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THE ROLE OF ARTIFICIAL INTELLIGENCE IN SHAPING SUSTAINABLE PRACTICES: A STUDY OF THE 2023 TOP SUSTAINABLE COMPANIES

Inês de Sousa Brites Dourado
53642

Work project carried out under the supervision of:

Professor Ricardo Zózimo

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Inês Dourado

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Abstract

This project studies Artificial Intelligence (AI) as a strategic instrument for enhancing sustainability practices within top global companies. In a time characterised by rapid technological progress and growing environmental concerns, the convergence of sustainability and innovation has become imperative. Employing a qualitative Gioia methodology of data from 50 top sustainable companies in 2023 according to Corporate Knights, the research traces the implementation of AI across Planet, People and Profit dimensions. This study contributes to the discourse on the dynamic role of leveraging AI to enhance companies' sustainable efforts.

Keywords: Sustainability; Sustainable Innovation; Artificial Intelligence; Qualitative

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1. Introduction

In an era marked by fast technological advancements and increasing environmental challenges, the intersection of sustainability and innovation has emerged as a critical area of interest for both the academic and industry worlds (Maier, et al. 2020). In the past, innovation was often associated with unsustainable practices and as a contribution to environmental degradation. Nowadays, sustainability is hinged on innovation (Kusi-Sarpong et al., 2019 as cited in Guptaa, Kusi-Sarpong and Rezaei 2020), companies should innovate their business models in response to socio-environmental negative effects and accomplish social, economic, and environmental sustainability.

There is an increase in the global awareness to be more sustainable (Dyllick and Muff 2016), however, many managers are still hesitant to adopt sustainability as their company's core business strategy because they believe that the costs of that change will outweigh the benefits (Whelan and Fink 2016). Consumers are seeking out sustainable products and governments are implementing more and more regulations on carbon emissions, pollution, and resource usage, so sustainability cannot be ignored as a central factor in companies' long-term strategy if they want to keep competitive (Yadav and Veettil 2022). It is important to note that advances in the sustainability field typically require a much longer time horizon, so they require as much consideration as short-term aspects (Dyllick and Muff 2016).

The fast evolution of Artificial Intelligence (AI) technologies offers an immense number of opportunities to address various sustainability challenges. AI's ability to analyse large datasets, optimise operations, and predict future trends makes it a potent tool for companies committed to sustainable development goals (Vinuesa, et al. 2020). Therefore, to better understand this new reality, this report investigates the implementation of AI in the strategy of sustainable companies addressing the research question: **"How do sustainable companies leverage AI**

technologies to enhance their sustainability efforts?" To answer this question, a Gioia qualitative analysis followed the 50 more sustainable companies of 2023 according to the Corporate Knights Global 100. Through their 2022/2023 reports and press releases, the aim is to expand the knowledge on how AI implementation can intersect with the Triple Bottom Line (TBL) sustainable framework. As a result, the analysis suggests that AI can be systematically integrated across People, Planet and Profit dimensions. This work project delineates the interdependencies among the three pillars of the TBL (People, Planet and Profit), providing insights into how companies can enhance their sustainable practices through AI-driven innovations.

The report is organised into 7 Chapters. The next Chapter is the literature review on existing knowledge on corporate sustainable innovation and Industry 4.0, more precisely, Artificial Intelligence. The methodology, in Chapter 3, explains the research design, sampling process, data collection and data analysis. Chapter 4 presents the findings on the methodology, while Chapter 5 is the discussion on the findings in the context of broader theory. The last two Chapters are the conclusions (Chapter 6), which comprise the answer to the research question, and the limitations, and possible directions for future research (Chapter 7).

2. Literature Review

2.1 AI's role in achieving SDGs

The current state of the global environment should be considered a wake-up call for people and businesses equally. Their good intentions and actions have not been leading to sizable sustainability improvement on a global level (Dyllick and Muff 2016). The United Nations Brundtland Commission, in 1987 defined sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs''. Although many authors have different approaches to sustainability, it is a consensus that it is sustained

on three pillars: economic, social and environmental (Haugh and Talwar 2017). In investigating the complex role of AI in achieving the 17 United Nations Sustainable Development Goals (UN SDGs), Vinuesa et al. (2020) provide a comprehensive analysis of AI's potential to meet those goals. Although the meaning of Artificial Intelligence was first made by John McCarthy in 1956, this term's definition varies with goals and domain. The main characteristic of copying human cognitive function and problem-solving capabilities agrees with all the definitions of AI made so far (Lee, et al. 2019). According to IBM (2022), "Artificial intelligence in business is the use of AI tools such as machine learning, natural language processing, and computer vision to optimise business functions, boost employee productivity and drive business value". Vinuesa et al. (2020) categorised the SDGs into the three pillars of sustainable development and concluded that AI can enable 134 targets across all the goals and inhibit 59 (Vinuesa, et al. 2020). AI can act as an enabler for societal, economic, and environmental results by promoting circular economies and smart cities, increasing productivity, and preserving the environment, respectively. Table 1 resumes Vinuesa, et al (2020) results on the positive and negative impacts AI has on the UN SDGs.

Table 1: Impacts of AI on UN SDGs retrieved from Vinuesa et al. (2020)

Pillars of Sustainable Development	Positive Impacts of AI	Negative Impacts of AI
Society (SDGs: 1, 2, 3, 4, 5, 6, 7, 11, 16)	Improve education, healthcare, and energy services. Assistance with access to food and water. Enhances smart city initiatives, which help efficient management of resources, and low-carbon energy systems. Boost the integration of renewable and electrical solutions.	Advanced AI technology requires more resources and, thus, more costs for countries. Exacerbate inequalities across different societies through societal biases against minorities due to lack of diversity in datasets. "Big nudging", which is the use of AI to manipulate psychological debilities to manage decisions (commercial or political propaganda).
Economy (SDGs: 8, 9, 10, 12, 17)	Increase productivity and innovation. Optimise supply chains. Enhance manufacturing processes.	Unequal access to resources between low and middle-income countries.

	Create new market opportunities.	Job displacements and replacement for higher-skilled workforce, particularly affecting lower-skilled jobs. Targeted content that leads to political polarization or affects social cohesion. AI discrimination on targeted job advertising.
Environment (SDGs: 13, 14, 15)	Large data analysis to develop actions to preserve the environment. Support the understanding of climate change and its impacts. Improve the health and conservation of ecosystems.	High energy demands to apply AI. The operation of large data centres increases the need for computing power which leads to higher carbon emissions. Over-exploitation of resources due to increasing access to AI-related information on biodiversity.

According to Vinuesa et al. (2020), it is important to note that, although AI acts more as a facilitator than a barrier to achieving SDGs, two critical considerations emerge. First, the AI research community and industry may be biased towards reporting favourable outcomes to their studies. Second, it may require more time to identify the negative effects of AI, and there are limited established methodologies for such evaluations. They argue that there is still a limited grasp of AI's potential effects on institutions, but there are some positive effects that can be seen already like fraud detection and evaluate the potential outcomes of specific legislation (Vinuesa, et al. 2020). Taking this into account they advocate for legislation regarding transparency, accountability, and ethical standards of AI that companies should respect and be guided by.

Goralski and Tan (2020), studied the impact of AI in three different case studies to understand how AI impacts sustainable development, namely the UN SDGs. These authors agree with Vinuesa et al (2020) when claiming that SDGs constitute a very significant business opportunity for the AI industry. They found that AI can create data for targeted interventions, cut waste and losses in manufacture and consumption, build new applications that transform entire industries

and facilitate enhancements in connectivity and cost-efficiency. These improvements extend the advantages of fast-paced technological advancements to a global audience.

2.2 Key Concepts of AI in Sustainability

With the increase of new technology usage, the intersection of AI and sustainability garnered increasing attention in academic research and corporate practices (Rakha 2023). Some studies have started recently exploring AI as a driver of business model innovation. There is still a lot to be explored, especially the expected consequences of AI on business model innovation (Lee, et al. 2019).

If we combine sustainability and innovation terms, we have sustainable innovation which can be defined as the development of new products, strategies, services, and business models that contribute to the meeting of human and institutional needs while taking into consideration the world's natural resources and regenerative capacity (Maier, et al. 2020). Rakha (2023) explored how AI can contribute to sustainable production and distribution processes in different sectors of activity. Through the reviewing of different literature, the author discovered that AI has a main role in stimulating sustainability across various industries, mainly healthcare, manufacturing, transportation, utilities, and construction. For example, Rakha (2023) found that Amazon (an online retailer) implemented Amazon Scout, an AI-powered optimisation technology, to improve the efficiency of deliveries and reduce the environmental impact through data analysis on customer preferences, traffic, and weather. This technology helped to reduce 20% of transportation costs, decrease delivery time by 30% and cut carbon emissions by up to 10%. Another example is AB InBev (a brewery), which implemented SmartBarley, another AI-powered system, to analyse real-time data on the amount of energy usage patterns, performance of the equipment and environmental conditions to recommend behaviours to optimise energy consumption and an AI irrigation system that analyses weather conditions, soil moisture and crop growth to optimise irrigation and reduce water waste to analyse data on

weather conditions, soil moisture. Results show a reduction of 20% in energy consumption and 15% less in water used in farms. Table 2 provides an overview of the author's findings.

Table 2: AI Role retrieved from Rakha (2023)

AI Role In Production Processes	Boost Resource Utilisation. Lower Energy Consumption. Reduce Waste. Analyse Data. Predict Maintenance Requirements and Equipment Failures.
AI Role In Distribution Processes	Enhance Logistics Routes. Cut Transportation Costs. Improve Inventory Management. Lower Carbon Emissions. Real-Time Tracking. Improve Supply Chain Transparency. Reduce the Unethical Procedures' Risk.
AI Role In Promoting Sustainability in Various Industries	Personalised Customer Service. Predictive Tool. Suggest Environmentally Friendly Alternatives to Traditional Products and Services. Monitors Infrastructure.
AI Challenges	Quality and Ease of Access to Data. Lack of Regulation and Interoperability. Privacy and Security. Unintentional Consequences. May Enhance Existent Inequalities.

When exploring AI in sustainability, some common key concepts arise in the literature (Goralski and Tan 2020; Rakha 2023; Vinuesa, et al. 2020): optimisation, efficiency, data analysis, monitoring and support. Optimisation and efficiency are facilitated by AI tools for prediction analysis/maintenance, facilitation of manufacturing and other logistics, control of

inventory, energy and resources management or creating new market opportunities. AI is widely used in large-scale data analysis and data security, serving as a crucial component of decision support systems. The application of AI in monitoring infrastructures and inventories, or supporting the understanding of sustainability-related problems further underscores its pivotal role in advancing sustainable development agendas. After demonstrating how AI can be used in production and distribution processes, its role in promoting sustainability across industries and AI's challenges, the author provides some solutions companies and policymakers can use to overcome the challenges. Among the solutions is the importance of partnerships between technology companies, sustainability organisations and legislators to promote sustainability (Rakha 2023). For example, Microsoft's collaboration with Ecolab and the Alliance for Water Stewardship helped build a water management tool that uses AI and the Internet of Things (IoT) to supervise water usage and identify saving opportunities.

The innovations made by stakeholders using AI-enabled applications (Goralski and Tan 2020), increased companies' efficiency, helped in the conservation of non-renewable resources, spread essential knowledge and expertise and facilitated effective multi-sector partnerships among governments, industries, civil society, and individuals that contribute to global sustainability. Goralski and Tan (2020) highlighted that while AI can support life-enhancing and sustainability-focused applications, it can also be used to create negative impacts on the world and perpetuate the continuous growth model of today's capitalist world. Even the more straightforward and cost-effective innovations need incentives and collaborations among governments, businesses, citizens, civil society, labour forces and scholars to implement, oversee and maintain these impactful technologies.

Hence, by building on top of these ideas, this report aims to explore the different uses of Artificial Intelligence among the most sustainable companies in 2023, according to Corporate

Knights. Focusing on the Profit, People, and Planet dimensions of AI usage[1], this work project explores the connection between AI and sustainability by asking the following research question: **"How do sustainable companies leverage AI technologies to enhance their sustainability efforts?".**

3. Methodology

Innovation can be simply described as a service, product, business model, technology or strategy that is new and functional (Boyles 2022). According to IBM (2022), "Industry 4.0, which is synonymous with smart manufacturing, is the realization of the digital transformation of the field, delivering real-time decision making, enhanced productivity, flexibility, and agility to revolutionize the way companies manufacture, improve, and distribute their products". Industry 4.0 brings several advantages for companies that implement them in their business model such as enhanced competitiveness and performance, more versatility and resilience and increased profitability and consumer service (Javaid, et al. 2022). Artificial Intelligence (AI) is one of the main technologies driving Industry 4.0 and has different subcategories (McKinsey & Company 2024) (Appendix 1). Most companies studied in the methodology use Generative AI as a tool for their sustainable strategies.

