

Sustainability in a Changing World: Navigating Population Growth, Circular Economy, and AI Integration in the Oil and Gas Sector

Sustainability in a Changing World: Navigating Population Growth, Circular Economy, and AI Integration in the Oil and Gas Sector.

ALHASAN MAHMOOD

2317316

University of Wales

Trinity Saint David

Assignment 1

13/11/2023

Sustainability in a Changing World: Navigating Population Growth, Circular Economy, and AI Integration in the Oil and Gas Sector

Abstract:

The contemporary world grapples with challenges stemming from a significant increase in human population and the consequential impacts on the environment. This paper explores the intersection of population growth, circular economy concepts, and the role of artificial intelligence (AI) in fostering sustainability, particularly in the oil and gas industry. The adoption of Circular Economy principles and the integration of AI technologies emerge as crucial strategies for mitigating environmental degradation, resource scarcity, and climate change impacts. The intricate landscape of decision-making in various sectors, including oil and gas, necessitates a nuanced understanding of the role emotions play and how AI can enhance decision-making processes. As climate change becomes a central concern for corporations, AI proves instrumental in implementing sustainable practices. The paper delves into the benefits and challenges of AI integration in achieving circular economy goals, emphasising the need for ethical considerations. The overarching theme underscores the urgent call for sustainability across sectors, with AI serving as a transformative force in shaping a more environmentally conscious and resilient future.

Sustainability in a Changing World: Navigating Population Growth, Circular Economy, and AI Integration in the Oil and Gas Sector

We inhabit a planet where the human population has experienced a massive increase. According to the United Nations, the world population is projected to reach 9.8 billion by 2050 [1]. Throughout history, the human population size has remained relatively stable for long periods. However, advancements in industry, innovation, energy, food, water, and medical care have accelerated the growth of the world human population dramatically, impacting the global climate and ecosystems. The population growth can have various impacts on the planet, such as environmental degradation resulting from human activities. Additionally, it leads to an accelerated extraction of resources such as fossil fuels, minerals, and water, resulting in more pollution and harm to ecosystems. For instance, the burning of fossil fuels for energy, expanding urbanization, and intensified agricultural practices contribute to ecological impacts, habitat destruction, and biodiversity loss [2]. This population increase is accompanied by resource scarcity, posing a serious challenge to individuals, governments, and businesses. Therefore, governments, policymakers, and organisations have initiated a process to explore new, creative approaches that utilize resources to overcome challenges. This led to the invention of the concept of the 'Circular Economy.'

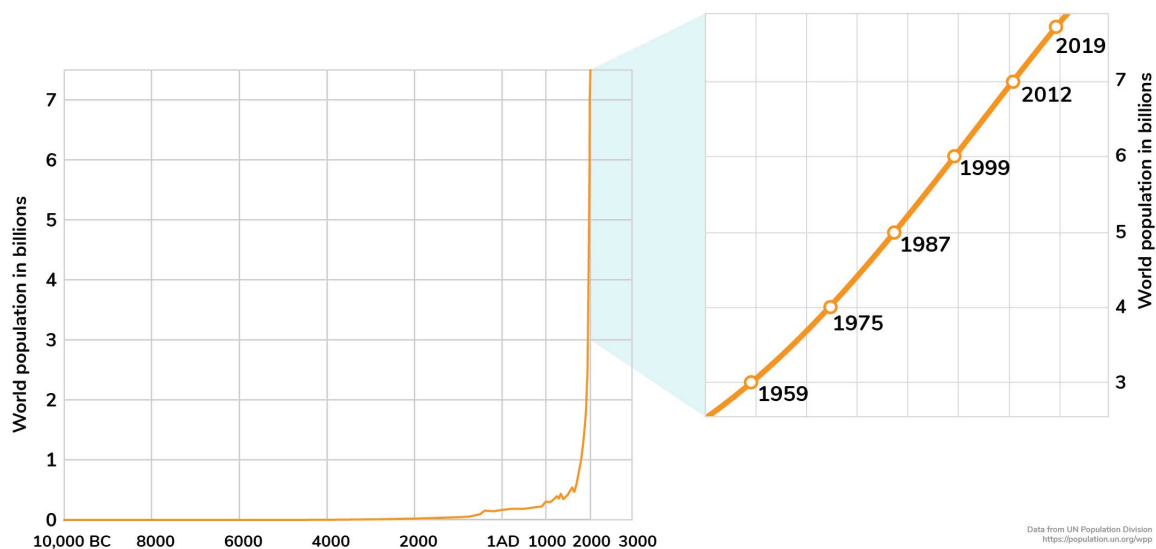


Figure 1: Shows world population in billions [2].

