enhance connectivity and reduce costs, as evidenced by the Clean Water AI project, thereby extending the advantages of rapid technological advancement to a significant global population. In order to promote the achievement of the Sustainable Development Goals (SDGs), it may be necessary to adopt and establish certain inventions and endeavours. However, this process may entail certain expenses and include possible risks. Artificial intelligence has both positive and negative implications.

The subject under consideration may provide a range of obstacles and complex challenges, necessitating thorough investigation and careful management in order to mitigate its adverse and unanticipated consequences. The aforementioned applications, which have the potential to enhance life and promote sustainability, can also be utilised in ways that contribute to the exacerbation of the adverse consequences associated with global warming, pollution, excessive consumption, and irresponsible production practises. These activities further perpetuate the culture of perpetual growth that is inherent to the current capitalist global economic order. The aforementioned three examples illustrate that even seemingly uncomplicated and cost-effective innovations necessitate incentives and collaborations among governments, companies, communities, employees, employers, and academic institutions for their adoption, management, and maintenance. The advent of artificial intelligence (AI) has precipitated substantial transformations in the field of education. In the contemporary digital era, students have the convenience of accessing a vast repository of knowledge via platforms such as Google, Amazon, and similar entities. Consequently, the utilisation of libraries for information discovery has diminished among students. Even at a young age, children are already engaging with artificial intelligence via the use of mobile devices, educational software like Leap Frog, and responsive technologies such as Google's Alexa and Amazon's Siri. Prior to commencing kindergarten, a significant number of youngsters in Western societies have already attained proficiency in reading and fundamental arithmetic operations. Hence, the integration of artificial intelligence (AI) inside educational settings is not a phenomenon that elicits surprise among students; rather, it is seen as a valuable and indispensable element in the learning process. Artificial intelligence (AI) is poised to assume a prominent role in educational contexts in the foreseeable future, with the potential to profoundly transform the fundamental framework of both formal and informal education. Educational information and activities that include artificial intelligence (AI) as the teacher are readily available to consumers on the internet. These advancements signify the beginning of a pattern in this particular trajectory. There is a growing trend towards the integration of artificial intelligence (AI) inside educational environments.

The availability of translation programmes such as Google Translate, Microsoft Translator, and others has significantly reduced language inequalities, hence eliminating communication barriers. Artificial

intelligence (AI) is assuming a progressively significant role in the scientific assistance that students use, either as an auxiliary tool or as a collaborative teaching companion. The significance of this function is increasing. It is inconclusive to definitively assert that in the foreseeable future, artificial intelligence will replace human educators. In Teramachi's (2018) analysis, he posits that a fundamental issue with contemporary education lies in its reliance on the premise that individuals are irreplaceable. He contends that in order to effectively navigate the dynamic nature of society and the environment, it is imperative to cultivate an educational framework that fosters adaptability. The movie titled "Humans Need Not Apply," accessible on the YouTube platform, presents an argument by C. G. P. Grey (2014) asserting that artificial intelligence need not possess absolute perfection, but rather should demonstrate a level of performance that is comparable to or beyond that of human beings. It may be reasonably inferred that children would not see the integration of artificial intelligence as "unnatural" inside educational environments, considering their existing level of interaction with AI and the apparent ease with which they engage in such interactions. The strategic utilisation of artificial intelligence in projects and applications aimed at promoting sustainability has the potential to generate extensive and geographically diverse business prospects. Moreover, it can facilitate the implementation of more efficient and impactful public policies pertaining to sustainability. Specifically, the integration of artificial intelligence can enhance accessibility, connectivity, and efficiency across various industries such as agriculture, education, h The academic community plays a crucial role in equipping future generations of business leaders and policymakers at both national and international levels to effectively address the opportunities and challenges presented by artificial intelligence (AI). Furthermore, it is imperative for academia to contribute towards the advancement of the Global Goals in order to adequately prepare for a future driven by AI. The absence of access to proficient management education poses a significant danger to the ability of individuals, organisations, and governments to effectively attain sustainable economic growth.