According to the IBM Global AI Adoption Index 2022, two-thirds (66%) of companies are currently executing or planning to apply AI to address their sustainability goals. To study how sustainable companies leverage AI technologies to enhance their sustainability efforts and look for answers to this research question, the investigation follows the journey of the Corporate Knights' (CK) 50 more sustainable companies in 2023, towards sustainability**.** CK chooses the

[1] TBL views and measures the success of a truly sustainable company through the economic benefits for stakeholders (Profit), the benefits for the natural environment (Planet) and advantages to the people influenced directly or indirectly by the company (People) (Miller 2020). On the other hand, ESG evaluates how sustainable and ethical a company is: how a company impacts the planet (Environment), its relationship with the stakeholders (Social), and evaluation of its management and decision-making processes (Governance) (Conmy n.d.). This study primarily focuses on the TBL for assessing corporate sustainability but incorporating ESG considerations within the Literature Review provides valuable insights into the multidimensional nature of sustainability.

Global 100 most sustainable companies out of the 6000 public companies with revenue over US$1 billion, based on 25 key performance indicators linked to one or more United Nations Sustainable Development Goals (UN SDGs) (Corporate Knights 2023). The ranking is based on the companies' available information and compared to the Corporate Knights Peer Group (CKPG), for further understanding of their methodology refer to Appendix 2.

3.1 Research Design

Business leaders recognise the power of using sustainable strategies to help solve the world's most important issues while driving organisational success. This report applies qualitative research, using an inductive approach, focusing on an in-depth analysis of secondary data such as companies' websites, reports, and other relevant company-related news before defining a clear theory. The primary objective is to build a theory from the qualitative data collected, that explains the relationship between AI applications and sustainability initiatives within these top-performing companies. The Gioia methodology (qualitative method) guides the data collection and analysis, facilitating a structured yet flexible approach to theory development (Magnani and Gioia 2023). The Gioia is developed and integrated with the TBL, a sustainability framework created by Elkington in 1997, which helps understand business sustainability efforts and develop a grounded theoretical model. Using the Gioia methodology (GM), the analysis progresses through collecting 1st-order terms (which are direct data extracted from the reports), creating 2nd-order terms (broader themes), and aggregated dimensions (which are the themes organised into the three key dimensions of the TBL). The purpose of this report is to study **how sustainable companies leverage AI technologies to enhance their sustainability efforts**, the objective is to analyse the role of AI in sustainable business practices and explore AI's impact on environmental, social, and economic sustainability.

3.2 Sampling Process

Corporate Knights presents each year the Global 100. Out of the 100 global sustainable companies, where the first 51 were selected since there were two companies with the same overall score, tied for the 7th place. Consequently, this selection allows for a more detailed and thorough analysis of each company and a clearer comparison between them (Table 4, Appendix 3). The objective was to be left with those companies who scored higher on the Corporate Knights methodology. This approach enables an in-depth exploration of how AI technologies are integrated into sustainability efforts providing richer qualitative data and facilitating a clearer comparison and contrast between companies' strategies. The final sample, composed of 51 companies, was then organised by industries to allow an easier visualisation and organisation of data (Table 5 in Appendix 3).

3.3 Data Collection

For this study, data was collected from secondary sources: companies' reports, which include Sustainability Reports, Annual Reports, and other relevant publications available on their official websites or articles from press releases, and other industry-specific reports that supplement companies' statements by providing additional context and analysis of AI application in sustainability efforts across different sectors. Since the ranking is dated 2023, the data collected correspond to what companies are still implementing in 2023. In total, 51 Annual Reports, and 51 Sustainability Reports were analysed. Approximately 16,000 pages were analysed, representing an average of 313,72 pages per company.

3.4 Data Analysis

Data Analysis was developed according to Magnani and Gioia (2023) through three stages: 1) the creation of categories according to how companies integrate AI into their sustainability strategies; 2) the development of a grounded theoretical model, through the comparison of data across companies; and 3) the representation of the study's findings through a detailed data-

based narrative. **Categorising the data** took a central part of this work. It involves the initial data processing to develop 1st and 2nd order terms. This ensures data was well collected from the reports and structured and categorised consistently. The 1st-order terms are the labels that are derived from the raw data. A detailed analysis of each company's reports was done, to collect the maximum amount of data that could be useful for this study (Appendix 4). In this case, the objective was to find how companies use AI in their sustainability practices/ strategies. After collecting all the required data and observing a clear pattern of AI usage among different companies, categories that reflect the integration of the raw data into broader conceptual categories were generated. The 18 key concepts were obtained through an inductive approach to relate information (Magnani and Gioia 2023). These were then put in Table 3 for a better overview of the extracted data. **Inductive Approach**. The concepts emerged from reading the reports and relevant press releases. The categories were generated one by one and once a new category emerged, all the companies were run through again to see if that category would fit in them. The category generation would cease once there were no more new categories. In the end, 18 key concepts are shown in Table 3. 2nd-order terms were generated, from the 1st-order ones, however, as can be seen next, some key concepts ended up being removed so the 2nd-order terms had to be rearranged. A more detailed explanation of data collection and categorisation is presented in Appendix 4.

Table 3: Key Concept and Descriptions (Source: Author)

Key Concept	Description
Carbon Management	AI is used to manage companies' carbon emissions.
Improve People's Lives	Make the lives of stakeholders easier by helping on daily tasks, on smart homes, or sustainable practices.
Personalised Customer Experience	AI is implemented on companies' websites or on-store to create a more tailored service for customers.
Reduce Costs	AI is implemented in a way that makes company reduce its yearly general expenses.
Mitigate Environmental Risks	AI used as environmental risks prediction and mitigation.

Build Innovative Products	AI as a research and development tool to create new products/services for companies.
Data Security	AI is used as a platform for data security (Cloud to store data), and threats detector.
Data Analysis	AI is used to help companies process large and complex amounts of data.
Waste Management	AI as a tool to help customers manage their homes' trash in an eco-friendly way.
Energy Optimization	AI is used in renewable energy integration and energy consumption analysis.
Employee Engagement Tool	AI as a tool to personalise training programs, facilitate feedback and communication and engagement surveys.
Predict Sales	AI as a tool to help a company predict sales and avoid over or under-production.
Control Inventory	AI is used to effectively allocate inventory across locations, real-time tracking through the supply chain or shelf-life management.
Automation Tool	Use of AI to do repetitive work and tasks that do not require too much specific knowledge.
Identify Inefficiencies Across Operations and Make More Efficient Decisions	AI as a tool to predict inefficiencies in the supply chain, increasing the efficiency of decision-making and resources used.
Fraud Detection	AI as a tool to detect fraud inside a company's business model.
Shareholder Virtual Assistant	AI as an assistance tool for company shareholders to instant access to information or investment guidance.
Recruitment	AI as a tool to promote a more diverse and inclusive workforce, help conduct/build interviews or analyse candidate resumes.

Development of a Grounded Theoretical Model shows the main relationships among the evolving concepts that explain the phenomena of interest (Magnani and Gioia 2023). Firms ought to prioritize assessing their social and environmental impacts alongside their financial performance, rather than concentrating exclusively on profitability (Miller 2020). It was important to find a framework in which we could keep most of the key concepts. The TBL was the model chosen, the three P's of the TBL framework are Profit (economic sustainability), People (social sustainability), and Planet (environmental sustainability), for an overview of how this model works, refer to Appendix 5. **Reflexion on the Employment of Methodology** When deciding on this TBL sustainable model, five key concepts that were initially identified were ultimately excluded from the final TBL model integration. Those are shareholder virtual assistant; data security; data analysis; predict sales; and control inventory because they might

dilute the focus on direct sustainability impacts. While concepts like data security and data analysis are important, they were considered secondary to the core objectives of evaluating economic, social, and environmental impacts. Consequently, by excluding these key concepts, there is a more concentrated analysis of transformative AI applications aligned with TBL's dimensions. These key concepts may be used in other studies more focused on areas like supply-chain operations, human resources management or data management. Each key concept was then allocated to one of the P's, as shown in Figure 1. This involved iterative cycles of comparing the data that was left with new codes and themes, which developed and adjusted the model to make it more aligned with the new data (Magnani and Gioia 2023).

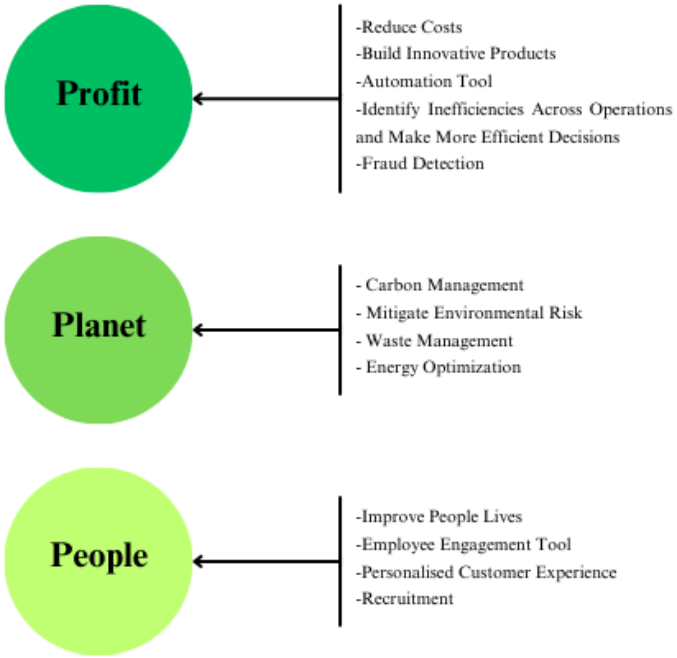

Figure 1: Key Concepts and TBL

4. Presentation of the Study's Findings

4.1 AI Integration in Sustainable Practices: 1st-Order Concepts

The qualitative analysis executed permitted the exploration of various ways in which AI is implemented in top companies' sustainable strategies. This data analysis involved identifying direct quotations and observable data points from corporations' reports and press releases. Appendix 6 explains in detail each 1st-order concept under the data collected.

In the Planet context, AI is used for monitoring energy usage and reducing emissions. For example, Neste Oyj is using a carbon management software platform, powered by AI to identify sustainable alternatives to existing links in their existing supply chain. Sims Ltd uses AI as a

tool to manage waste in smart houses through the analysis of vast amounts of data related to waste and recycling and by offering adapted solutions to its clients. To mitigate environmental risks, companies are using AI to predict floods, fires, or deforestation, for example, Stantec Inc. uses machine learning to predict a flood, inform how to act in case of a flood and solve the problems that appear while and after the flood occurs. Vestas Wind Systems A/S utilises AI to generate more energy from wind turbines by optimising the wake steering, which means that the front turbines are adjusted to redirect the turbulent air they create away from the turbines behind them, resulting in an overall increase in power production by the wind farms. Regarding People, AI's application transformed basic customer service for example, by having access to personalised online customer experience through virtual try-ons, Puma's clients can "shop the look" without being in-store. Telus Corp aims to improve people's lives with the SmartHome Security solution which employs AI computer vision as a customer's home "security". AI can be used as a tool to sustain a team's growth through quick learning insights from managers, as Cocego Communications Inc. is doing. Some companies are using AI as a tool to enhance recruitment, like Xerox Holdings Corp, which is working with AI to increase the pool of women and diversity of candidates for job openings.