The concept of the Circular Economy has gained significant momentum in recent years, fuelled by growing interest from various parties such as businesses, academics, and governments. It is built on three main pillars: designing out waste and pollution, keeping products and materials at their highest value, and regenerating natural systems [3]. Achieving

Sustainability in a Changing World: Navigating Population Growth, Circular Economy, and AI Integration in the Oil and Gas Sector

a Circular Economy in any industry requires deeply integrated cooperation between various disciplines and professions, such as engineering and business administration. This integration is coupled with the adoption of specific tools and technologies that facilitate the transition. For example, business administration is where professionals implement efforts and decisions to ensure that businesses and organizations run effectively, efficiently, and profitably [4]. In other words, organisations must remain in continuous improvement, development, and adaptability mode to keep the business on the right track. Recently, many organisations have started to view the Circular Economy and Circular Business as potential solutions to foster sustainable development [5]. There are various ways for organisations to adopt and implement circular economy practices to achieve circular sustainability, and one of them is through digitalism.

Digitalism plays an essential role in the transformation towards a Circular Economy. Given the rapid development in business and technology, digitalisation is becoming inevitable across all sectors [6]. Various applications and technological tools can be adopted to develop, optimise, and enhance business activities, but one of the most powerful and efficient is Artificial Intelligence (AI). For instance, the adoption of AI by an organisation can strengthen existing products, optimise external and internal operations, stimulate creativity among individuals involved, and assist leaders in making informed decisions [3]. The term "intelligence" is derived from the Latin root 'Legere,' which means "to collect, to gather, and to assemble." Its congener, 'intelligent,' means "to know, to understand, to perceive, and to choose among" [7]. Digital technologies are poised to play a vital role in moving towards a net-zero emissions future. Their ability to efficiently handle large amounts of data, facilitate fast problem-solving, and enable virtual testing is crucial for efforts to reduce carbon emissions.

Energy intensive systems can benefit from efficiency improvements driven by digital and web3 technologies, including cloud and edge computing, artificial intelligence (AI), machine learning (ML), Internet of Things (IoT) sensors, and blockchain. Together, these innovations provide avenues to improve sustainability and promote a shift towards a more environmentally friendly and efficient landscape [8]. Energy serves as a vital lifeline for modern civilization, and, as such, the oil and gas industry play a crucial role in facilitating humanity's access to and use of energy in various forms. However, concurrently, this industry grapples with multiple challenges that continue to evolve and become more sophisticated. For instance, the oil and gas industry encounter extensive challenges concerning the patterns of profitability and sustainability. The generation of an enormous amount of data within this

Sustainability in a Changing World: Navigating Population Growth, Circular Economy, and AI Integration in the Oil and Gas Sector

industry remains underutilised, hindering the maximisation of benefits from extracting information that could aid decision-makers in gaining a clearer vision [9]. The adoption of new technologies, such as Artificial Intelligence (AI), proves to be helpful and efficient in addressing complex problems like resource scarcity, thus steering the industry towards a Circular Economy.