***Masters of Technology**
****Professor**
*****Research Scholar**
Department of Computer Sciences & Engineering
Hemvati Nandan Bahuguna Garhwal University
Srinagar, India

BIBLIOGRAPHY

1. Agrawal, A., Gans, J., & Goldfarb, A. (2018). *Prediction machines: The simple economics of artificial intelligence*. Harvard Business Review Press.
2. Arpaci, I. (2020). What drives students' online self-disclosure behaviour on social media? A hybrid SEM and artificial intelligence approach. *International Journal of Mobile Communications, 18*(2), 229–241.

3. Artificial Intelligence. (2018). *Opposing viewpoints online collection, Gale*. Opposing viewpoints in context.
4. Artificial intelligence technology could help protect water supplies. (2018, July 18). *Phys Org*.
5. Barnett, V. (2002). Which was the "real" Kondratiev: 1925 or 1928? *Journal of the History of Economic Thought, 24*(4), 475–478.
6. Brewster, S. (2016, November 7). Wilting shrubs? Diagnose plant diseases with an app. *MIT Technology Review*.
7. Campbell-Kelly, M. (2018). *Computer, Student Economy Edition: A history of the information machine*. Routledge.
8. Cairns, M. L. (2017). Computers in education: The impact on schools and classrooms. In *Life Schools Classrooms* (pp. 603-617). Springer.
9. Chassignol, M., Khoroshavin, A., Klimova, A., & Bilyatdinova, A. (2018). Artificial intelligence trends in education: A narrative overview. *Procedia Computer Science*.
10. Cosgrove, W. J., & Loucks, D. P. (2015). Water management: Current and future challenges and research directions. *Water Resources Research*.
11. Cousteau, J. M. (n.d.). Quote on the architects of peace website. *Digging Deeper: Plant Village* [Video]. WPSU Penn State.
12. Flamm, K. (1988). *Creating the computer: Government, industry, and high technology*. Brookings Institution Press.
13. Hill, T. (2018, March 5). How artificial intelligence is reshaping the water sector. *Water Finance & Management*.
14. Kaneshige, T., & Hong, D. (2018). Predictions 2019: This is the year to invest in humans, as backlash against chatbots and AI begins.
15. Kaufman, D. (2018, October 18). Watch out workers, algorithms are coming to replace you – maybe. (An interview with Israeli author and historian Yuval Noah Harari). *New York Times – Business Day*.
16. Lant, K. (2018, May 3). Clean water AI puts prevention of waterborne disease in the palm of your hand. *Environmental Monitor*.
17. Lohr, S. (2018, October 19). From agriculture to art – the AI wave sweeps in. *New York Times, Business Day*.
18. Markoff, J. (2014, December 16). Study to examine effects of artificial intelligence. *New York Times*, A19(L). Opposing Viewpoints in Context.
19. Marr, B. (2018). What is artificial intelligence and how will it change our world?
20. Marconi, F. (2019, March 18). AI pioneer Fei-Fei Li on building benevolent machines. *Wall Street Journal*.

21. National Artificial Intelligence Research and Development Strategic Plan. (2016, October). Executive Office of the President of the United States, National Science and Technology Council, and Networking and Information Technology Research and Development Subcommittee.
22. Penn, F. (2017). Stephen Hawking: Self-evolving artificial intelligence (AI) has a free will & may destroy humanity. [Video]. Available from:
23. PlantVillage About Us. (n.d.).
24. Sainato, M. (2015). Stephen Hawking, Elon Musk, and Bill Gates warn about artificial intelligence. *The Observer*.
25. Schwab, K. (2018). *Future of jobs report 2018*. Centre for the New Economy and Society Insight Report, World Economic Forum.
26. Whitby, B. (2008). *Artificial intelligence: A beginner's guide*. Oneworld.