Economically, AI contributes to cost-saving and revenue-generating activities. Cascades Inc. uses AI to optimise its logistics by defining the best routes to reduce the km and transportation costs. When people think about AI the word "innovation" comes to mind, and companies do employ AI to help them build innovative products. An example of such is McCormick & Company Inc., which uses AI to predict new flavour combinations for their products by combining data from sensory science, consumer preferences and flavour palettes. AI is already replacing humans in some work tasks and some decision-making. Atea SA uses AI-driven tools to help businesses make better decisions based on business intelligence and to simplify repetitive and monotonous work. Although the security of implementing AI inside companies

is still doubted by many specialists, some companies are using it to help them detect fraud. Banco do Brasil SA, uses AI to detect fraud on its website, for example, when clients receive emails or messages to access a certain link or make a specific payment, they can detect whether it is fraudulent or not, as well as block suspicious accesses to Banco's page. There are many ways in which AI can identify inefficiencies across a company's operations and help it make more efficient decisions. SAP SE created a Generative AI-driven tool called Joule, that maximises the efficiency of its business model operations by fastening the work, making smarter insights, and providing better outcomes while users maintain full control and security.

4.2 Creation of 2nd-Order Concepts and Aggregated Dimensions

The 2nd-order themes were developed by synthesising 1st-order ones into broader categories that reflect underlying patterns across the data set (Magnani and Gioia 2023). As Figure 2 shows, 1st-order concepts of carbon management, waste management, and energy optimisation were identified and analysed. Through a process of synthesis, these concepts were integrated into a 2nd-order theme of *AI as a sustainable resources management tool to promote environmental sustainability*. Sustainable resources management involves integrating Planet considerations to ensure the long-term viability and resistance of natural resources systems. It reflects how AI contributes to the management of natural resources in a responsible way to meet the present needs without compromising the ability of future generations to meet their own needs (United Nations s.d.). Taiwan High Speed Rail Corp is providing services through an AI tool that analyses large amounts of operational data to adjust the trains' speed and manage power usage depending on the number of passengers and other train conditions, to reduce energy consumption. Mitigating environmental risk maintained its name on the 2nd-order term. As the name indicates, it encompasses the use of AI to anticipate, identify and mitigate potential environmental risks (Figure 2) floods, for example. Improving people's lives, and personalised customer experience came together to create a 2nd-order theme called *AI to enhance*

stakeholders' engagement to boost social responsibility. This theme explores the AI application to deepen engagement with companies' external stakeholders (customers, suppliers/partners, and overall society). In the case of customers, this engagement can be made through strengthening relationships by actively involving them in decision-making processes and seeking feedback. Engagement with suppliers can be increased with new partnerships and with open and transparent communications. Puma SE partnership with Google Cloud to enhance shopping experience through the deployment of data analytics and other AI solutions. The employee engagement tool and recruitment lead to the 2nd-order theme of *workforce optimisation* which emphasises the alignment between a company's goals and workforce needs and skills. It captures the use of AI to optimise internal processes related to companies' human resources to maximise their value. Konica Minolta Inc. combines Software as a Service (SaaS) with AI-based services to reduce the complexity in workplaces, increase employees 'efficiency and encourage new digital workflows. Reducing costs, automation tools, identifying inefficiencies across operations and making more efficient decisions constitute the *focus on how AI enhances operational efficiency to reach economic sustainability* (Figure 2). AI can be implemented in different departments inside a company to reach operational efficiency, fostering resilience, competitiveness, and sustainable growth. Kone Oyj predicts maintenance problems through AI. In partnership with the IBM Watson IoT platform, Kone 24/7 Connected Services enable escalators and elevators to talk to the Cloud in real-time and inform building managers to monitor the performance of their equipment and schedule maintenance or upgrades if necessary. Lastly, building innovative products and fraud detection leads to the 2nd-order theme of *using AI to make strategic decisions and innovate.* This theme emphasises AI integration to foster innovation through strategic decision-making while enhancing corporate security from external threats and internal vulnerabilities. Beyond product innovation, AI can optimise processes and operations, and experiment with new technologies and business models

to explore new markets. First Solar Inc., uses AI in much of its manufacturing process. The company combines a series of technologies (AI, IoT, skilled workforce) to transform a sheet of glass into a fully functioning solar panel in 4 hours.

The aggregated dimensions represent the synthesis of 2nd-order terms to construct theoretical dimensions that explain the phenomena studied (Magnani and Gioia 2023). In this analysis, the 3 P's from the TBL (Planet, People and Profit) provide a synthesis of all data and theory embodying the interactions between AI applications and sustainability strategies within the 51 companies. The findings from this analysis are resumed in the Gioia illustrated in Figure 2.

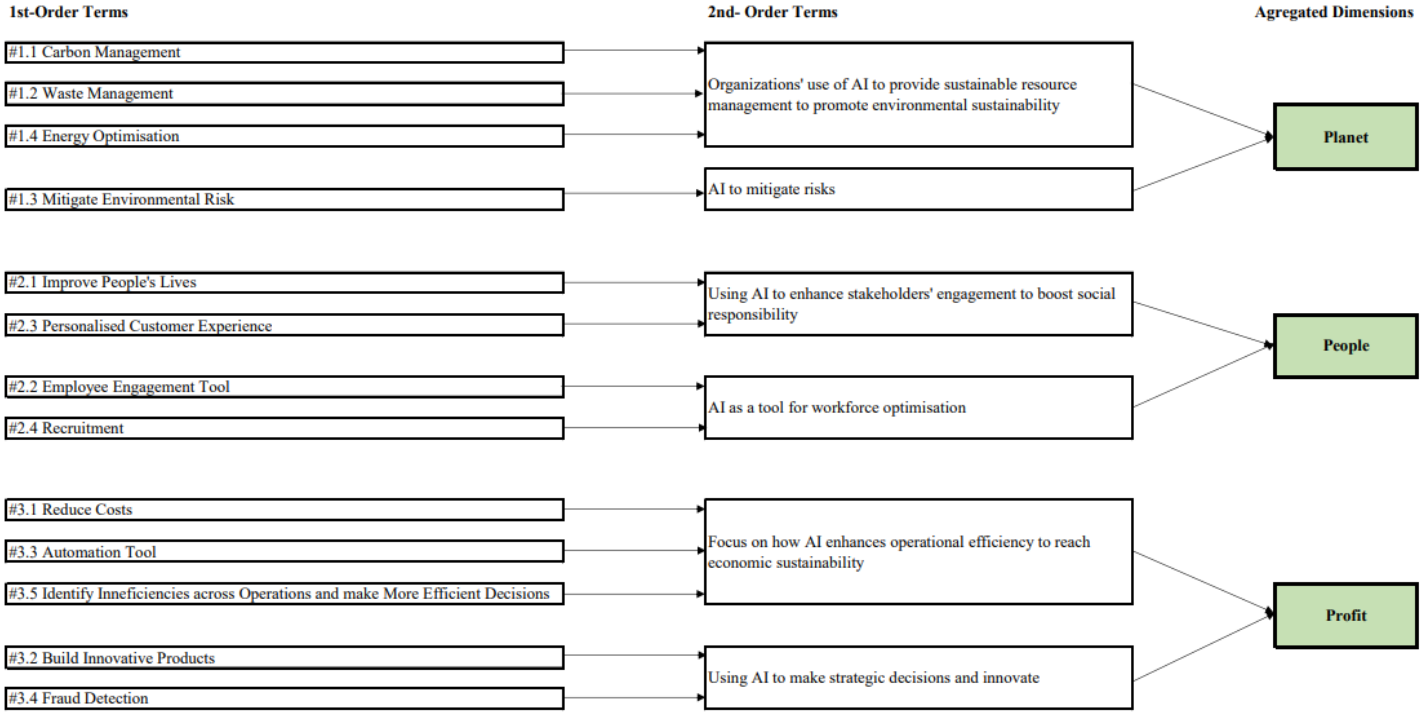

Figure 2: Final GIOIA

Organisations' use of AI to provide sustainable resources management and to mitigate risks aggregated into the Planet dimension; using AI to enhance stakeholders' engagement and as a tool for workforce optimisation fits into the People dimension; and AI enhancing operational efficiency and to make strategic decisions and innovate are aggregated in the Profit dimension.

5. Discussions on AI and Corporate Sustainability

The analysis studied the main usages of AI in sustainable strategies within the 51 more sustainable companies in 2023 according to CK. The findings demonstrated the potential AI can have on corporate sustainability efforts and illustrated the growing trend of technological integration in sustainable practices. The alignment of the Gioia with the TBL framework contributes to a distinct understanding of AI's capability to foster a sustainable future, thus results support the idea that AI has the potential to reduce companies' environmental impact, boost integration of renewable solutions, optimise supply chains and reduce waste (Goralski and Tan 2020; Vinuesa, et al. 2020; Rakha 2023). The findings of this study illustrate that, to reduce its negative impacts on the **Planet**, a company may use AI to provide sustainable resources management and to mitigate environmental risks. For example, Sims Ltd AI tool offers tailored recycling solutions to its clients through the analysis of data related to their waste and recycling habits or Koninklijke KPN NV Smart Devices that help customers monitor their energy consumption through smart routing configurations. This is aligned with the AI's role in production processes (Rakha 2023) when he stated that AI reduces waste, lowers energy consumption, and boosts resource utilisation. However, these findings add information to Vinuesa's et al. (2020) positive impact of AI on the environmental pillar of sustainable development. Although this study, does not have enough information on the amount of energy demand to implement AI, according to the findings, AI leads to fewer carbon emissions. As the Kering SA example of AI-driven tools to control its carbon footprint and water usage on production processes shows. Furthermore, Vinuesa et al. (2020) state, on the negative impacts of AI in the society pillar of sustainable development, that having targeted advertisements especially, on social media can lead to negative impacts, namely, on political polarisation. When this is applied to companies, the findings on the **People** dimension, suggest that using AI can enhance stakeholders' engagement, which means that, targeted advertisement is stated as

one of the many applications of AI that increase social sustainability. Personalised customer service or products will lead to an improvement in customer experience, thus positively impacting society (Rakha 2023). One of the findings was Alphabet Inc. targeted online advertisements which increased users' engagement and usage of products, thus not agreeing with Vinuesa et al. (2020) social negative impact once the advertisement is made based on users' preferences, not propaganda. This author also includes the enhancement of smart cities which help efficient management of resources and low carbon energy systems in the positive impact of AI for the society pillar, however, in this work, this dimension was included in the environment pillar due to its clear connections to natural environment/ **Planet.** Vinuesa et al. (2020) also stated that AI can trigger inequalities, namely in job recruitment. Although the findings of this research do not provide any concrete data on the effectiveness of recruitment via AI, there are two companies under this study (Xerox Holdings Corp and Cocego Communications Inc.) using this technology to increase diversity in job openings and decrease potential bias, raising social responsibility (**People**). The findings contradict existing literature on the negative impacts of AI on the society pillar because it was found that AI is a tool for workforce optimisation as demonstrated by the Xerox Holdings Corp, working with AI vendors to increase the pool of women and diversity of candidates for job openings. AI in the **Profit** dimension is used to make strategic decisions and innovate. Some authors say that there is limited knowledge of AI algorithms aimed at improving fraud detection (Vinuesa, et al. 2020; Rakha 2023), however, findings show evidence of AI being used as a fraud detector, for example, BCE Inc. using AI to automatically block fraudulent calls from company's network, thus contradicting AI challenges stated by Rakha (2023). Through the literature analysis, many corporations would use AI in partnerships with other companies, to help overcome the challenges inherent to AI implementation by financing data infrastructures and management systems (Rakha 2023; Goralski and Tan 2020), the findings of this study also show that

partnerships can help on implementing AI, enhancing operational efficiency to reach economic sustainability (**Profit**). For example, Schneider Electric SE partnered with Microsoft Cloud to create solutions to improve resource allocation, and time-consuming tasks, gain speed and efficiency and advance innovation in its portfolio through harnessing the potential of big data, AI and Machine Learning to transform businesses.

Another matching point between the findings and the literature review is the focus on AI enhancing operational efficiency to reach economic sustainability and AI as an enabler for societal (People), economic (Profit), and environmental (Planet) results (Vinuesa, et al. 2020; Rakha 2023; Goralski and Tan 2020). It is an agreement between authors that AI is an essential tool to help companies reduce costs, predict events, identify inefficiencies across operations and make more efficient decisions. Although AI still presents some risks (Goralski and Tan 2020), due to a lack of further experimentation, it offers substantial opportunities for sustainable development. Contrary to the predominantly cautious tone of the existing literature, the findings of this study reveal a more optimistic view on AI implementation in companies' sustainable strategies. These findings also show a greater and more varied extent of AI applications than previously studied.