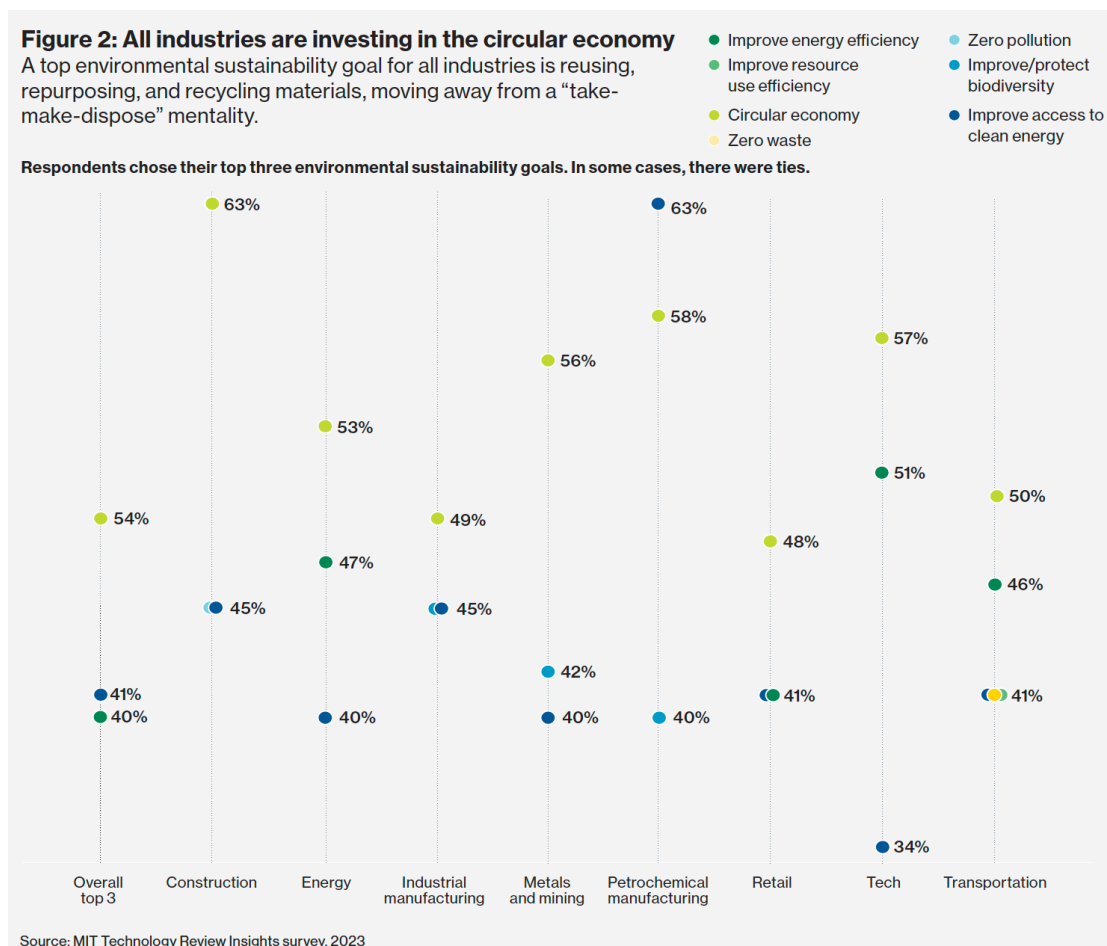


Figure 2: Shows industries investing in the circular economy [8].

In contemporary times, climate change has become a concern for oil and gas corporations, driven by factors like regulations and public pressure. Consequently, many corporations are progressively exploring sustainable practices through the utilisation of AI. Industry leaders such as ADNOC and BP have undertaken various initiatives to curb greenhouse gas emissions and reduce freshwater consumption. The integration of AI technologies is recognized as a key strategy in achieving sustainability goals across the industry [10].

Sustainability in a Changing World: Navigating Population Growth, Circular Economy, and AI Integration in the Oil and Gas Sector

In any business, decision-making is a pivotal aspect of operations, playing a vital role in shaping the direction, efficiency, and overall success of the organisation. In simple terms, the choices made by managers are among the most crucial factors in achieving short and long-term goals, significantly impacting whether the organization succeeds or fails [11]. For the oil and gas industry, the decision-making process is central to determining how organisations can move towards a circular economy in various ways. Various factors influence how managers make decisions, and one of them is emotions [11]. Emotions can significantly influence decisions related to sustainability. Typically, such decisions are based on objective data, ethical considerations, and long-term impact. However, emotions can introduce biases and might affect the decision-making process.

With the assistance of AI, decision-makers in oil and gas corporations will be better equipped to make well-informed decisions. AI can be a valuable tool for these corporations to progress towards sustainability by optimising operational efficiency, leading to a reduction in carbon emissions. The significance of AI in this mission lies in its ability to analyse massive datasets within refineries and offer recommendations to optimize operational efficiency. Furthermore, advanced AI applications have demonstrated notable improvements in economic optimise action, reducing asset maintenance, enhancing safety, and ensuring quality. The applications of AI in water reduction and carbon capture storage contribute to a more sustainable and efficient future in the oil and gas industry [12]. "The utilisation of artificial intelligence transcends the mere enhancement of technical aspects pertaining to the cultivation of organizational behaviour favouring the adoption and implementation of sustainable practices, particularly those aligned with the principles of the circular economy. Its applicability extends beyond the confines of technical domains, encompassing a broader spectrum of sustainable strategies.