6. Conclusions

By answering the research question made at the beginning of the study, this report studies how sustainable companies leverage AI technologies to enhance their sustainability efforts. This qualitative analysis of the top 51 sustainable companies in 2023, according to Corporate Knights, shows that AI is an essential element in the strategic framework of these companies. Based on the research, companies use AI to manage resources, mitigate risks, enhance stakeholders' engagement, optimise the workforce, increase operational efficiency and help make strategic decisions and innovate. All of which contribute to sustainability agendas. The integration of AI technologies in companies' sustainable strategies offers a promising chance

to address the People, Planet and Profit dimensions of the TBL model. This work adds to the academic discourse on sustainability by explaining how AI boundaries with various dimensions of sustainability. It also proves, through the examples of the companies analysed, that AI not only supports but accelerates the achievement of these dimensions, aligning and expanding upon previous literature.

7. Limitations and Future Research

The world we live in is constantly evolving (Lee, et al. 2019) and it is important to note that the complexity and scale of AI's implications for sustainability do not allow one study to explore all the aspects around it. This study acknowledges several limitations namely the dependence on publicly available data, which may not capture all aspects of companies' AI strategies; the qualitative, inductive approach, while detailed, also limits the ability to generalise findings across the broader industry due to the sample size; and the rapidly evolving fields of AI and sustainability also means that findings become outdated as corporate strategies advance.

As stated by Vinuesa et al. (2020), identifying the negative effects of AI on a company requires time and there are limited established methods for such evaluations, future research about this would be an interesting point to enrich the study of AI effects on companies. Further exploration of different areas of AI application, that were not explored in this study, could uncover additional layers of its impact on companies and could reveal contradictions between short-term efficiencies and long-term sustainability goals. The research is primarily based on qualitative data, which does not capture the quantitative impact of AI on sustainability. Quantitatively measuring the impact of AI implementation on sustainable metrics could also be an interesting expansion of this research. Furthermore, exploring the data privacy and ethical considerations concerns among companies and individuals could also provide a more comprehensive assessment of AI's role in sustainable development.

By addressing these limitations and expanding the scope of analysis, future research can build on the findings of this report and further contribute to more effective strategies to leverage AI in the pursuit of a sustainable future.

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9. Appendix

Appendix 1 The Evolution of Artificial Intelligence **(McKinsey & Company 2024)**.

Appendix 2 Corporate Knights Methodology **(Corporate Knights 2023)**

Appendix 3 Sampling Process **(Corporate Knights 2023)**

Appendix 4 Data Analysis

Appendix 5 Triple Bottom Line Framework **(Miller 2020)**

Appendix 6 Generating 1st-order terms

Appendix 1: The Evolution of Artificial Intelligence

Adapted from: McKinsey & Company (2024)

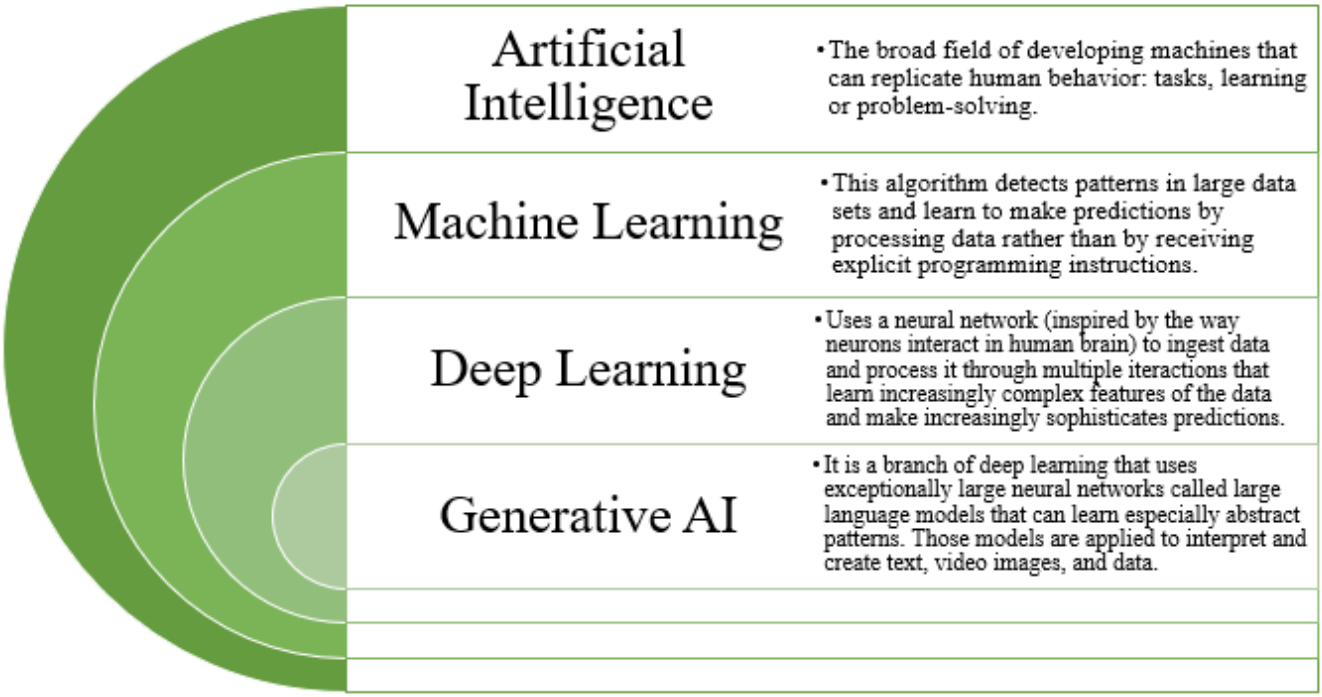

Figure 3: Artificial Intelligence Evolution

Appendix 2: Corporate Knights Methodology

Source: Corporate Knights 2023

Figure 4: 17 UN SDGs

Table 4 shows the 25 key performance indicators (KPIs) on which CK methodology is based and each KPI's respective UN SDGs. VOC Productivity; NOx Productivity; SOx Productivity; PM Productivity; and Fatalities are converted from variable weights to penalties that are applied to a company's overall score. All the companies involved in activities like thermal coal usage, obstructing climate policies, or deforestation are automatically excluded and only those companies that integrate sustainable solutions into their main business model and commit substantial investments towards reducing their carbon emissions are considered successful in this evaluation.

Table 4 : KPIs and UN SDGs

KPI	**UN SDGs**
Energy Productivity	7 9
Greenhouse Gas Productivity	9 13
Water Productivity	6 9
Waste Productivity	9 11 12 15
VOC Productivity	3 9 11 12
NOx Productivity	3 9 11 12
Sox Productivity	3 9 11 12
Particulate Matter Productivity	3 9 11 12
Percentage Tax Paid	10

CEO-Average Employee Pay Ratio	8 10
Pension Fund Quality	1 8
Supplier Sustainability Score	1 2 3 5 6 7 8 9 10 11 12 13 14 15 16 17
Injury Rate	8
Fatalities	8
Employee Turnover	8
Executive Gender Diversity	5
Board Gender Diversity	5
Racial Diversity Among Executive Management	10
Racial Diversity on Boards	10
Paid Sick Leave	3 8
Sustainability Pay Link	3 5 6 7 8 9

	10 11 12 13 14 15 16
Sanctions Deduction	1 3 5 6 7 8 9 10 11 12 13 14 15 16
Political Influence	13
Sustainable Revenue	1 2 3 4 5 6 7 8 9 10 11 12 13

	14 15 16 17
Sustainable Investment	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

All 6000 companies selected to be part of the Global 100 are compared with their Corporate Knights Peer Group (CKPGs). There are 63 CKPGs which are presented in Figures 5 and 6.

CKPG Group A				
Aluminum manufacturing	Food and beverage manufacturing	Medical equipment manufacturing	Personal products (retail chemical)	Semiconductor and electronic components manufacturing
Appliances and lighting fixtures manufacturing	Forest products	Metal and coal mining	Pesticide and fertilizer manufacturing	Smelters and steel making
Automobile retail	Freight transport, all modes	Metal products manufacturing	Pharmaceutical manufacturing	Steel products
Basic inorganic chemicals and synthetics	Furniture and general manufacturing	Mining industry support	Plastic and rubber product manufacturing	Telecom providers
Battery manufacturing	Glass and ceramics	Natural gas transmission and distribution	Power generation	Telephones and telecom equip manufacturing
Cars and trucks manufacturing, including parts	Grocery stores	Non-metallic mining	Power transmission and distribution	Textiles and clothing manufacturing
Cement, lime and concrete	Health care	Non-road transport equipment manufacturing	Real estate and leasing	Tobacco
Commercial building construction	Hotels and entertainment venues	Non-store retailers	Refining, petrochemicals and basic organic chemicals	Transit and ground transportation
Computers and peripherals manufacturing	HVAC equipment manufacturing	Oil and Gas production	Residential construction	Waste Management
Electrical equipment manufacturing	Instrumentation and other electronic manufacturing	Packaging	Restaurants	Water and sewage treatment
Farming and fishing	Machinery manufacturing	Passenger airlines	Retail, except grocery and auto	Wholesale trade and warehousing

Figure 5: CKPG Group A

In CKPG Group A are all the groups assessed on at least three variably weighted indicators (Carbon Productivity, Energy Productivity, Water Productivity, Waste Productivity and Injury Rate) while the CKPG Group B includes the groups assessed on two variably weighted indicators (Carbon and Energy Productivity) (Corporate Knights 2023).

Figure 6: CKPG Group B

Appendix 3: Sampling Process

Retrieved from: Corporate Knights 2023

Table 5 presents the Global 100, 2023 ranking according to Corporate Knights. In a qualitative study based on the 100 more sustainable companies, the 50 first places were selected. Because there was a tie for the 7th place, 51 companies were finally selected. The final sample is coloured in green.

Table 5: Ranking Global 100, 2023

2023 G100 Rank	**Name**	**2023 G100 Rank**	**Name**
1	Schnitzer Steel Industries Inc	~~51~~	~~Giant Manufacturing Co Ltd~~
2	Vestas Wind Systems A/S	~~52~~	~~Essity AB (publ)~~
3	Brambles Ltd	~~53~~	~~Eisai Co Ltd~~
4	Brookfield Renewable Partners LP	~~54~~	~~ERG SpA~~
5	Autodesk Inc	~~55~~	~~Sprouts Farmers Market Inc~~
6	Evoqua Water Technologies Corp	~~56~~	~~CapitaLand Investment Ltd~~
7	Stantec Inc	~~57~~	~~Sino Land Co Ltd~~
7	Schneider Electric SE	~~58~~	~~Severn Trent PLC~~
8	Siemens Gamesa Renewable Energy SA	~~59~~	~~Intesa Sanpaolo SpA~~
9	Taiwan High Speed Rail Corp	~~60~~	~~Gildan Activewear Inc~~
10	Dassault Systemes SE	~~61~~	~~Sanofi SA~~
12	Xinyi Solar Holdings Ltd	~~62~~	~~Swatch Group AG~~

13	Orsted A/S	~~63~~	~~Samsung SDI Co Ltd~~
14	Sims Ltd	~~64~~	~~Yadea Group Holdings Ltd~~
15	Banco do Brasil SA	~~65~~	~~Telefonaktiebolaget LM Ericsson~~
16	Rockwool A/S	~~66~~	~~Adidas AG~~
17	Johnson Controls International PLC	~~67~~	~~Hewlett Packard Enterprise Co~~
18	Chr Hansen Holding A/S	~~68~~	~~KB Financial Group Inc~~
19	Kone Oyj	~~69~~	~~Maxeon Solar Technologies Ltd~~
20	Cascades Inc	~~70~~	~~Orkla ASA~~
21	Atlantica Sustainable Infrastructure PLC	~~71~~	~~BNP Paribas SA~~
22	McCormick & Company Inc	~~72~~	~~Svenska Handelsbanken AB~~
23	Novozymes A/S	~~73~~	~~Apple Inc~~
24	Iberdrola SA	~~74~~	~~Kesko Oyj~~
25	BT Group PLC	~~75~~	~~Quadient SA~~
26	Alphabet Inc	~~76~~	~~Investec Ltd~~
27	Vitasoy International Holdings Ltd	~~77~~	~~Sun Life Financial Inc~~
28	City Developments Ltd	~~78~~	~~Teck Resources Ltd~~
29	Neste Oyj	~~79~~	~~NIO Inc~~
30	Ecolab Inc	~~80~~	~~Ricoh Co Ltd~~
31	Kering SA	~~81~~	~~Henkel AG & Co KgaA~~
32	Beijing Enterprises Water Group Ltd	~~82~~	~~Storebrand ASA~~
33	ASM International NV	~~83~~	~~Gilead Sciences Inc~~
34	StarHub Ltd	~~84~~	~~Sekisui Chemical Co Ltd~~
35	SunPower Corp	~~85~~	~~Commerzbank AG~~
36	Xerox Holdings Corp	~~86~~	~~Tesla Inc~~
37	Telus Corp	~~87~~	~~Beazley PLC~~
38	Unilever PLC	~~88~~	~~Bank of Montreal~~
39	HP Inc	~~89~~	~~Arcelik AS~~
40	VMware Inc	~~90~~	~~Canadian Tire Corporation Ltd~~
41	SAP SE	~~91~~	~~National Australia Bank Ltd~~
42	BCE Inc	~~92~~	~~IGM Financial Inc~~
43	Coloplast A/S	~~93~~	~~Pfizer Inc~~
44	Koninklijke KPN NV	~~94~~	~~Nordea Bank Abp~~
45	Cogeco Communications Inc	~~95~~	~~Merck KGaA~~
46	First Solar Inc	~~96~~	~~Societe Generale SA~~

47	Puma SE	~~97~~	~~AstraZeneca PLC~~
48	Cisco Systems Inc	~~98~~	~~Koninklijke Philips NV~~
49	Atea ASA	~~99~~	~~Danaher Corp~~
50	Konica Minolta Inc	~~100~~	~~Novavax Inc~~

The final sample was reorganised, on Table 6, according to industries for better data visualisation. From now on, on the methodology, companies are organised through industries instead of raking positions.

Table 6: Final Sample

2023 G100 Rank	Company Name	Global Industry Classification Standard (GICS) Sector
25	BT Group PLC	Communication Services
26	Alphabet Inc	Communication Services
34	StarHub Ltd	Communication Services
37	Telus Corp	Communication Services
42	BCE Inc	Communication Services
44	Koninklijke KPN NV	Communication Services
45	Cogeco Communications Inc	Communication Services
31	Kering SA	Consumer Discretionary
47	Puma SE	Consumer Discretionary
22	McCormick & Company Inc	Consumer Staples
27	Vitasoy International Holdings Ltd	Consumer Staples
38	Unilever PLC	Consumer Staples
29	Neste Oyj	Energy
15	Banco do Brasil SA	Financials
43	Coloplast A/S	Health Care
2	Vestas Wind Systems A/S	Industrials
3	Brambles Ltd	Industrials
6	Evoqua Water Technologies Corp	Industrials
7*	Stantec Inc	Industrials
7*	Schneider Electric SE	Industrials
8	Siemens Gamesa Renewable Energy SA	Industrials
9	Taiwan High Speed Rail Corp	Industrials
16	Rockwool A/S	Industrials
17	Johnson Controls International PLC	Industrials

19	Kone Oyj	Industrials
5	Autodesk Inc	Information Technology
10	Dassault Systemes SE	Information Technology
12	Xinyi Solar Holdings Ltd	Information Technology
33	ASM International NV	Information Technology
35	SunPower Corp	Information Technology
36	Xerox Holdings Corp	Information Technology
39	HP Inc	Information Technology
40	VMware Inc	Information Technology
41	SAP SE	Information Technology
46	First Solar Inc	Information Technology
48	Cisco Systems Inc	Information Technology
49	Atea ASA	Information Technology
50	Konica Minolta Inc	Information Technology
1	Schnitzer Steel Industries Inc	Materials
14	Sims Ltd	Materials
18	Chr Hansen Holding A/S	Materials
20	Cascades Inc	Materials
23	Novozymes A/S	Materials
30	Ecolab Inc	Materials
28	City Developments Ltd	Real Estate
4	Brookfield Renewable Partners LP	Utilities
13	Orsted A/S	Utilities
21	Atlantica Sustainable Infrastructure PLC	Utilities
24	Iberdrola SA	Utilities
32	Beijing Enterprises Water Group Ltd	Utilities

Appendix 4: Data Analysis

Source: Companies Reports and Press Releases

All the data collected from the companies was inserted in Table 7. Direct quotes were made from companies' reports and put in the "Description" column. The other three columns are the company name, the industry name, and the United Nations Sustainable Development Goals they support.

A detailed analysis of each company's reports and press releases was made, and all the information regarding AI implementation on sustainable strategies among the various companies was collected and organised in Table 7. There are six companies (Vitasoy International Holdings Ltd; Coloplast A/S; Rockwool A/S; Xinyi Solar Holdings Ltd; Schnitzer Steel Industries Inc; and Beijing Enterprises Water Group Ltd) with a blank description column because there was no information regarding AI usage on their reports or press releases.

Table 7: Data Collection

Company Name	Industry	UN SDGs	Description
BT Group PLC	Communication services	4 5 8 9 10 12 13 16	Launched an AI-powered edge computing solution in partnership with QiO, to help business customers **cut carbon** by optimising energy use across their operations. Create personalised experiences for customers, build innovative products and protect them through state-of-the-art network monitoring: Developed Cloud and AI-led strategic technology platforms to create **brilliant customer experiences and digital engagement.** BT Group PLC develops cloud and AI-led strategic technology platforms to **reduce costs,** as well as create new products and platforms to help revenue growth.
Alphabet Inc	Communication services	All	Google research is used to **forecast floods** using AI and geospatial analysis to provide real-time flooding information. Google Research: teamed up with American Airlines and Breakthrough Energy to **collect data** and use AI to develop contrail forecast maps to test if pilots can choose routes that avoid creating contrails (those white lines left by planes in the sky). Offer more **personalized experiences** and increase engagement and usage of products (advertisements targeted to specific people). **Analyse large amounts** of medical **data** and develop new treatments and cures. **Fuel-efficient routing** in Google Maps uses AI to suggest routes that have fewer hills, less traffic, and constant speeds.
StarHub Ltd	Communication services	3 4 5 7 8 9 10 11 12 13 17	Leveraging AI to unify rich cloud-based data accumulated across the organisation to **enable innovative customer engagement models**, give rise to **new monetisation opportunities,** and drive **greater internal efficiencies** through data-driven strategic business decisions. Established the use of Generative Artificial Intelligence (GenAI) Policy to guide the **ethical and responsible use of GenAI** such as ChatGPT, Google Bard, Microsoft CoPilot etc by their employees, and other 3rd parties.
Telus Corp	Communication services	7 8 9 10 11 12 14	**Using data with integrity** in a way that aligns with Telus Privacy Commitment. SmartHome Security solution uses **AI to protect customers' homes** through computer vision. Smart building solutions use AI to monitor and control the air conditioning and heating in the buildings which enables the **optimisation of energy efficiency to reduce carbon footprint.** Partnership with Intuitive AI to install Oscar Sort technology which **provides recycling assistance** through visual, text, and audio nudges to **engage customers** and improve sorting, all while educating them on waste best practices in their building.

BCE Inc	Communication services	3 8 9 10 11 12 13 17	**AI to automatically and permanently** block callers identified as fraudulent **from the company's network.** **Collaboration with Mila, a research institute in AI, to apply deep learning neural network algorithms to Bell's systems and data to** improve business performance and customer experience and accelerate AI innovations using cloud computing.
Koninklijke KPN NV	Communication services	5 8 9 10 11 12 13	Creates Smart devices (lights, plugs or thermostats that use AI) that help customers understand and **reduce their energy consumption** by configuring smart routines that prevent lights from being left on unnecessarily or that turn down the heating.
Cogeco Communications Inc	Communication services	5 7 8 9 12 13	**Employee engagement assessment tool** offers quick AI-driven learning insights for managers to sustain the team's growth. Partnership with Actifai (an AI software service provider) to deploy Cogeco's connection industry-leading AI customer experience platform across Canada operations **accelerating recruitment practices** using data analytics, and AI to decrease potential bias in recruitment and to attract top talent from a wider pool.
Kering SA	Consumer Discretionary	1 3 4 5 6 7 8 12 13 14 15 16 17	AI-driven tools to **control the carbon footprint and water usage** of production processes. AI-driven analytics to gather insights into consumer behaviour and preferences, which enables **more targeted marketing and product development.** Uses robotics and AI in manufacturing processes to **optimise production lines and reduce energy consumption** to boost profitability and align its' sustainability goals. This anticipates demand and seasonal trends to avoid unwanted production of excess stock.
Puma SE	Consumer Discretionary	9 12 14 15	Partnership with Google Cloud to deploy its' data analytics and AI solutions to enhance online shopping experience- **personalised customer experiences, "**shop the look" = virtual try-ons of sportswear using AI-generated content.
McCormick & Company Inc	Consumer Staples	1 2 3 4 5 6 7 8 10 11 12 13 15	Use AI to help them **increase the rate of innovation**: explore flavour territories more quickly and efficiently using AI to learn and predict new flavour combinations from hundreds of millions of data points across areas of sensory science, consumer preference and flavour palettes.

Vitasoy International Holdings Ltd	Consumer Staples	2 3 6 7 8 12 13	
Unilever PLC	Consumer Staples	1 2 3 5 6 8 13	Global AI lab in Toronto, focusing on 3 main areas: **forecasting**, modelling complex data relationships with graph technology, and generating insights on trends, patterns, and predictions (through Generative AI). AI to **optimise portfolio** of brands and products- data-driven platform. Use AI to help **identify alternative ingredients** that can strengthen the resilience of the supply chain, making formulations more sustainable and cost-efficient, and simplifying them by reducing the number of ingredients without impacting products' quality or effectiveness. Use Google Cloud to **monitor deforestation status.**
Neste Oyj	Energy	7 8 9 10 11 12 13 15 17	AI as a driver of **identification of inefficiencies** across global operations. **Carbon Management** software platforms powered by AI to identify more sustainable alternatives to existing links in the chain. AI-driven algorithms to **power precision agriculture** effectively by analysing soil data, plant health, and weather forecasts. **Smart waste management systems** (through AI) enable sorting and remanufacturing.
Banco do Brasil SA	Financials	7 8 9 12 13	Chatbots/Voice bots on WhatsApp or App of the Banco. AI as a **tool to identify the dissatisfaction** of clients. AI tool **for fraud detection** through document analysis. AI as a solution for **more efficient operations** and **better client experience.** Uses AI to **interpret satellite image data** and generate a solution for agribusiness.
Coloplast A/S	Health Care	3 5 8 10 12 13	
Vestas Wind Systems A/S	Industrials	7 8 12 13 17	Use AI in job roles that do **not require a specific skill** or knowledge; actions that are tedious, rule-based, and repetitive. Development of WindAMS AI to **automate inspection data analysis**. AI and Machine Learning to **reduce operational costs** to improve the value of customers' assets over their lifecycles. Uses AI and high-performance computing to **generate more energy** from wind turbines by optimizing what is known as wake steering.
Brambles Ltd	Industrials	2 3 4 5 6	AI and Machine Learning to sort data and **remove inefficiencies** from business and customer supply chains. **Targeted diagnostics**- gather data to optimise the network; lower costs for suppliers; more consistent shipments and reduce the need for new pallet purchases. AI to **monitor and track** pallets.