In today's world, with more uncertainty and increasing extreme events due to climate change, decision-makers face the challenge of finding effective adaptive strategies that need thorough evaluation. In this complex situation, AI becomes a powerful tool, offering a fast and efficient way to assess the value of different response options. In practical terms, the role of AI becomes pronounced as it contributes to the refinement of the assessment of option values, thereby mitigating the risk of misallocating precious resources. Moreover, it facilitates a

Sustainability in a Changing World: Navigating Population Growth, Circular Economy, and AI Integration in the Oil and Gas Sector

paradigm shift towards a more market-driven approach, empowering decision-makers to discern with precision which adaptation options hold the potential to generate optimal societal welfare. This transformative role positions AI as a linchpin in navigating the complexities inherent in climate-related challenges. By fostering a more nuanced and data-driven decision-making process, artificial intelligence not only aids in averting potential pitfalls but also propels organizations towards a trajectory of sustainable growth and resilience. As societies grapple with the multifaceted challenges posed by climate change, the integration of AI into the decision-making fabric stands as a testament to its indispensable role in ensuring the judicious allocation of resources and the pursuit of adaptive strategies that maximize societal well-being.[13].

In contrary, the transformative potential AI brings to improving organisational behaviour and decision-making processes in the context of the circular economy, there exists of both benefits and drawbacks. While the integration of AI holds promise for optimising resource usage and fostering sustainability, it is imperative to navigate the ethical considerations that accompany such advancements. AI as a driving force in the transition to the Circular Economy (CE), presents an array of benefits. It has the capacity to streamline operations, enhance efficiency, and contribute to a more sustainable and environmentally conscious approach to production and consumption. The data analytics capabilities of AI enable organisations to make informed decisions through identifying opportunities for circularity and minimising waste. However, this technological leap is not without its caveats. Ethical implications cast a long shadow over the seamless integration of AI into the circular economy. Privacy concerns, potential biases, and issues related to algorithmic transparency pose challenges that demand careful consideration. There is a delicate balance to be struck between the pursuit of efficiency and the protection of individual rights. Moreover, the threat of negative social and environmental consequences looms large if AI adoption is not approached with precision. Inconsistent or improper integration may lead to unintended consequences, jeopardising the goals of the circular economy. The risk of exacerbating societal inequalities and undermining well-being through unethical AI applications is a concern that demands proactive mitigation. Striking a balance between technological progress and ethical considerations is paramount to ensure that the circular economy reaps the rewards of AI while mitigating its potential pitfalls [14].

Sustainability in a Changing World: Navigating Population Growth, Circular Economy, and AI Integration in the Oil and Gas Sector

In conclusion, the current developmental module reveals a concerning lack of sustainability, with far reaching implications for both the planet and human life. Urgent action is imperative, necessitating the formulation and execution of comprehensive plans that embrace sustainable practices, moving us towards the transformative ideals of a circular economy. The term "sustainability" remains elusive, intricately connected across diverse disciplines and sectors. A meticulous refinement process is indispensable to establish a definitive, universally applicable definition tailored to every facet of our complex, interconnected world. Energy, the lifeblood of human civilisation, underscores its paramount importance. However, the adverse effects of the oil and gas sector on the environment and human health underscore the urgent need for substantial investments in embracing sustainability. This imperative shift begins with arming decision-makers with comprehensive insights to facilitate well-informed choices regarding sustainable opportunities. The incorporation of cutting-edge digital technologies, notably Artificial Intelligence (AI) to scrutinize data and monitor performance becomes an indispensable cornerstone in this transformative journey.

The objective is not merely persuasion but empowerment; equipping oil and gas organisations to envision and implement robust, sustainable products. Simultaneously, there is a call to foster innovative circular business models aligned with the principles of sustainability, contributing substantially to the realisation of a more sustainable planet. The instrumental role of advanced technologies, exemplified by AI in navigating this paradigm shift cannot be overstated. To effectively address the sustainability challenge, a multi-faceted approach is essential. Beyond the immediate need for sustainability in energy production, attention must be directed towards refining the broader concept of sustainability itself. This entails collaborative efforts across various disciplines and sectors, fostering a shared understanding that can serve as a foundation for tailored sustainability practices. Moreover, the urgency extends to enhancing awareness and knowledge dissemination. Decision-makers must be equipped with the tools and information needed to grasp the intricacies of sustainability, enabling them to make informed choices that align with long-term ecological balance. The deployment of AI to analyse vast datasets and monitor performance emerges as a transformative solution in this context, providing real-time insights and facilitating adaptive decision-making.