		7 8 9 10 12 13 15 16 17	
Evoqua Water Technologies Corp	Industrials	3 6 7 9 12 13	Corp Water One WX remote monitors wastewater ion exchange system with **predictive analytics** and proactive service. Water one- real-time **data analytics for system optimization**: water quality, use, status, and maintenance. Sophis Digital Services, part of the Water One services solution, uses AI to enhance water system management- predictive analytics to anticipate issues and optimise system efficiency, remote monitoring of critical system parameters, and expert engineering analysis of operational data to maintain high performance and reliability.
Stantec Inc	Industrials	6 7 9 11 13 14 15	Partnerships with IBM to **simplify data and organize tasks**. Deep learning for large-scale projects with difficult features and **repetition**. Stantec Altitude- cloud-based operational analytics platform **unlocks hidden operational efficiencies, improves performance, and mitigates risks.** Uses Machine Learning to deliver comprehensive **flood prediction** support for various flood types through the entire life cycle of a flood event. Evoqua's Water One platform, a holistic water management solution, combines their extensive water expertise with data intelligence- and aims to minimize water system downtime and ensure a consistent, high-quality water supply by employing real-time data analytics and remote monitoring capabilities. It enhances the **predictive maintenance** of water systems and **optimises the scheduling and routes of service personnel**.
Schneider Electric SE	Industrials	All	AI helps manage critical quality parameters, stock management, automated visual inspection, industrial safety, and self-healing supply chain. AI in **predictive maintenance** is possible with anomaly detection for resilience in infrastructure. AI as a tool to make data-based buying and selling decisions and manage demand peaks efficiently- **control inventory.** Collaboration with Microsoft to create solutions to **optimise resource allocation, and time-consuming tasks, gain speed and efficiency, and advance innovation in its portfolio.**
Siemens Gamesa Renewable Energy SA	Industrials	5 7 8 13 16	Uses an AI tool that addresses skill shortages in the industry, and it **empowers** less-experienced shop-floor **employees**, making them more efficient and effective in their roles. AI algorithm that **automates data analysis** and streamlines the entire inspection process of blades. Uses AI algorithms to **analyse data** from sensors on wind turbines to adjust blade positions and operational parameters in real time to optimise their performance. AI into **predictive maintenance**, enabling faster and easier maintenance decisions. Senseye Predictive Maintenance uses AI and Machine Learning to automatically generate machine and maintenance worker behaviour models to direct users' attention and expertise to where it's needed most.
Taiwan High Speed	Industrials	4	**AI Customer Support Services**.

Rail Corp		7 8 9 11 12 13	AI **service platform for inspection of viaducts** using a central control room to monitor and operate the train line using state-of-the-art AI, as well as keeping the main line running, the control room also controls access to and from depots. **Reduce energy consumption** by providing AI services that analyse vast amounts of operational data to adjust the speed of trains and manage power usage depending on passenger numbers and other train conditions. AI and IoT technology to s**trengthen the effectiveness of disaster warning and facility monitoring.**
Rockwool A/S	Industrials	2 3 6 7 8 9 11 12 13 14 17	
Johnson Controls International PLC	Industrials	2 4 6 7 8 9 10 11 12 13 17	AI-driven OpenBlue (smart building platform) to **improve energy efficiency**, reduce CO2 emission, optimise space use and equipment performance, and ensure the health and well-being of smart building occupants. **Monitoring energy efficiency and space performance using central AI**- This helps with remote diagnostics, predictive maintenance, compliance monitoring, and advanced risk assessments.
Kone Oyj	Industrials	3 4 5 8 9 11 12 13 16	**Predict maintenance** problems through AI. Kone and IBM are collaborating on bringing Kone 24/7 Connected Services to market. Here the IBM Watson IoT platform enables escalators and elevators to talk to the cloud intelligently and in real time. The data derived in this way allows building managers to monitor the performance of their equipment and helps them schedule upgrades and maintenance work before problems occur.
City Developments Ltd	Real Estate	3 4 5 6 7 8 9 10 11 12 13 14	Created a powerful AI chatbot on their website to **assist customers.** Implemented AI Voice Assistant, which enhances hotel guests' experience and reduces 15% of front desk's workload. digiHUB is a digital platform that uses AI and Machine Learning, Analytical Tools and Internet of Things focused on **predictive and integrated facilities management solutions**. Employed Xylo Systems, a cloud-based AI platform to **measure and manage biodiversity impact**, conduct in-depth assessments, predict potential consequences of activities, and make informed decisions backed by data.

		15 16 17	
Iberdrola SA	Utilities	7 13	Advanced Smart Assistance- a digital platform for **managing consumers' consumption** of smart electrical devices. **Shareholder Virtual Assistant**- a chatbot to answer shareholder questions. MateoFlow system is a Machine Learning instrument that **estimates the production of renewable energy** facilities based on weather forecasts. Transmission Operations Centre- AI helps **identify more efficiently any type of interference in transmission lines**, which facilitates operation work and activates the maintenance team for appropriate interventions.
Beijing Enterprises Water Group Ltd	Utilities	5 6 8 9 11 13 15 16 17	
Brookfield Renewable Partners LP	Utilities	7 13	Use Generative AI to **automate complex tasks** and fuel advanced analytics; data storage and processing requirements from enterprises migrating workloads and applications from on-premises to the cloud, as well as the widespread adoption of new use cases such as 5G technology. AI as a **digital assistant**
Orsted A/S	Utilities	7 13 16	Azure, helping Ørsted to sort, understand and intelligently apply myriad turbine data. The software transforms data from its offshore wind turbines into insights for **predictive maintenance**, saving time and driving team efficiency. By enhancing asset performance management with SparkCognition's AI solution, Ørsted will increase energy production, decrease maintenance costs, and improve operational efficiency. Renewable Suite provides **predictive recommendations** to identify impending failures, quickly identify underperforming assets, and ensure effective follow-through.
Atlantica Sustainable Infrastructure PLC	Utilities	5 6 7 8 9 13 15	AI to **provide new solutions to predictive analysis** for the maintenance and operation of generating assets sustainably and cost-effectively. Data analytics capabilities to **prevent failures** in wind turbines, electric transformers in solar and wind assets, and water feed pumps in solar assets. Energy production **forecasts**, predict equipment breakages or malfunctions, reduce risk of major outages and health and safety and environment.
Schnitzer Steel Industries Inc (Radius Recycling)	Materials	2 3 5 6 7 8 9 10 11	

		12 16	
Ecolab Inc	Materials	5 6 13	ECOLAB3D **helps conserve water, cut back on energy use,** identify, and employ **better responses for at-risk water safety locations,** anomaly detection, prescriptive optimisation, and **predictive maintenance**, get the most out of assets and enhance asset and equipment service life-AI as a **predictive analytics** tool to detect system deviations.
Sims Ltd	Materials	8 12 13	AI is a tool to **analyse vast amounts of data** related to waste and recycling. It offers more **tailored recycling solutions** to its clients, enhancing economic outcomes and reducing environmental impacts. Sims Metal uses thermal cameras supplemented with **AI analysis to help detect fires**, before spreading. SIMS AI helps identify patterns and trends in data sets, automate tasks such as monitoring and inspecting equipment; and convert non-structure data into structured data- **Improving efficiency and decision-making industry.**
Chr Hansen Holding A/S	Materials	2 3 12 13	Emphasizes investments in R&D processes, and **improving operational efficiencies** through process innovations, robotics, and automation. Uses AI algorithms to **analyse data sets** identify patterns and predict the effectiveness of new microbial strains and enzymes. This will help reduce the time and resources required for traditional trial and error methods and **develop more effective** and sustainable products faster.
Cascades Inc	Materials	3 5 6 7 11 12 13 15 17	AI to **optimise logistics**, reduce the empty km, define the best routes to better manage the operational and legal constraints, and reduce transportation costs.
Novozymes A/S	Materials	2 4 5 6 7 8 9 11 12 13 14 15 16 17	LaundryLab uses AI to **predict how much CO2** emissions a person can save per year, **simulate performance output** when reformulating, and review product biodegradability and toxicity.
Cisco Systems Inc	Information Technology	All	AI-driven **security platform** that helps customers make decisions, augment tool capabilities, and automate complex tasks- against cyber threats. Cisco AI Observability Platform **simplifies business monitoring** to **automate IT processes** and **keep operations teams productive** and responsive. Cisco X-Series Direct technologies to help businesses develop and

			optimise infrastructures to support AI. Partnership with NVIDIA to create AI infrastructure solutions for the **data centre** that are easy to deploy and manage, enabling the massive computing power that enterprises need to succeed in the AI era.
HP Inc	Information Technology	All	AI Elite and Pro Personal computers are equipped with AI capabilities (better audio, video, and responsiveness). Uses AI algorithms to predict maintenance in manufacturing and improve energy efficiency. AI in Operations and Customer Solutions: HP integrates AI to **improve operational processes** and to **develop innovative customer solutions**, particularly in areas such as cybersecurity and predictive analytics. Digital Transformation: HP emphasizes its ongoing digital transformation, which involves leveraging advanced technologies, including AI, to **enhance operational efficiency and customer experiences**. AI is used in sustainability efforts, such as **enhancing the energy efficiency** of products and operations and contributing to more sustainable business practices.
Autodesk Inc	Information Technology	6 7 8 9 11 12 13	Autodesk Infodrainage uses a new built-in AI to **predict Flood maps** quickly and accurately. Autodesk Forma uses AI in **predictive analysis** for wind, noise, and operational energy in real-time. Autodesk Flame uses Machine Learning to **save hours of repetitive work by automating tasks.** Autodesk AI Technology used in construction **Clouds that analyses project data** to identify and prioritise design, quality, safety, and project **control risks**; automate 2D documentation with interactive experiences of manufacturing drawings, reducing time spent on non-value tasks. AI to analyse urban design factors so alternatives can be considered and optimised.
Dassault Systemes SE	Information Technology	3 4 7 13	AI as a **predictive and strategic analysis tool.** 3D Experience platform uses AI to **understand, analyse, correlate, describe, and predict complex information.** Processing software based on AI to provide better customer experience solutions.
Xinyi Solar Holdings Ltd	Information Technology	7 8 9 12 13	
ASM International NV	Information Technology	7 8 9 12 13	Incorporates AI to enhance the demand for its semiconductor technologies in Atomic Layer Deposition and Epitaxy tools, and leverages AI to **advance its product development**. As part of Knowledge Net, they are developing AI and Machine Learning-**based data capture and learning to understand how to make tools operate most effectively** to levels that were previously unobtainable.
SunPower Corp	Information Technology	7 10 12 16	SunPower Design Studio uses AI and high-resolution satellite imagery to **help residential consumers design custom** solar power for their homes. AI and Machine Learning as **a tool to create digitally generated solar power installation** plans for each unique roof.
Xerox Holdings Corp	Information Technology	All	AI-enabled hybrid work. **Remote assistance** and guidance support to field technicians on customer sites. Use apps that leverage AI to **enhance productivity, efficiency, and creativity**.

			Working with AI vendors to **increase the pool of women and diverse candidates** for job openings using their algorithms. Analytics to **identify inefficiencies, simplify processes and improve workflow automation**, deliver **predictive support**, supplies, and maintenance, reducing downtime and wasted replacement of parts. AI in an omnichannel **virtual assistant** to interpret the sentiment and intent of customers' requests. AI-driven **voice control** on the Xerox AltaLink Multifunction Printers.
Atea ASA	Information Technology	5 8 9 12 13 16	Uses analytics, namely AI-driven tools to help businesses make **better decisions** based on business intelligence and simplify and **streamline away repetitive and monotonous work** processes with Robotics Process Automation. Different data centre offerings: storing data, migrating and managing operations and monitoring, disaster recovery, cost-effective management of data, and continuity planning to minimise risks. Intelligent IT systems **search for and detect security gaps**.
VMware Inc	Information Technology	3 4 5 6 7 8 9 10 12 13 16 17	VMware Private AI is an architectural approach for AI services, that enables privacy and control of corporate data, choice of open source and commercial AI solutions, quick time-to-value, and integrated security and management. With VMware Private AI, people get the flexibility to run a range of AI solutions for their environment. **Augment productivity by eliminating redundant tasks and building intelligent process improvement mechanisms.** Private chatbots that generate intelligent outputs.
SAP SE	Information Technology	4 5 8 10 13 17	Created Joule, a Generative AI tool that **maximizes the efficiency of business operations** through faster work, smarter insights, and better outcomes and maintains its full control and security. RISE with SAP is a business transformation solution aimed at helping customers migrate their Enterprise Resource Planning system to the cloud and accelerate their digital transformation, aiming to **provide enhanced productivity utilizing automated processes**. Global AI Ethics Policy ensures AI software is live with ethical standards. SAP combines Generative AI with business data to provide **AI solutions that are integral to customers 'critical business processes** and ensure that they are embedded in portfolio, relevant, reliable, and responsible.
First Solar Inc	Information Technology	4 7 12 13	AI **controls much of the manufacturing process**, it produces solar panels with a higher degree of automation, precision, and improvement. Uses AI, the Internet of Things, machine-to-machine communication, skilled workers, and industry 4.0 architecture to transform a sheet of glass into fully functioning solar panels in 4h.
Konica Minolta Inc	Information Technology	3 5 8 12 13 17	Intelligent information management combines Software as a service offering with AI-based services to **reduce the complexity in workplaces**, **increase efficiency** and foster new digital workflows, among employees. COBOT solutions: **automation of projects** to improve manufacturing workflow, quality control, and productivity. API Platform: AI Partner Portal helps developers and partners to build applications around imaging, video and cognitive services.

After building Table 7, there were clear common AI usages among companies of various industries. These concepts were gathered to create broader concepts that would encompass these AI usages. The key concepts were created and organised in an Excel sheet to have a better overview of all the information collected (Figure 7). The different colours are differentiating each industry type, and it is merely for easier visualization. The companies with no colour are those whose reports/press releases do not disclaim any information regarding AI. Each column is a key concept, and each row corresponds to one company. The x marks the intersection between a company and a key concept.

Figure 7: Data Organization. (Source Author)

Company Name	Industry	Carbon Management	Improve People Lives	Personalised Customer Experience	Reduce Costs	Mitigate Environmental Risk	Build Innovative Products	Data Security	Data Analysis	Waste Management	Energy Optimization	Employee engagement tool	Predict Sales	Control Inventory	Automation Tool	Identify Inneficiencies across operations and make more efficient decisions	Fraud Detection	Shareholder Virtual Assistant	Recruitment
BT Group PLC	Communication Services	X	X	X	X		X												
Alphabet Inc	Communication Services		X	X		X	X	X	X										
StarHub Ltd	Communication Services			X	X		X	X	X							X			
Telus Corp	Communication Services	X	X	X			X			X	X								
BCE Inc	Communication Services			X			X	X	X							X			
Koninklijke KPN NV	Communication Services			X	X		X				X					X			
Cogeco Communications Inc	Communication Services			X					X			X				X			
Kering SA	Consumer Discretionary			X				X	X			X	X	X	X		X	X	
Puma SE	Consumer Discretionary			X				X											
McCormick & Company Inc	Consumer Staples						X		X				X	X		X			
Vitasoy International Holdings Ltd	Consumer Staples																		
Unilever PLC	Consumer Staples			X	X	X	X		X	X			X	X	X				
Neste Oyj	Energy	X	X			X	X		X	X					X	X			
Banco do Brasil SA	Financials			X					X							X	X		
Coloplast A/S	Health Care																		
Vestas Wind Systems A/S	Industrials				X		X		X		X					X			
Brambles Ltd	Industrials				X				X						X	X			
Evoqua Water Technologies Corp	Industrials								X	X	X				X	X			
Stantec Inc	Industrials					X			X	X		X			X	X			
Schneider Electric SE	Industrials			X					X				X	X	X	X			
Siemens Gamesa Renewable Energy SA	Industrials			X					X		X	X			X	X			
Taiwan High Speed Rail Corp	Industrials		X	X		X				X	X				X	X			
Rockwool A/S	Industrials										X				X	X			
Johnson Controls International PLC	Industrials	X		X		X	X		X						X	X			
Kone Oyj	Industrials								X			X			X	X			
Autodesk Inc	Information Technology	X	X	X		X	X		X		X				X	X			
Dassault Systemes SE	Information Technology		X	X			X		X			X			X				
Xinyi Solar Holdings Ltd	Information Technology																		
ASM International NV	Information Technology						X		X							X			X
SunPower Corp	Information Technology			X							X				X	X			
Xerox Holdings Corp	Information Technology		X	X	X							X			X	X			X
HP Inc	Information Technology		X	X			X		X			X	X		X				
VMware Inc	Information Technology			X				X	X							X	X		
SAP SE	Information Technology			X	X		X	X	X			X	X	X	X	X			
First Solar Inc	Information Technology					X	X				X					X			
Cisco Systems Inc	Information Technology			X	X		X	X	X						X	X	X		
Atea ASA	Information Technology				X	X		X	X						X	X	X		
Konica Minolta Inc	Information Technology		X					X				X			X	X		X	
Schnitzer Steel Industries Inc	Materials																		
Sims Ltd	Materials					X			X							X			
Chr Hansen Holding A/S	Materials						X								X	X			
Cascades Inc	Materials				X										X	X			
Novozymes A/S	Materials	X			X	X				X	X					X			
Ecolab Inc	Materials		X	X	X	X									X	X			
City Developments Ltd	Real Estate			X	X	X			X	X					X	X			
Brookfield Renewable Partners LP	Utilities			X					X			X		X	X	X			
Orsted A/S	Utilities				X		X		X		X	X			X	X			
Atlantica Sustainable Infrastructure PLC	Utilities				X		X		X		X				X	X			
Iberdrola SA	Utilities		X	X		X	X		X					X	X	X		X	
Beijing Enterprises Water Group Ltd	Utilities																		

After analysing the data on the excel (Figure 7), the 1st-order terms with all the key concepts were created, and the respective 2nd-order terms were built, as shown in the Figure 8.

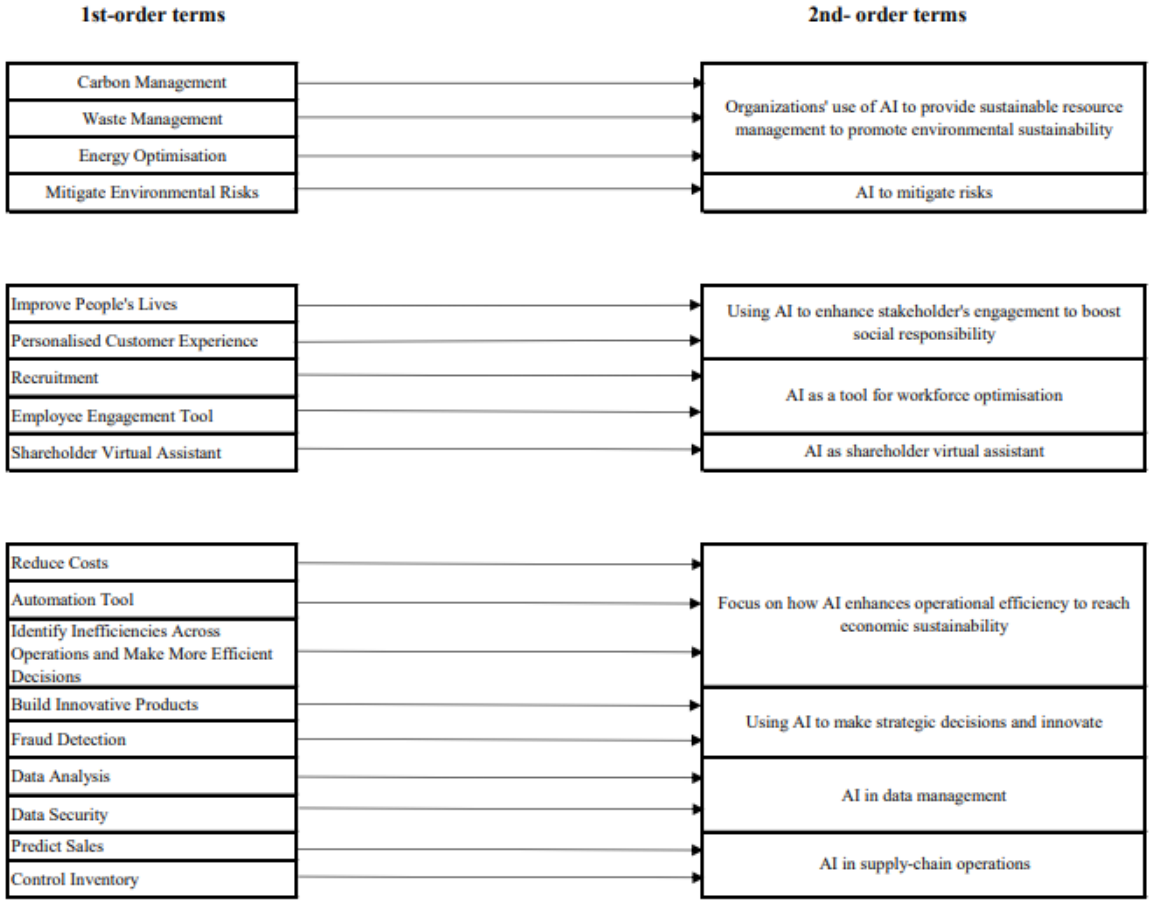

Figure 8: 1st-order and 2nd-order terms (Source: Author).

Planet	Carbon Management, Waste Management, and Energy Optimisation can be grouped into *organizations' use of AI to provide sustainable resource management to promote environmental sustainability*. Mitigate Environmental Risks forms its own group called *AI to mitigate risks.*
People	Improve people's lives and personalised customer experience are grouped to form *AI to enhance stakeholders' engagement to boost social responsibility*. Recruitment and employee engagement tool form *AI as a tool for workforce optimisation* and shareholder virtual assistant stay as it is on 2nd-order terms.
Profit	Reduce costs, automation tool, identifying inefficiencies across operations and make more efficient decisions are grouped together to focus on how *AI enhances operational efficiency to reach economic sustainability*. Build innovative products and fraud detection come together to create *using AI to make strategic decisions and innovate.* Data Analysis and data security formulates *AI in data management* and, lastly, predict sales and control inventory form *AI in supply-chain operations*.

Appendix 5: Triple Bottom Line Framework

Source: Miller (2020)

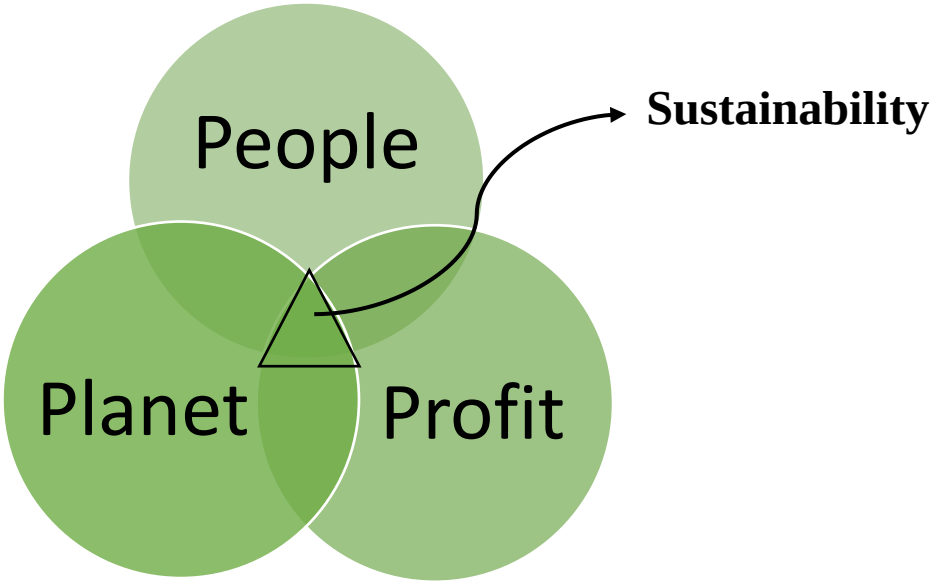

Figure 9: TBL retrieved from Miller (2020)

The goal of a sustainable business is to impact the environment and society positively while benefiting the company's shareholders (Miller 2020). The TBL model has three categories that help us understand a business sustainability effort: people, profit, and planet. Although each one is a different category, they are all interrelated. Profit, as the name indicates, is nothing more than generating a profit by reducing the company's costs and mitigating the risks. A firm's success heavily depends on its financial performance and the earnings it generates for shareholders, so it must be economically sustainable. People (social sustainability) aim to find ways to make stakeholders' (customers, employees, communities) lives better. Planet (environment sustainability) is a company's ability to reduce its negative effect on the environment.

Appendix 6: Generating 1st-order terms

#1.1 Carbon Management

BT Group PLC launched an AI-powered edge computing solution in partnership with QiO, to help business customers cut carbon by optimising energy use across their operations.

Novozymes A/S LaundryLab uses AI to predict how much CO2 emissions a person can save per year, plus review a product's biodegradability and toxicity**.**

Johnson Controls International PLC AI-driven OpenBlue (smart building platform) to improve energy efficiency, reduce CO2 emission, optimise space use and equipment performance, and ensure the health and well-being of smart building occupants.

Telus Corp smart building solutions employ AI to monitor and control the air conditioning and heating in the buildings which enables the optimisation of energy efficiency to reduce carbon footprint.

Kering SA uses AI-driven tools to control the carbon footprint and water usage of production processes.

Neste Oyj utilizes a carbon management software platform powered by AI to identify more sustainable alternatives to existing links in the chain.