Sustainability in a Changing World: Navigating Population Growth, Circular Economy, and AI Integration in the Oil and Gas Sector

In essence, achieving sustainability in the oil and gas sector is not a mere directive; it's a comprehensive transformation of practices, ideologies, and business models. This shift is integral to mitigating the adverse impacts on the environment and human health, paving the way for a future where industry and sustainability coalesce harmoniously. The journey towards sustainability demands collective commitment, innovation, and the strategic integration of advanced technologies, ensuring a sustainable legacy for generations to come.

References:

- 1- Nations U. World population projected to reach 9.8 billion in 2050, and 11.2 billion in 2100 [Internet]. United Nations. 2017. Available from: <https://www.un.org/en/desa/world-population-projected-reach-98-billion-2050-and-112-billion-2100>
- 2- <https://ugc.berkeley.edu/background-content/population-growth/#:~:text=Human%20population%20growth%20impacts%20the,wildlife%2C%20especially%20in%20the%20oceans>.
- 3- ARTIFICIAL INTELLIGENCE AND THE CIRCULAR ECONOMY AI AS A TOOL TO ACCELERATE THE TRANSITION [Internet]. mckinsey.com. UK: McKinsey & Company; 2019. Available from: <https://www.mckinsey.com/business-functions/sustainability/our-insights/artificial-intelligence-and-the-circular-economy-ai-as-a-tool-to-accelerate-the-transition>
- 4- December 18, Bogle 2017 S. What is Business Administration? [Internet]. www.snhu.edu. Available from: <https://www.snhu.edu/about-us/newsroom/business/what-is-business-administration>
- 5- Barros, M.V., Salvador, R., Francisco do Prado, G., Carlos de Francisco, A. and Piekarski, C.M. (2020). Circular economy as a driver to sustainable businesses. *Cleaner Environmental Systems*, [online] 2(2), p.100006. doi:<https://doi.org/10.1016/j.cesys.2020.100006>.
- 6- Dordevic M. Council Post: How Artificial Intelligence Can Improve Organizational Decision Making [Internet]. Forbes. [cited 2022 Sep 10]. Available from: <https://www.forbes.com/sites/forbestechcouncil/2022/08/23/how-artificial-intelligence-can-improve-organizational-decision-making/?sh=ee5abf22a1c4>
- 7- Chang AC. Intelligence-based medicine: artificial intelligence and human cognition in clinical medicine and healthcare. London, United Kingdom: Academic Press; 2020.
- 8- Digital technology. (n.d.). Available at: https://www.shell.com/energy-and-innovation/digitalisation/_jcr_content/root/main/section_244830622/simple/promo_34998403/links/item0.stream/1678207879539/34a35ef0e6176ff3eb255e6270f5bd0b2e9fd9f9/mittr-shell-digitalisation-and-decarbonisation.pdf [Accessed 12 Nov. 2023].

- 9- Roberty EAMa. Predictive Analytics Applications for Oil and Gas Processing Facilities [Internet] [PDF]. [The Massachusetts Institute of Technology]; 2021 [cited 2022 Aug 28]. Available from: <https://dspace.mit.edu/bitstream/handle/1721.1/140083/machadoroberty-emachado-sm-sdm-2021-thesis.pdf?sequence=1&isAllowed=1>
- 10- WhatNext (2022). *Artificial Intelligence and Oil & Gas Industry – Partnership towards sustainable future*. [online] Available at: <https://whatnextglobal.com/artificial-intelligence-and-oil-gas-industry-partnership-towards-sustainable-future/> [Accessed 12 Nov. 2023].
- 11- Nadolna, K.K. and Beyer, K. (2021). Determinants of the decision-making process in organizations. *Procedia Computer Science*, [online] 192(1), pp.2375–2384. doi:<https://doi.org/10.1016/j.procs.2021.09.006>.
- 12-Energy Connects. (2021). *How AI is helping oil and gas companies achieve net zero*. [online] Available at: <https://www.energyconnects.com/opinion/thought-leadership/2021/november/how-ai-is-helping-oil-and-gas-companies-achieve-net-zero/>.
- 13-Brookings. (n.d.). *How artificial intelligence will affect the future of energy and climate*. [online] Available at: <https://www.brookings.edu/articles/how-artificial-intelligence-will-affect-the-future-of-energy-and-climate/>.
- 14- Roberts, H., Zhang, J., Bariach, B., Cows, J., Gilbert, B., Juneja, P., Tsamados, A., Ziosi, M., Taddeo, M. and Floridi, L. (2022). Artificial intelligence in support of the circular economy: ethical considerations and a path forward. *AI & SOCIETY*. doi:<https://doi.org/10.1007/s00146-022-01596-8>.