#1.2 Waste Management

Ecolab Inc ECOLAB3D is a secure, AI and IoT platform that helps conserve water and cut on energy use.

Telus Corp partnership with Intuitive AI to install Oscar Sort technology which provides recycling assistance through visual, text, and audio nudges to engage customers and improve sorting, all while educating them on waste best practices in their building.

Sims Ltd uses AI as a tool to analyse vast amounts of data related to waste and recycling. It offers more tailored recycling solutions to its clients, enhancing economic outcomes and reducing environmental impacts**.**

#1.3 Mitigate Environmental Risk

Ecolab Inc ECOLAB3D is a secure, AI and IoT platform that helps identify and employ better responses for at-risk water safety locations.

City Developments Ltd employed Xylo Systems (cloud-based AI platform) to examine the interaction of their projects with the surrounding natural environment (biodiversity).

Stantec Inc uses Machine Learning to deliver comprehensive flood prediction support for various flood types through the entire life cycle of a flood event.

Autodesk Inc Autodesk Infodrainage utilizes a new built-in AI to predict Flood maps quickly and accurately.

Alphabet Inc Google research is used to forecast floods using AI and geospatial analysis to provide real-time flooding information.

Sims Ltd Sims Metal employs thermal cameras supplemented with AI analysis to help detect fires, before spreading.

Unilever PLC AI tool allows to predict where forests are at risk of deforestation. Use Google Cloud to monitor deforestation status

#1.4 Energy Optimization

Koninklijke KPN NV creates Smart devices (lights, plugs or thermostats that use AI) that help customers understand and reduce their energy consumption by configuring smart routines that prevent lights from being left on unnecessarily or that turn down the heating.

HP Inc applies AI algorithms to predict maintenance in manufacturing and improve energy efficiency.

Vestas Wind Systems A/S use AI and high-performance computing to generate more energy from wind turbines by optimizing what is known as wake steering.

Taiwan High Speed Rail Corp reduces energy consumption by providing AI services that analyse vast amounts of operational data to adjust the speed of trains and manage power usage depending on passengers' number and other train conditions.

Atlantica Sustainable Infrastructure PLC AI analyses weather data to predict solar irradiance, wind speeds and other energy production forecasts. It also predicts equipment breakages or malfunctions and reduces the risk of major outages.

Neste Oyj uses AI-driven algorithms to power precision agriculture effectively by analysing soil data, plant health, and weather forecasts

#2.1 Improve People Lives

Iberdrola SA customers can use the Advanced Smart Assistant to monitor their energy consumption. This AI service allows them to change their consumption to maximize the electricity savings from their homes.

Telus Corp SmartHome Security solution utilizes AI to protect customers' homes through computer vision.

Cisco Systems Inc AI-driven security platform that helps customers make decisions, augment tool capabilities, and automate complex tasks- against cyber threats.

HP Inc AI in Operations and Customer Solutions: HP integrates AI to improve operational processes and to develop innovative customer solutions, particularly in areas such as cybersecurity and predictive analytics.

SAP SE RISE with SAP is a business transformation solution aimed at helping customers migrate their ERP system to the cloud and accelerate their digital transformation, aims to provide enhanced productivity by employing automated processes.

#2.2 Employee Engagement Tool

Cisco Systems Inc Cisco AI Observability Platform simplifies business monitoring to automate IT processes and keep operations teams productive and responsive.

Siemens Gamesa Renewable Energy SA utilizes an AI tool that addresses skill shortages in the industry, it empowers less-experienced shop-floor employees, making them more efficient and effective in their roles.

Konica Minolta Inc. Intelligent information management: Combine software as a service offering, with AI-based services to reduce the complexity in workplaces, increase efficiency and foster new digital workflows among employees. COBOT solutions: automation of projects to improve manufacturing workflow, quality control, and productivity.

Xerox Holdings Corp Remote assistance and guidance support to field technicians on customer sites. Apps that leverage AI to enhance productivity, efficiency, and creativity.

Cogeco Communications Inc employee engagement assessment tool offers quick AI-driven learning insights for managers to sustain the team's growth.

#2.3 Personalised Customer Experience

Kering SA uses AI-driven analytics to gather insights into consumer behaviour and preferences, which enables more targeted marketing and product development.

City Developments Ltd created a powerful AI chatbot on their website to assist customers. Implemented AI Voice Assistant on their hotels, which enhances guests' experience and reduces the front desk's workload.

BT Group PLC develops cloud and AI-led strategic technology platforms to create brilliant customer experiences and digital engagement.

StarHub Ltd leverages AI to unify rich cloud-based data accumulated across the organisation to enable innovative customer engagement models.

SunPower Corp SunPower Design Studio uses AI and high-resolution satellite imagery to help residential consumers design custom solar power for their homes. AI and Machine Learning as a tool to create digitally generated solar power installation plans for each unique roof.

Puma SE Partnership with Google Cloud to deploy its data, analytics, and AI solutions to enhance online shopping experience- personalised customer experiences. "Shop the look" = virtual try-ons of sportswear using ai-generated content.

Alphabet Inc. offers more personalised experiences and increases engagement and usage of products (advertisements targeted to specific people).

#2.4 Recruitment

Xerox Holdings Corp Working with AI vendors to increase the pool of women and diversity of candidates for job openings using their algorithms.

Cogeco Communications Inc. Partnership with Actifai (an AI software service provider) to deploy Cogeco's connection industry-leading AI customer experience platform across Canada operations accelerating recruitment practices using data analytics, technology, and AI to decrease potential bias in recruitment and attract top talent from a wider pool**.**

#3.1 Reduce Costs

Novozymes A/S LaundryLab uses AI to identify potential formulation cost savings.

Cascades Inc uses AI tools to optimise logistics, reduce the empty km, define the best routes and better manage the operational and legal constraints, and reduce transportation costs.

BT Group PLC develops cloud and AI-led strategic technology platforms to reduce costs, as well as create new products and platforms to help revenue growth.

#3.2 Build Innovative Products

Konica Minolta Inc API Platform: AI Partner Portal helps developers and partners to build applications around imaging, video, and cognitive services.

First Solar Inc AI controls much of the manufacturing process- Producing solar panels with a higher degree of automation, precision, and improvement. Uses AI, IoT, machine-to-machine communication, skilled workers, and industry 4.0 architecture to transform a sheet of glass into fully functioning solar panels in 4h.

McCormick & Company Inc. customs AI to help increase the rate of innovation- Explore flavour territories more quickly and efficiently using AI to learn and predict new flavour combinations from hundreds of millions of data points across areas of sensory science, consumer preference and flavour palettes.

Unilever PLC uses AI to help identify alternative ingredients that can strengthen the resilience of the supply chain, making formulations more sustainable and cost-efficient, and simplifying them by reducing the number of ingredients without impacting products' quality or effectiveness.

Chr Hansen Holdings S/A employs AI algorithms to analyse data sets identify patterns and predict the effectiveness of new microbial strains and enzymes. This will help reduce the time and resources required for traditional trial and error methods and develop more effective and sustainable products faster.

#3.3 Automation Tool

Iberdrola SA uses the MateoFlow system. This machine-learning instrument estimates the production of renewable energy facilities based on weather forecasts.

Ecolab Inc ECOLAB3D employ AI for anomaly detection, prescriptive optimization, and predictive maintenance.

Autodesk Inc. Autodesk Forma uses AI in predictive analysis for wind, noise, and operational energy in real-time. Autodesk Flame uses Machine Learning to save hours of repetitive work by automating tasks.

Brookfield Renewable Partners LP uses Generative AI to automate complex tasks and fuel advanced analytics.

Vestas Wind Systems A/S Development of WindAMS AI to automate inspection data analysis. Apply AI in job roles that do not require a specific skill or knowledge; actions that are tedious, rule-based, and repetitive.

Evoqua Water Technologies Corp Water One WX remote monitors wastewater ion exchange system with predictive analytics and proactive service. Water one = real-time data analytics for system optimization: water quality, use, status, and maintenance.

City Developments Ltd digiHUB is a digital platform that uses AI and Machine Learning, Analytical Tools and IoT that focuses on predictive and integrated Facilities Management solutions.

Kone Oyj Predict maintenance problems through AI. Kone and IBM are collaborating on bringing Kone 24/7 Connected Services to market. Here the IBM Watson IoT platform enables escalators and elevators to talk to the cloud intelligently and in real time. The data derived in this way allows building managers to monitor the performance of their equipment and helps them schedule upgrades and maintenance work before problems occur.

VMware Inc VMware Private AI is an architectural approach for AI services, that enables privacy and control of corporate data, choice of open source and commercial AI solutions, quick time-to-value, and integrated security and management. Augmented productivity by eliminating redundant tasks and building intelligent process improvement mechanisms.

Atea ASA utilizes analytics, namely AI-driven tools to help businesses make better decisions based on business intelligence and simplify and streamline away repetitive and monotonous work processes with Robotics Process Automation.

#3.4 Fraud detection

Banco do Brasil SA AI tool for fraud detection.

BCE Inc AI to automatically and permanently block callers identified as fraudulent from the company's network.

#3.5 Identify Inefficiencies across operations and make more efficient decisions

Kering SA utilizes robotics and AI in manufacturing processes to optimise production lines and reduce energy consumption to boost profitability and align its' sustainability goals.

Siemens Gamesa Renewable Energy SA applies AI algorithms to analyse data from sensors on wind turbines to adjust blade positions and operational parameters in real time to optimise their performance.

Senseye Predictive Maintenance uses AI and Machine Learning to automatically generate machine and maintenance worker behaviour models to direct users' attention and expertise to where it's needed most. AI into predictive maintenance, enabling faster and easier maintenance decisions.

Banco do Brasil SA use AI to interpret satellite imaging data and generate a solution for agricultural business**.**

Alphabet Inc Google Maps employs AI to suggest routes that have fewer hills, less traffic, and constant speeds- fuel efficiency.

Sims Ltd SIMS AI help identify patterns and trends in data sets, automate tasks such as monitoring and inspecting equipment; and convert non-structure data into structured data- Improving efficiency and the decision-making industry.

Orsted A/S in partnership with SparkCognition created an AI solution that provides predictive recommendations to identify impending failures, quickly identify underperforming assets and ensure effective follow-through.

Stantec Inc Evoqua's Water One platform, a holistic water management solution, combines their extensive water expertise with data intelligence- and aims to minimize water system downtime and ensure a consistent, high-quality water supply by employing real-time data analytics and remote monitoring capabilities. It enhances the predictive maintenance of water systems and optimises the scheduling and routes of service personnel (Aqua Evoqua).

BCE Inc Collaboration with Mila, a research institute in AI, to apply deep learning neural network algorithms to Bell's systems and data to improve business performance and customer experience and accelerate AI innovations using cloud computing.

Autodesk Inc Autodesk AI Technology used in construction Cloud that analyses project data to identify and prioritise design, quality, safety, and project control risks; automate 2D documentation with interactive experiences of manufacturing drawings, reducing time spent on non-value tasks; In repetitive tasks.

Dassault Systemes SE 3D Experience platform uses AI- to help understand, analyse, correlate, describe, and predict complex information**.**

Brambles Ltd AI and Machine Learning to sort data and remove inefficiencies from business and customer supply chains. Targeted diagnostics- gather a lot of data to optimise the network; lower costs for suppliers; more consistent shipments and reduce the need for new pallet purchases.

Xerox Holdings Corp Analytics to identify inefficiencies, simplify processes and improve workflow automation, deliver predictive support, supplies, and maintenance, reducing downtime and wasted replacement of parts.

HP Inc AI in Digital Transformation: HP emphasizes its ongoing digital transformation, which involves leveraging advanced technologies, including AI, to enhance operational efficiency and customer experiences.

Taiwan High Speed Rail Corp AI-Service platform for inspection of viaducts using a central control room to monitor and operate the train line using state-of-the-art AI, as well as keeping the main line running, the control room also controls access to and from depots.

Schneider Electric SE Collaboration with Microsoft to create solutions to optimise resource allocation, and time-consuming tasks, gain speed and efficiency, and advance innovation in its portfolio through harnessing the potential of big data, AI and Machine Learning to transform businesses.

SAP SE created Joule, which is a Generative AI tool that maximizes the efficiency of business operations through faster work, smarter insights, and better outcomes and maintains its full control and security.

ASM International NV incorporates AI to enhance the demand for its semiconductor technologies in ALD and Epi tools, and leverages AI to advance its product development